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Supplemental Groundwater Investigation Report

Operable Unit No. 10
Site 35 - Camp Geiger Area Fuel Farm
Marine Corps Base
Camp Lejeune, North Carolina

Volume II of III
Appendices

Prepared For:

Department of the Navy
Atlantic Division
Naval Facilities
Engineering Command
Norfolk, Virginia

Under the

LANTDIV CLEAN Program

Comprehensive Long-Term
Environmental Action Navy

LIST OF APPENDICES

APPENDIX A
REMEDIAL INVESTIGATION REPORT, OPERABLE UNIT NO. 10, CAMP GEIGER FUEL FARM

FINAL

REMEDIAL INVESTIGATION
AT OPERABLE UNIT NO. 10
(SITE 35, CAMP GEIGER AREA FUEL FARM)

MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

CONTRACT TASK ORDER 0232

MAY 31, 1995

Prepared For:

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
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Prepared by

BAKER ENVIRONMENTAL, INC
Coraopolis, Pennsylvania

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LIST OF ACRONYMS AND ABBREVIATIONS

ABS	adsorption factor
AF	soil to skin adherence factor
AQTESOLV	Aquifer Test Solver Program
AQUIRE	Aquatic Information Retrieval Database
ARARs	Applicable or Relevant and Appropriate Requirements
ARL	Aquatic Reference Level
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
AT	averaging time
ATc	averaging time carcinogen
ATnc	averaging time noncarcinogen
ATEC	ATEC Associates, Inc.
AWQC	Federal Ambient Water Quality Criteria
Baker	Baker Environmental, Inc.
BCF	bioconcentration factor
bgs	below ground surface
BI	biotoxic index
BOD	biological oxygen demand
BRA	baseline risk assessment
BTEX	benzene, toluene, ethylbenzene, xylenes
BW	body weight
CAMA	Coastal Area Management Act
CDI	chronic daily intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CF	conversion factor
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
COPC	contaminant of potential concern
COD	chemical oxygen demand
CRAVE	Carcinogen Risk Assessment Verification Endeavor
CRQL	Contract Required Quantitation Limit
CSA	Comprehensive Site Assessment
CSF	Cancer Slope Factor
DoN	Department of the Navy
1,2-DCE	1,2-dichloroethene
DEM	Division of Environmental Management
DDE	dichlorodiphenyldichloroethylene
DDT	diphenyltrichloroethane

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

ECD	electron capture detector
ED	exposure duration
EF	exposure frequency
EL	exposure level
ERA	ecological risk assessment
ER-L	Effects Range-Low
ER-M	Effects Range-Median
ESE	Environmental Science and Engineering, Inc.
ET	exposure time
FAWQC	Federal Ambient Water Quality Criteria
FFA	Federal Facilities Agreement
FFS	Focused Feasibility Study
F_i	fraction ingested from source
FID	flame ionization detector
f_{oc}	sediment particle grain size
FSAP	Field Sampling and Analysis Plan
FWS	Fish and Wildlife Service
FWQSV	Freshwater Water Quality Screening Values
gpd/ft	gallons per day per foot
gpm	gallons per minute
H	mean species diversity
HA	health advisory
HEAST	Health Effects Assessment Summary Tables
HHAG	Human Health Assessment Group
HHRA	Human Health Risk Assessment
HI	hazard index
HQ	hazard quotient
HQW	high quality water
i	hydraulic gradient
IAS	Initial Assessment Study
ICR	incremental cancer risk
ID	inside diameter
IDW	investigative derived wastes
IR	ingestion rate
IRA	interim remedial action
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
K	hydraulic conductivity
K_d	soil sorption coefficient
K_{oc}	organic carbon partition coefficient
K_{ow}	octanol-water partition coefficient

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

LANTDIV	Naval Facilities Engineering Command, Atlantic Division
LAW	Law Engineering
LOAEL	lowest observed adverse effect level
LUST	leaking underground storage tank
MBI	Macroinvertebrate Biotic Index
MCAS	Marine Corps Air Station
MCB	Marine Corps Base
MCL	maximum contaminant level
mg/kg	milligram per kilogram
mg/L	milligram per liter
MF	modifying factor
MI	mobility index
ml	milliliter
mL/g	milliliters per gram
msl	mean sea level
MTBE	methyl-tertiary-butyl-ether
MW	monitoring well
NACIP	Navy Assessment and Control of Installation Pollutants
NC DEHNR	North Carolina Department of Environment, Health and Natural Resources
NC DOT	North Carolina Department of Transportation
NCMFC	North Carolina Marine Fisheries Commission
NCSPCS	North Carolina State Plane Coordinate System
NCP	National Oil and Hazardous Substances Contingency Plan
NCWP	Near Coastal Waters Program
NCWQC	North Carolina Water Quality criteria
NCWQS	North Carolina Water Quality Standards
NCWRC	North Carolina Wildlife Resources Commission
N_e	effective porosity
NEESA	Naval Energy and Environmental Support Activity
NEP	National Estuary Program
NOAA	National Oceanic and Atmospheric Administration
NOAEL or NOEL	No observed adverse effect level
NPL	National Priorities List
NPS	National Park Service
NSW	nutrient sensitive waters
NUS	NUS Corporation
NWI	national wetlands inventory
O&G	oil and grease
OU	Operable Unit
PAH	polynuclear aromatic hydrocarbon
PC	permeability constant
PCBs	polychlorinated biphenyls

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

PCE	tetrachloroethene
PEF	particulate emissions factor
PHA	public health assessment
PID	photoionization detector
POL	petroleum, oil, lubricants
ppb	parts per billion
ppm	parts per million
psi	pounds per square inch
PVC	polyvinyl chloride
pw	pumping well
QA/QC	quality assurance/quality control
QI	quotient index
RA	risk assessment
RBC	risk based concentrations
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RI/FS	remedial investigation/feasibility study
ROD	record of decision
RMC	RMC Environmental Services, Inc.
S	storativity, water solubility
SA	site assessment or surface area
SAP	Sample and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SB	soil boring
SCS	Soil Conservation Service
SD	sediment
SMCL	Secondary Drinking Water Regulations
SQC	sediment quality criteria
SOPs	standard operating procedures
SSV	sediment screening value
SU	standard units
SVOCs	semivolatile organic compounds
SW	surface water
SWQSVs	surface water quality screening values
T	transmissivity
TAL	target analyte list
TBC	to be considered
TCE	trichloroethene
TCL	target compound list
TCLP	toxicity characteristic leaching procedure
TDS	total dissolved solids
TEF	toxicity equivalency factor

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

TICs	tentatively identified compounds
TOC	total organic carbon
TPH	total petroleum hydrocarbons
Tracer	Tracer Research Corporation
trans-1,2-DCE	trans-1,2-dichloroethene
TRVs	terrestrial reference values
TSS	total suspended solids
UCL	upper confidence limit
UF	uncertainty factor
μg/g	micrograms per gram
μg/L	micrograms per liter
USDI	United States Department of the Interior
USEPA	United States Environmental Protection Agency
USCS	Unified Soil Classification System
USGS	United States Geological Survey
USMC	United States Marine Corps
UST	underground storage tank
VOCs	volatile organic compounds
VP	vapor pressure
V_x	average seepage velocity
WAR	Water and Air Research, Inc.
WOE	weight of evidence
WQS	water quality standards
WQSV	water quality screening values
WS	Wilderness Society

EXECUTIVE SUMMARY

Introduction

This document was prepared by Baker Environmental, Inc. (Baker) to serve as a report on the Remedial Investigation (RI) conducted at Operable Unit (OU) No. 10, Site 35 - Camp Geiger Area Fuel Farm in the spring and summer of 1994.

The purpose of this RI was to evaluate the nature and extent of the threat to public health and the environment caused by the release of hazardous substances, pollutants or contaminants. This was accomplished by sampling several media (soil, groundwater, sediment, surface water, fish, crabs, and benthic macroinvertebrates) at OU No. 10, evaluating the analytical data and performing a human health risk assessment (RA) and ecological RA. This RI Report contains the results of all field investigations, a technical memorandum summarizing groundwater data and aquifer characteristics at MCB, Camp Lejeune, the human health RA, and the ecological RA. Previous investigations were conducted by Water and Air Research, Inc., (WAR), Environmental Science and Engineering, Inc. (ESE), NUS Corporation (NUS), Law Engineering (LAW), and Baker Environmental, Inc. (Baker).

Site Location and Description

Camp Geiger is located at the extreme northwest corner of MCB, Camp Lejeune. The main entrance to Camp Geiger is off U.S. Route 17, approximately 3.5 miles southeast of the City of Jacksonville, North Carolina. Site 35, the Camp Geiger Area Fuel Farm refers primarily to five, 15,000-gallon aboveground storage tanks (ASTs), a pump house, and a fuel unloading pad situated within Camp Geiger just north of the intersection of Fourth and "G" Streets.

Site History

Construction of Camp Geiger was completed in 1945, four years after construction of MCB, Camp Lejeune was initiated. Originally, the Fuel Farm ASTs were used for the storage of No. 6 fuel oil, but, were later converted for storage of other petroleum products including unleaded gasoline, diesel fuel, and kerosene. The date of their conversion is not known.

Routinely, the ASTs at Site 35 supply fuel to an adjacent dispensing pump. A leak in an underground line at the station was reportedly responsible for the loss of roughly 30 gallons per day of gasoline over an unspecified period (Law, 1992). The leaking line was subsequently sealed and replaced.

The ASTs at Site 35 are currently used to dispense gasoline, diesel and kerosene to government vehicles and to supply USTs in use at Camp Geiger and the nearby New River Marine Corps Air Station. The ASTs are supplied by commercial carrier trucks which deliver product to fill ports located on the fuel unloading pad at the southern end of the facility. Six, short-run (120 feet maximum), underground fuel lines are currently utilized to distribute the product from the unloading pad to the ASTs. Product is dispensed from the ASTs via trucks and underground piping.

Reports of a release from an underground distribution line near one of the ASTs date back to 1957-58 (ESE, 1990). Apparently, the leak occurred as the result of damage to a dispensing pump. At that time, the Camp Lejeune Fire Department estimated that thousands of gallons of fuel were released although records which document this incident do not exist. The fuel reportedly migrated to the east and northeast toward Brinson Creek. Interceptor trenches were excavated, and the captured fuel was ignited and burned.

Another abandoned underground distribution line extended from the ASTs to the former Mess Hall Heating Plant, located adjacent to "D" Street, between Third and Fourth Streets. The underground line dispensed No. 6 fuel oil to a UST which fueled the Mess Hall boiler. The Mess Hall, located across "D" Street to the west, was demolished along with its Heating Plant in the 1960s.

In April 1990, an undetermined amount of fuel had been discovered by Camp Geiger personnel along the unnamed drainage channels north of the Fuel Farm. Apparently, the source of the fuel, believed to be diesel or jet fuel, was an unauthorized discharge from a tanker truck that was never identified. The Activity reportedly initiated an emergency clean-up which included the removal of approximately 20 cubic yards of soil.

The Fuel Farm is scheduled to be decommissioned in April 1995. Plans are currently being prepared to empty, clean, dismantle, and remove the ASTs along with all concrete foundations, slabs on grade, berms and associated underground piping. The Fuel Farm is being removed to make way for a six lane divided highway proposed by the North Carolina Department of Transportation (NCDOT). Construction of the highway is scheduled to commence in August 1995.

<u>Previous Investigations</u>

The following is a summary of the previous investigations performed at Site 35.

Initial Assessment Study

MCB, Camp Lejeune was placed on the National Priority List (NPL) on October 4, 1989 after the Initial Assessment Study of 1983 identified 76 potentially contaminated sites at the base (Water and Air Resources, 1983). Site 35 was identified as one of 22 sites warranting further investigation. Sampling and analysis of environmental media was not conducted during the Initial Assessment Study.

Confirmation Study

ESE performed Confirmation Studies of the 22 sites requiring further investigation and investigated Site 35 between 1984 and 1987 (ESE, 1990). In 1984, ESE advanced three hand-auger borings and collected groundwater and soil samples from each location. Soils were analyzed for lead and oil and grease. Lead was detected in soil samples obtained from hand auger borings at concentrations ranging from 6 to 8 mg/kg. Oil and grease was also detected at concentrations ranging from 40 to 2,200 mg/kg.

Shallow groundwater samples were obtained from the open boreholes and analyzed for lead, oil and grease, and volatile organic compounds (VOCs) including benzene, trans-1,2-dichloroethene (T-1,2-DCE), trichloroethene (TCE), and methylene chloride. Lead was detected in each sample ranging from 3,659 μg/L to 1,063 μg/L. Oil and grease was detected in only one sample at 46,000 μg/L. The only detected VOC was methylene chloride in one sample at 4 μg/L.

In 1986, ESE collected two sediment and two surface water samples from Brinson Creek and installed three permanent monitoring wells: two east of and one west of the Fuel Farm. Surface water and sediment samples were analyzed for lead, oil and grease and ethylene dibromide. Groundwater samples were obtained in December 1986 and again in March 1987 and were analyzed for lead, oil and grease, and VOCs.

No target analytes were detected in either surface water sample. Both sediment samples were reported to contain lead and oil and grease although no data indicating actual levels of detection were provided in ESE's report. Levels were reported to be higher in the upstream sample, prompting ESE to suggest that the discharge of contaminated groundwater to the creek is occurring at the far northern section of the fuel farm ASTs or that the source of oil and grease and lead may be upstream.

Lead was detected in only one of six samples (33 μg/L) obtained from the three permanent monitoring wells. Oil and grease was detected in all six samples ranging from 200 μg/L to 12,000 μg/L. Detected VOCs included benzene (1.3 μg/L to 30 μg/L), trans-1,2-DCE (3.2 μg/L to 29 μg/L), and TCE (detected at 11 μg/L on both sample dates).

Focused Feasibility Study

A Focused Feasibility Study (FFS) was conducted in 1990 in the area north of the Fuel Farm by NUS Corporation. The investigation included the installation of four groundwater monitoring wells. Results of laboratory analysis revealed that groundwater in one well and soil cuttings from two borings were contaminated with petroleum hydrocarbons. No nonaqueous product was observed.

A geophysical investigation was conducted by NUS as part of the FFS in an attempt to identify underground storage tanks (USTs) at the site of the former gas station. The results indicated the presence of a geophysical anomaly to the north of the former gas station.

Comprehensive Site Assessment

Law Engineering, Inc. (Law) conducted a Comprehensive Site Assessment (CSA) during the fall of 1991 (Law, 1992). The CSA involved the drilling of 18 soil borings to depths ranging from 15 to 44.5 feet. These soil borings were ultimately converted to nested wells that monitor the water table aquifer along two zones. The shallow zone, or water table zone, generally extends from 2.5 to 17.5 feet, below ground surface (bgs). The deeper zone monitored by the nested wells generally ranges from 17.5 to 35 feet bgs. Five additional soil borings were drilled and nine soil borings were hand-augered to provide data regarding soil contamination in the vadose zone. Additional groundwater data was provided via 21 drive-point groundwater or "Hydropunch" samples. A "Tracer" study was also performed to investigate the integrity of the ASTs and underground distribution piping.

Soil and groundwater samples obtained under the CSA were analyzed for both organic and inorganic compounds. Groundwater analyses included purgeable hydrocarbons (EPA 601), purgeable aromatics and methyl-tertiary butyl ether (MTBE) (EPA 602), polynuclear aromatic hydrocarbons (EPA 610), and unfiltered lead (EPA 239.2). Soil analyses were limited to total petroleum hydrocarbons (TPH) (SW846 3rd Edition, 5030/3550: gasoline/diesel fractions) and lead (SW846 3rd Edition, 6010). Ten soil samples were analyzed for ignitability by SW846 3rd Edition, 1010.

The results of the CSA identified areas of impacted soil and groundwater. The nature of the contamination included both halogenated (i.e., chlorinated) organic compounds (e.g., TCE, trans-1,2-DCE, and vinyl chloride) and nonhalogenated, petroleum-based constituents (e.g., TPH, MTBE, benzene, toluene, ethylbenzene, and xylene). The contamination encountered was typically identified in both shallow (2.5 to 17.5 feet bgs) and deep (17.5 to 35 feet bgs) wells.

Law also identified several plumes of shallow groundwater contamination including two plumes comprised primarily of petroleum-based constituents (e.g., BTEX) and two plumes comprised of halogenated organic compounds (e.g., TCE). The plumes are all located north of Fourth Street and east of E Street except for a portion of a TCE plume. This plume extends southwest beyond the corner of Fourth and E Streets.

In general, contaminant concentrations in soil were greatest in those samples taken at or below the water table. Law concluded that soil contamination at Site 35 was likely due to the presence of a dissolved phase groundwater plume and seasonal fluctuations of the water table.

A follow-up to the CSA was conducted by Law in 1992. Reported as an Addendum to the CSA (Law, 1993), it was designed to provide further characterization of the southern extent of the petroleum contamination resulting from historical releases. Three monitoring wells were installed including MW-26, -27, and PW-28. Soil samples were obtained from each of these locations and analyzed for TPH (gasoline and diesel fractions). As part of the follow-up, a pump test was performed to estimate the hydraulic characteristics of the surficial aquifer. This test was designed to determine performance characteristics of a designated pumping well and to estimate hydraulic parameters of the aquifer. An approximate hydraulic conductivity of 100 feet/day was determined for the surficial aquifer.

<u>Interim Remedial Action RI/FS by Baker</u>

Baker conducted an Interim Remedial Action RI in December 1993. An additional seven soil borings were located within and around groundwater contaminant plume areas identified during the CSA. In addition to the soil borings, thirteen shallow soil samples were taken adjacent to Brinson Creek to determine the extent of contamination emanating from Site 35. Two of these shallow soil samples were situated upstream along Brinson Creek to provide background information on TPH and oil and grease.

In addition to soil sampling, a second round of groundwater level measurements were obtained for comparison to those presented in the CSA.

The most prevalent contaminants detected in soil samples taken during the Interim Remedial Action RI were benzene, toluene, ethylbenzene xylenes, naphthalene, and 2-methylnaphthalene. These constituents are commonly associated with fuel contamination. TPH (gasoline and diesel) and oil and grease were also observed, in addition to sporadic occurrences of lead, chromium, vanadium, and arsenic.

Analytical results, in general, confirm the previous findings that contamination in the majority of the identified soil is associated with a dissolved petroleum hydrocarbon contaminant plume in shallow groundwater. Oil and grease results observed in shallow soil samples obtained from the Brinson Creek area are likely influenced by the presence of naturally occurring organics in soils or an upgradient contamination source. This is supported by elevated background concentrations of oil and grease in surface soil samples obtained along the banks of Brinson Creek approximately 1/2-mile upstream of the site.

The Interim Remedial Action RI/FS culminated with an executed Interim Record of Decision (ROD) signed on September 15, 1994, for the remediation of contaminated soil along and adjacent to the proposed highway right-of-way at Site 35. Three areas of soil contamination requiring remediation have been identified. The first area is located in the vicinity of the Fuel Farms ASTs, and the two other areas are located north of the Fuel Farm. The larger of these two areas is located along "F" Street in the vicinity of monitoring well MW-11; the smaller area is in the area of monitoring well MW-25. Baker has estimated that approximately 3,600 cubic yards (4,900 tons) of contaminated soil is present in these three areas.

A fourth area of soil contamination, located immediately north of Building G480, was also identified in the Interim ROD. Additional data pertaining to this fourth area became available subsequent to the execution of the Interim ROD. This data indicated that contaminated soil was encountered in this area during the removal of a UST there in January 1994. The contaminated soil was excavated and reportedly disposed off site; however, no documentation is available regarding how or where the soil was disposed. An additional soil investigation will be conducted in this area to confirm that the contaminated soil was not returned to the excavation and that follow-up soil remediation in this area is not necessary.

<u>Other Investigations</u>

Two USTs located near the Fuel Farm have been the subject of previous investigations conducted under an Activity-wide UST program. The two USTs include a No. 6 fuel oil UST situated adjacent to the former Mess Hall Heating Plant and a No. 2 fuel oil UST situated adjacent to the Explosive Ordnance and Disposal Armory, Office, and Supply Building. The former UST was abandoned in place years ago (date unknown) and has been the subject of previous environmental investigations performed by ATEC Associates, Inc. and Law. The latter UST was removed in January 1994. Contaminated soils adjacent to the UST were reportedly removed with the tank. However, samples were not collected to confirm the limits of the contaminated soils. Sampling is expected to be conducted to corroborate the limits of soil contamination.

<u>Comprehensive Remedial Investigation/Feasibility Study</u>

A comprehensive RI was conducted by Baker in 1994 to evaluate the nature and extent of the threat to public health and the environment caused by the release of hazardous substances, pollutants, or contaminants, and to support a Feasibility Study evaluation of potential remedial alternatives.

<u>Remedial Investigation Field Activities</u>

The RI field program was initiated on April 11, 1994. Data gathering activities were derived from: a soil gas survey and groundwater screening investigation; a soil investigation; a groundwater investigation; a surface water and sediment investigation; and an ecological investigation.

Soil Gas Survey and Groundwater Screening Investigation

Baker monitored the collection of 67 soil gas samples and 72 groundwater screening samples from sample locations established across the Site 35 study area. This investigation focused on obtaining additional information to assess the source(s) of halogenated compounds in shallow groundwater. The majority of the sample locations were located south of the Fuel Farm and south of Fourth Street, and were based on the results of previous investigations, which revealed TCE in groundwater. The purpose of this activity was to assist in the placement of soil borings/monitoring wells.

Soil Investigation

The soil investigation involved the drilling of 26 soil borings at locations primarily determined by the results of the soil gas survey and groundwater screening investigation. Borings were advanced to three depths and included 10 shallow borings (14 to 17 feet bgs), 11 intermediate borings (41 to 47 feet bgs), and five deep borings drilled to a depth equivalent to 5 to 10 feet below the semi-confining layer separating the surficial aquifer from the Castle Hayne Aquifer (51.0 to 66.0 feet bgs).

Soil samples (surface and subsurface) obtained from the borings were analyzed for a few of the following parameters; TCL volatiles, semivolatiles, pesticides/PCBs, TAL metals, as well as a variety of engineering parameters that will be used in the FS. A summary of each sample, the depth it was collected and parameters analyzed is provided in Appendix I.

Groundwater Investigation

The groundwater investigation included the installation of shallow, intermediate, and deep groundwater monitoring wells. The shallow monitoring wells were installed to intercept the upper portion of the surficial aquifer. The intermediate wells were constructed to monitor the lower portion of the surficial aquifer with screens set just above what appeared to be a semi-confining layer separating the surficial aquifer from the underlying Castle Hayne Aquifer (see Appendix H for boring logs/well construction records). A total of 21 shallow and intermediate wells were installed under this RI. In addition, five deep groundwater wells were installed to monitor the upper portion of the Castle Hayne Aquifer immediately below the suspected semi-confining layer.

Groundwater samples were obtained from each of the 26 newly installed wells and 29 existing wells. The samples were analyzed for TCL volatiles, semivolatiles, pesticides/PCBs, and TAL metals as well as a variety of engineering parameters.

Surface Water/Sediment Investigation

Surface water and sediment samples were obtained along Brinson Creek which flows roughly north to south immediately east of the Fuel Farm. Samples were obtained from ten stations including three upstream and seven adjacent/downstream locations. Surface water and sediment samples were also collected from an off-base reference station. The reference station included the White Oak River watershed.

The surface water and sediment samples were analyzed for TCL volatiles, semivolatiles, pesticides/PCBs, TAL metals, and particle size distribution.

Ecological Investigation

The ecological investigation included biological sampling (i.e., fish, shellfish, and benthic macroinvertebrates) along Brinson Creek and along three streams in the nearby White Oak River watershed including Webb Creek, Hadnot Creek, and Holland Mill Creek. The work performed in the White Oak River watershed was part of an overall ecological background investigation conducted as part of this RI.

Nature and Extent of Contamination

The nature and extent of contamination at Site 35 was determined based on the analytical results of the various media considered under the RI including soil, groundwater, sediment, surface water, and fish tissue. The RI results were also compared to the results from previous environmental investigations performed at Site 35, when applicable.

Surface and Subsurface Soil

Relatively few detections of VOCs and SVOCs were observed in surface and subsurface soil samples obtained under the RI. The most significant contamination detected involved tetrachloroethane in subsurface soil at boring 35MW-30B located near the barracks southwest of the Fuel Farm. Pesticides were detected in surface soil samples only, but, are not deemed to be site related. No PCBs were detected in surface soil samples. Detected inorganics were generally similar to background surface and subsurface soil concentrations at Camp Lejeune.

Groundwater

The nature and extent of groundwater contamination was considered based on the interval of groundwater monitored and included the upper portion of the surficial aquifer; the lower portion of the surficial aquifer; and the upper portion of the Castle Hayne Aquifer.

The results of the RI confirm the results of previous environmental investigations conducted at Site 35 and expand the existing database. Additional groundwater monitoring wells were installed in the surficial aquifer south of the Fuel Farm, and Fourth Street and in the upper portion of the Castle Hayne Aquifer.

No substantial contamination was detected in the upper portion of the Castle Hayne Aquifer. This indicates that, to date, the suspected semi-confining layer that separates the surficial aquifer from the Castle Hayne Aquifer has served effectively as an aquitard (see Figure 3-4).

Extensive groundwater contamination was observed in the surficial aquifer along both the upper and lower monitored intervals. Fuel-related organic contaminants, when encountered, appear more prevalent in the upper portion of the surficial aquifer. Conversely, solvent-related organic contaminants, when encountered, appear more prevalent in the lower portion of the surficial aquifer. This is likely due to the fact that the latter are the more dense compounds having a specific gravity greater than groundwater.

The extent of fuel-related contamination appears to be adequately defined based on the data obtained to date. It is limited to the area north of Fourth Street in the vicinity of obvious suspected sources such as the Fuel Farm and nearby former UST sites.

The extent of solvent-related contamination has not been completely defined to date nor have all of its sources been identified. A plume appears to extend from north of Fourth Street south to Fifth Street beyond which the RI did not extend in the southerly direction (see Figures 4-4 and 4-7). The source of this plume has not been determined. A second smaller plume is present in the vicinity of the Former Vehicle Maintenance Garage (Building TC474). The smaller plume appears to be adequately defined with Building TC474 and the immediate vicinity as the likely source of contamination.

Elevated levels of inorganic contaminants (total and dissolved) were detected in groundwater samples obtained from within the surficial aquifer. It is questionable whether this contamination is due to past site activities because the results are similar to those obtained by Baker at other Camp Lejeune sites. The elevated total metals are believed to be caused by suspended particulates in the samples.

Surface Water and Sediment

Significant levels of organic and inorganic contaminants were detected in sediment samples obtained from locations adjacent to and downstream of Site 35. The results of VOC analyses were "masked" by the presence of high levels of Tentatively Identified Compounds (TICs), and consequently, few VOC detections were reported. Nevertheless, the Baker field team commented during sampling that the sediment samples appeared to contain elevated levels of fuel-related contaminants which could also explain the presence of TICs. Lead at elevated levels was also detected in these sediment samples, and like the organic contaminants, could be related to Site 35.

Surface water contamination was limited to a single detection of lead and zinc downstream of Site 35 at levels in excess of the WQSVs and the NCWQS. No organic contaminants were detected in surface water samples.

Fish

A variety of organic and inorganic contaminants were detected in fillet and whole body samples analyzed under this RI. The most significant contaminants detected were the pesticides dieldrin, and 4,4'-DDD with a single detection of inorganic mercury. These contaminants were primarily responsible for the calculated risk to human health in excess of EPA guidelines.

<u>Baseline Human Health Risk Assessment</u>

The BRA highlights the media of interest from the human health standpoint at OU No. 10 by identifying areas with elevated ICR and HI values. Current and future potential receptors at the site include current military personnel, current recreational adults and children, future residents (i.e., children and adults), and future construction workers. Contaminants of Potential Concern (COPCs) are identified by media and the total site risk for each of these receptors is estimated by logically summing the multiple pathways likely to affect the receptor during a given activity (see Table ES-1). The following algorithms defined the total site risk for the current and future potential receptor groups assessed in a quantitative manner. The risk associated with each site is derived using the estimated risk from multiple areas of interest.

1. Current Military Personnel

    a. Incidental ingestion of COPCs in surface soil + dermal contact with COPCs in surface soil + inhalation of airborne COPCs

TABLE ES-1

SUMMARY OF COPCs IN ENVIRONMENTAL MEDIA OF CONCERN
OPERABLE UNIT NO. 10 (SITE 35)
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil		Subsurface Soil		Ground-water		Surface Water		Sediment		Fish	
VOCs												
Acetone				X						X	•	X
1,1,2,2-Tetrachloroethane						X						
Chloroform						X						
Methylene Chloride				X								X
1,1,2-Trichloroethane						X						
1,1-Dichloroethane						X						
1,1-Dichloroethene					•	X						
2-butanone												X
Benzene					•	X						
Carbon disulfide		X										X
cis-1,2-Dichloroethene					•	X						
Ethylbenzene					•	X						
Methyl Tertiary Butyl Ether					•	X						
Tetrachloroethene				X		X						
Toluene		X			•	X				X		X
trans-1,2-Dichloroethene					•	X						
Trichloroethene					•	X						
Xylenes (Total)		X			•	X						
SVOCs												
Benzo(a) pyrene		X										
Indeno(1,2,3-cd) pyrene		X										
Dibenz(a,h) anthracene		X										
Benzo(g,h,i) perylene	•	X										
4-Methylphenol						X						
2,4-Dimethylphenol						X						
Naphthalene					•	X						
Dibenzofuran					•	X						
Fluorene						X						
Anthracene						X						
Carbazole						X						
Diethylphthalate									•	X		
Di-n-butylphthalate										X		

TABLE ES-1 (Continued)

SUMMARY OF COPCs IN ENVIRONMENTAL MEDIA OF CONCERN
OPERABLE UNIT NO. 10 (SITE 35)
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil		Subsurface Soil		Ground-water		Surface Water		Sediment		Fish	
Bis(2-ethylhexyl)phthalate		X								X		
Phenol		X				X						
2-Methylnaphthalene					•	X						
2-Methylphenol						X						
Acenaphthene		X										
Phenanthene	•	X			•	X						
Carbazole		X										
Fluoranthene		X										
Pyrene		X		X								
Butylbenzlphthalate		X										
Benzo(a)anthracene		X										
Chrysene		X										
Benzo(b) fluoranthene	•	X	•	X								
Pesticides												
Aldrin						X						X
gamma-BHC												X
alpha-Chlordane		X							•	X	•	X
beta-BHC		X				X				X	•	X
Dieldrin	•	X							•	X	•	X
Endosulfan II	•	X							•	X	•	X
Endrin Ketone	•	X							•	X	•	X
Endrin Aldehyde	•	X							•	X	•	X
Endrin		X							•	X	•	X
delta-BHC					•	X				X		X
gamma-Chlordane		X							•	X		
Heptachlor					•	X				X	•	X
Heptachlor Epoxide									•	X		X
Methoxychlor									•	X		
4,4'-DDE		X							•	X	•	X
4,4'-DDT		X				X			•	X	•	X
4,4'-DDD	•	X				X			•	X	•	X
Inorganics												
Aluminum		X		X		X		X		X	•	X
Antimony		X			•	X	•	X				
Arsenic	•	X	•	X	•	X	•	X	•	X		

TABLE ES-1 (Continued)

SUMMARY OF COPCs IN ENVIRONMENTAL MEDIA OF CONCERN
OPERABLE UNIT NO. 10 (SITE 35)
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil		Subsurface Soil		Ground-water		Surface Water		Sediment		Fish	
Barium		X		X	●	X		X	●	X	●	X
Beryllium		X			●	X			●	X		
Cadmium		X		X	●	X						X
Calcium		X		X		X		X		X		
Chromium		X		X	●	X	●	X	●	X		
Cobalt		X		X	●	X	●	X	●	X		
Copper		X		X		X			●	X	●	X
Lead	●	X	●	X	●	X	●	X	●	X	●	X
Magnesium		X		X		X		X		X		
Manganese	●	X		X	●	X	●	X	●	X	●	X
Mercury						X	●	X		X	●	X
Nickel		X		X	●	X			●	X		
Potassium				X		X		X		X		
Selenium		X		X		X		X	●	X	●	X
Silver				X	●	X						
Sodium						X		X		X		
Thallium		X	●	X	●	X	●	X	●	X		
Vanadium		X		X	●	X	●	X	●	X		
Zinc		X		X	●	X	●	X	●	X	●	X
Iron		X		X		X		X		X		

● Selected as COPC.
X Positively detected in media.

2. Future Residents (Children and Adults)

   a. Incidental ingestion of COPCs in surface soil + dermal contact with COPCs in surface soil + inhalation airborne of COPCs

   b. Ingestion of COPCs in groundwater + dermal contact with COPCs in groundwater + inhalation of volatile COPCs

3. Future Construction Worker

   a. Incidental ingestion of COPCs in on-site subsurface soil + dermal contact with COPCs in subsurface soil + inhalation of airborne COPCs

4. Current Recreational Children and Adults

   a. Ingestion of COPCs in surface water and sediment + dermal contact with COPCs in surface water and sediment

   b. Ingestion of fish tissue (adults only)

The total site ICR and HI values associated with current and future receptors at this site are presented in Table ES-2. The total site ICR for the current recreational child (4.4×10^{-7}) current recreational adult (1.9×10^{-5}), and current military personnel (3.1×10^{6}) are below the USEPA's upper bound risk range (1×10^{-4} to 1×10^{-6}), therefore adverse effects are considered unlikely. The total site HI for the current recreational child (0.01) and current military personnel (0.09) did not exceed unity. Therefore, adverse effects are considered unlikely. The total site HI for the current recreational adult (1.8) is slightly above unity. The total site risk is due to potential exposure from fish fillet ingestion which is driven by the presence of mercury. However, the exposure parameters used to calculate risk from fish ingestion are very conservative; mercury was not found to be causing a risk in any other media at Site 35; and the fish collected at Site 35 are considered migratory and move along Brinson Creek, therefore this risk may not be due to contamination at the site. Therefore, the risk from ingestion of fish may not be site related.

The total site ICR and HI for the future construction worker (1.2×10^{-7} and 0.02, respectively) are below the USEPA's risk range, therefore, risk to this receptor is considered unlikely. The total site ICR for future adult residents (4.3×10^{-3}) and future child residents (2.1×10^{-3}) exceed the USEPA's upper bound risk range (1×10^{-4} to 1×10^{-6}). The total site risk is driven by future potential exposure to groundwater. The ICR values are driven by the presence of arsenic and beryllium. The total site HI for the future adult resident (44) and the future child resident (104) exceed unity. The total site risk is driven by future potential exposure to groundwater. The HI values are driven by the presence of cis-1,2-dichlorothene, trichloroethene, benzene, antimony, arsenic, barium, chromium, cadmium, manganese, and vanadium.

Ecological Risk Assessment

Overall, metals and pesticides appear to be the most significant site related COPCs that have the potential to affect the integrity of the aquatic and terrestrial receptors at Site 35. Although the

American alligator has been observed at Site 35, potential adverse impacts to this species could not be quantitatively evaluated.

Aquatic Ecosystem

Surface water quality showed exceedances of aquatic reference values for lead, mercury, and zinc. In addition, iron, cobalt and manganese were above the concentration that caused adverse impacts to aquatic species in a few studies. However, most of the studies did not meet the criteria for reliability, and other studies indicated that potential impacts to aquatic organisms did not occur at the concentrations detected in the surface water at Brinson Creek. For sediments, concentrations of lead and the organics dieldrin, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endrin, alpha-chlordane, and gamma-chlordane exceeded the aquatic reference values. In the surface water, mercury exceeded aquatic reference values in the upstream stations. Although these levels were indicative of a high potential for risk (QI > 100), mercury is not believed to be site related. Zinc only exceeded unity slightly and was only found at a single station. Lead has a single exceedance of the aquatic reference value by slightly greater than 10 indicating a moderate potential for risk to aquatic receptors. Lead also was found in the groundwater samples at similar levels and is site related.

In the sediments, lead exceeded the lower sediment aquatic reference value throughout Brinson Creek. The only exceedances of the higher sediment aquatic reference value occurred downstream of Site 35 with the highest QI of 137 representing a high potential for risk to aquatic receptors. The lead detected in the sediments is likely site related, the result of past reported surface spills/runoff and past and ongoing groundwater discharges to surface water.

Pesticides exceeded the sediment aquatic reference values throughout Brinson Creek. The highest QI, 2,600 for dieldrin, represents a high potential for risk to aquatic receptors. There is no documented pesticide disposal or storage/preparation activities at Site 35. The pesticide levels detected in the sediments probably are a result of routine application in the general vicinity of Site 35.

Although, the pesticides in the sediments were found at levels indicating contamination throughout the watershed, the highest levels were observed in the lower reaches of Brinson Creek. This deposition trend may be related to the higher organics in the sediments in the lower reach, which would accumulate more of these types of contaminants.

The fish community sampled in Brinson Creek was representative of an estuarine ecosystem with both freshwater and marine species present. In addition, the presence of blue crabs, grass shrimp, and crayfish support the active use of Brinson Creek by aquatic species.

The absence of pathologies observed in the fish collected from Brinson Creek indicates that the surface water and sediment quality may not adversely impact the fish community.

The benthic macroinvertebrate community demonstrated the typical tidal/freshwater species trend of primarily chironmids and oligochaetes in the upper reaches and polychaetes and amphipods in the lower reaches. Species representative of both tolerant and intolerant taxa were present. Species richness and densities were representative of an estuarine ecosystem.

In summary, the aquatic community in Brinson Creek is representative of an estuarine community and does not appear to be significantly impacted by surface water and sediment quality.

Terrestrial Ecosystem

Surface soil quality indicated a potential for adversely impacting the terrestrial receptors that have direct contact with the surface soils. This adverse impact is primarily due to cadmium in the surface soils. Cadmium was detected at a relatively high concentration in only out of ten surface soil samples, therefore any estimation of adverse effects on terrestrial receptors using this cadmium concentration is conservative.

There also appears to be impacts to the terrestrial receptors due to copper in the fish tissue. Copper was not detected in the surface water but was detected in sediment samples collected downstream of Site 35 at concentrations lower than the sediment samples taken upstream of Site 35. As such, the copper in the fish tissue does not appear to be site related.

Conclusions

- Site 35 is an active petroleum product Fuel Farm scheduled for decommissioning and dismantlement in early 1995. The Fuel Farm dates back to 1945 and has a poorly documented history of various spills and leaks associated with aboveground and underground storage tanks and associated piping.

- Site 35 is situated within Camp Geiger in the northwest corner of Camp Lejeune. It is located along Brinson Creek which is a boundary line between Camp Lejeune and adjacent private property.

- Several environmental studies have been conducted at Site 35 dating back to 1983. The data obtained to date indicate the presence of significant elevated levels of organic and inorganic contaminants in surficial groundwater, Brinson Creek sediments, and fish tissue. Contaminated soil (fuel-related) in the vicinity of a proposed highway through Site 35 has been addressed through an Interim Record of Decision executed on September 15, 1994. One potentially significant area of subsurface soil contamination was identified during the RI in the vicinity of the Barracks located southwest of the Fuel Farm based on detections of PCE subsurface soil samples obtained from borings 35MW-30B and -37B. In addition, the Baker field team commented that during the drilling of boring 35MW-29B a strong odor was encountered although no VOCs or SVOCs were detected in subsurface soil samples obtained at this location.

- Organic contamination in groundwater is presently limited to the surficial aquifer which is monitored at two levels including the groundwater surface (upper portion) and atop an underlying suspected semi-confining layer (lower portion). The suspected semi-confining layer appears to be adequately serving as an effective aquitard separating the surficial aquifer from the underlying Castle Hayne Aquifer as no significant levels of contamination were detected in the underlying Castle Hayne Aquifer. Relative to organic contaminants, both fuel- and solvent-related contaminants were detected in groundwater samples obtained from the upper and lower portions of the surficial aquifer. In general, fuel-related contamination was detected most prevalently in samples obtained from wells monitoring the upper portion of the surficial aquifer. Conversely, solvent-related contaminants were more prevalent in groundwater samples obtained from wells monitoring the lower portion of the surficial aquifer.

TABLE ES-2

TOTAL SITE RISK
OPERABLE UNIT NO. 10 (SITE 35)
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Receptors	Soil		Groundwater		Surface Water		Sediment		Fish		TOTALS	
	ICR	HI	ICR	HI	ICR	HI	ICR	HI	ICR	HI	ICR	HI
Future Child Resident	4.5E-05 (<1)	0.93 (1)	2.1E-03 (99)	103 (99)	NA	NA	NA	NA	NA	NA	2.1E-03	104
Future Adult Resident	2.7E-05 (<1)	0.10 (<1)	4.3E-03 (99)	44 (99)	NA	NA	NA	NA	NA	NA	4.3E-03	44
Future Construction Worker	1.2E-07 (100)	0.02 (100)	NA	NA	NA	NA	NA	NA	NA	NA	1.2E-07	0.02
Current Military Personnel	3.1E-06 (100)	0.09 (100)	NA	NA	NA	NA	NA	NA	NA	NA	3.1E-06	0.09
Current Recreational Child	NA	NA	NA	NA	1.1E-07 (27)	<0.01 (<1)	3.3E-07 (73)	0.01 (99)	NA	NA	4.4E-07	0.01
Current Recreational Adult	NA	NA	NA	NA	1.2E-07 (<1)	<0.01 (<1)	4.5E-07 (<1)	<0.01 (<1)	1.8E-05 (99)	1.8 (99)	1.9E-05	1.8

Notes: ICR = Incremental Lifetime Cancer Risk
HI = Hazard Index
ND = Not Determined
NA = Not Applicable
( ) = Percent Contribution to Total Risk

The source of the fuel-related groundwater contamination appears to be the Fuel Farm, underground piping, and nearby USTs. It appears to be adequately defined and somewhat limited to the area north of Fourth Street.

Solvent-related contamination appears to be separated into two plumes. The smaller plume is located in the vicinity of Building TC474, a former Vehicle Maintenance Garage, which is its most likely source. The larger plume is located west of the Fuel Farm and extends from north of Fourth Street south to Fifth Street and possibly beyond. Based on data obtained to date the horizontal limits of the second solvent-related plume has not been defined and its source is not known.

- Elevated levels of inorganic contaminants (total and dissolved) were detected in groundwater samples obtained from within the surficial aquifer. It is questionable whether this contamination is due to past site activities because the results are similar to those obtained by Baker at other Camp Lejeune sites.

- Organic and inorganic contaminants were detected in sediment samples obtained at locations adjacent to and downstream of Site 35. The results of VOC analyses were "masked" by the presence of Tentatively Identified Compounds (TICs) at high levels. The TICs may be indicative of accumulated higher molecular weight hydrocarbons which are the remnants of past contamination.

  Inorganic contamination, primarily in the form of lead, was also detected at elevated concentrations and is likely related to Site 35.

- Baker calculated that the human health risk associated with Site 35 is in excess of the acceptable range. The total risk was driven by future potential exposure to groundwater and current potential exposure to fish. However, only non-carcinogenic risks were likely with exposure to fish.

- The ecological risk assessment indicated that the aquatic community within Brinson Creek was representative of an estuarine community and does not appear to be adversely impacted by surface water and sediment quality. Additionally, there are no significant adverse impacts to terrestrial receptors from site-related contaminants.

<u>Recommendations</u>

Based on the data obtained it is recommended that:

- The remedial investigation at Site 35 be extended south of Fifth Street as needed to define the extent and locate the source(s) of solvent-related groundwater contamination in the surficial aquifer.

- The monitoring wells screened within the surficial aquifer that were sampled under the RI for inorganic contaminants (total phase only) be resampled using low-flow pumping techniques. This technique uses a peristaltic pump that limits the pumping rate to between 0.20 - 0.30 gallons per minute (gpm). These pumping rates are set to produce no net head loss in the well being sampled. Sediments (the likely source of the high inorganic concentrations in total phase samples) in the bottom of the well are also left mostly undisturbed. Samples are collected only after 3 to 5 well volumes have been removed, water quality has stabilized, and turbidity levels are less than 10 Nephelometric Turbidity Units (NTUs).

- Sediment samples along Brinson Creek be obtained at locations adjacent to and downstream of Site 35 and analyze for TPH (EPA Methods 5030 and 3550) so as to provide data regarding the extent of organic contamination that was "masked" by TICs in results obtained under the RI.

- An Interim Remedial Action Feasibility Study be prepared that focuses on groundwater in the vicinity of the Fuel Farm and north of Fourth Street. The purpose of this Interim FS will be to address groundwater contamination in this area which may be a continuing source of contamination to Brinson Creek.

- The northeastern edge of the halogenated organic plume has not been delineated. Therefore, soil and groundwater samples should be collected on the northern side of Brinson Creek in order to determine if the creek is acting as a barrier to groundwater contamination that may be migrating off-site.

- Special precautions be taken when soil excavation is performed during the construction of the new highway. Specifically, it is recommended that the written construction workplans reference the need for monitoring of volatile organic contaminant concentrations in the breathing zone of the workers, and that institutional and engineering controls be established to minimize human exposure to both VOCs and fugitive dust particulates. Although the calculated risk to human health for future construction workers on Site 35 is well below the EPA acceptable range, adverse exposure to a volatilized fraction of contaminants in the subsurface soil or inhalation of airborne contaminants is possible.

1.0 INTRODUCTION

This document is a report on the Remedial Investigation (RI) activities performed at Operable Unit (OU) No. 10, Site 35 - Camp Geiger Area Fuel Farm. It has been prepared by Baker Environmental, Inc. (Baker) for presentation to the Department of the Navy (DoN), Naval Facilities Engineering Command, Atlantic Division (LANTDIV) under Navy CLEAN Contract Number N62470-89-D-4814. The RI has been conducted in accordance with guidelines and procedures presented in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP)(40 CFR 300.430). USEPA's Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA 1988) was used as a guide for preparing this document.

The purpose of this RI was to evaluate the nature and extent of the threat to public health and the environment caused by the release of hazardous substances, pollutants or contaminants. This was accomplished by sampling several media (soil, groundwater, sediment, surface water, fish, crabs, and benthic macroinvertibrates) at OU No. 10, evaluating the analytical data and performing a human health risk assessment (RA) and ecological RA. This RI report contains the results of all field investigations, a technical memorandum summarizing groundwater data and aquifer characteristics at MCB, Camp Lejeune, the human health RA, and the ecological RA. Previous investigations were conducted by Water and Air Research, Inc., (WAR) Environmental Science and Engineering, Inc. (ESE), NUS Corporation (NUS), Law Engineering (LAW) and Baker Environmental, Inc. (Baker).

Marine Corps Base (MCB) Camp Lejeune, North Carolina has been actively involved in various environmental investigation and remediation programs since 1983, beginning with the Navy Assessment and Control of Installation Pollutants (NACIP) Program. The first study conducted under the NACIP to investigate potentially hazardous site at MCB Camp Lejeune was an Initial Assessment Study (IAS). It was conducted in 1983 and identified areas of concern that may potentially cause threats to human health and the environment as a result of past storage, handling, and/or disposal of hazardous material. Based on a review of historical records, field inspections and personal interviews, 76 areas of concern (AOCs) were identified. The IAS concluded that none of the sites pose an immediate threat to human health or the environment, however, 22 sites warrant further investigation to assess long-term impacts. During preliminary investigation of the AOCs, an additional AOC (Site 78, Hadnot Point Industrial Area) was identified.

The Department of Navy's Installation Restoration Program (IRP) was initiated in 1986 following the legislation of the Superfund Amendments and Reauthorization Act (SARA). The IRP was implemented to follow the requirements of SARA and replaced the NACIP.

MCB Camp Lejeune was placed on the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) National Priorities List (NPL) effective October 4, 1989 (54 Federal Register 41015, October 4, 1989). Subsequently, a Federal Facilities Agreement (FFA) between the United States Environmental Protection Agency Region IV (EPA), the North Carolina Department of Environment, Health and Natural Resources (NC DEHNR), and the DoN was signed in February 1991. The primary purpose of the FFA is to ensure that environmental impacts associated with past and present activities at the MCB are thoroughly investigated and appropriate CERCLA response/Resource Conservation and Recovery Act (RCRA) corrective action alternatives are developed and implemented as necessary to protect public health and the environment.

The FFA covers 23 sites at MCB Camp Lejeune that require investigation in accordance with the NCP, CERCLA and SARA under the terms and conditions outlined in the FFA. These sites have been divided into 13 operable units to simplify proceeding with Remedial Investigation/Feasibility Studies (RI/FS) activities.

1.1 Background

This section presents an overview of Site 35 and is divided into two subsections, Site Description and Site History.

1.1.1 Site Description

MCB, Camp Lejeune (also referred to as the "Activity") is located in Onslow County, North Carolina (Figure 1-1). The Activity currently covers approximately 234 square miles and is bisected by the New River, which flows in a southeasterly direction and forms a large estuary before entering the Atlantic Ocean. The borders of the Activity are defined by the U.S. Route 17 and State Route 24 to the west and northwest, respectively. The eastern border is defined by the Atlantic Ocean shoreline and the City of Jacksonville, North Carolina, borders the Activity to the north.

Camp Geiger is located at the extreme northwest corner of MCB Camp Lejeune and contains a mixture of troop housing, personnel support and training facilities. The main entrance is located along U.S. Route 17, approximately 3.5 miles southeast of the City of Jacksonville, North Carolina. Site 35, Camp Geiger Area Fuel Farm refers primarily to five, 15,000-gallon aboveground storage tanks (ASTs), a pump house, a fuel loading/unloading pad, an oil water separator, and a distribution island situated just north of the intersection of Fourth and "G" Streets. Results of previous investigations have expanded the study area beyond the confines of the Fuel Farm. To date, the study area is bounded on the west by D Street, on the north by Second Street, on the east by Brinson Creek and on the south by Fifth Street and Building No. TC572 (Figure 1-2).

Brinson Creek begins north of US Route 17 and forms the eastern boundary of the site and Camp Geiger, as it flows to the New River. East of Brinson Creek is private property. It appears, based on rough field measurements and observations, that Brinson Creek is tidally influenced to some point north of Site 35.

The 40-acre study area surrounding Site 35 is primarily covered with vegetation. Although the majority of the area is maintained, the portion adjacent to Brinson Creek is heavily wooded and overgrown. Roadways, buildings, former building foundations and several large parking areas are located throughout the study area. Eight large warehouses (TC572, TC470, TC473, TC474, TC462, TC560, TC341, and TC342), five barracks (G530 through G534) for temporary housing troops and an armory (G480) presently exist within the boundaries of the study area.

A pair of abandoned railroad tracks are located near warehouses TC462 and TC560 oriented in the north/south direction which appear to have been used to supply the series of three warehouses (two existing and one former), the ice house and the fuel farm. Chemicals are currently being stored within a fenced portion of the study area located between warehouses TC470 and TC572. The foundations of previously existing structures are scattered throughout the study area marking the former existence of a warehouse (TC460), a mess hall, a mess hall heating plant, a gas station and an ice house.

Two large fields exist in the central and western central portions of the study area. Both of the fields are used for recreation and training exercises. The "COMMARFORLANT Nuclear Biological Chemical Defense School Training Range" is located southeast of the site. Training exercises and lectures on nuclear, chemical and biological warfare are administered at this facility. This facility stores and employs the chemical warfare training agent CS (0-chlorobenzylidene malonitrile) on a regular basis.

1.1.2 Site History

Construction of MCB, Camp Lejeune began in 1941 with the objective of developing the "Worlds Most Complete Amphibious Training Base." Construction started at Hadnot Point, where the major functions of the Activity are centered. Development at the Activity is primarily in five geographical locations under the jurisdiction of the Base Command. These areas include Camp Geiger, Montford Point, Courthouse Bay, Mainside, and the Rifle Range Area.

Construction of Camp Geiger was completed in 1945, four years after construction of MCB, Camp Lejeune was initiated. Originally, the Fuel Farm ASTs were used for the storage of No. 6 fuel oil, but were later converted for storage of other petroleum products including unleaded gasoline, diesel fuel, and kerosene. The date of their conversion is not known.

Routinely, the ASTs at Site 35 supply fuel to an adjacent dispensing pump. A leak in an underground line at the station was reportedly responsible for the loss of roughly 30 gallons per day of gasoline over an unspecified period (Law, 1992). The leaking line was subsequently sealed and replaced.

The ASTs at Site 35 are currently used to dispense gasoline, diesel and kerosene to government vehicles and to supply underground storage tanks (USTs) in use at Camp Geiger and the nearby New River Marine Corps Air Station. The ASTs are supplied by commercial carrier trucks which deliver product to fill ports located on the fuel loading/unloading pad located south of the ASTs. Six, short-run (120 feet maximum), underground fuel lines are currently utilized to distribute the product from the unloading pad to the ASTs. Product is dispensed from the ASTs via trucks and underground piping.

Previously abandoned underground distribution line extended from the ASTs to the former Mess Hall Heating Plant, located adjacent to "D" Street, between Third and Fourth Streets. The underground line dispensed No. 6 fuel oil to a UST which fueled the Mess Hall boiler. The Mess Hall, located across "D" Street to the west, is believed to have been demolished along with its Heating Plant in the 1960s.

Reports of a release from an underground distribution line near one of the ASTs date back to 1957-58 (ESE, 1990). Apparently, the leak occurred as the result of damage to a dispensing pump. At that time the Camp Lejeune Fire Department estimated that thousands of gallons of fuel were released although records of the incident have since been destroyed. The fuel reportedly migrated to the east and northeast toward Brinson Creek. Interceptor trenches were excavated and the captured fuel was ignited and burned.

In April 1990, an undetermined amount of fuel was discovered by Camp Geiger personnel along two unnamed drainage channels north of the Fuel Farm. Apparently, the source of the fuel, believed to diesel or jet fuel, was an unauthorized discharge from a tanker truck that was never identified. The

Activity reportedly initiated an emergency clean-up which included the removal of approximately 20 cubic yards of soil.

The Fuel Farm is scheduled to be demolished by April 1995. Plans are currently being prepared to empty, clean, dismantle, and remove the ASTs along with all concrete foundations, slabs on grade, berms and associated underground piping. The Fuel Farm is being removed to make way for a six lane divided highway proposed by the North Carolina Department of Transportation (NCDOT) (Figure 1-3).

In addition to the Fuel Farm dismantling, soil remediation activities will be executed along the highway right-of-way as per an Interim Record of Decision executed on September 15, 1994. The soil remediation work is scheduled to commence in May 1995.

1.2 Summary of Previous Investigations

The purpose of this section is to summarize existing information pertaining to previous environmental studies involving Site 35. Information presented herein can be found in the Initial Assessment Study of Marine Corps Base, Camp Lejeune, North Carolina (WAR, 1983), Final Site Summary Report, MCB Camp Lejeune (ESE, 1990) Draft Field Investigation/Focused Feasibility Study, Camp Geiger Fuel Spill Site (NUS, 1990), Underground Fuel Investigation and Comprehensive Site Assessment (Law, 1992) and the Addendum Report of Underground Fuel Investigation and Comprehensive Site Assessment (Law, 1993) and the Interim Remedial Action Remedial Investigation/Feasibility Study (Baker, 1994). Sample locations associated with each of these studies are depicted on Figure 1-4.

1.2.1 Initial Assessment Study

MCB, Camp Lejeune was placed on the National Priority List (NPL) in 1983 after the Initial Assessment Study (IAS) identified 76 potentially contaminated sites at the Activity (WAR, 1983). Site 35 was identified as one of 23 sites warranting further investigation. Sampling and analysis of environmental media was not conducted during the IAS.

1.2.2 Confirmation Study

ESE performed Confirmation Studies of the 22 sites requiring further investigation which included a study of the Fuel Farm between 1984 and 1987 (ESE, 1990). In 1984, ESE advanced three hand-auger borings (35GW-1, -2, and -3) downgradient of the site, and collected groundwater and soil samples from each location. Soils were analyzed for lead and oil and grease. Lead was detected in soil samples obtained from hand auger borings at concentrations ranging from 6 to 8 mg/kg. Oil and grease was also detected at concentrations ranging from 40 to 2,200 mg/kg.

Shallow groundwater samples were obtained from the open boreholes and analyzed for lead, oil and grease, and volatile organic compounds (VOCs) including benzene, trans-1,2,-dichloroethene (trans-1,2,-DCE), trichloroethene (TCE), and methylene chloride. Lead was detected in each sample ranging from 1,063 μg/L (35GW-3) to 3,659 μg/L (35GW-1). Oil and grease was detected in sample 35GW-2 at 46,000 μg/L. The only detected VOC was methylene chloride in sample 35GW-1 at 4 μg/L.

In 1986, ESE collected two sediment (35SE1 and 35SE2) and two surface water (35SW1 and 35SW2) samples from Brinson Creek and installed three permanent monitoring wells (35GW-4, -5, and -6 which were later renamed EMW-5, -6, and -7), two east of and one west of the Fuel Farm. Table 1-1 details well construction. Surface water and sediment samples were analyzed for lead, oil and grease and ethylene dibromide. Groundwater samples were obtained in December 1986 and again in March 1987 and were analyzed for lead, oil and grease (O&G), and volatile organic compounds (VOCs).

No target analytes were detected in either surface water sample. Both sediment samples were reported to contain lead and oil and grease although no data indicating actual levels of detection were provided in ESE's report. Levels were reported to be higher in the upstream sample, prompting ESE to suggest that the discharge of contaminated groundwater to the creek is occurring at the far northern section of the Fuel Farm ASTs or that the source of O&G and lead may be upstream.

Lead was detected in only one of six samples (33 µg/L: EMW-6) obtained from the three permanent monitoring wells. Oil and grease was detected in all six samples in a range from 200 µg/L (EMW-5: December 1986) to 12,000 µg/L (EMW-5: March 1987). Detected VOCs included benzene (range: 1.3 µg/L at EMW-7 to 30 µg/L at EMU-6), trans-1,2,-DCE (range: 3.2 µg/L at EMW-5 to 29 µg/L at EMW-7), and TCE (detected at 11 µg/L at EMW-7 on both sample dates).

ESE recommended further investigations designed to determine the horizontal and vertical extent of contamination residing within the soils and groundwater beneath the site and sediments in Brinson Creek. In addition, ESE recommended investigation of the adjacent automotive maintenance/hobby shop to determine if it is a source of VOC contamination. In conjunction with the investigations, ESE recommended a risk assessment for portions of the ESE report that pertain to Site 35 (Appendix A).

1.2.3 Focused Feasibility Study

A Focused Feasibility Study (FFS) was conducted in 1990 in the area north of the Fuel Farm by NUS. Although the FFS was conducted, a Record of Decision was not signed as a result. The FFS included the installation of four groundwater monitoring wells numbered EMW-1, -2,-3, and -4. Table 1-1 summarizes well construction details. Baker was not able to obtain a copy of the NUS report. It was, however, discussed in the Comprehensive Site Assessment Report (Law, 1992). Law indicated that the results of laboratory analysis revealed groundwater in one well and soil cuttings from two borings were contaminated with petroleum hydrocarbons although non-aqueous product was not observed. No quantifiable data was provided in the Law report.

A geophysical investigation was also conducted by NUS as part of the FFS in an attempt to identify USTs at the site of the former gas station. The results indicated the presence of a geophysical anomaly in the vicinity of the former gas station.

1.2.4 Comprehensive Site Assessment

Law conducted a Comprehensive Site Assessment (CSA) during the fall of 1991 (Law, 1992). The CSA involved the drilling of 18 soil borings to depths ranging from 15 to 44.5 feet. These soil borings were ultimately converted to nested wells (MW-8 through 25) that monitor the water table aquifer along two zones. The shallow wells were constructed to monitor the water table and generally screened from 2.5 to 17.5 feet below ground surface (bgs). The deeper wells monitored the lower portion of the surficial aquifer and are generally screened from 17.5 to 35 feet bgs. Table 1-2 summarizes well construction details. Well MW-20 was the only well installed that is not a double nested well. It is screened from 3 to 12.5 feet bgs. Five additional soil borings were drilled and nine soil borings were hand-augered to provide data regarding vadose zone soil contamination. Three soil borings (SB-1, SB-2, SB-3) were drilled specifically to provide subsurface stratigraphic data. Additional groundwater data was provided via 21 drive-point groundwater or "Hydropunch" samples. A "Tracer" study was also performed to investigate the integrity of the ASTs and underground distribution piping.

Soil and groundwater samples obtained under the CSA were analyzed for both organic and inorganic compounds. Groundwater analyses included purgeable hydrocarbons (EPA 601), purgeable aromatics and methyl-tertiary-butyl-ether (MTBE) (EPA 602), polynuclear aromatic hydrocarbons (PAHs) (EPA 610), and unfiltered lead (EPA 239.2). Soil analyses were limited to total petroleum hydrocarbons (TPH) (SW846 3rd Edition, 5030/3550: gasoline/diesel fractions) and lead (SW846 3rd Edition, 6010). In addition, ten soil samples were analyzed for ignitability by SW846 3rd Edition, 1010.

The results of the CSA identified areas of impacted soil and groundwater. The nature of the contamination included both halogenated (i.e., chlorinated) organic compounds (e.g., TCE, trans-1,2-DCE, and vinyl chloride) and nonhalogenated, petroleum-based constituents (e.g., TPH, MTBE, benzene, toluene, ethylbenzene, and xylene). The contamination encountered was typically identified in both shallow (2.5 to 17.5 feet bgs) and deep (17.5 to 35 feet bgs) wells.

Law also identified several plumes of shallow groundwater contamination including two plumes comprised primarily of petroleum-based constituents (e.g., BTEX) and two plumes comprised of halogenated organic compounds (e.g., TCE). The plumes are all located north of Fourth Street and east of E Street except for a portion of a TCE plume that extends southwest beyond the corner of Fourth and E Streets.

In general, contaminant concentrations in soil were greatest in those samples taken at or below the water table. Law concluded that soil contamination at Site 35 was likely due to the presence of a dissolved phase groundwater plume and seasonal fluctuations of the water table. For portions of this report, refer to Appendix B.

A follow-up to the CSA was conducted by Law in 1992. Reported as an Addendum to the CSA (Law, 1993), it was designed to provide further characterization of the southern extent of the previously identified petroleum contamination. Three monitoring wells were installed including MW-26, -27, and PW-28. Monitoring well construction details are summarized in Table 1-2. Soil samples were obtained from each of these locations and analyzed for TPH (gasoline and diesel fractions). As part of the follow-up, a pump test was performed to estimate the hydraulic characteristics of the surficial aquifer. This test was designed to determine performance characteristics of the pumping well (PW-28) and to estimate hydraulic parameters of the aquifer. An approximate hydraulic conductivity of 100 feet/day was determined for the surficial aquifer. Portions of the Addendum to the CSA is provided in Appendix C.

1.2.5 Interim Remedial Action RI/FS

An Interim Remedial Action field investigation was initiated by Baker in December 1993. Its purpose was to provide additional soil data to augment the existing Site 35 database, to determine the presence of non-fuel related chemical contaminants, to provide additional information regarding the extent of soil contamination, and to support an Interim Remedial Action FS.

Seven soil borings (SB-29 through SB-35) were advanced to depths 6 to 12 feet for the purpose of collecting samples for chemical analysis. Samples were screened with an HNu photoionization detector (PID) to detect potential volatile organic hydrocarbons and to help select which sample would be submitted for laboratory analysis. Samples submitted to the laboratory were analyzed for USEPA Contract Laboratory Program (CLP) Target Compound List (TCL) volatiles and semivolatiles, Target Analyte List (TAL) inorganics, TPH by SW846 3rd Edition, Modified Method 8015 and oil and grease by SW846 3rd Edition Method 9071. Samples analyzed for TPH were extracted in accordance with SW 846 3rd Edition, Methods 5030 (gasoline range organics) and 3550 (diesel range organics). A composite sample was analyzed for the TCLP and RCRA Hazardous Waste Characteristics.

In addition, 13 shallow surface soil samples (BCSB-01 through BCSB-13) were collected at a depth of 0" to 12" from topographically low areas of Brinson Creek and the drainage channel located north of the Fuel Farm. Soil samples BCSB-01 through BCSB-10 were analyzed for CLP TCL volatiles and semivolatiles, TAL inorganics, TPH by SW 846 3rd Edition, Modified Method 8015 and oil and grease by SW 846 3rd Edition, Method 9071. Soil samples BCSB-11, 12, and 13 were analyzed for TPH and oil and grease only. A composite sample was analyzed for full TCLP and RCRA characteristics.

In general, analytical data gathered during the Interim RI suggests that the petroleum hydrocarbon contamination is primarily located near the surface of the shallow groundwater. The results indicate that the highest TPH related contamination occurs at or below the water table and groundwater fluctuations likely account for the subsurface soil contamination detected immediately above the top of the groundwater.

The Interim Remedial Action RI/FS culminated with an executed Interim Record of Decision (ROD), signed on September 15, 1994, for the remediation of contaminated soil along and adjacent to the proposed highway right-of-way at Site 35. Three areas of contaminated soil have been identified. The first area is located in the vicinity of the Fuel Farm ASTs, and the two other areas are located north of the Fuel Farm. The larger of these two areas is located along "F" Street in the vicinity of monitoring well MW-25. Baker has estimated that approximately 3,600 cubic yards (4,900 tons) of contaminated soil is present in these areas. Contaminated soil located in these areas is scheduled for removal and disposal at an off-site soil recycling facility beginning in 1995.

A fourth area of soil contamination, located immediately north of Building G480, was also identified in the Interim ROD. Additional data pertaining to this fourth area became available subsequent to the execution of the Interim ROD. This data indicated that contaminated soil was encountered in this area during the removal of a UST there in January 1994. The contaminated soil was excavated and reportedly disposed off site; however, no documentation is available regarding how or where the soil was disposed. An additional soil investigation will be conducted in this area to confirm that the contaminated soil was not returned to the excavation and that follow-up soil remediation in this area is not necessary.

1.2.6 Other Investigations

Two USTs located near the Fuel Farm have been the subject of previous investigations conducted under the Activity's UST program. The two USTs include a No. 6 fuel oil UST situated adjacent to the former Mess Hall Heating Plant and a No. 2 fuel oil UST situated adjacent to Building G480 (Explosive Ordnance and Disposal Armory, Office, and Supply Building). The former was abandoned in place years ago (date unknown) and has been the subject of previous environmental investigations performed by ATEC Associates, Inc. (ATEC) and Law. The latter was removed in January 1994. Contaminated soils adjacent to the UST were reportedly removed with the tank. However, samples were not collected to confirm the limits of contamination.

As part of the Interim Remedial Action for soil to be executed in 1995 by OHM Corporation, four soil borings will be advanced in the immediate vicinity of the former No. 2 fuel oil UST. Soil samples will be collected from each location immediately above the water table and analyzed for TPH (5030 and 3550). The sampling is expected to verify the remaining soils do not contain hydrocarbon contamination associated with the former UST.

ATEC conducted a site assessment in the vicinity of Building TC341 to investigate contamination associated with the UST previously used to supply fuel to the Mess Hall Heating Plant. During the investigation, ATEC installed three shallow monitoring wells and analyzed the soils and groundwater for TPH (EPA Method 8015) and BTEX (EPA Method 8020) (ATEC, 1992). The details of well construction are summarized on Table 1-1.

Results of TPH in soils ranged from 110 mg/kg (MW-3) to 2,000 mg/kg (MW-2). Total BTEX was detected in soils ranging from non-detected concentrations to 5,530 µg/kg in MW-2. TPH in groundwater was detected in MW-1 at a concentration of 5 mg/L and in MW-2 at 3 mg/L. Total BTEX was detected in the groundwater sample collected from MW-2 at a concentration of 34 µg/L. Based on these results, ATEC had recommended removal of the UST and associated piping. For details of the ATEC report please refer to Appendix E.

Law submitted a report for a leaking underground storage tank (LUST) site assessment for Building TC341 on April 13, 1994, to LANTDIV summarizing the activities conducted in March 1994. The assessment was conducted in order to delineate the extent of contamination identified by ATEC.

The assessment involved the installation of 12 Type II and two Type III groundwater monitoring wells and analysis of soils and groundwater (Figure 1-4). Well construction details are provided on Table 1-3. The soils were analyzed for TPH according to EPA Methods 5030/8015 (volatile fractions), 3550/8015 (semivolatile fraction), and 9071 (oil and grease), TCLP metals, ignitability, and pH. Groundwater samples were analyzed for purgeable aromatic hydrocarbons (EPA Method 602), polynuclear aromatic hydrocarbons (EPA Method 610), and the eight RCRA metals.

Results of TPH (5030/8015) in soils ranged from nondetectable concentrations to 4,100 mg/kg in MW-14 (3.5 to 5 feet). TPH (3550/8015) was detected in soil samples at MW-11, MW-17, MW-14, and MW-15 at concentrations of 11 mg/kg, 11 mg/kg, 800 mg/kg, and 490 mg/kg, respectively. In addition, TCLP metals (barium, chromium, and cadmium) were detected in samples at concentrations below TCLP limits. Results for pH in soils range between 5.53 to 7.48 and ignitability was not detected.

RCRA metals, volatile organic compounds, and semivolatile organic compounds were detected in groundwater samples from monitoring wells MW-1 through MW-17. RCRA metals were detected in both of the samples submitted for metals analyses. Volatile organic compounds were detected in four of the five samples submitted for analyses. Seventeen samples were submitted for analyses of semivolatile organic compounds and five possessed detectable concentrations. For complete details and results of the investigation, refer to Appendix F.

Law concluded that the majority of the soil and groundwater contamination originating from the tank system at Building TC341 had been adequately defined. Preparation of a Corrective Action Plan is in progress and was scheduled to be completed in January 1995.

1.3 Report Organization

The RI Report is a compilation of nine sections. Section 1.0, Introduction, presents the purpose of the RI, site description, site history, and results of previous investigations. The field investigation activities conducted under the RI are summarized in Section 2.0 and the physical characteristics of the study are summarized in Section 3.0. Section 4.0 presents a discussion of the nature and extent of contamination. Contaminant fate and transport and the baseline risk assessment are presented in Sections 5.0 and 6.0, respectively. Section 7.0 presents details of the ecological risk assessment. Conclusions and recommendations are discussed in Section 8.0. Tables, figures, and references pertinent to each section are presented at the end of each section.

SECTION 1.0 TABLES

TABLE 1-1

SUMMARY OF EXISTING WELL CONSTRUCTION DETAILS
1992 UNDERGROUND STORAGE TANK ASSESSMENT NEAR THE FORMER MESS HALL HEATING PLANT
1990 FIELD INVESTIGATION OF CAMP GEIGER FUEL SPILL SITE
1986 SITE ASSESSMENT OF CAMP GEIGER FUEL FARM
SITE 35, CAMP GEIGER AREA FUEL FARM
MARINE CORPS BASE, CAMP LEJEUNE, NORTH CAROLINA
CONTRACT TASK ORDER 0232

Well No.	Date Installed	Consultant Supervising Well Installation	Top of PVC Casing Elevation (feet, above MSL)[1]	Ground Surface Elevation (feet, above MSL)	Stick-Up (feet, above ground surface)	Boring Depth (feet, bgs)[2]	Well Depth (feet, bgs)	Screen Interval Depth (feet, bgs)	Depth to Sand Pack (feet, bgs)	Depth to Bentonite (feet, bgs)
1992 Underground Storage Tank Assessment Near Former Mess Hall Heating Plant										
MW-1[3]	6-1-92	ATEC and Associates	20.59[6]	--	--	20.0	20.0	5.0 - 20.0	3.0 - 20.0	2.0 - 3.0
MW-2[3]	6-2-92	ATEC and Associates	21.13[6]	--	--	20.0	20.0	5.0 - 20.0	3.0 - 20.0	2.0 - 3.0
MW-3[3]	6-2-92	ATEC and Associates	20.49[6]	--	--	20.0	20.0	5.0 - 20.0	3.0 - 20.0	2.0 - 3.0
1990 Field Investigation of Camp Geiger Fuel Spill Site										
EMW-1	1990[4]	NUS	19.16[7]	17.4[7]	1.8[7]	--	23.0	8.5 - 17.5[4]	--	--
EMW-2	1990[4]	NUS	--	--	--	--		1.87 - 10.89[4]	--	--
EMW-3	1990[4]	NUS	7.00[7]	4.7[7]	2.3[7]	--	14.85	3.06 - 12.06[4]	--	--
EMW-4	1990[4]	NUS	--	--	--	--		2.61 - 11.61[4]	--	--
1986 Site Assessment of Camp Geiger Fuel Farm										
EMW-5	1986[5]	ESE	17.98[7]	16.1[7]	1.9[7]	--	26.30	10.5 - 24.5[4]	--	--
EMW-6	1986[5]	ESE	15.97[7]	14.2[7]	1.8[7]	--	28.67	10.5 - 24.5[4]	--	--
EMW-7	1986[5]	ESE	18.49[7]	16.4[7]	2.1[7]	--	27.80	10.5 - 24.5[4]	--	--

Notes:
(1) MSL = mean sea level
(2) bgs = below ground surface
(3) Calculated values based on elevations recorded in Law's report, "Final Report Underground Fuel Investigation Comprehensive Site Assessment," dated February 7, 1992.
(4) Data/information was found in Law's report, "Final Report Underground Fuel Investigation Comprehensive Site Assessment," dated February 7, 1992.
(5) Data/information found in ESE's "Site Summary Report," dated September 1990.
(6) Elevations as recorded in Law's report, "Leaking Underground Storage Tank, Site Assessment Report," dated April 13, 1994.
(7) Data was gathered by Baker during 1994 Remedial Investigation.
(8) -- Indicates that the data is not known.

TABLE 1-2

SUMMARY OF EXISTING WELL CONSTRUCTION DETAILS
1991 ASSESSMENT OF A SUSPECTED FUEL LEAK ORIGINATING FROM THE CAMP GEIGER FUEL FARM (1991)
SITE 35, CAMP GEIGER AREA FUEL FARM
MARINE CORPS BASE, CAMP LEJEUNE, NORTH CAROLINA
CONTRACT TASK ORDER 0232

Well No.	Date Installed	Consultant Supervising Well Installation	Top of PVC Casing Elevation (feet, above MSL)(1)	Ground Surface Elevation (feet, above MSL)	Stick-Up (feet, above ground surface)	Boring Depth (feet, bgs)(2)	Well Depth (feet, bgs)	Screen Interval Depth(3) (feet, bgs)	Depth to Sand Pack(3) (feet, bgs)	Depth to Bentonite(3) (feet, bgs)
MW-8S/D	8-15-91	Law Engineering	19.17(4)	16.8(5)	2.4(4)	30.0	30.0	4.5 - 13.5 20.5 - 29.5	2.0 - 15.0 18.0 - 30.0	1.0 - 2.0 15.0 - 18.0
MW-9S/D	8-16-91	Law Engineering	18.88	16.9	2.0	30.0	30.0	3.5 - 12.5 25.5 - 29.5	2.0 - 13.0 16.0 - 30.0	1.0 - 2.0 13.0 - 16.0
MW-10S/D	8-19-91	Law Engineering	19.01	16.6	2.4	30.0	30.0	4.5 - 13.5 25.5 - 29.5	2.0 - 14.0 19.0 - 30.0	1.0 - 2.0 16.0 - 19.0
MW-11S/D	8-19-91	Law Engineering	18.39(4)	15.9(5)	2.5(4)	30.0	30.0	4.5 - 13.5 25.5 - 29.5	2.0 - 19.5 22.5 - 30.0	1.0 - 2.0 19.5 - 22.5
MW-12S/D	8-19-91	Law Engineering	19.94	17.3	2.6	28.5	28.5	5.0 - 14.0 24.0 - 28.0	3.0 - 14.5 19.0 - 28.5	2.0 - 3.0 15.5 - 19.0
MW-13S/D	8-19-91	Law Engineering	17.02	14.6	2.4	30.0	30.0	5.5 - 14.5 25.5 - 29.5	3.0 - 18.5 22.5 - 30.0	2.0 - 3.0 18.5 - 22.5
MW-14S/D	8-20-91	Law Engineering	17.73	15.3	2.4	30.0	30.0	3.5 - 12.5 24.5 - 28.5	2.0 - 13.0 21.0 - 29.0	1.0 - 2.0 18.0 - 21.0
MW-15S/D	8-20-91	Law Engineering	18.05(4)	15.5(5)	2.6(4)	30.0	30.0	4.5 - 13.5 25.5 - 29.5	2.5 - 17.5 25.0 - 30.0	1.5 - 2.5 17.5 - 23.0
MW-16S/D	8-21-91	Law Engineering	20.06	17.6	2.5	29.0	29.0	5.0 - 14.0 24.0 - 28.5	2.0 - 17.5 20.0 - 24.5	1.0 - 2.0 17.5 - 20.5
MW-17S/D	8-21-91	Law Engineering	16.77	14.1	2.7	29.5	29.5	7.5 - 16.5 25.0 - 29.0	4.5 - 19.5 22.5 - 30.0	3.5 - 4.5 19.5 - 22.5
MW-18S/D	8-21-91	Law Engineering	13.40(4)	10.8(5)	2.6(4)	25.0	25.0	3.0 - 12.0 20.5 - 24.5	1.5 - 14.0 17.0 - 25.0	0.5 - 1.5 14.0 - 17.0
MW-19S/D	8-22-91	Law Engineering	8.72	6.0	2.7	25.0	25.0	4.5 - 13.5 22.5 - 24.5	2.0 - 15.0 20.0 - 25.0	1.0 - 2.0 17.0 - 20.0

TABLE 1-2 (Continued)

SUMMARY OF EXISTING WELL CONSTRUCTION DETAILS
1991 ASSESSMENT OF A SUSPECTED FUEL LEAK ORIGINATING FROM THE CAMP GEIGER FUEL FARM (1991)
SITE 35, CAMP GEIGER AREA FUEL FARM
MARINE CORPS BASE, CAMP LEJEUNE, NORTH CAROLINA
CONTRACT TASK ORDER 0232

Well No.	Date Installed	Consultant Supervising Well Installation	Top of PVC Casing Elevation (feet, above MSL)(1)	Ground Surface Elevation (feet, above MSL)	Stick-Up (feet, above ground surface)	Boring Depth (feet, bgs)(2)	Well Depth (feet, bgs)	Screen Interval Depth(3) (feet, bgs)	Depth to Sand Pack(3) (feet, bgs)	Depth to Bentonite(3) (feet, bgs)
MW-20S/D	8-23-91	Law Engineering	15.97(4)	13.6(5)	2.4(4)	12.5	12.5	3.0 - 12.0	1.5 - 12.5	0.5 - 1.5
MW-21S/D	8-23-91	Law Engineering	17.57	15.1	2.5	27.5	27.5	4.5 - 13.5 25.5 - 27.0	2.0 - 14.0 22.0 - 28.5	1.0 - 2.0 19.0 - 22.0
MW-22S/D	8-28-91	Law Engineering	19.18(4)	16.3(5)	2.9(4)	35.0	35.0	5.5 - 14.5 32.5 - 35.0	3.0 - 25.5 29.0 - 35.0	2.0 - 3.0 25.5 - 29.0
MW-23S/D	8-27-91	Law Engineering	8.74	6.4	2.3	20.0	20.0	2.5 - 9.5 17.5 - 20.0	1.0 - 10.0 13.0 - 21.0	0.5 - 1.0 10.0 - 13.0
MW-24S/D	8-28-91	Law Engineering	18.72(4)	16.5(5)	2.2(4)	29.0	29.0	8.5 - 17.5 26.5 - 29.0	4.0 - 20.0 23.0 - 29.0	0.8 - 3.0 20.0 - 23.0
MW-25S/D	8-29-91	Law Engineering	13.32	11.3	2.0	30.0	30.0	4.5 - 13.5 27.5 - 30.0	2.0 - 22.0 25.0 - 30.0	1.0 - 2.0 22.0 - 25.0

Notes: (1) MSL = mean sea level
(2) bgs = below ground surface
(3) Two wells were installed within the same borehole, therefore, the two ranges of depth correspond to depths at which the screen, sand pack, and bentonite seal can be located with respect to each well.
(4) Elevations as recorded in Law's report, "Final Report Underground Fuel Investigation Comprehensive Site Assessment, dated February 7, 1992.
(5) Calculated values based on elevations recorded in Law's report, "Final Report Underground Fuel Investigation Comprehensive Site Assessment, dated February 7, 1992.

* A shallow and an intermediate well were installed in the same borehole at locations with an S/D designation. Law Engineering installed two separate sets of wells on two occasions (August 1991 and March 1994) and duplicated designations MW-8 through MW-17. Baker added the S/D designation for clarity. The designation indicates a shallow well screened across the water table. The D designation indicates an intermediate well screen in the 20 to 30-foot interval.

TABLE 1-3

SUMMARY OF EXISTING WELL CONSTRUCTION DETAILS
1994 UNDERGROUND STORAGE TANK ASSESSMENT NEAR BUILDING TC341
SITE 35, CAMP GEIGER AREA FUEL FARM
MARINE CORPS BASE, CAMP LEJEUNE, NORTH CAROLINA
CONTRACT TASK ORDER 0232

Well No.	Date Installed	Consultant Supervising Well Installation	Top of PVC Casing Elevation (feet, above MSL)(1)	Ground Surface Elevation (feet, above MSL)	Stick-Up (feet, above ground surface)	Boring Depth (feet, bgs)(2)	Well Depth (feet, bgs)	Screen Interval Depth (feet, bgs)	Depth to Sand Pack (feet, bgs)	Depth to Bentonite(3) (feet, bgs)
MW-4	3-1-94	Law Engineering	20.52	18.4	2.1	14.0	13.0	3.0-13.0	2.0-14.0	0.0-2.0
MW-5	3-1-94	Law Engineering	19.79(4)	17.9(5)	1.9(4)	14.0	13.0	3.0-13.0	2.0-14.0	0.0-2.0
MW-6	3-1-94	Law Engineering	19.16(4)	17.3(5)	1.9(4)	14.0	13.0	3.0-13.0	2.0-14.0	0.0-2.0
MW-7	3-1-94	Law Engineering	19.12(4)	17.2(5)	1.9(4)	14.0	13.0	3.0-13.0	2.0-14.0	0.0-2.0
MW-8	3-1-94	Law Engineering	16.56(4)	16.56(5)	Flush(4)	14.0	13.0	3.0-13.0	2.0-14.0	0.0-2.0
MW-9	3-3-94	Law Engineering	19.36(4)	17.4(5)	2.0(4)	33.0	32.0	27.0-32.0	24.5-33.0	0.0-22.0
MW-10	3-3-94	Law Engineering	19.31(4)	17.4(5)	1.95(4)	14.0	13.0	3.0-13.0	2.0-14.0	0.0-2.0
MW-11	3-4-94	Law Engineering	19.21(4)	17.3(5)	1.95(4)	14.0	13.0	3.0-13.0	2.0-14.0	0.0-2.0
MW-12	3-7-94	Law Engineering	19.75(4)	17.8(5)	2.0(4)	14.0	13.0	3.0-13.0	2.0-14.0	0.0-2.0
MW-13	3-7-94	Law Engineering	17.79(4)	15.8(5)	2.0(4)	14.0	13.0	3.0-13.0	2.0-14.0	0.0-2.0
MW-14	3-8-94	Law Engineering	16.31(4)	16.3(5)	Flush(4)	14.0	13.0	3.0-13.0	2.0-14.0	0.0-2.0
MW-15	3-8-94	Law Engineering	16.20(4)	16.2(5)	Flush(4)	30.0	30.0	25.0-30.0	23.0-30.0	0.0-22.0
MW-16	3-8-94	Law Engineering	16.53(4)	16.5(5)	Flush(4)	14.0	13.0	3.0-13.0	2.0-14.0	0.0-2.0
MW-17	3-8-94	Law Engineering	16.14(4)	16.1(5)	Flush(4)	14.0	13.0	3.0-13.0	2.0-14.0	0.0-2.0

Notes: (1) MSL = mean sea level
(2) bgs = below ground surface
(3) Indicates that interval is recorded as cement in well construction records submitted to the State of North Carolina, however, some bentonite usually exists as a barrier within this interval to prevent cement intrusion into sand pack.
(4) Elevations as recorded in Law's report, "Leaking Underground Storage Tank, Site Assessment Report," dated April 13, 1994.
(5) Calculated values based on elevations recorded in Law's report, "Leaking Underground Storage Tank, Site Assessment Report," dated April 13, 1994.

* Law Engineering installed two separate sets of wells at this site on two occasions (August 1991 and March 1994) and duplicated designations MW-8 through MW-17. Additional designations (S [shallow]/D [deep]) were added to these nested wells installed in 1991 for clarity.

3.4 Geology

3.4.1 Regional Geology

MCB Camp Lejeune is located in the Atlantic Coastal Plain physiographic province. The sediments of the Atlantic Coastal Plain consist of interbedded sands, clays, calcareous clays, shell beds, sandstone, and limestone. These sediments are layered in interfingering beds and lenses that gently dip and thicken to the southeast (ESE, 1990). Regionally, they comprise 10 aquifers and nine confining units which overlie igneous and metamorphic basement rocks of pre-Cretaceous age. The combined thickness of these sediments is approximately 1,500 feet. These sediments were deposited in marine or near-marine environments and range in age from early Cretaceous to Quaternary time. Table 3-2 presents a generalized geologic and hydrogeologic units in coastal North Carolina (Harned et al., 1989).

United States Geological Survey (USGS) studies at MCB Camp Lejeune indicate that the area is underlain by sand and limestone aquifers separated by semi-confining units (i.e., in some portions of the base) of silt and clay. These aquifers include the water table (surficial), Castle Hayne, Beaufort, Peedee, Black Creek, and upper and lower Cape Fear. The surficial aquifer ranges in thickness from 0-73 feet and averages 25 feet according to U.S.G.S (Cardinell et al, 1993). The estimated lateral hydraulic conductivity for the surficial aquifer is 50 ft/d and is based on a general composition of fine sand mixed with some silt and clay (Cardinell et al, 1993). Less permeable clay and silt beds function as confining units or semi-confining units which separate the aquifers and impede the flow of groundwater between aquifers. The vertical hydraulic conductivity of the Castle Hayne confining unit was estimated to range from 0.0014 to 0.41 ft/d and is comparable to those determined for silt (Cardinell et al, 1993). A generalized hydrogeologic cross-section of this area is presented in Figures 3-1 and 3-2. This cross-section illustrates the relationship between the aquifers in this area (Cardinell et al., 1993).

3.4.2 Site Geology

Numerous borings were advanced within the study area during the field investigations conducted by Baker. Subsurface soil descriptions are provided in the Test Boring and Well Construction Records in Appendix H. Additional information regarding the soils were obtained from the previous investigations. The following provides detailed description of the stratigraphy underlying the study area.

Soil conditions are generally uniform throughout the study area. In general, the shallow soils consist of unconsolidated deposits of silty sand, clayey silt, silt and sand. These soils represent the Quaternary age "undifferentiated" deposits which characterize the River Bend Formation and is underlain by the Castle Hayne Formation. Sands are primarily fine to medium grained and contain varied amounts of silt (0-50%), shell fragments (0-35%), clay (0-10%).. Results of the standard penetration tests indicate that the sands have a relative density of loose to dense. Based on field observations, the sands classify as silty sand (SM) and/or poorly graded sand (SP) according to the USCS.

Silts are plastic to nonplastic, contain varied amounts of sand (0-50%) and clay (0-10%) and classify as ML or MH. Standard penetration tests indicate that the silts have a relative density of loose to dense for the nonplastic, and soft to very stiff for the plastic.

Geologic cross-sections were constructed to illustrate subsurface soil beneath the study area. As shown on Figure 3-3, several areas were traversed to provide a cross-sectional view of the study area. Three cross-sections were constructed: A-A' crosses west to east across the upper portion of the study area; B-B' crosses north to south; and C-C' crosses west to east across the lower portion of the study area.

Cross-section A-A' depicts subsurface soils to an elevation of -51.3 feet msl from the western boundary of the study area to the eastern boundary. As illustrated on Figure 3-4, the soil underlying this portion of the area consist of fine to medium sands, clayey silts, and silty sands.

In general, on the western portion of the study area, a fine sand with trace to some silt is underlain by another fine sand that is partially cemented with calcium carbonate and contains 10-20% shell fragments to a depth of approximately -25 msl. Underlying the partially cemented sand is a very dense to dense, greenish gray, fine sand containing some silt, trace to some shell fragments. This soil unit is the semi-confining unit separating the Quaternary sediments from the Castle Hayne Aquifer. The semi-confining unit appears to be approximately 8 to 12 feet thick, generally thickening toward the east. Beneath this unit resides the Castle Hayne Formation. Borings were only advanced 10 to 15 feet into this formation during the RI, therefore providing limited knowledge of specific details regarding the condition of the Castle Hayne beneath the study area. The upper portion of the Castle Hayne was described as a partially cemented, gray, fine sand with some shell fragment and limestone fragments encountered periodically.

On the eastern portion of the study area this entire sequence of soil types appears to be overlain by silty clay or a clayey silt. The unit is not uniform and varies from approximately 4 to 20 feet thick.

Cross-section B-B' depicts the subsurface soil conditions to an elevation of -42.1 feet (Figure 3-5). The soils consisted of clayey silts, sands, silty sands, peats, and clays. Overall the soils did not differ substantially from those encountered in the A-A' cross-section. In general, a fine to medium sand with trace to some silt was interbedded with silts, silty sands, clayey silts and clays to an elevation of -6 to -12 msl. The only difference was the 8 feet of peat observed in soil boring 35MW-34B. This boring was located in the southeastern portion of the study area.

Beneath the fine to medium sand resides the partially cemented, gray, fine sand with trace to some shell fragments. The semi-confining unit underlies this unit followed by the Castle Hayne Formation.

Cross-section C-C' illustrates the soils beneath the southern portion of the site to an elevation of -51.3 (Figure 3-6). In general, the soils consisted of the same types observed in the other cross-sections previously discussed. The only difference in this cross-section when compared with the others is the increase in interbedded soils on the eastern portion of the area.

Overall, the soils encountered during investigations within the study area are fairly consistent throughout. Note that within the study area, a laterally continuous semi-confining unit was present and between -26.0 and -28.1 feet msl. The location of the semi-confining unit separating the surficial from the Castle Hayne Aquifer was encountered approximately 40 feet below ground surface. This is consistent with the range reported by the U.S.G.S. but exceeds the average of 25 feet they had reported (Cardinell et al, 1993).

3.5 Surface Soils

Information regarding site soil conditions was obtained from the Soil Survey publication prepared by the U.S. Department of Agriculture - Soil Conservation Service (SCS) for Marine Corps Base Camp Lejeune, North Carolina (SCS, 1984). Due to past grading and surface activities at the site, the soils described in the SCS publication may differ from current site conditions.

According to the SCS Soil Survey the site is underlain by a single distinct soil unit, the Baymeade-Urban (BaB) Land Complex. Baymeade-Urban soils exhibit 0 to 6 percent slopes and only about 30 percent of their surface area has been altered through urbanization. Infiltration is rapid and surface water runoff slow in the remaining undisturbed areas. The seasonal high water table ranges from 4 to 5 feet bgs for Baymeade-Urban soils.

3.6 Hydrogeology

The following sections discuss the regional and site-specific hydrogeologic conditions. The information presented on the regional hydrogeology is from literature (Harned, et al., 1989); site-specific hydrogeologic information presented is from data collected during the field investigation.

3.6.1 Regional Hydrogeology

The surficial water table aquifer lies in a series of undifferentiated sediments, primarily sand and clay, which commonly extend to depths of 50 to 100 feet. This aquifer is not used for water supply at MCB Camp Lejeune because of its low yielding production rates. A confining unit is present underlying the surficial aquifer within the eastern portion of MCB Camp Lejeune (Harned, et al., 1989).

The principal water supply aquifer for the Activity lies in a series of sand and limestone beds between 50 and 300 feet bgs. This series of sediments generally is known as the Castle Hayne Aquifer. The Castle Hayne Aquifer is about 150 to 350 feet thick in the area and is the most productive aquifer in North Carolina. Estimated transmissivity (T) and hydraulic conductivity (K) values for the Castle Hayne Aquifer range from 4,300 to 24,500 ft^2/day (32,200 to 183,300 gallons/foot/day) and 14 to 82 feet/day, respectively (Harned et al., 1989).

Onslow County and MCB Camp Lejeune lie in an area where the Castle Hayne Aquifer contains freshwater, although the proximity of saltwater in deeper layers just below the aquifer and in the New River estuary is of concern in managing water withdrawals from the aquifer. Overpumping of the deeper parts of the aquifer could cause intrusion of saltwater. The aquifer contains water having less than 250 milligrams per liter (mg/l) chloride throughout the area of the Base (Harned et al., 1989).

The aquifers that lie below the Castle Hayne consist of thick sequences of sand and clay. Although some of these aquifers are used for water supply elsewhere in the Coastal Plain, they contain saltwater in the MCB Camp Lejeune area and are not used (Harned et al., 1989).

Rainfall in the MCB Camp Lejeune area enters the ground in recharge areas, infiltrates the soil, and moves downward until it reaches the water table, which is the top of the saturated zone. In the saturated zone, groundwater flows in the direction of lower hydraulic head, moving through the system to discharge areas like the New River and its tributaries or the ocean (Harned et al., 1989).

Water levels in wells tapping the surficial aquifer vary seasonally. The surficial aquifer receives more recharge in the winter than in the summer when much of the water evaporates or is transpired by plants before it can reach the water table. Therefore, the water table generally is highest in the winter months and lowest in summer or early fall (Harned et al., 1989).

In semi-confined aquifers, water is sometimes under excess head and the level to which it rises in a tightly cased well is called the potentiometric surface. The hydraulic head in the semi-confined Castle Hayne Aquifer, shows a different pattern of variation over time. Some seasonal variation also is common in the potentiometric surface of the Castle Hayne Aquifer, but the changes tend to be slower and over a smaller range than for water table wells (Harned et al., 1989).

3.6.2 Site Hydrogeology

The following sections describe the site hydrogeologic conditions for the surficial (water table aquifer) and the deep (Castle Hayne Aquifer) water-bearing zones at Site 35. Hydrogeologic characteristics in the vicinity of the site were evaluated by reviewing existing information (e.g., USGS publications) and installing a network of shallow, intermediate and deep monitoring wells.

Groundwater was encountered at varying depths during the drilling program. This variation is primarily attributed topographical changes. In general, the groundwater was encountered between 5.5 and 8.5 feet bgs. The water table nears the surface in the area of Brinson Creek, where the topography drops.

Multiple rounds of groundwater level measurements were obtained from the shallow, intermediate and deep monitoring wells within the study area. Three complete rounds were obtained on June 14, July 12, and September 9, 1994 and are summarized on Tables 2-3, 2-4, and 2-5.

Shallow groundwater elevations exhibited some fluctuation over the three month period. The water table aquifer exhibited a 0.73 to 3.25 foot increase in elevation. The increase may be due to increased precipitation experienced during the latter portion of the summer and early fall of 1994. Typically at MCB, Camp Lejeune, a higher water table is noted in the spring and a lower water table is noted in the late fall. However, the spring of 1994 was reported by Activity personnel unseasonably dry and may have resulted in a decrease in the elevation of the groundwater. Approximately 1.67 inches of rainfall was recorded by Baker's rain gauge between March 12, 1994 and May 10, 1994. Typically, Camp Lejeune receives approximately 6.5 inches of rain during the months of March and April according to the Naval Oceanography Command Detachment (see Table 3-1).

Shallow groundwater flow patterns in the vicinity of the site on September 9, 1994 are depicted on Figure 3-7. The data indicates that the groundwater flow is toward the northeast, with an average gradient of 1.7×10^{-2} ft/ft.

Hydraulic conductivity test were performed at the site between September 9 and 10, 1994. The average hydraulic conductivity for the upper portion of the water table aquifer is 0.628 ft/day (2.22×10^{-4} cm/sec) and the average for the lower portion of the water table aquifer is 5.16 ft/day (1.8×10^{-3} cm/sec). These values were calculated using the Geraghty and Miller aquifer test solver (AQTESOLV) program which uses the Bouwer and Rice (1976) method for unconfined aquifers. The average values are consistent with expected values of hydraulic conductivity for the sands and silty sands at the site (Fetter, 1980). The copies of the AQTESOLV printouts are located in Appendix N and the results are summarized on Table 3-3.

A study of data from other aquifer tests (pump tests) performed at MCB Camp Lejeune was conducted by Baker to further evaluate aquifer characteristics and production capacities. The technical memorandum is provided in Appendix O. The information contained in this memorandum pertains primarily to the surficial aquifer. Average pumping rates range from 0.5 to 3 gallons per minute (gpm). Transmissivity ranges from 7.17 to 7,099.20 ft^2/day; storativity ranges from 1.51×10^{-3} to 7.48×10^{-2}; and hydraulic conductivity ranged from 0.48 to 1.42 ft/day.

Fluctuation of the groundwater elevations within the deep wells was observed over the three months, however the fluctuation was not as dramatic as in the shallow and intermediate wells. Fluctuations ranged from 0.88 to 1.77 feet. It is not uncommon for a semi-confined aquifer to not respond to precipitation or seasonal fluctuations with the same magnitude as an unconfined aquifer. The presence of the semiconfining unit will impede the vertical migration of precipitation causing a delayed and minimal effect on the head of the aquifer.

The upper portion of the Castle Hayne Aquifer also flows northeast across the site with a gradient of 1.4×10^{-2} (see Figure 3-8). The calculated hydraulic conductivity for this unit was calculated from a slug test at 6.03 ft/day (2.03×10^{-3} cm/sec). These values are consistent with the sands encountered in the upper portion of the Castle Hayne Formation beneath the site (Fetter, 1980). The result of the slug test is summarized in Table 3-4 and the data is provided in Appendix N.

3.7 Land Use and Demography

Present military population of MCB, Camp Lejeune is approximately 40,928 active duty personnel. The military dependent community is in excess of 32,081. About 36,086 of these personnel and dependents reside in base housing units. The remaining personnel and dependents live off base and have had dramatic effects on the surrounding area. An additional 4,412 civilian employees perform facilities management and support functions. The population of Onslow County has grown from 17,739 in 1940, prior to the formation of the base, to its present population of 121,350.

Site 35, the Camp Geiger Area Fuel Farm, is presently used to dispense gasoline, diesel, and kerosene to government vehicles and to supply USTs in use at Camp Geiger and the New River Marine Corps Air Station. The fuel farm is planned for demolition for a proposed highway. Barracks are located within 1,000 feet of the site and many warehouses and storage facilities are located adjacent to and within the boundaries of the study area. A COMMARFORLANT Nuclear Biological Chemical Defense School Training Range is located adjacent to the southeast boundary of the site.

Sensitive environmental areas would include Brinson Creek and associated unnamed tributaries.

3.8 Regional Ecology

MCB Camp Lejeune is located in the Coastal Plain Province. The ecology of the region is influenced by climate, which is characterized by hot, humid summers and cool winters. Some subfreezing cold spells occur during the winters, and there are occasional accumulations of snow that rarely persist. The average precipitation is 55.96 inches and the mean temperature is 60.9°F.

The area exhibits a long growing season, typically more than 230 days. Soils in the region range from very poorly drained muck to well-drained sandy loam.

A number of natural communities are present in the Coastal Plain Province. Subcommunities and variations of these major community types are also present, and alterations of natural communities have occurred in response to disturbance and intervention (i.e., forest cleared to become pasture). The natural communities found in the area are summarized as follows:

- Mixed Hardwood Forest - Found generally on slopes of ravines. Beech is an indicator species with white oak, tulip, sweetgum, and holly.

- Southeastern Evergreen Forest - Dominated by pines, especially longleaf pine.

- Loblolly Pine/Hardwoods Community - Second growth forest that includes loblolly pine with a mix of hardwoods -- oak, hickory, sweetgum, sour gum, red maple, and holly.

- Southern Floodplain Forest - Occurs on the floodplains of rivers. Hardwoods dominate with a variety of species present. Composition of species varies with the amount of moisture present.

- Maritime Forest - Develops on the lee side of stable sand dunes protected from the ocean. Live oak is an indicator species with pine, cedar, yaupon, holly, and laurel oak. Deciduous hardwoods may be present where forest is mature.

- Pocosins - Lowland forest community that develops on highly organic soils that are seasonally flooded. Characterized by plants adapted to drought and acidic soils low in nutrients. Pond pine is dominant tree with dense layer of evergreen shrubs. Strongly influenced by fire.

- Cypress\Tupelo Swamp Forest - Occurs in the lowest and wettest areas of floodplains. Dominated by bald cypress and tupelo.

- Freshwater Marsh - Occurs upstream from tidal marshes and downstream from non-tidal freshwater wetlands. Cattails, sedges, and rushes are present. On the coast of North Carolina swamps are more common than marshes.

- Salt Marsh - Regularly flooded, tidally influenced areas dominated by salt-tolerant grasses. Saltwater cordgrass is a characteristic species. Tidal mud flats may be present during low tide.

- Salt Shrub Thicket - High areas of salt marshes and beach areas behind dunes. Subjected to salt spray and periodic saltwater flooding. Dominated by salt resistant shrubs.

- Dunes/Beaches - Zones from the ocean shore to the maritime forest. Subjected to sand, salt, wind, and water.

TABLE 3-3

SUMMARY OF HYDRAULIC CONDUCTIVITY TESTS
SITE 35, CAMP GEIGER AREA FUEL FARM
MCB, CAMP LEJEUNE, NORTH CAROLINA
CONTRACT TASK ORDER 0232

Well No.	Hydraulic Conductivity Falling Head Test		Hydraulic Conductivity Rising Head Test	
	ft/day	cm/sec	ft/day	cm/sec
35MW-30A	1.18	4.16×10^{-4}	1.50	5.31×10^{-4}
35MW-31A	0.346	1.22×10^{-4}	0.269	9.51×10^{-5}
35MW-35A	0.119	4.20×10^{-5}	0.115	4.06×10^{-5}
35MW-32B	6.22	2.20×10^{-3}	5.15	1.82×10^{-3}
35-MW36B	2.91	1.03×10^{-3}	3.20	1.13×10^{-3}
35MW-37B	7.06	2.49×10^{-3}	6.44	2.27×10^{-3}
35GWD-1	6.80	2.40×10^{-3}	6.03	2.13×10^{-3}

Average Hydraulic Conductivity for shallow wells:
0.628 ft/day (2.22×10^{-4} cm/sec)

Average Hydraulic Conductivity for intermediate wells:
5.16 ft/day (1.82×10^{-3} cm/sec)

Notes: Hydraulic conductivity test results were analyzed using Bouwer and Rice method as presented in the Geraghty and Miller "AQTESOLV" program, version 1.10.

Hydraulic conductivity tests were conducted on September 28 and 29, 1994, using an In-Situ Environmental Data Logger (Model SE-1000C) and pressure transducer.

Monitoring wells with an "A" or "B" designation indicate wells completed within the shallow aquifer at shallow and intermediate depths, respectively. The well with "GWD" designation was completed in the upper-most portion of the Castle Hayne Aquifer.

Falling Head Test data was not used in the calculation of the average hydraulic conductivity for shallow wells. Falling Head Tests are inappropriate for wells that have screens that split the water table.

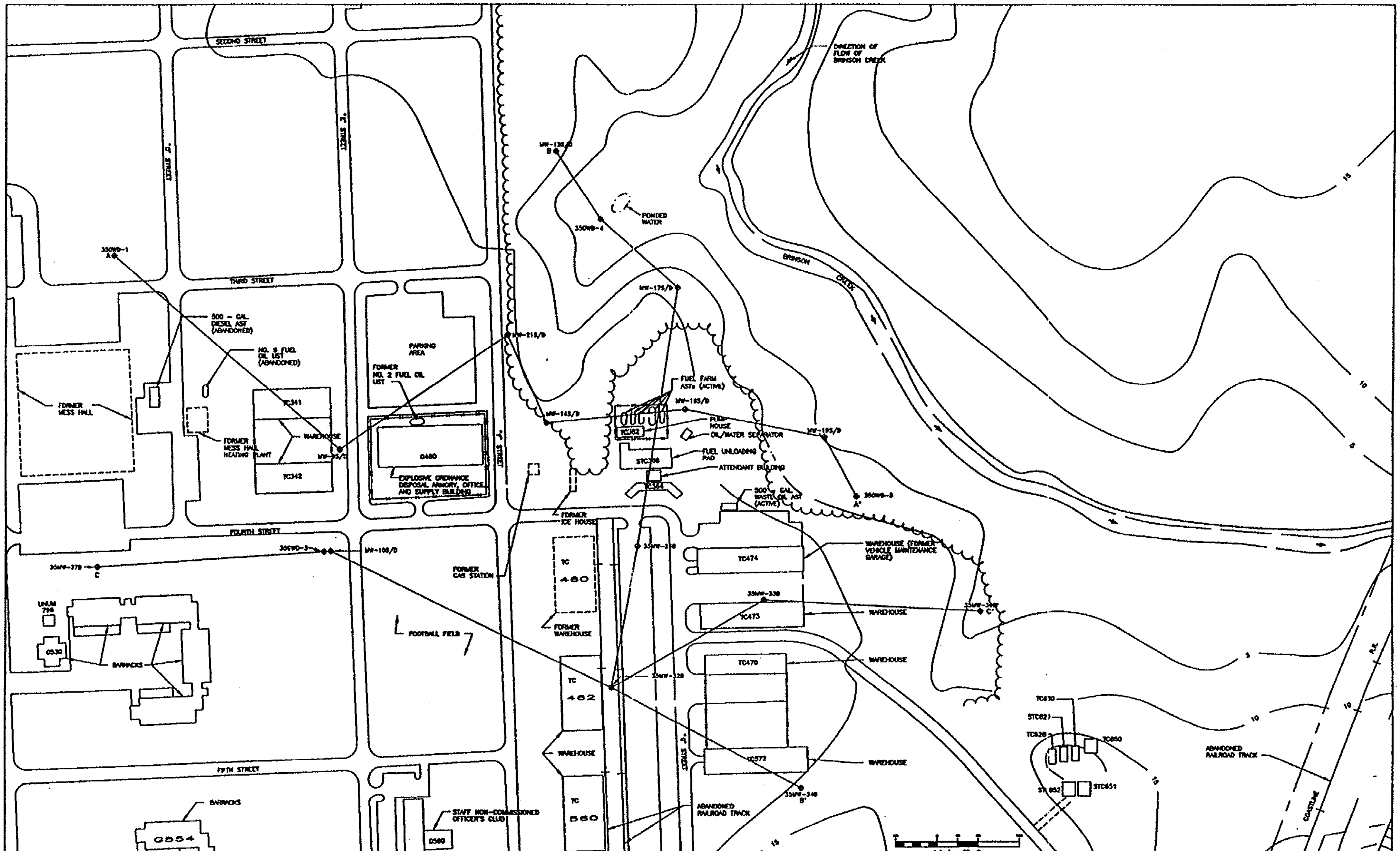
TABLE 3-4

SUMMARY OF WATER SUPPLY WELLS WITHIN A ONE-MILE RADIUS
SITE 35, CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
CONTRACT TASK ORDER 0232

Well No.	USGS Identification Number	Date Drilled	Drilling Company	Screen Depth (feet)	Screen Depth (feet)	Approximate Distance and Direction from Site (feet)
MCAS-203	3443230772653.1	--	--	173	--	4620/South
MCAS-106	3443260772701.1	1954 (est.)	--	--	--	4290/South
TC-1251	3443290772710.1	1975	Carolina Well and Pump Co.	240	120-140 160-170	4290/South-Southwest
TC-1253	3443370772729.1	1975	Carolina Well and Pump Co.	250	120-135 155-170	4290/Southwest
MCAS-1254	--	--	--	--	--	5280/Southwest
TC-901	3443450772727.1	1941	Layne Atlantic Co.	77	46-56 66-76	3465/Southwest
TC-700[(1)]	3443560772727.1	1941	--	76	27.5-76	2970/West-Southwest
TC-504	3444090772804.1	1942	Layne Atlantic Co.	113	50-60 75-85	5280/West
TC-600	344405077728.1	1941	Layne Atlantic Co.	70	48-70	2640/West
NC-52[(1)]	3444180772729.1	1941	Layne Atlantic Co.	70	25-66	2640/West
TC-502[(1)]	3444070772728.1	1941	Virginia Machine and Well Co.	182	110-184	2640/West-Northwest
T-15[(1)]	3444250772707.1	1959	Heater Well Co.	477	--	1320/North
X-25616[(1)]	3444350772640.1	1978	NC Division of Environmental Mgmt.	185	--	2970/North-Northeast
TC-100[(1)]	3444280772729.1	1941	Layne Atlantic Co.	67	--	3300/Northwest
TC-104[(1)]	3444300772729.1	1941	Virginia Machine and Well Co.	182	107-182	3300/Northwest
TC-202	3444120772755.1	1942	--	80	35-40 45-50 55-60 65-70 75-80	3300/Northwest
TC-325	3444120772755.2	1980	Carolina Well and Pump Co.	--	--	4620/West

Notes: (1) Wells are listed as open hole wells according to the U. S. Geological Survey, Water Resources Investigations Report 89-4096.
-- No data was available.
est. - estimated

Source: According to U. S. Geological Survey, Water Resources Investigations Report 89-4096.



LEGEND	
-x-x-	FENCE LINE
--15--	CONTOUR LINES DEPICTING SURFICIAL RELIEF
35GWD-3	MONITORING WELL LOCATION AND DESCRIPTION

DATE	OCT. 1994
SCALE	1" = 80'
DRAWN	WJH
REVIEWED	JSC
S.O.#	62470-232-0000-07000
CADD#	2325129

NORTH

SITE 35, CAMP GEIGER AREA FUEL FARM RI/FS
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

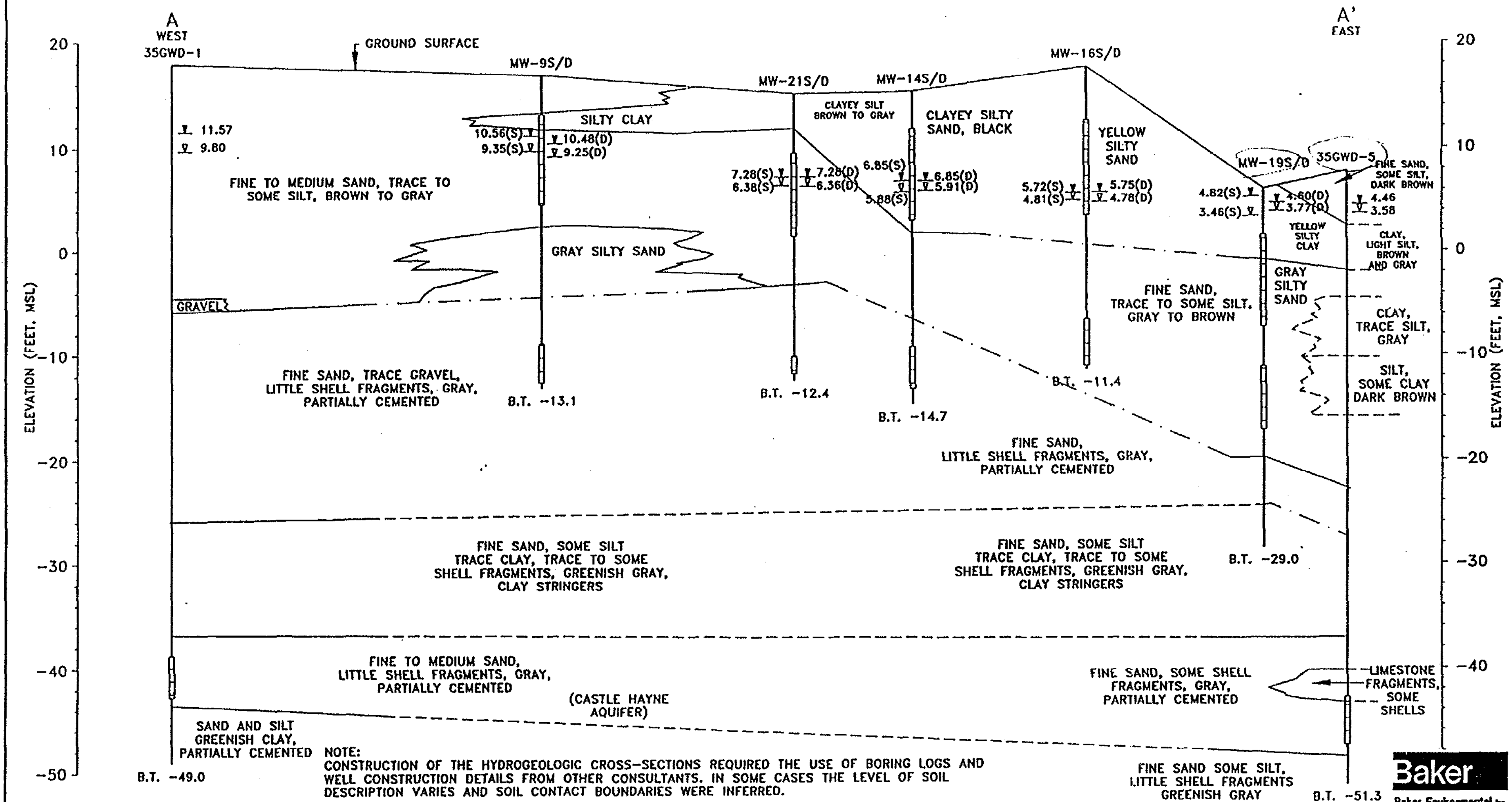
Baker
Baker Environmental, Inc.

CROSS-SECTION LOCATIONS AT SITE 35
CONTRACT TASK ORDER - 0232

SCALE	1" = 80'	DATE	SEPT. 1994

FIGURE No.
3-3

212513RI



NOTE:
CONSTRUCTION OF THE HYDROGEOLOGIC CROSS-SECTIONS REQUIRED THE USE OF BORING LOGS AND WELL CONSTRUCTION DETAILS FROM OTHER CONSULTANTS. IN SOME CASES THE LEVEL OF SOIL DESCRIPTION VARIES AND SOIL CONTACT BOUNDARIES WERE INFERRED.

Baker
Baker Environmental, Inc.

LEGEND

- 10.48 GROUNDWATER ELEVATION COLLECTED ON 9-9-94 (MSL)
- 9.25 GROUNDWATER ELEVATION COLLECTED ON 7-20-94 (MSL)
- B.T. -49.0' BORING TERMINATED, ELEVATION MSL
- WELL SCREEN INTERVAL
- INFERRED SOIL CONTACT
- ESTIMATED SOIL CONTACT
- PROJECTED SOIL CONTACT

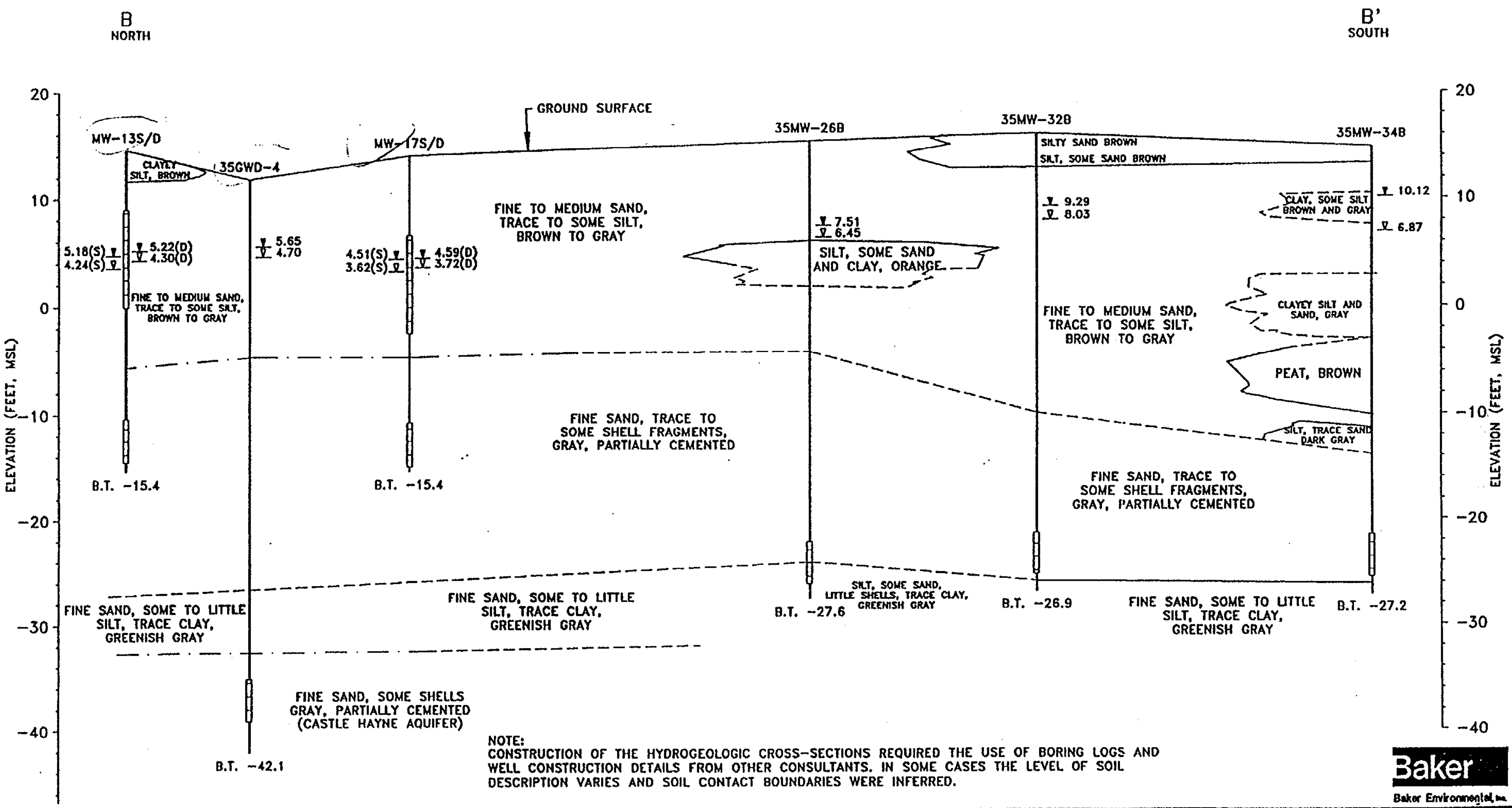
160 0 80 160 320
Horizontal Scale: 1 inch = 160 ft.

10 0 5 10 20
Vertical Scale: 1 inch = 10 ft.

THE SOIL BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS. SUBSURFACE CONDITIONS INTERPOLATED BETWEEN BORINGS ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.

FIGURE 3-4
HYDROGEOLOGIC CROSS-SECTION A-A'
SITE 35, CAMP GEIGER AREA FUEL FARM RI/FS
CONTRACT TASK ORDER 0232

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



NOTE:
CONSTRUCTION OF THE HYDROGEOLOGIC CROSS-SECTIONS REQUIRED THE USE OF BORING LOGS AND WELL CONSTRUCTION DETAILS FROM OTHER CONSULTANTS. IN SOME CASES THE LEVEL OF SOIL DESCRIPTION VARIES AND SOIL CONTACT BOUNDARIES WERE INFERRED.

Baker
Baker Environmental, Inc.

LEGEND

- 5.22 GROUNDWATER ELEVATION COLLECTED ON 9-9-94 (MSL)
- 4.30 GROUNDWATER ELEVATION COLLECTED ON 7-20-94 (MSL)
- B.T. -42.1' BORING TERMINATED, ELEVATION MSL
- WELL SCREEN INTERVAL
- INFERRED SOIL CONTACT
- ESTIMATED SOIL CONTACT
- PROJECTED SOIL CONTACT

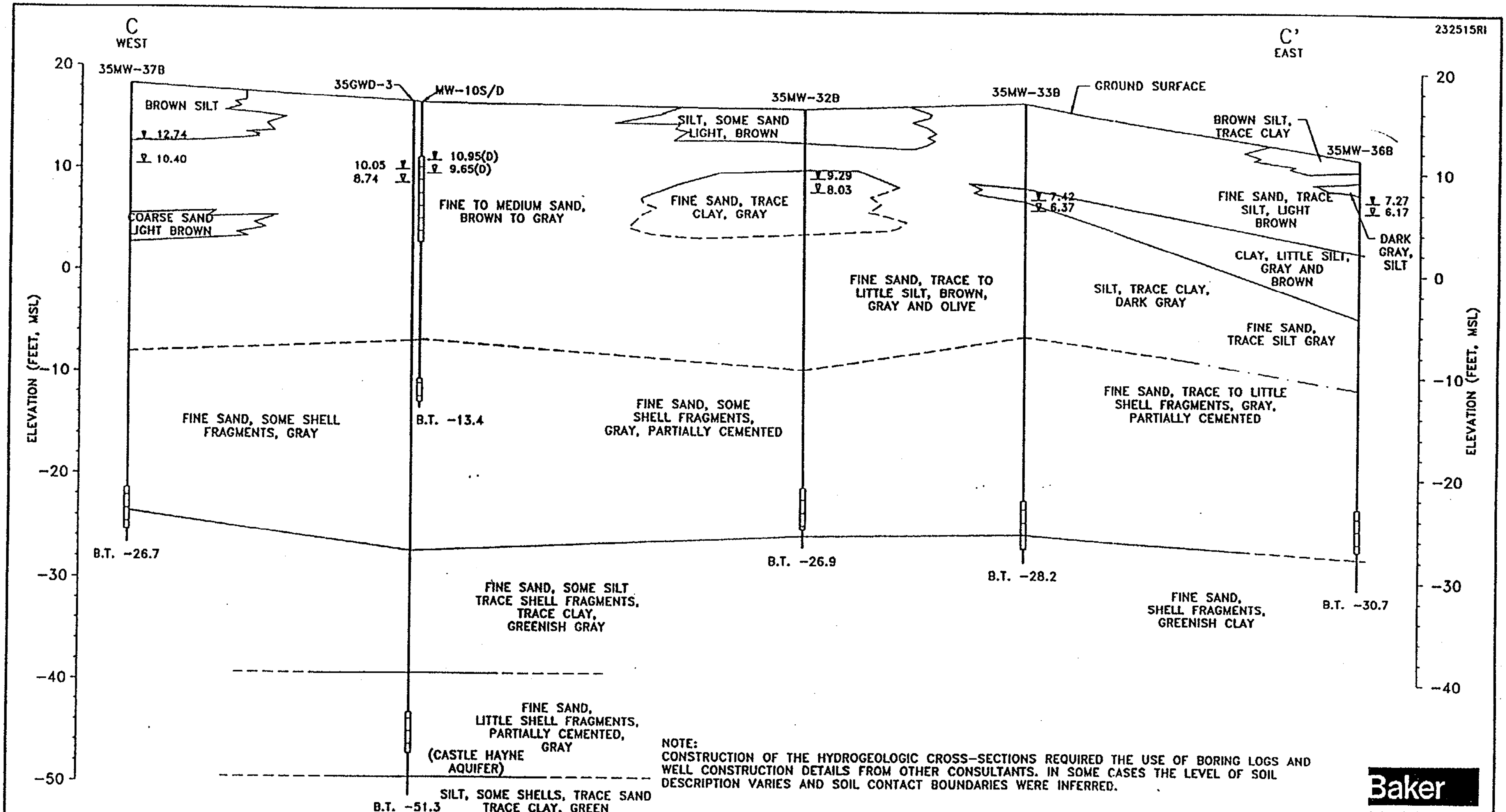
130 0 65 130 260
Horizontal Scale: 1 inch = 130 ft.

10 0 5 10 20
Vertical Scale: 1 inch = 10 ft.

THE SOIL BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS. SUBSURFACE CONDITIONS INTERPOLATED BETWEEN BORINGS ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.

FIGURE 3-5
HYDROGEOLOGIC CROSS-SECTION B-B'
SITE 35, CAMP GEIGER AREA FUEL FARM RI/FS
CONTRACT TASK ORDER - 0232

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



NOTE:
CONSTRUCTION OF THE HYDROGEOLOGIC CROSS-SECTIONS REQUIRED THE USE OF BORING LOGS AND WELL CONSTRUCTION DETAILS FROM OTHER CONSULTANTS. IN SOME CASES THE LEVEL OF SOIL DESCRIPTION VARIES AND SOIL CONTACT BOUNDARIES WERE INFERRED.

Baker
Baker Environmental, Inc.

LEGEND

- 12.74 GROUNDWATER ELEVATION COLLECTED ON 9-9-94 (MSL)
- 10.40 GROUNDWATER ELEVATION COLLECTED ON 7-20-94 (MSL)
- B.T. -26.7' BORING TERMINATED, ELEVATION MSL
- WELL SCREEN INTERVAL
- INFERRED SOIL CONTACT
- ESTIMATED SOIL CONTACT
- PROJECTED SOIL CONTACT

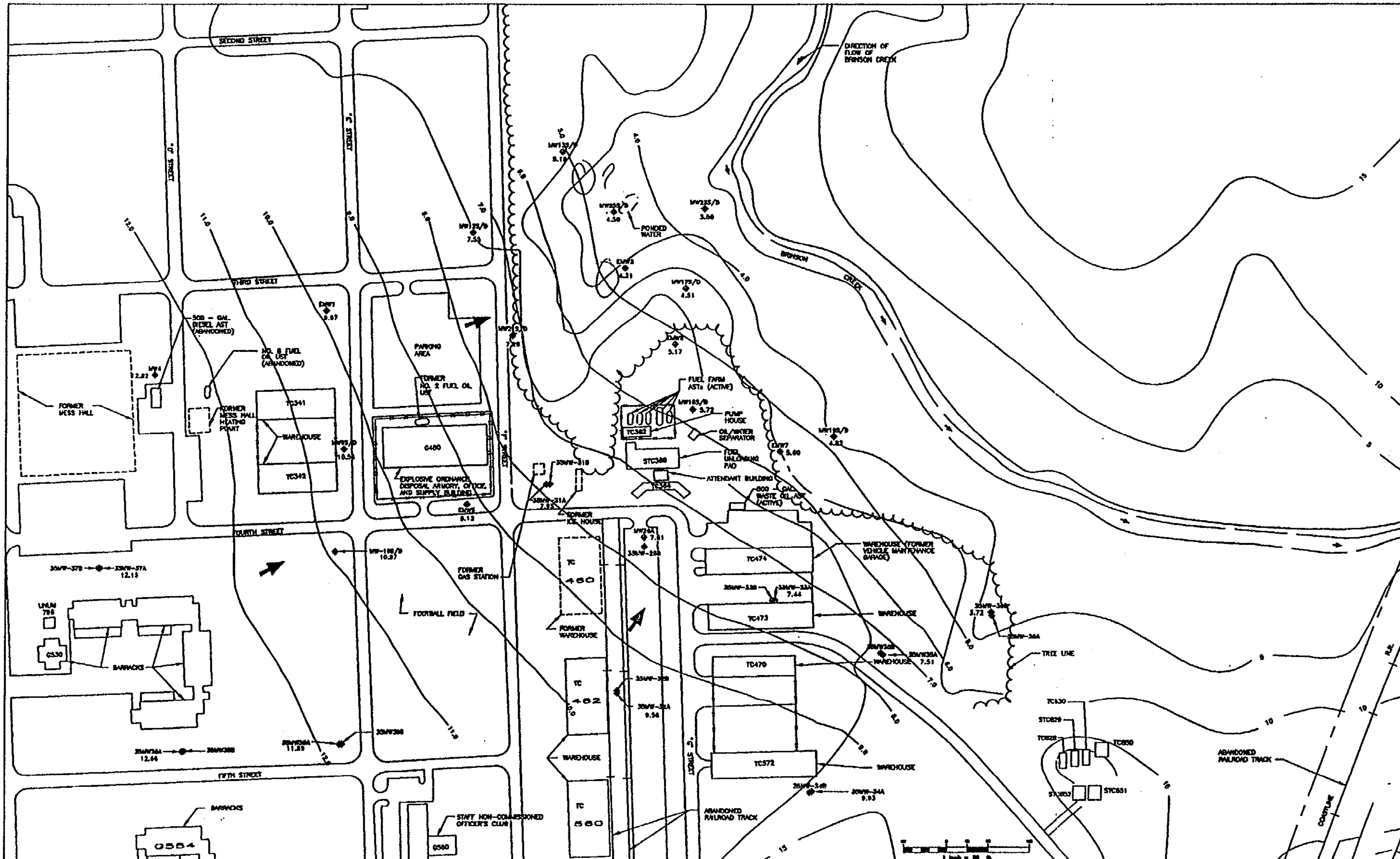
160 0 80 160 320
Horizontal Scale: 1 inch = 160 ft.

10 0 5 10 20
Vertical Scale: 1 inch = 10 ft.

THE SOIL BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS. SUBSURFACE CONDITIONS INTERPOLATED BETWEEN BORINGS ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.

FIGURE 3-6
HYDROGEOLOGIC CROSS-SECTION C-C'
SITE 35, CAMP GEIGER AREA FUEL FARM RI/FS
CONTRACT TASK ORDER - 0232

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND	
—+—+—	FENCE LINE
—15—	CONTOUR LINES DEPICTING SURFICIAL RELIEF
MW13S/D 4.82	MONITORING WELL LOCATION AND DESCRIPTION (MEASURED STATIC WATER LEVEL IN BLUE)
—11.0—	GROUNDWATER CONTOUR
→	INDICATES DIRECTION OF GROUNDWATER FLOW

DATE	OCT. 1994
SCALE	1" = 80'
DRAWN	W.M
REVIEWED	JSC
S.O.#	62470-232-0000-07000
CADD#	23752381

NORTH

SITE 35, CAMP GEIGER AREA FUEL FARM RI/FS
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

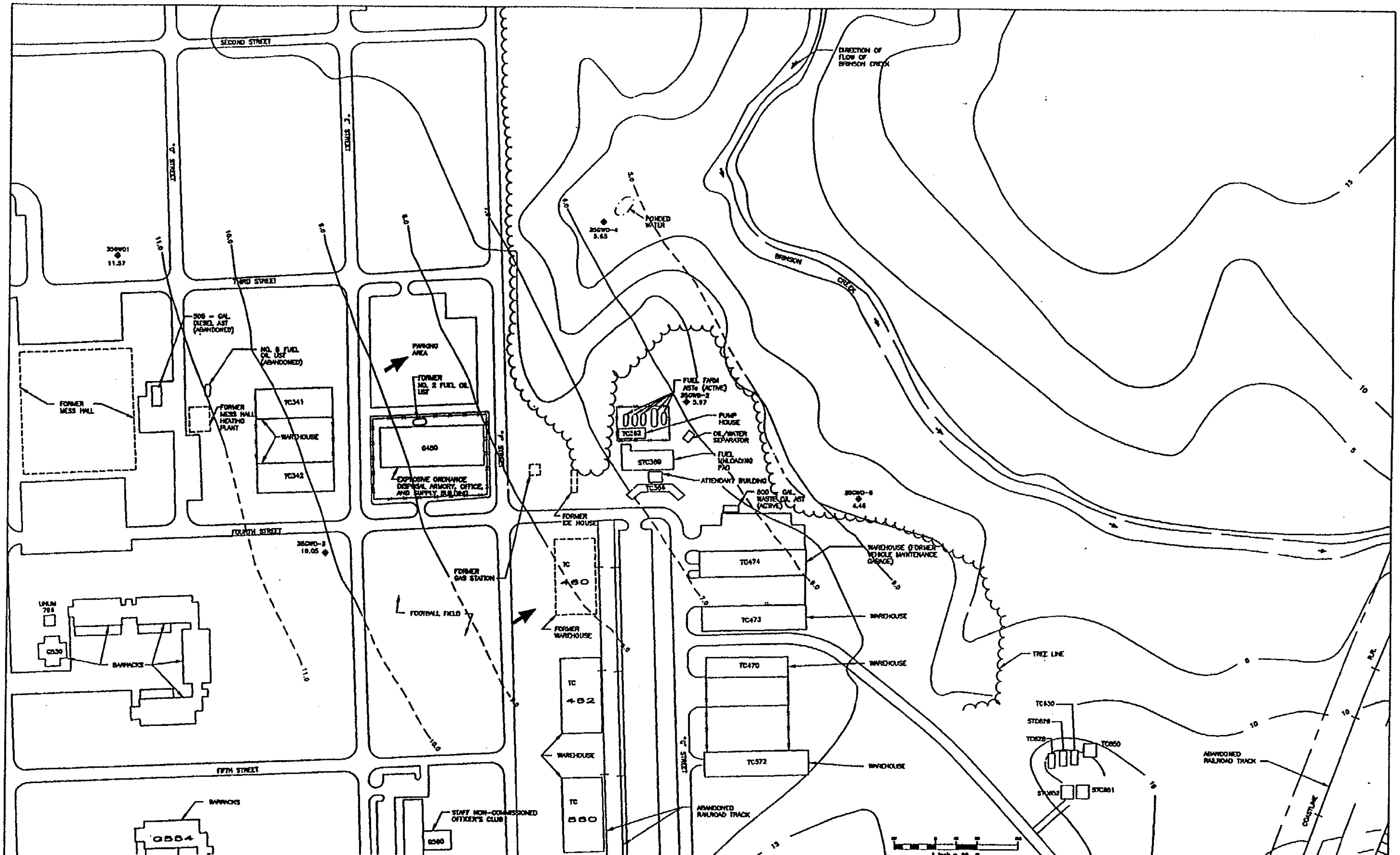
BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

GROUNDWATER CONTOUR MAP DEPICTING
FLOW IN THE SURFICIAL AQUIFER
CONTRACT TASK ORDER – 0232

SCALE 1" = 80' DATE OCT. 1994

FIGURE No.
3–7



LEGEND	
	FENCE LINE
—15—	CONTOUR LINES DEPICTING SURFICIAL RELIEF
35GWD-6	MONITORING WELL LOCATION AND DESCRIPTION
—11.0—	GROUNDWATER CONTOUR
- -11.0- -	INFERRED GROUNDWATER CONTOUR
	INDICATES DIRECTION OF GROUNDWATER FLOW

DATE	OCT. 1994
SCALE	1" = 80'
DRAWN	W.M
REVIEWED	JSC
S.O.#	62470-232-0000-07000
CADD#	23251691

NORTH

SITE 35, CAMP GEIGER AREA FUEL FARM RI/FS
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

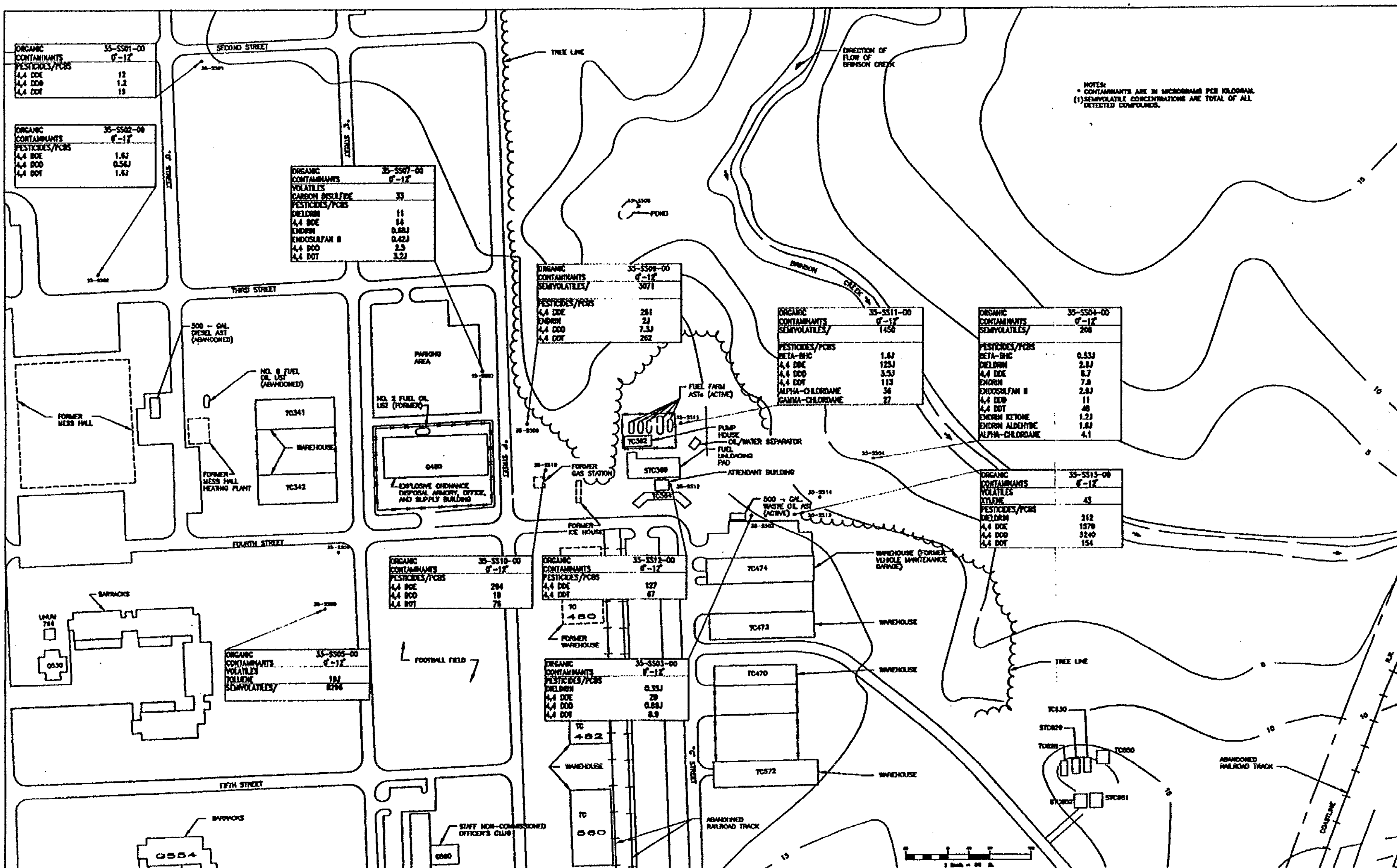
BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

GROUNDWATER CONTOUR MAP DEPICTING FLOW IN THE UPPER-MOST PORTION OF THE CASTLE HAYNE AQUIFER
CONTRACT TASK ORDER - 0232

SCALE 1" = 80' DATE OCT. 1994

FIGURE No.
3-8



LEGEND	
	FENCE LINE
—15—	CONTOUR LINES DEPICTING SURFICIAL RELIEF
35-SS01	SURFACE SOIL SAMPLE LOCATION

DATE	OCT. 1994
SCALE	1" = 80'
DRAWN	W.M
REVIEWED	JSC
S.O.#	62470-232-0000-07080
CADD#	232914AR

NORTH

SITE 35, CAMP GEIGER AREA FUEL FARM RI/FS
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

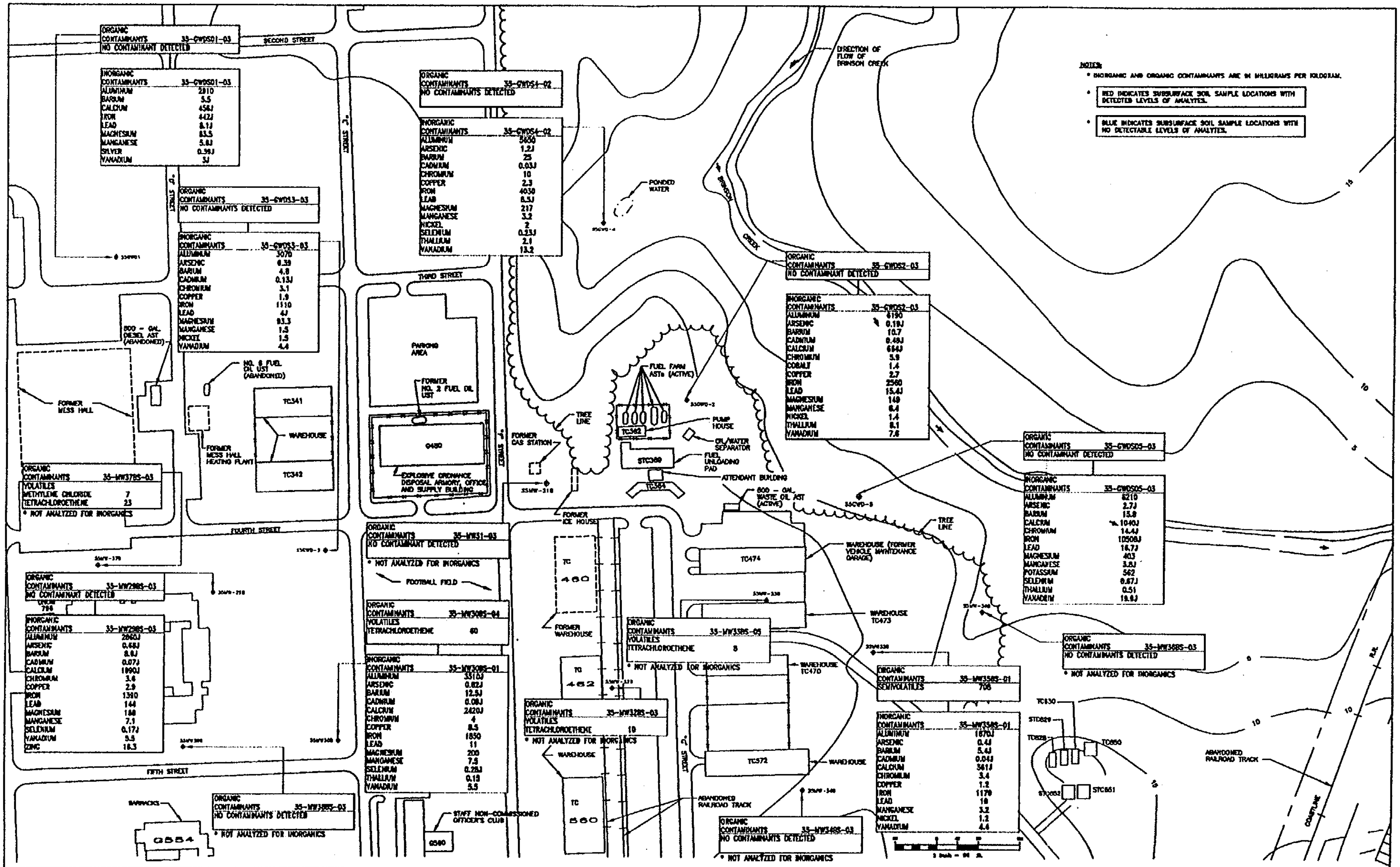
BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

DETECTED ORGANICS IN SURFACE SOIL
CONTRACT TASK ORDER - 0232

SCALE 1" = 80' DATE OCT. 1994

FIGURE No. 4-1



LEGEND
FENCE LINE
15 — CONTOUR LINES DEPICTING SURFICIAL RELIEF
SUBSURFACE SOIL SAMPLE LOCATION/MONITORING WELL INSTALLATION UNDER BAKER III (1994).

DATE	OCT. 1994
SCALE	1" = 80'
DRAWN	W.H
REVIEWED	JSC
S.O.#	62470-232-0000-07000
CADD#	23291531

NORTH

SITE 35, CAMP GEIGER AREA FUEL FARM RI/FS
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

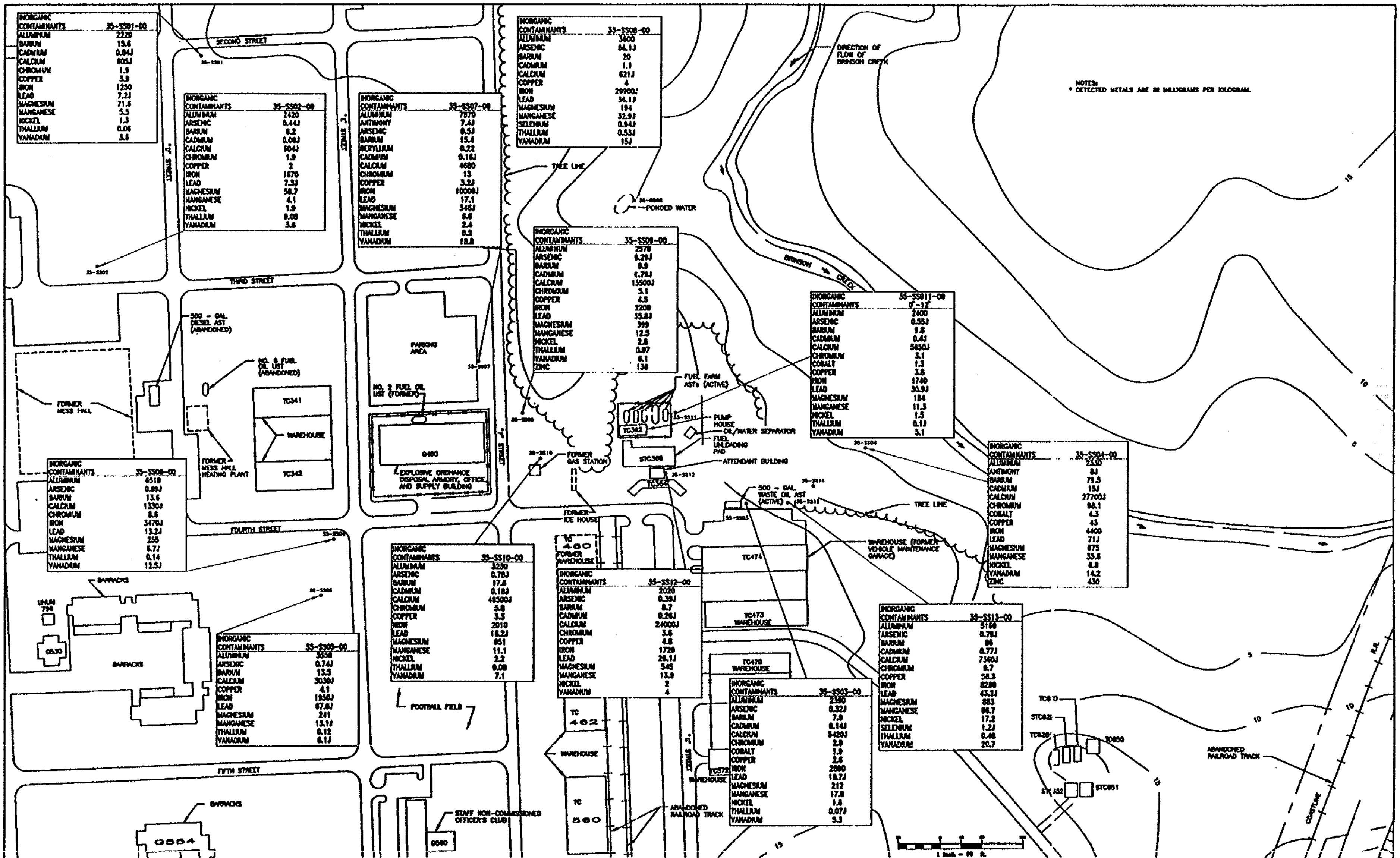
BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

DETECTED INORGANICS AND ORGANICS IN SUBSURFACE SOIL
CONTRACT TASK ORDER – 0232

SCALE 1" = 80'   DATE OCT. 1994

FIGURE No. 4-2



INORGANIC CONTAMINANTS	35-SS01-00
ALUMINUM	2220
BARIUM	15.6
CADMIUM	0.04J
CALCIUM	605J
CHROMIUM	1.9
COPPER	3.9
IRON	1250
LEAD	7.2J
MAGNESIUM	71.6
MANGANESE	5.5
NICKEL	1.3
THALLIUM	0.06
VANADIUM	3.6

INORGANIC CONTAMINANTS	35-SS02-00
ALUMINUM	2420
ARSENIC	0.44J
BARIUM	6.2
CADMIUM	0.06J
CALCIUM	604J
CHROMIUM	1.9
COPPER	2
IRON	1670
LEAD	7.3J
MAGNESIUM	58.7
MANGANESE	4.1
NICKEL	1.9
THALLIUM	0.08
VANADIUM	3.6

INORGANIC CONTAMINANTS	35-SS07-00
ALUMINUM	7870
ANTIMONY	7.4J
ARSENIC	0.5J
BARIUM	15.4
BERYLLIUM	0.22
CADMIUM	0.16J
CALCIUM	4680
CHROMIUM	13
COPPER	3.2J
IRON	10000J
LEAD	17.1
MAGNESIUM	346J
MANGANESE	6.6
NICKEL	2.4
THALLIUM	0.2
VANADIUM	18.8

INORGANIC CONTAMINANTS	35-SS08-00
ALUMINUM	3600
ARSENIC	64.1J
BARIUM	20
CADMIUM	1.1
CALCIUM	621J
COPPER	4
IRON	29900J
LEAD	36.1J
MAGNESIUM	194
MANGANESE	32.9J
SELENIUM	0.94J
THALLIUM	0.53J
VANADIUM	15J

INORGANIC CONTAMINANTS	35-SS09-00
ALUMINUM	2570
ARSENIC	0.29J
BARIUM	8.9
CADMIUM	0.79J
CALCIUM	13500J
CHROMIUM	5.1
COPPER	4.5
IRON	2200
LEAD	35.8J
MAGNESIUM	399
MANGANESE	12.5
NICKEL	2.8
THALLIUM	0.07
VANADIUM	6.1
ZINC	138

INORGANIC CONTAMINANTS	35-SS011-00 0"-12"
ALUMINUM	2400
ARSENIC	0.55J
BARIUM	9.8
CADMIUM	0.4J
CALCIUM	5450J
CHROMIUM	3.1
COBALT	1.3
COPPER	3.8
IRON	1740
LEAD	30.9J
MAGNESIUM	184
MANGANESE	11.3
NICKEL	1.5
THALLIUM	0.1J
VANADIUM	5.1

INORGANIC CONTAMINANTS	35-SS04-00
ALUMINUM	2350
ANTIMONY	8J
BARIUM	79.5
CADMIUM	15J
CALCIUM	27700J
CHROMIUM	98.1
COBALT	4.3
COPPER	43
IRON	4400
LEAD	71J
MAGNESIUM	675
MANGANESE	35.6
NICKEL	8.8
VANADIUM	14.2
ZINC	430

INORGANIC CONTAMINANTS	35-SS06-00
ALUMINUM	6510
ARSENIC	0.89J
BARIUM	13.6
CALCIUM	1330J
CHROMIUM	8.6
IRON	3470J
LEAD	13.2J
MAGNESIUM	255
MANGANESE	6.7J
THALLIUM	0.14
VANADIUM	12.5J

INORGANIC CONTAMINANTS	35-SS10-00
ALUMINUM	3230
ARSENIC	0.78J
BARIUM	17.8
CADMIUM	0.18J
CALCIUM	48500J
CHROMIUM	5.8
COPPER	3.3
IRON	2010
LEAD	18.2J
MAGNESIUM	951
MANGANESE	11.1
NICKEL	2.2
THALLIUM	0.08
VANADIUM	7.1

INORGANIC CONTAMINANTS	35-SS05-00
ALUMINUM	3550
ARSENIC	0.74J
BARIUM	13.5
CALCIUM	3030J
COPPER	4.1
IRON	1850J
LEAD	67.8J
MAGNESIUM	241
MANGANESE	13.1J
THALLIUM	0.12
VANADIUM	8.1J

INORGANIC CONTAMINANTS	35-SS12-00
ALUMINUM	2020
ARSENIC	0.39J
BARIUM	8.7
CADMIUM	0.26J
CALCIUM	24000J
CHROMIUM	3.6
COPPER	4.6
IRON	1720
LEAD	26.1J
MAGNESIUM	545
MANGANESE	13.9
NICKEL	2
VANADIUM	4

INORGANIC CONTAMINANTS	35-SS03-00
ALUMINUM	2390
ARSENIC	0.32J
BARIUM	7.9
CADMIUM	0.14J
CALCIUM	5420J
CHROMIUM	2.9
COBALT	1.9
COPPER	2.6
IRON	2890
LEAD	18.7J
MAGNESIUM	212
MANGANESE	17.8
NICKEL	1.6
THALLIUM	0.07J
VANADIUM	5.3

INORGANIC CONTAMINANTS	35-SS13-00
ALUMINUM	5160
ARSENIC	0.79J
BARIUM	86
CADMIUM	0.77J
CALCIUM	7340J
CHROMIUM	9.7
COPPER	58.3
IRON	8280
LEAD	43.2J
MAGNESIUM	883
MANGANESE	86.7
NICKEL	17.2
SELENIUM	1.2J
THALLIUM	0.48
VANADIUM	20.7

LEGEND
- FENCE LINE
—15— CONTOUR LINES DEPICTING SURFICIAL RELIEF
- SURFACE SOIL SAMPLE LOCATION

DATE	OCT. 1994
SCALE	1" = 80'
DRAWN	WJH
REVIEWED	JSC
S.O.#	02479-232-0000-07000
CADD#	2329136

NORTH

SITE 35, CAMP GEIGER AREA FUEL FARM RI/FS
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

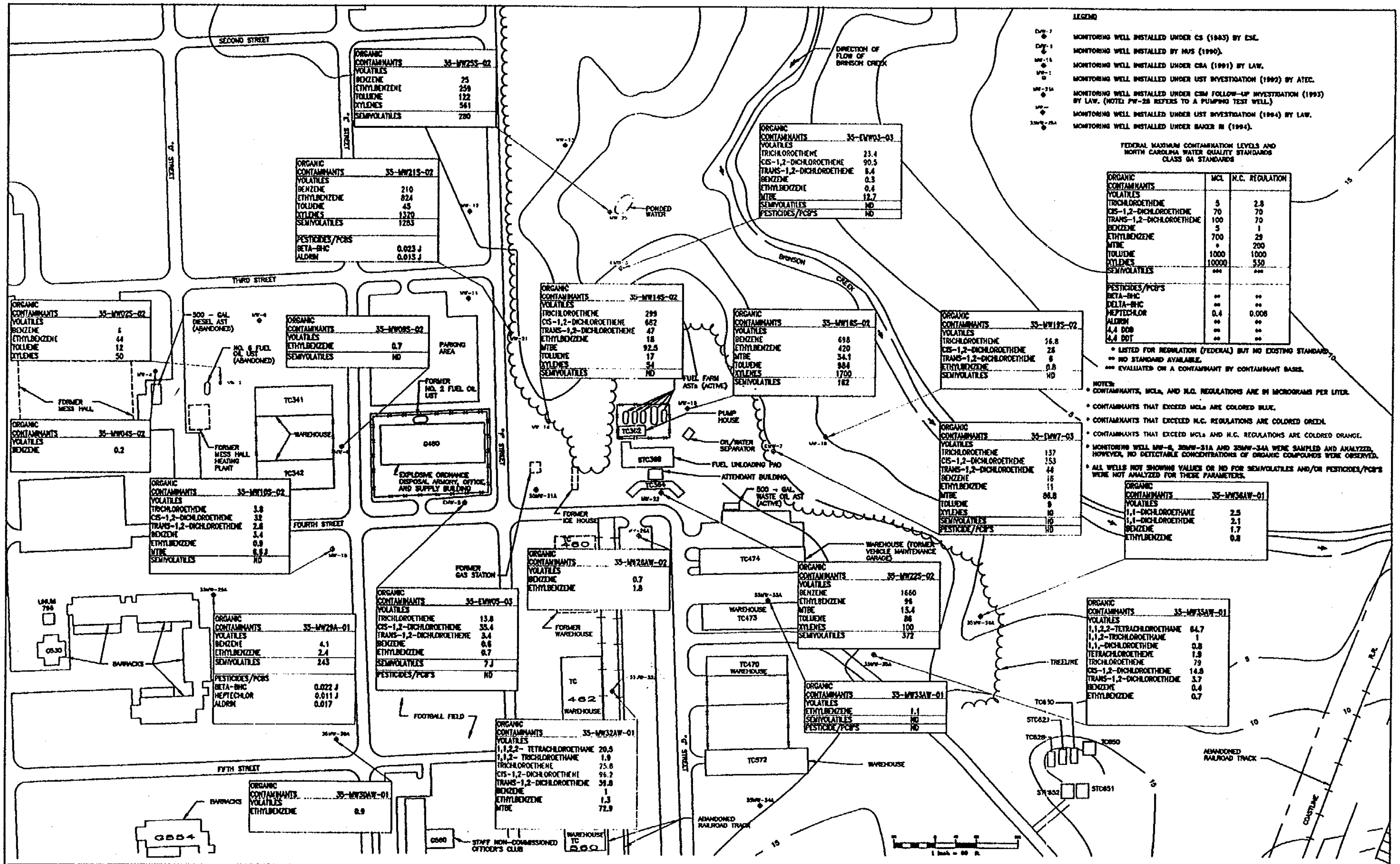
BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

DETECTED INORGANICS IN SURFACE SOILS
CONTRACT TASK ORDER - 0232

SCALE 1" = 80' DATE OCT. 1994

FIGURE No.
4-3



ORGANIC CONTAMINANTS	MCL	N.C. REGULATION
VOLATILES		
TRICHLOROETHENE	5	2.8
CIS-1,2-DICHLOROETHENE	70	70
TRANS-1,2-DICHLOROETHENE	100	70
BENZENE	5	1
ETHYLBENZENE	700	29
MTBE	*	200
TOLUENE	1000	1000
XYLENES	10000	530
SEMIVOLATILES	***	***
PESTICIDES/PCB'S		
BETA-BHC	**	**
DELTA-BHC	**	**
HEPTACHLOR	0.4	0.008
ALDRIN	**	**
4,4 DDD	**	**
4,4 DDT	**	**

LEGEND
—x—x— FENCE LINE
—15— CONTOUR LINES DEPICTING SURFICIAL ROUT
LEGEND CONTINUED IN UPPER RIGHT HAND CORNER.

DATE OCT. 1994
SCALE 1" = 80'
DRAWN WJH
REVIEWED JSC
S.O.# 62470-232-0000-07000
CADD# 2322000

NORTH

SITE 35, CAMP GEIGER AREA FUEL FARM RI/FS
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

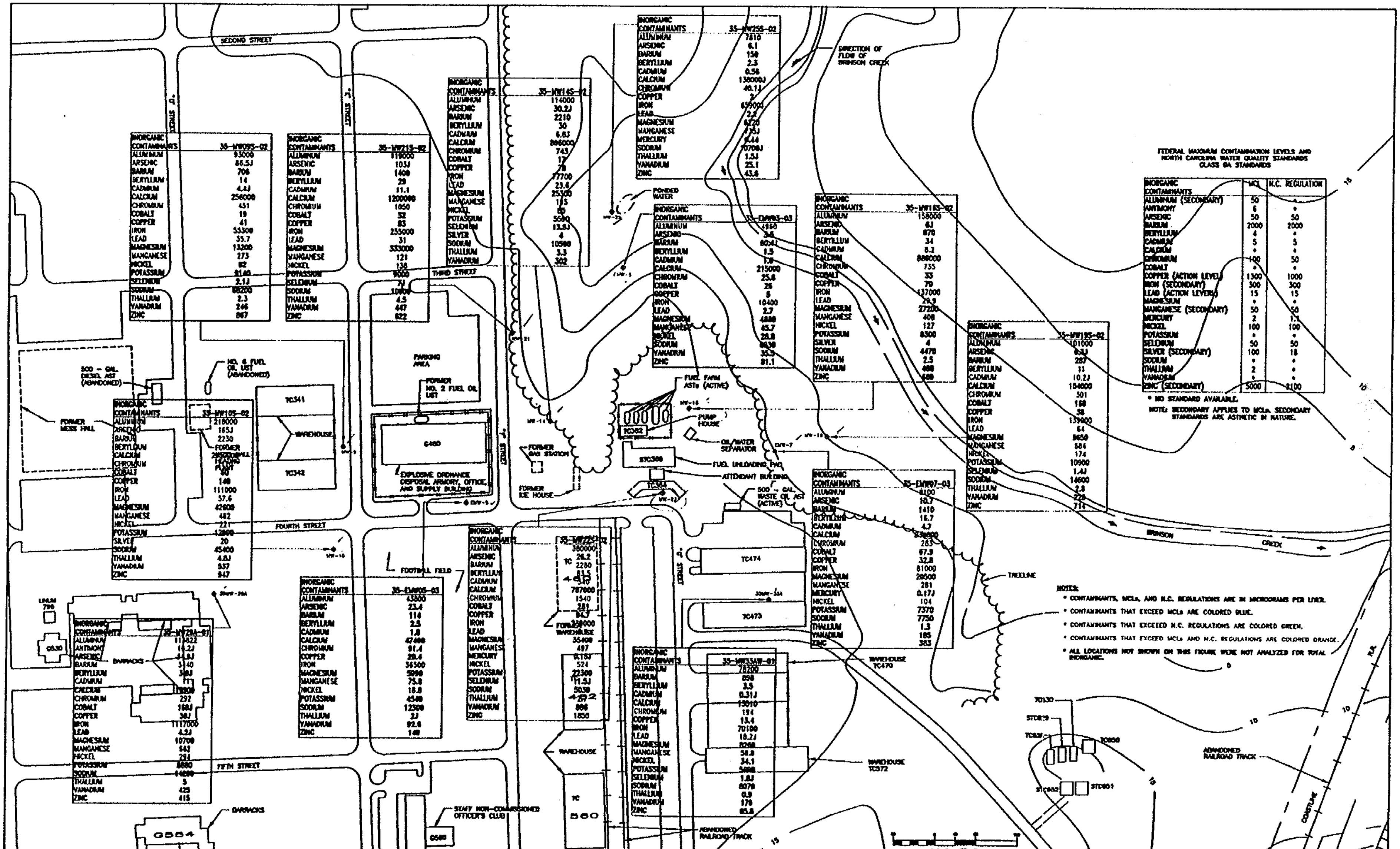
BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

DETECTED ORGANICS IN UPPER PORTION OF SURFICIAL AQUIFER
CONTRACT TASK ORDER – 0232

SCALE 1" = 80'
DATE OCT. 1994

FIGURE No. 4–4



LEGEND
MONITORING WELL INSTALLED UNDER CS (1985) BY ESE.
MONITORING WELL INSTALLED BY NUS (1990).
MONITORING WELL INSTALLED UNDER CSA (1991) BY LAW.
MONITORING WELL INSTALLED UNDER BAKER RI (1994).
FENCE LINE
CONTOUR LINES DEPICTING SURFICIAL RELIEF

DATE	OCT. 1994
SCALE	1" = 80'
DRAWN	W.H
REVIEWED	JSC
S.O.#	02179-232-0000-07000
CADD#	2329023R

NORTH

SITE 35, CAMP GEIGER AREA FUEL FARM RI/FS
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

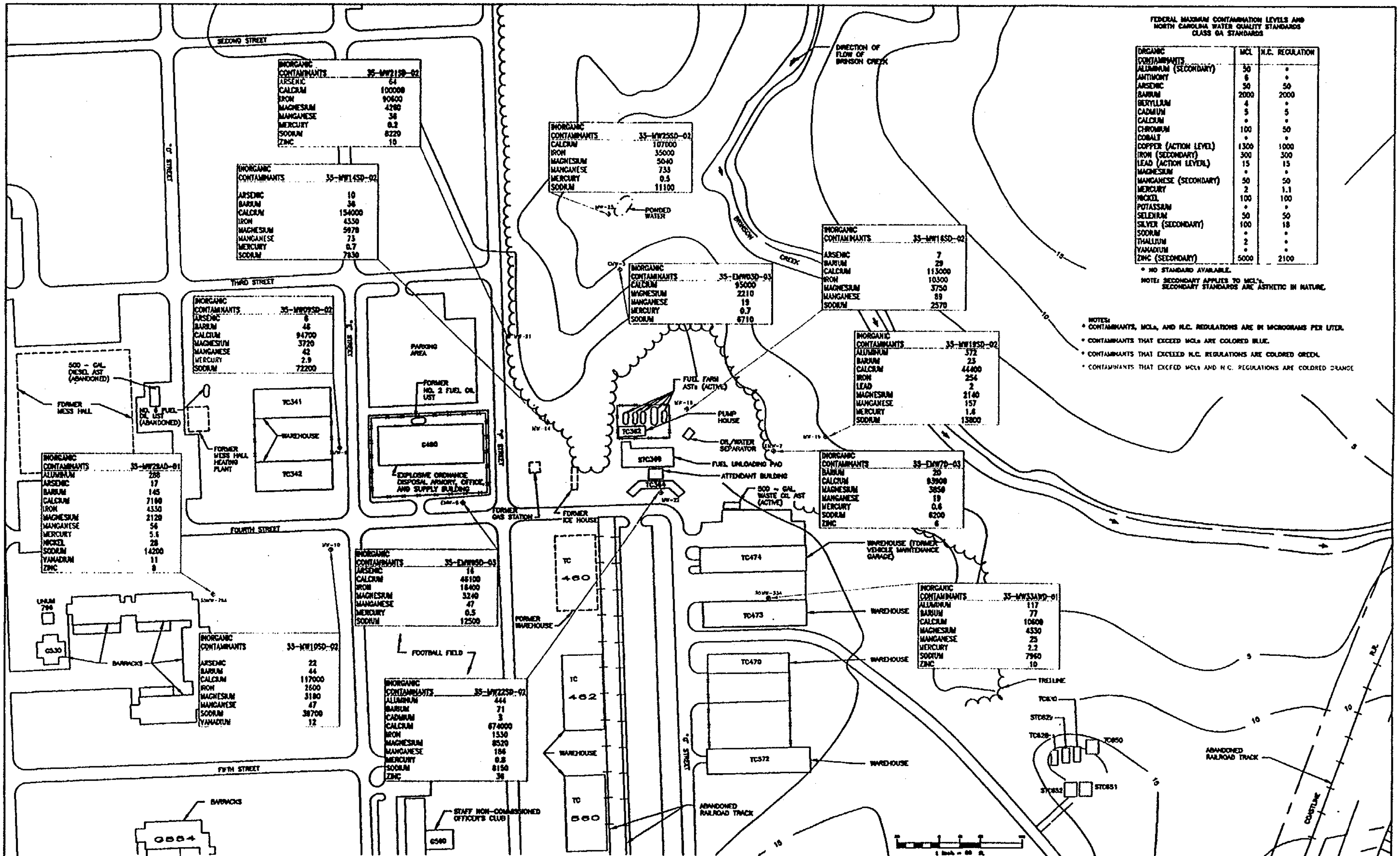
BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

DETECTED TOTAL INORGANICS IN UPPER PORTION OF SURFICIAL AQUIFER CONTRACT TASK ORDER - 0232

SCALE 1" = 80' DATE OCT. 1994

FIGURE No. 4-5



LEGEND	
—⊖—⊖—	FENCE LINE

DATE	OCT. 1994
SCALE	1" = 80'
DRAWN	W.M.
REVIEWED	JSC
W.O.#	62470-232-0000-07000
CADD#	23290306

NORTH

SITE 35, CAMP GEIGER AREA FUEL FARM RI/FS
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

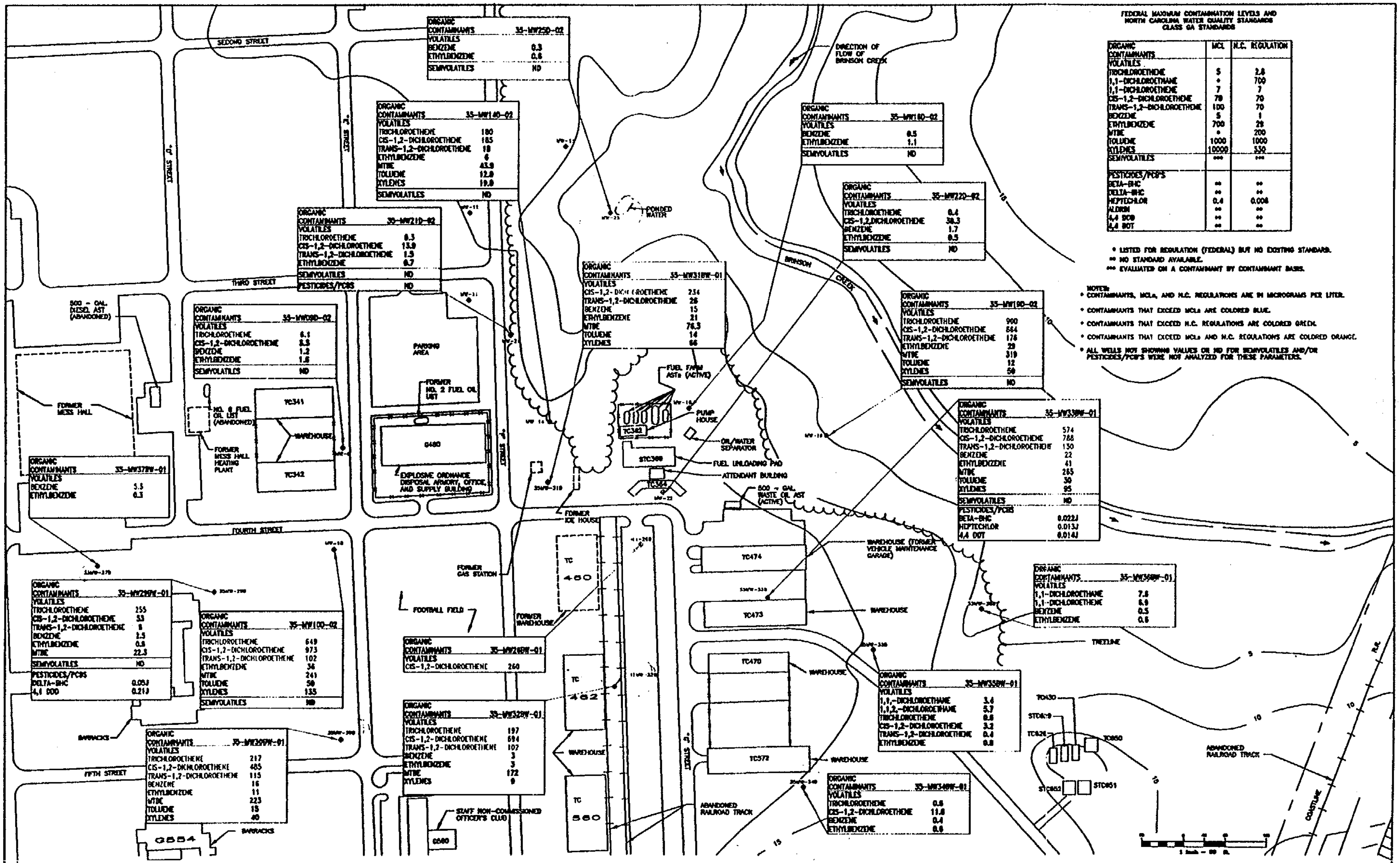
BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

DETECTED DISSOLVED INORGANICS IN UPPER PORTION OF SURFICIAL AQUIFER
CONTRACT TASK ORDER – 0232

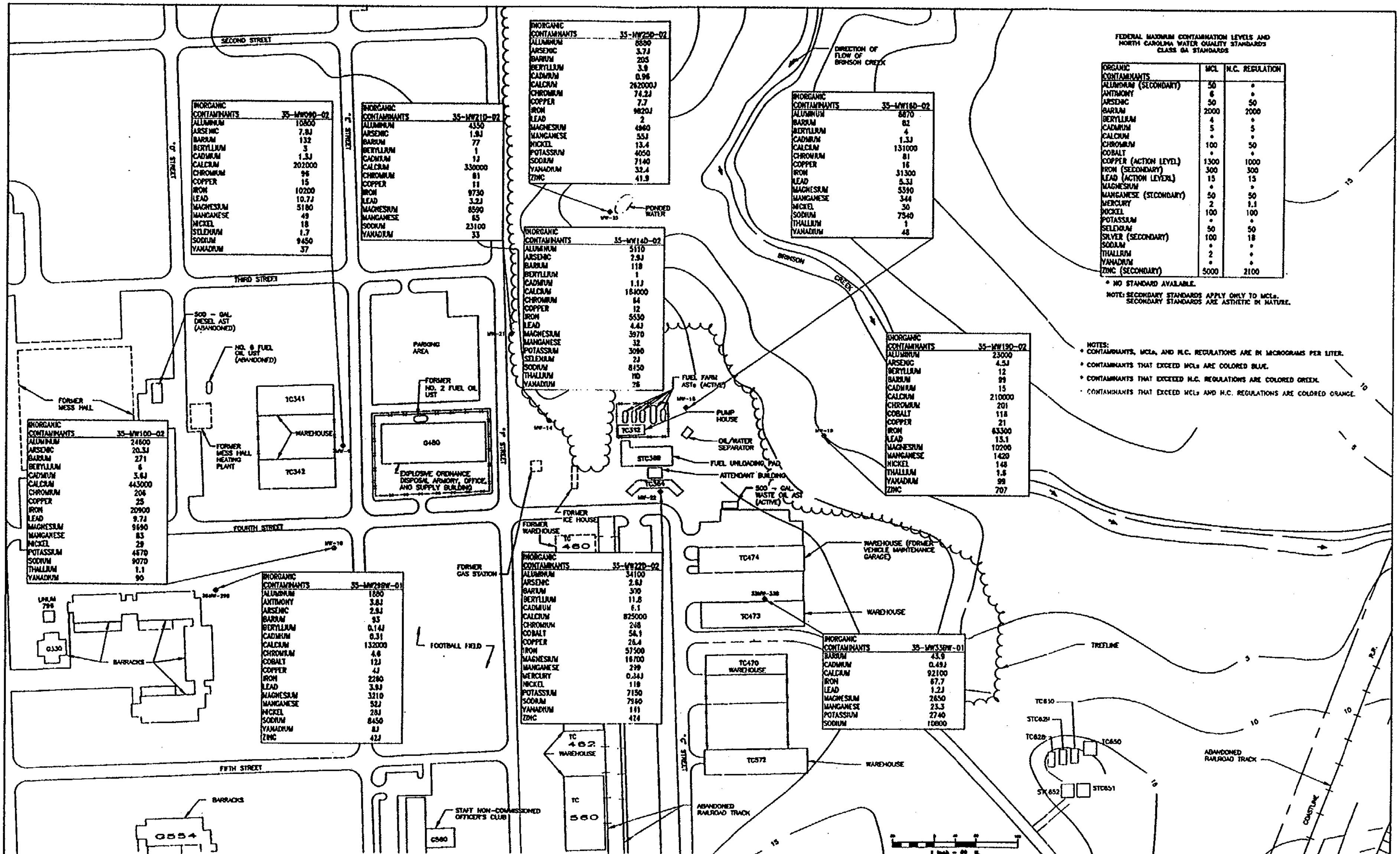
FIGURE No. 4–6

SCALE	1" = 80'	DATE	OCT. 1994



LEGEND 35MW-30B ♦ - MONITORING WELL INSTALLED UNDER BAKER RI (1994). MW-10 ♦ - MONITORING WELL INSTALLED UNDER CSA (1991) BY LAW. —×— - FENCE LINE —15— - CONTOUR LINES DEPICTING SURFICIAL RELIEF	DATE OCT. 1994 SCALE 1" = 80' DRAWN W.H REVIEWED JSC W.O.# 62470-232-0000-07000 CADD# 2329044B	NORTH	SITE 35, CAMP GEIGER AREA FUEL FARM RI/FS MARINE CORPS BASE, CAMP LEJEUNE NORTH CAROLINA BAKER ENVIRONMENTAL, Inc. Coraopolis, Pennsylvania	Baker Baker Environmental, Inc.	DETECTED ORGANICS IN LOWER PORTION OF SURFICIAL AQUIFER CONTRACT TASK ORDER - 0232 SCALE 1" = 80' DATE OCT. 1994

FIGURE No. 4-7



INORGANIC CONTAMINANTS	35-MW09D-02
ALUMINUM	10800
ARSENIC	7.8J
BARIUM	132
BERYLLIUM	3
CADMIUM	1.3J
CALCIUM	202000
CHROMIUM	96
COPPER	15
IRON	10200
LEAD	10.7J
MAGNESIUM	5180
MANGANESE	49
NICKEL	18
SELENIUM	1.7
SODIUM	9450
VANADIUM	37

INORGANIC CONTAMINANTS	35-MW21D-02
ALUMINUM	4350
ARSENIC	1.9J
BARIUM	77
BERYLLIUM	1
CADMIUM	1J
CALCIUM	330000
CHROMIUM	81
COPPER	11
IRON	9730
LEAD	3.2J
MAGNESIUM	8590
MANGANESE	65
SODIUM	23100
VANADIUM	33

INORGANIC CONTAMINANTS	35-MW25D-02
ALUMINUM	8880
ARSENIC	3.7J
BARIUM	205
BERYLLIUM	3.9
CADMIUM	0.96
CALCIUM	262000J
CHROMIUM	74.2J
COPPER	7.7
IRON	9820J
LEAD	2
MAGNESIUM	4960
MANGANESE	55J
NICKEL	13.4
POTASSIUM	4050
SODIUM	7140
VANADIUM	32.4
ZINC	41.9

INORGANIC CONTAMINANTS	35-MW14D-02
ALUMINUM	5110
ARSENIC	2.9J
BARIUM	118
BERYLLIUM	1
CADMIUM	1.1J
CALCIUM	184000
CHROMIUM	64
COPPER	12
IRON	5530
LEAD	4.4J
MAGNESIUM	3970
MANGANESE	32
POTASSIUM	3090
SELENIUM	2J
SODIUM	8150
THALLIUM	ND
VANADIUM	26

INORGANIC CONTAMINANTS	35-MW16D-02
ALUMINUM	8870
BARIUM	82
BERYLLIUM	4
CADMIUM	1.3J
CALCIUM	131000
CHROMIUM	81
COPPER	16
IRON	31300
LEAD	5.3J
MAGNESIUM	5390
MANGANESE	344
NICKEL	30
SODIUM	7540
THALLIUM	1
VANADIUM	48

INORGANIC CONTAMINANTS	35-MW19D-02
ALUMINUM	23000
ARSENIC	4.5J
BERYLLIUM	12
BARIUM	99
CADMIUM	15
CALCIUM	210000
CHROMIUM	201
COBALT	118
COPPER	21
IRON	63300
LEAD	13.1
MAGNESIUM	10200
MANGANESE	1420
NICKEL	148
THALLIUM	1.8
VANADIUM	99
ZINC	707

INORGANIC CONTAMINANTS	35-MW10D-02
ALUMINUM	24600
ARSENIC	20.3J
BARIUM	271
BERYLLIUM	6
CADMIUM	3.6J
CALCIUM	443000
CHROMIUM	206
COPPER	25
IRON	20900
LEAD	9.7J
MAGNESIUM	9690
MANGANESE	83
NICKEL	29
POTASSIUM	4670
SODIUM	9070
THALLIUM	1.1
VANADIUM	90

INORGANIC CONTAMINANTS	35-MW29BW-01
ALUMINUM	1880
ANTIMONY	3.8J
ARSENIC	2.9J
BARIUM	93
BERYLLIUM	0.14J
CADMIUM	0.31
CALCIUM	132000
CHROMIUM	4.6
COBALT	12J
COPPER	4J
IRON	2280
LEAD	3.9J
MAGNESIUM	3210
MANGANESE	52J
NICKEL	28J
SODIUM	8450
VANADIUM	8J
ZINC	42J

INORGANIC CONTAMINANTS	35-MW22D-02
ALUMINUM	34100
ARSENIC	2.8J
BARIUM	300
BERYLLIUM	11.8
CADMIUM	6.1
CALCIUM	825000
CHROMIUM	248
COBALT	54.1
COPPER	26.4
IRON	57500
MAGNESIUM	18700
MANGANESE	299
MERCURY	0.34J
NICKEL	118
POTASSIUM	7150
SODIUM	7960
VANADIUM	141
ZINC	424

INORGANIC CONTAMINANTS	35-MW33BW-01
BARIUM	43.9
CADMIUM	0.49J
CALCIUM	92100
IRON	87.7
LEAD	1.2J
MAGNESIUM	2650
MANGANESE	23.3
POTASSIUM	2740
SODIUM	10800

FEDERAL MAXIMUM CONTAMINATION LEVELS AND NORTH CAROLINA WATER QUALITY STANDARDS CLASS GA STANDARDS

ORGANIC CONTAMINANTS	MCL	N.C. REGULATION
ALUMINUM (SECONDARY)	50	*
ANTIMONY	6	*
ARSENIC	50	50
BARIUM	2000	2000
BERYLLIUM	4	*
CADMIUM	5	5
CALCIUM	*	*
CHROMIUM	100	50
COBALT	*	*
COPPER (ACTION LEVEL)	1300	1000
IRON (SECONDARY)	300	300
LEAD (ACTION LEVERL)	15	15
MAGNESIUM	*	*
MANGANESE (SECONDARY)	50	50
MERCURY	2	1.1
NICKEL	100	100
POTASSIUM	*	*
SELENIUM	50	50
SILVER (SECONDARY)	100	18
SODIUM	*	*
THALLIUM	2	*
VANADIUM	*	*
ZINC (SECONDARY)	5000	2100

* NO STANDARD AVAILABLE.

NOTE: SECONDARY STANDARDS APPLY ONLY TO MCLs. SECONDARY STANDARDS ARE ASTHETIC IN NATURE.

NOTES:
- CONTAMINANTS, MCLs, AND N.C. REGULATIONS ARE IN MICROGRAMS PER LITER.
- CONTAMINANTS THAT EXCEED MCLs ARE COLORED BLUE.
- CONTAMINANTS THAT EXCEED N.C. REGULATIONS ARE COLORED GREEN.
- CONTAMINANTS THAT EXCEED MCLs AND N.C. REGULATIONS ARE COLORED ORANGE.

LEGEND
- FENCE LINE
- 15 — CONTOUR LINES DEPICTING SURFICIAL RELIEF
- 35MW-29B — MONITORING WELL INSTALLED UNDER BAKER RI (1994).
- MW-18 — MONITORING WELL INSTALLED UNDER CSA (1991) BY LAW.

DATE	MAY 1995
SCALE	1" = 80'
DRAWN	WJH
REVIEWED	JSC
S.O.#	62470-252-0000-07000
CADD#	232905RI

SITE 35, CAMP GEIGER AREA FUEL FARM RI/FS
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

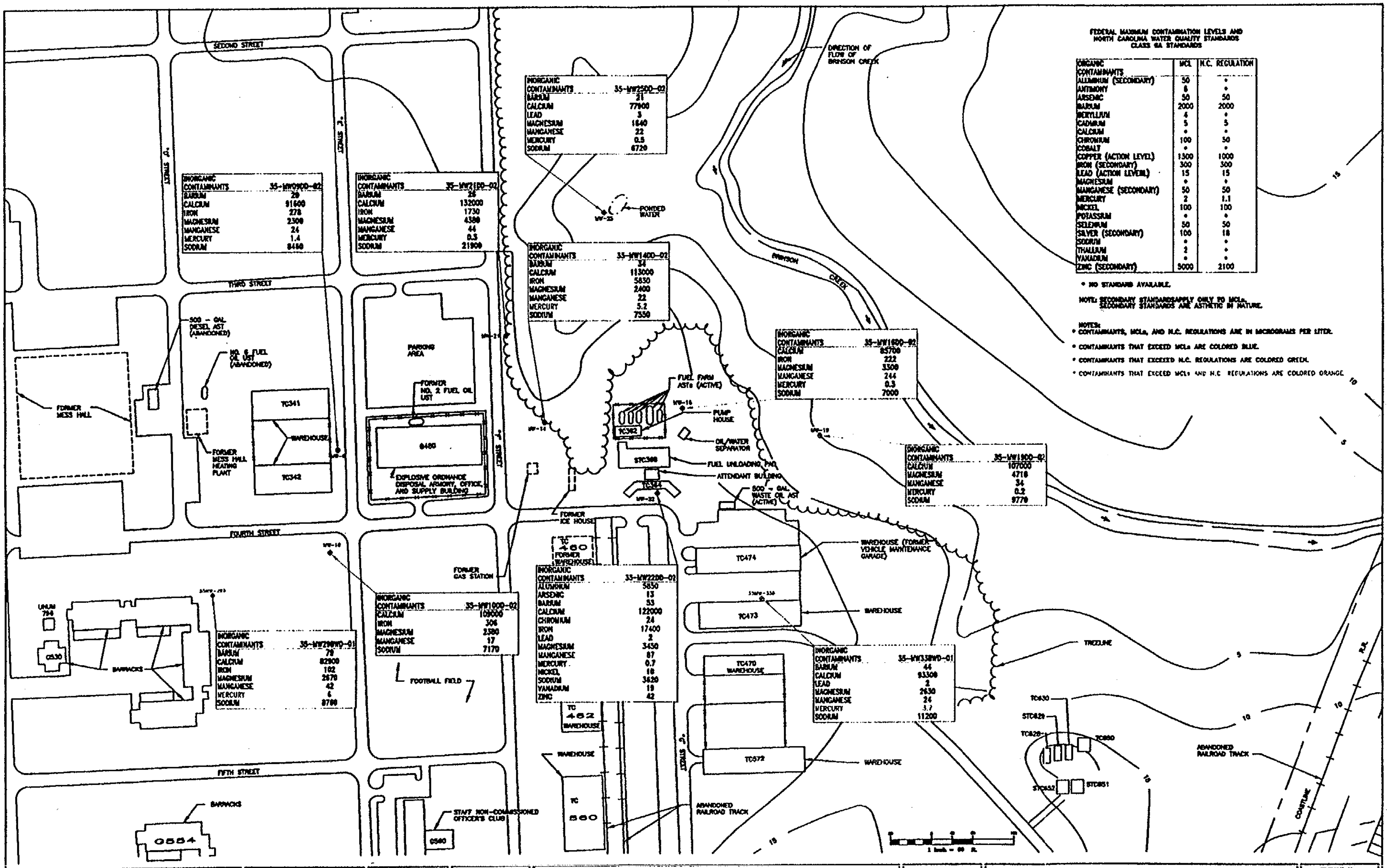
BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

DETECTED TOTAL INORGANICS IN LOWER PORTION OF SURFICIAL AQUIFER
CONTRACT TASK ORDER - 0232

SCALE 1" = 80' DATE MAY 1995

FIGURE No. 4-8



FEDERAL MAXIMUM CONTAMINATION LEVELS AND NORTH CAROLINA WATER QUALITY STANDARDS CLASS GA STANDARDS

ORGANIC CONTAMINANTS	MCL	N.C. REGULATION
ALUMINUM (SECONDARY)	50	*
ANTIMONY	6	*
ARSENIC	50	50
BARIUM	2000	2000
BERYLLIUM	4	*
CADMIUM	5	5
CALCIUM	*	*
CHROMIUM	100	50
COBALT	*	*
COPPER (ACTION LEVEL)	1300	1000
IRON (SECONDARY)	300	300
LEAD (ACTION LEVEL)	15	15
MAGNESIUM	*	*
MANGANESE (SECONDARY)	50	50
MERCURY	2	1.1
NICKEL	100	100
POTASSIUM	*	*
SELENIUM	50	50
SILVER (SECONDARY)	100	18
SODIUM	*	*
THALLIUM	2	*
VANADIUM	*	*
ZINC (SECONDARY)	5000	2100

* NO STANDARD AVAILABLE.

NOTE: SECONDARY STANDARDS APPLY ONLY TO MCLs. SECONDARY STANDARDS ARE ASTHETIC IN NATURE.

NOTES:
- CONTAMINANTS, MCLs, AND N.C. REGULATIONS ARE IN MICROGRAMS PER LITER.
- CONTAMINANTS THAT EXCEED MCLs ARE COLORED BLUE.
- CONTAMINANTS THAT EXCEED N.C. REGULATIONS ARE COLORED GREEN.
- CONTAMINANTS THAT EXCEED MCLs AND N.C. REGULATIONS ARE COLORED ORANGE.

LEGEND
- FENCE LINE
- CONTOUR LINES DEPICTING SURFICIAL RELIEF
- MW-15 MONITORING WELL INSTALLED UNDER CSA (1991) BY LAW.
- MONITORING WELL INSTALLED UNDER BAKER RI (1994).

DATE OCT. 1994
SCALE 1" = 80'
DRAWN WJM
REVIEWED JSC
S.O.# 02470-232-0000-07000
CADD# 23290000

NORTH

SITE 35, CAMP GEIGER AREA FUEL FARM RI/FS
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

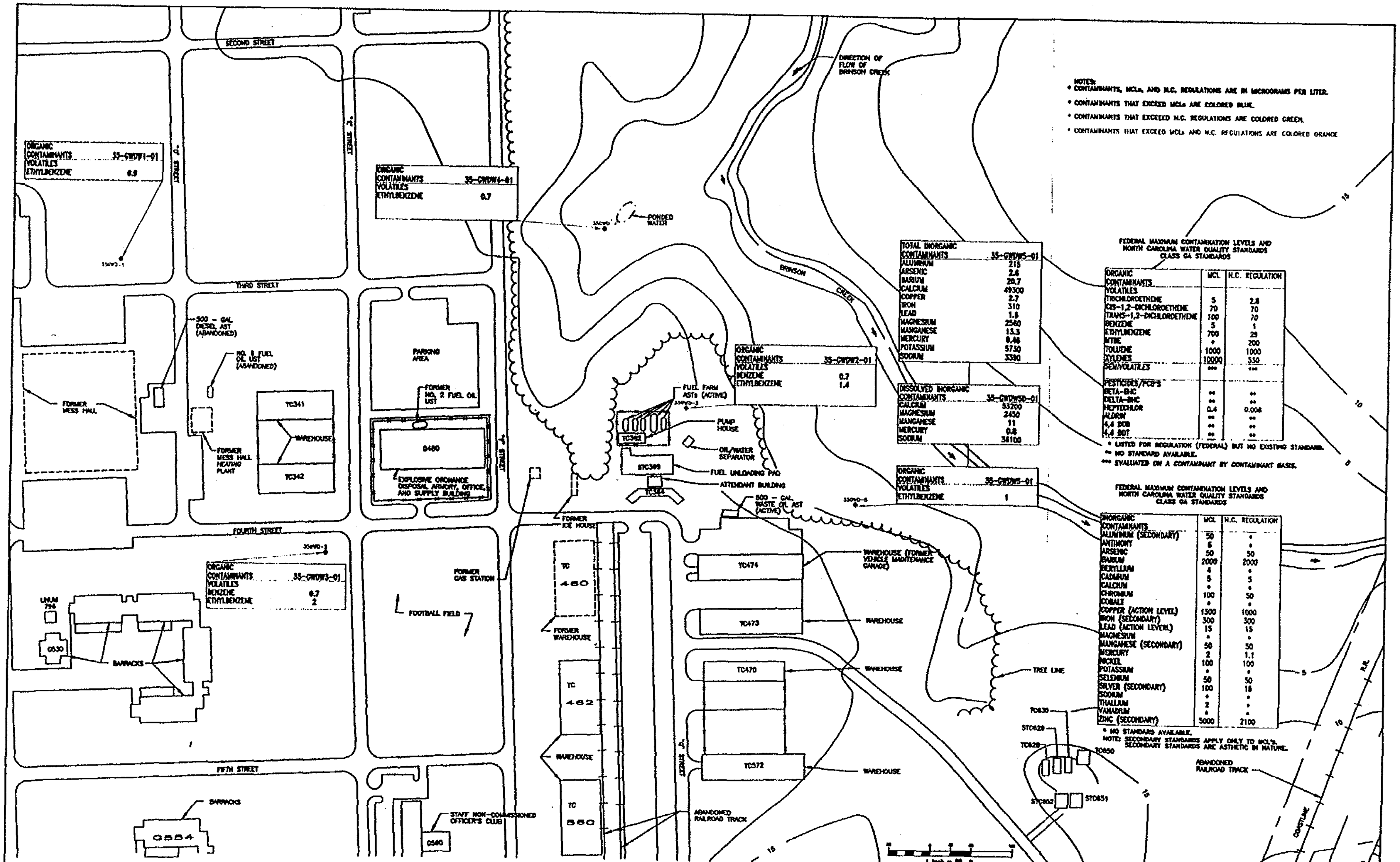
BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

DETECTED DISSOLVED INORGANICS IN THE LOWER PORTION OF THE SURFICIAL AQUIFER
CONTRACT TASK ORDER – 0232

SCALE 1" = 80'
DATE OCT. 1994

FIGURE No. 4-9



LEGEND
- FENCE LINE
- 15 - CONTOUR LINES DEPICTING SURFICIAL RELIEF
- MONITORING WELL INSTALLED UNDER BAKER III (1994).

DATE	OCT. 1994
SCALE	1" = 80'
DRAWN	WJH
REVIEWED	JSC
S.O.#	62470-232-0000-07000
CADD#	2329019N

NORTH

SITE 35, CAMP GEIGER AREA FUEL FARM RI/FS
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

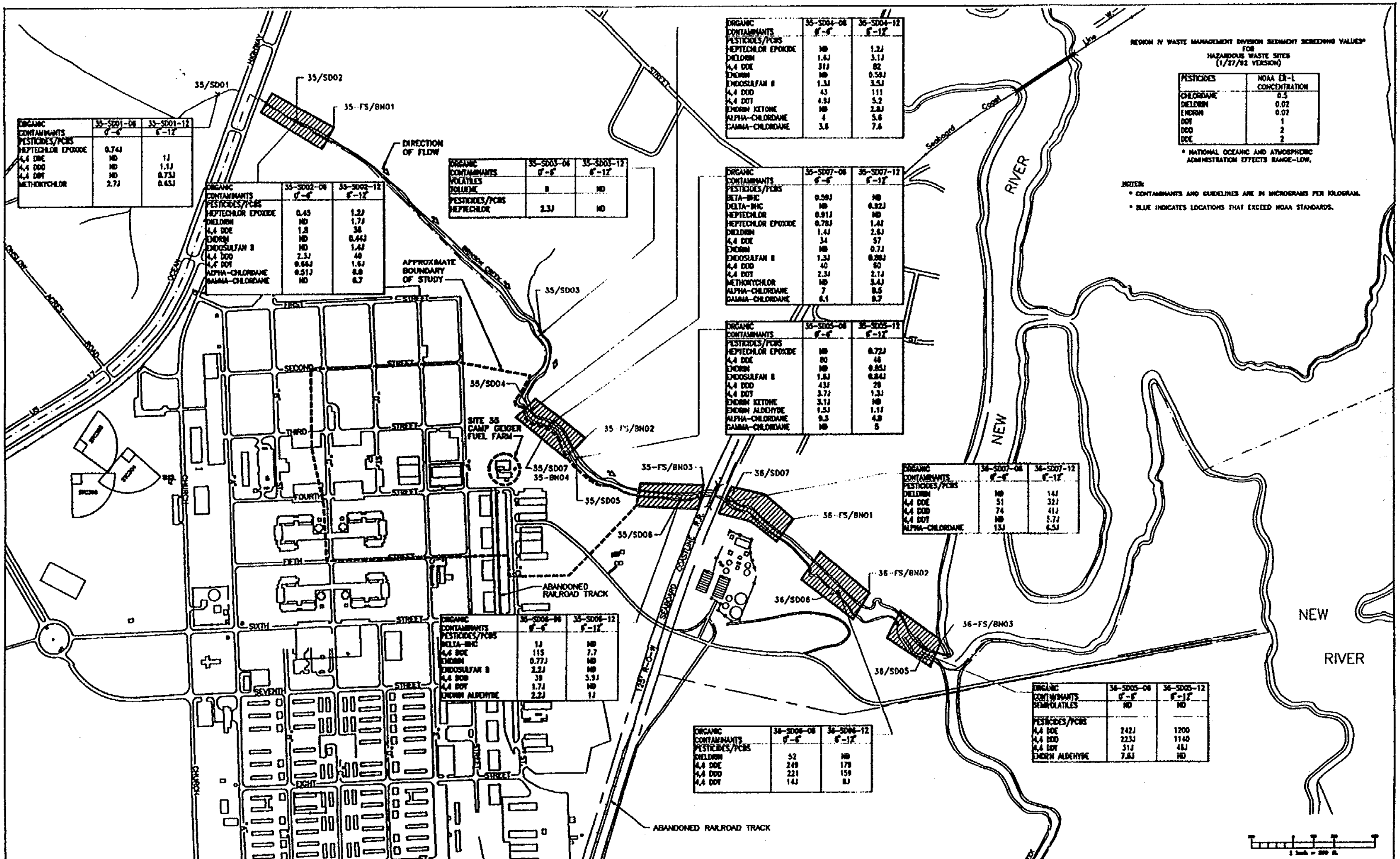
BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

DETECTED ORGANICS AND TOTAL DISSOLVED INORGANICS IN UPPER PORTION OF CASTLE HAYNE AQUIFER
CONTRACT TASK ORDER - 0232

SCALE 1" = 80'
DATE OCT. 1994

FIGURE No.
4-10



ORGANIC CONTAMINANTS	35-SD01-06 0"-6"	35-SD01-12 6"-12"
PESTICIDES/PCBS		
HEPTECHLOR EPOXIDE	0.74J	
4,4 DDE	ND	1J
4,4 DDD	ND	1.1J
4,4 DDT	ND	0.73J
METHOXYCHLOR	2.7J	0.65J

ORGANIC CONTAMINANTS	35-SD02-06 0"-6"	35-SD02-12 6"-12"
PESTICIDES/PCBS		
HEPTECHLOR EPOXIDE	0.43	1.2J
DIELDRIN	ND	1.7J
4,4 DDE	1.8	38
ENDRIN	ND	0.44J
ENDOSULFAN II	ND	1.4J
4,4 DDD	2.3J	40
4,4' DDT	0.66J	1.6J
ALPHA-CHLORDANE	0.51J	8.8
GAMMA-CHLORDANE	ND	8.7

ORGANIC CONTAMINANTS	35-SD03-06 0"-6"	35-SD03-12 6"-12"
VOLATILES		
TOLUENE	8	ND
PESTICIDES/PCBS		
HEPTECHLOR	2.3J	ND

ORGANIC CONTAMINANTS	35-SD04-06 0"-6"	35-SD04-12 6"-12"
PESTICIDES/PCBS		
HEPTECHLOR EPOXIDE	ND	1.2J
DIELDRIN	1.6J	3.1J
4,4 DDE	31J	82
ENDRIN	ND	0.58J
ENDOSULFAN II	1.3J	3.5J
4,4 DDD	43	111
4,4 DDT	4.9J	5.2
ENDRIN KETONE	ND	2.8J
ALPHA-CHLORDANE	4	5.6
GAMMA-CHLORDANE	3.6	7.6

ORGANIC CONTAMINANTS	35-SD07-06 0"-6"	35-SD07-12 6"-12"
PESTICIDES/PCBS		
BETA-BHC	0.59J	ND
DELTA-BHC	ND	0.92J
HEPTECHLOR	0.91J	ND
HEPTECHLOR EPOXIDE	0.78J	1.4J
DIELDRIN	1.4J	2.6J
4,4 DDE	34	57
ENDRIN	ND	0.7J
ENDOSULFAN II	1.3J	0.88J
4,4 DDD	40	60
4,4 DDT	2.3J	2.1J
METHOXYCHLOR	ND	3.4J
ALPHA-CHLORDANE	7	8.5
GAMMA-CHLORDANE	6.1	8.7

ORGANIC CONTAMINANTS	35-SD05-06 0"-6"	35-SD05-12 6"-12"
PESTICIDES/PCBS		
HEPTECHLOR EPOXIDE	ND	0.72J
4,4 DDE	80	46
ENDRIN	ND	0.85J
ENDOSULFAN II	1.8J	0.84J
4,4 DDD	43J	28
4,4 DDT	3.7J	1.3J
ENDRIN KETONE	3.1J	ND
ENDRIN ALDEHYDE	1.5J	1.1J
ALPHA-CHLORDANE	9.5	4.8
GAMMA-CHLORDANE	ND	5

ORGANIC CONTAMINANTS	36-SD07-06 0"-6"	36-SD07-12 6"-12"
PESTICIDES/PCBS		
DIELDRIN	ND	14J
4,4 DDE	51	32J
4,4 DDD	74	41J
4,4 DDT	ND	5.7J
ALPHA-CHLORDANE	13J	6.5J

ORGANIC CONTAMINANTS	35-SD08-06 0"-6"	35-SD08-12 6"-12"
PESTICIDES/PCBS		
DELTA-BHC	1J	ND
4,4 DDE	115	7.7
ENDRIN	0.77J	ND
ENDOSULFAN II	2.2J	ND
4,4 DDD	38	5.9J
4,4 DDT	1.7J	ND
ENDRIN ALDEHYDE	2.2J	1J

ORGANIC CONTAMINANTS	36-SD06-06 0"-6"	36-SD06-12 6"-12"
PESTICIDES/PCBS		
DIELDRIN	52	ND
4,4 DDE	249	179
4,4 DDD	221	159
4,4 DDT	14J	8J

ORGANIC CONTAMINANTS	36-SD05-06 0"-6"	36-SD05-12 6"-12"
SEMIVOLATILES	ND	ND
PESTICIDES/PCBS		
4,4 DDE	242J	1200
4,4 DDD	223J	1140
4,4 DDT	31J	48J
ENDRIN ALDEHYDE	7.6J	ND

REGION IV WASTE MANAGEMENT DIVISION SEDIMENT SCREENING VALUES* FOR HAZARDOUS WASTE SITES (1/27/92 VERSION)

PESTICIDES	NOAA ER-L CONCENTRATION
CHLORDANE	0.5
DIELDRIN	0.02
ENDRIN	0.02
DDT	1
DDD	2
DDE	2

* NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION EFFECTS RANGE-LOW.

NOTES:
- CONTAMINANTS AND GUIDELINES ARE IN MICROGRAMS PER KILOGRAM.
- BLUE INDICATES LOCATIONS THAT EXCEED NOAA STANDARDS.

SOURCE OF BASE MAPPING: LANTDIV, 1991

LEGEND
36/SD01 × – LOCATION OF SEDIMENT COLLECTION POINT
36-FS/BN02 – SAMPLE ZONE FOR FISH AND BENTHIC SAMPLES

DATE OCT. 1994
SCALE 1" = 300'
DRAWN WJH
REVIEWED JJC
S.O.# 02470-232-0000-07000
CADD# 2329111B

NORTH

SITE 35, CAMP GEIGER AREA FUEL FARM RI/FS
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

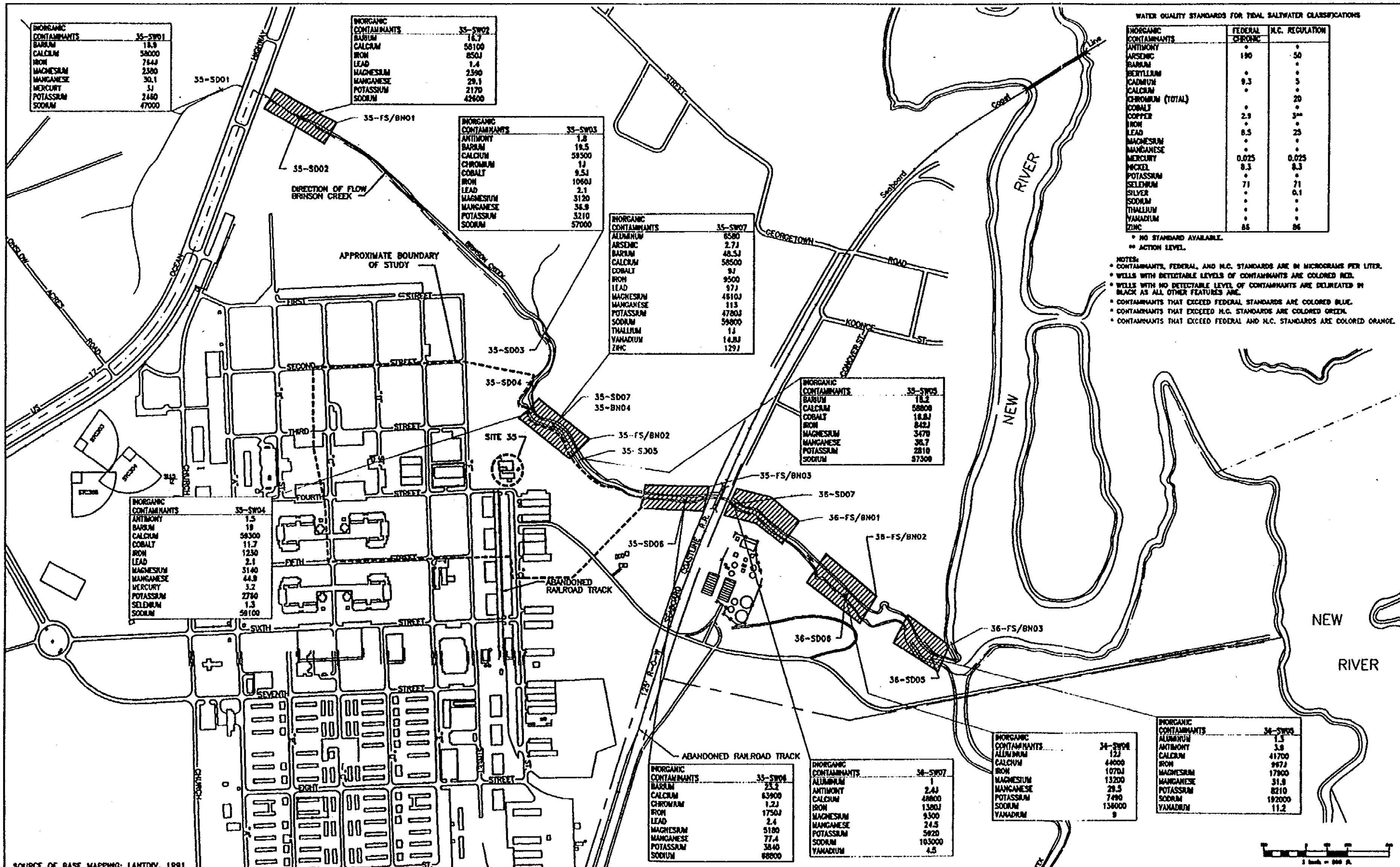
BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

DETECTED ORGANICS IN SEDIMENT
CONTRACT TASK ORDER – 0232

SCALE 1" = 300'
DATE OCT. 1994

SHEET NO. 4-11



INORGANIC CONTAMINANTS	35-SW01
BARIUM	18.9
CALCIUM	58000
IRON	764J
MAGNESIUM	2380
MANGANESE	30.1
MERCURY	3J
POTASSIUM	2460
SODIUM	47000

INORGANIC CONTAMINANTS	35-SW02
BARIUM	16.7
CALCIUM	58100
IRON	850J
LEAD	1.4
MAGNESIUM	2390
MANGANESE	29.1
POTASSIUM	2170
SODIUM	42600

INORGANIC CONTAMINANTS	35-SW03
ANTIMONY	1.8
BARIUM	19.5
CALCIUM	59500
CHROMIUM	1J
COBALT	9.5J
IRON	1060J
LEAD	2.1
MAGNESIUM	3120
MANGANESE	36.9
POTASSIUM	3210
SODIUM	57000

INORGANIC CONTAMINANTS	35-SW07
ALUMINUM	6580
ARSENIC	2.7J
BARIUM	48.5J
CALCIUM	58500
COBALT	9J
IRON	9500
LEAD	97J
MAGNESIUM	4810J
MANGANESE	113
POTASSIUM	4780J
SODIUM	59800
THALLIUM	1J
VANADIUM	14.8J
ZINC	129J

WATER QUALITY STANDARDS FOR TIDAL SALTWATER CLASSIFICATIONS

INORGANIC CONTAMINANTS	FEDERAL CHRONIC	N.C. REGULATION
ANTIMONY	*	*
ARSENIC	190	50
BARIUM		*
BERYLLIUM	*	*
CADMIUM	9.3	5
CALCIUM	*	*
CHROMIUM (TOTAL)		20
COBALT	*	*
COPPER	2.9	3**
IRON	*	*
LEAD	8.5	25
MAGNESIUM	*	*
MANGANESE	*	*
MERCURY	0.025	0.025
NICKEL	8.3	8.3
POTASSIUM	*	*
SELENIUM	71	71
SILVER	*	0.1
SODIUM	*	*
THALLIUM	*	*
VANADIUM	*	*
ZINC	86	86

* NO STANDARD AVAILABLE.
** ACTION LEVEL.

NOTES:
- CONTAMINANTS, FEDERAL, AND N.C. STANDARDS ARE IN MICROGRAMS PER LITER.
- WELLS WITH DETECTABLE LEVELS OF CONTAMINANTS ARE COLORED RED.
- WELLS WITH NO DETECTABLE LEVEL OF CONTAMINANTS ARE DELINEATED IN BLACK AS ALL OTHER FEATURES ARE.
- CONTAMINANTS THAT EXCEED FEDERAL STANDARDS ARE COLORED BLUE.
- CONTAMINANTS THAT EXCEED N.C. STANDARDS ARE COLORED GREEN.
- CONTAMINANTS THAT EXCEED FEDERAL AND N.C. STANDARDS ARE COLORED ORANGE.

INORGANIC CONTAMINANTS	35-SW05
BARIUM	18.2
CALCIUM	58800
COBALT	18.8J
IRON	842J
MAGNESIUM	3470
MANGANESE	38.7
POTASSIUM	2810
SODIUM	57300

INORGANIC CONTAMINANTS	35-SW04
ANTIMONY	1.5
BARIUM	19
CALCIUM	59300
COBALT	11.7
IRON	1230
LEAD	2.1
MAGNESIUM	3140
MANGANESE	44.8
MERCURY	3.2
POTASSIUM	2780
SELENIUM	1.3
SODIUM	58100

INORGANIC CONTAMINANTS	35-SW06
BARIUM	23.2
CALCIUM	63900
CHROMIUM	1.2J
IRON	1750J
LEAD	2.4
MAGNESIUM	5180
MANGANESE	77.4
POTASSIUM	3840
SODIUM	68800

INORGANIC CONTAMINANTS	36-SW07
ALUMINUM	1
ANTIMONY	2.4J
CALCIUM	48800
IRON	1380J
MAGNESIUM	9300
MANGANESE	24.5
POTASSIUM	5920
SODIUM	103000
VANADIUM	4.5

INORGANIC CONTAMINANTS	36-SW06
ALUMINUM	12J
CALCIUM	44000
IRON	1070J
MAGNESIUM	13200
MANGANESE	29.5
POTASSIUM	7490
SODIUM	136000
VANADIUM	9

INORGANIC CONTAMINANTS	36-SW05
ALUMINUM	1.5
ANTIMONY	3.8
CALCIUM	41700
IRON	967J
MAGNESIUM	17900
MANGANESE	31.8
POTASSIUM	8210
SODIUM	192000
VANADIUM	11.2

SOURCE OF BASE MAPPING: LANTDIV, 1991

LEGEND
- 35-SW/SD01 × 35-FS/BN01 - SAMPLE LOCATION FOR SURFACE WATER AND SEDIMENT
- COLLECTION AREA FOR FISH AND BENTHIC SAMPLES
- FENCE LINE
- EXISTING STRUCTURE

DATE	OCT. 1994
SCALE	1" = 300'
DRAWN	WJH
REVIEWED	JSC
S.O.#	62470-232-0000-07000
CADD#	23291OR1

NORTH

SITE 35, CAMP GEIGER AREA FUEL FARM RI/FS
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

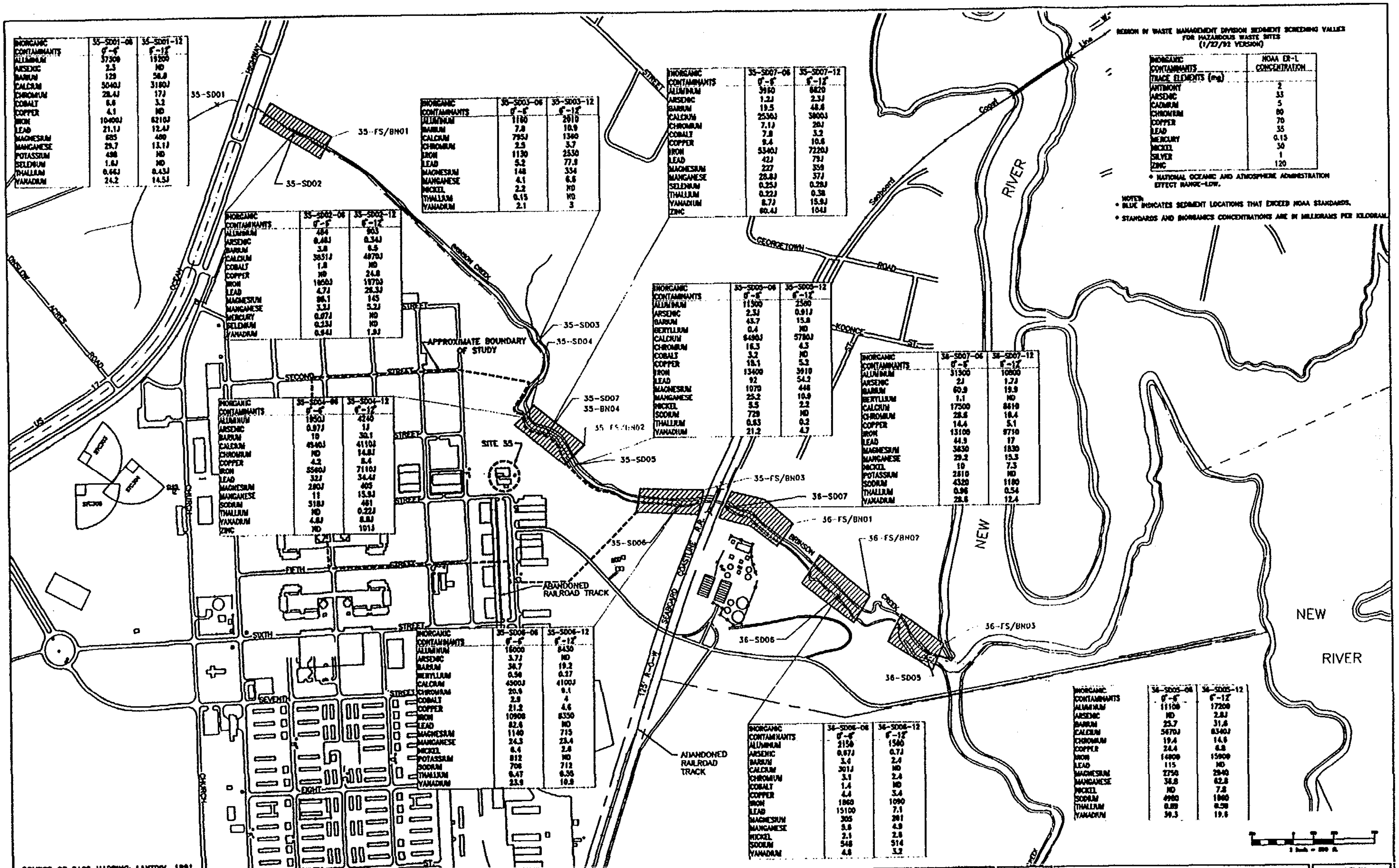
BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

DETECTED INORGANICS
IN SURFACE WATER
CONTRACT TASK ORDER - 0232

SCALE 1" = 300'
DATE OCT. 1994

SHEET NO.
4-12



INORGANIC CONTAMINANTS	35-SD01-06 0"-6"	35-SD01-12 6"-12"
ALUMINUM	37500	19200
ARSENIC	2.3	ND
BARIUM	129	58.8
CALCIUM	5040J	3180J
CHROMIUM	28.4J	17J
COBALT	6.6	3.2
COPPER	4.1	ND
IRON	10400J	6210J
LEAD	21.1J	12.4J
MAGNESIUM	685	400
MANGANESE	29.7	13.1J
POTASSIUM	498	ND
SELENIUM	1.6J	ND
THALLIUM	0.64J	0.43J
VANADIUM	24.2	14.5J

INORGANIC CONTAMINANTS	35-SD02-06 0"-6"	35-SD02-12 6"-12"
ALUMINUM	484	903
ARSENIC	0.48J	0.34J
BARIUM	3.8	6.5
CALCIUM	3851J	4870J
COBALT	1.8	ND
COPPER	ND	24.8
IRON	1860J	1870J
LEAD	4.7J	28.3J
MAGNESIUM	86.1	145
MANGANESE	3.3J	5.2J
MERCURY	0.07J	ND
SELENIUM	0.23J	ND
VANADIUM	0.84J	1.9J

INORGANIC CONTAMINANTS	35-SD03-06 0"-6"	35-SD03-12 6"-12"
ALUMINUM	1160	2010
BARIUM	7.8	10.9
CALCIUM	795J	1360
CHROMIUM	2.5	3.7
IRON	1130	2530
LEAD	5.2	77.8
MAGNESIUM	148	334
MANGANESE	4.1	6.6
NICKEL	2.2	ND
THALLIUM	0.15	ND
VANADIUM	2.1	3

INORGANIC CONTAMINANTS	35-SD07-06 0"-6"	35-SD07-12 6"-12"
ALUMINUM	3960	6820
ARSENIC	1.2J	2.3J
BARIUM	19.5	48.6
CALCIUM	2530J	3800J
CHROMIUM	7.1J	20J
COBALT	7.8	3.2
COPPER	9.4	10.6
IRON	5340J	7220J
LEAD	42J	79J
MAGNESIUM	227	359
MANGANESE	20.8J	37J
SELENIUM	0.25J	0.28J
THALLIUM	0.22J	0.38
VANADIUM	8.7J	15.9J
ZINC	80.4J	104J

INORGANIC CONTAMINANTS	35-SD05-06 0"-6"	35-SD05-12 6"-12"
ALUMINUM	11500	2580
ARSENIC	2.3J	0.91J
BARIUM	43.7	15.8
BERYLLIUM	0.4	ND
CALCIUM	8490J	5780J
CHROMIUM	16.3	4.3
COBALT	3.2	ND
COPPER	18.1	5.3
IRON	13400	3910
LEAD	92	54.2
MAGNESIUM	1070	446
MANGANESE	25.2	10.9
NICKEL	5.5	2.2
SODIUM	729	ND
THALLIUM	0.63	0.2
VANADIUM	21.2	4.7

INORGANIC CONTAMINANTS	36-SD07-06 0"-6"	36-SD07-12 6"-12"
ALUMINUM	31500	10800
ARSENIC	2J	1.7J
BARIUM	60.9	19.9
BERYLLIUM	1.1	ND
CALCIUM	17500	8610
CHROMIUM	28.6	10.4
COPPER	14.4	5.1
IRON	13100	9710
LEAD	44.9	17
MAGNESIUM	3830	1830
MANGANESE	29.2	15.3
NICKEL	10	7.3
POTASSIUM	2810	ND
SODIUM	4320	1180
THALLIUM	0.96	0.54
VANADIUM	28.6	12.4

INORGANIC CONTAMINANTS	35-SD04-06 0"-6"	35-SD04-12 6"-12"
ALUMINUM	1950J	4240
ARSENIC	0.07J	1J
BARIUM	10	30.1
CALCIUM	4940J	4110J
CHROMIUM	ND	14.8J
COPPER	4.2	8.4
IRON	5540J	7110J
LEAD	32J	34.4J
MAGNESIUM	280J	405
MANGANESE	11	15.9J
SODIUM	318J	461
THALLIUM	ND	0.22J
VANADIUM	4.8J	8.8J
ZINC	ND	101J

INORGANIC CONTAMINANTS	35-SD06-06 0"-6"	35-SD06-12 6"-12"
ALUMINUM	16000	8430
ARSENIC	3.7J	ND
BARIUM	38.7	19.2
BERYLLIUM	0.50	0.27
CALCIUM	4500J	4100J
CHROMIUM	20.9	9.1
COBALT	2.9	4
COPPER	21.2	4.6
IRON	10900	8350
LEAD	82.6	ND
MAGNESIUM	1140	715
MANGANESE	24.3	23.4
NICKEL	6.4	2.8
POTASSIUM	812	ND
SODIUM	706	712
THALLIUM	0.47	0.35
VANADIUM	23.9	10.8

INORGANIC CONTAMINANTS	36-SD06-06 0"-6"	36-SD06-12 6"-12"
ALUMINUM	2150	1580
ARSENIC	0.07J	0.7J
BARIUM	3.4	2.4
CALCIUM	301J	ND
CHROMIUM	3.1	2.4
COBALT	1.4	ND
COPPER	4.4	3.4
IRON	1860	1090
LEAD	15100	7.1
MAGNESIUM	305	281
MANGANESE	5.8	4.9
NICKEL	2.1	2.8
SODIUM	548	514
VANADIUM	4.8	3.2

INORGANIC CONTAMINANTS	36-SD05-06 0"-6"	36-SD05-12 6"-12"
ALUMINUM	11100	17200
ARSENIC	ND	2.8J
BARIUM	25.7	31.6
CALCIUM	5470J	8340J
CHROMIUM	19.4	14.6
COPPER	24.4	6.8
IRON	14800	15900
LEAD	115	ND
MAGNESIUM	2750	2940
MANGANESE	38.8	62.8
NICKEL	ND	7.8
SODIUM	4980	1860
THALLIUM	0.89	0.58
VANADIUM	39.3	19.6

REGION IV WASTE MANAGEMENT DIVISION SEDIMENT SCREENING VALUES FOR HAZARDOUS WASTE SITES (1/27/92 VERSION)

INORGANIC CONTAMINANTS	NOAA ER-L CONCENTRATION
TRACE ELEMENTS (mg)	
ANTIMONY	2
ARSENIC	33
CADMIUM	5
CHROMIUM	80
COPPER	70
LEAD	35
MERCURY	0.15
NICKEL	30
SILVER	1
ZINC	120

* NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION EFFECT RANGE-LOW.

NOTES:
- BLUE INDICATES SEDIMENT LOCATIONS THAT EXCEED NOAA STANDARDS.
- STANDARDS AND INORGANICS CONCENTRATIONS ARE IN MILLIGRAMS PER KILOGRAM.

SOURCE OF BASE MAPPING: LANTDIV, 1991

LEGEND
35-SW/SD01 × - SAMPLE LOCATION FOR SURFACE WATER AND SEDIMENT
35 FS/BN01 - SAMPLE ZONE FOR FISH AND BENTHICS

DATE OCT. 1994
SCALE 1" = 300'
DRAWN W.H
REVIEWED JBC
S.O.# 02470-232-0000-07000
CADD# 2329138

NORTH

SITE 35, CAMP GEIGER AREA FUEL FARM RI/FS
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

DETECTED INORGANICS IN SEDIMENT
CONTRACT TASK ORDER - 0232

SCALE 1" = 300'
DATE OCT. 1994

SHEET NO. 4-13

TABLE 6-1

ORGANIC DATA SUMMARY
SURFACE SOIL
OPERABLE UNIT NO. 10 (SITE 35)
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil	
	Range of Positive Detections	No. of Positive Detects/ No. of Samples
Carbon Disulfide	33	1/10
Toluene	19J	1/13
Xylenes (total)	43	1/13
Phenol	3,071	1/13
Acenaphthene	196J	1/13
Phenanthrene	191J - 1,186	2/13
Carbazole	183J	1/13
Fluoranthene	423 - 1,567	2/13
Pyrene	295J - 1,173	2/13
Butylbenzyphthalate	295J	1/13
Benzo(a)anthracene	566	1/13
Chrysene	204J - 683	2/13
bis(2-Ethylhexyl)phthalate	279J	1/13
Benzo(b)fluoranthene	337J - 1,186	2/13
Benzo(a)pyrene	625	1/13
Ideno (1,2,3-cd)pyrene	381	1/13
Dibenz(a,h)anthracene	184J	1/13
Benzo(g,h,i)perylene	208J - 366	2/13
beta-BHC	0.53J - 1.6J	2/10
Dieldrin	0.35J - 212	4/10
4,4'-DDE	1.6J - 1,570	10/10
Endrin	0.68J - 7.9	3/10
Endosulfan II	0.42J - 2.9J	2/10
4,4'-DDD	0.56J - 3,240	9/10
4,4'-DDT	1.6J - 262	10/10
Endrin ketone	1.2J	1/10
Endrin aldehyde	0.37J - 1.6J	2/10
alpha-Chlordane	4.1 - 36	2/10
gamma-Chlordane	27	1/10

Note: Concentrations expressed in microgram per kilogram (µg/kg).
J - Estimated value
All rejected results have been removed from the data.
Frequencies of detection are adjusted accordingly.

organics in the sediments in the lower reach, which would accumulate more of these types of contaminants.

- The fish community sampled in Brinson Creek was representative of an estuarine ecosystem with both freshwater and marine species present. In addition, the presence of blue crabs, grass shrimp, and crayfish support the active use of Brinson Creek by aquatic species.

- The absence of pathologies observed in the fish collected from Brinson Creek indicates that the surface water and sediment quality may not adversely impact the fish community.

- The benthic macroinvertebrate community demonstrated the typical tidal/freshwater species trend of primarily chironmids and oligochaetes in the upper reaches and polychaetes and amphipods in the lower reaches. Species representative of both tolerant and intolerant taxa were present. Species richness and densities were representative of an estuarine ecosystem.

- The aquatic community in Brinson Creek is representative of an estuarine community and does not appear to be significantly impacted by surface water and sediment quality.

- Surface soil quality indicated a potential for adversely impacting the terrestrial receptors that have indirect contact with the surface soils and copper in the tissue samples. This adverse impact is primarily due to cadmium in the surface soils. The cadmium in the surface soil is overestimating the adverse impacts since it was detected at a relatively high concentration in only one out of ten samples. In addition, the copper in the tissue samples does not appear to be site-related.

8.2 <u>Recommendations</u>

Based on the data obtained it is recommended that:

- The remedial investigation at Site 35 be extended south of Fifth Street as needed to define the extent and locate the source(s) of solvent-related groundwater contamination in the surficial aquifer.

- The monitoring wells screened within the surficial aquifer that were sampled under the RI for inorganic contaminants (total phase only) be resampled using low-flow pumping techniques in order to more accurately quantify total metals contamination. Based on past experiences with the technique at Camp Lejeune, it is anticipated that samples taken using the low-flow technique will produce results similar to previously obtained as dissolved metals results.

- Obtain sediment samples along Brinson Creek at locations adjacent to and downstream of Site 35 and analyze for TPH (EPA Methods 5030 and 3550) so as to provide data regarding the extent of organic contamination that was "masked" by TICs in results obtained under the RI.

data suggests that suspended solids in the sample may be contributing to elevated total metals.

- No significant organic or inorganic contamination was detected in the samples collected from the deep wells (Figure 4-10). The absence of TCE in the Castle Hayne Aquifer indicates that the unit identified as a semi-confining unit is retarding the vertical migration of the contaminates. Although the unit possesses very little clay and is not the "typical" semi-confining unit, the high permeability of the soils above and below the unit as well as the groundwater gradient exhibited at the site provide for the surficial aquifer waters to flow along the top of the unit instead of passing through the unit. Vertical migration may be occurring at the site but at a very slow rate such that the contamination has not been detected in the upper portion of the Castle Hayne Aquifer.

- No VOCs were detected in surface water samples. Toluene was the only volatile organic compound detected in the sediments obtained from station 35-SW/SD03 within Brinson Creek (Figure 4-11). Although VOCs generally were not detected, heavy sheens and hydrocarbon odors were noted during sampling. During sample validation, it was noted that an unusually high number of Tentatively Identified Compounds (TICs) were identified in the samples.

- Although no SVOCs were detected in the surface water samples, a number of SVOCs were detected in the sediment samples collected from Brinson Creek. The SVOCs were detected in greater frequency in the samples collected from 6 to 12 inches. SVOCs were detected both upgradient and downgradient of Site 35. However, the highest levels of SVOCs were detected in samples obtained adjacent to Site 35.

- Pesticides were detected at all 10 sediment sample locations; however, no pesticides were observed in the surface water samples. The application of pest control to the surfaces Camp Geiger leads to pesticide detections in the sediments of Brinson Creek. The pesticides are carried from the surface soil to the creek via surface runoff and natural erosion. This statement can be further supported by the large number of pesticides detected in the surface soils at the site. PCBs were not detected in any of the surfaced water or sediment samples collected from Brinson Creek.

- Inorganics above the Federal Screening Values (WQSVs and NOAA standards) and/or NCWQS are present in one surface water and seven sediment locations. The only compound to exceed the NOAA standards in sediments was lead. The greatest concentration was detected in sample number 36-SD06-06 collected from the 0 to 6 inch interval. The detected lead is prevalent adjacent to and downstream of Site 35 and could be related to past site activities. Mercury, lead and zinc were detected at levels exceeding the Federal and North Carolina Standards in surface water samples 35-SW01, 35-SW04 and 35-SW07. The mercury was detected in two samples (35-SW01 and 35-SW04) located upstream of Site 35 which indicates contamination may originate from an upgradient location. The concentrations of lead and zinc detected in sample 35-SW07 may be attributed to past practices at

TABLE 6-2

INORGANIC DATA SUMMARY
SURFACE SOIL
OPERABLE UNIT NO. 10 (SITE 35)
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Inorganic	Surface Soil				
	Average Base-Specific Background(1) Concentration	Twice the Average Base-Specific Background Concentration	Range of Positive Detections	No. of Positive Detects/ No. of Samples	No. of Times Exceeded Twice the Average Background Concentration
Aluminum	2,104	4,209	2,020 - 7,870	13/13	3
Antimony	2.41	4.81	7.4J - 8J	2/10	2
Arsenic	0.39	0.77	0.29J - 66.1J	11/13	4
Barium	7.1	14.2	6.2 - 86	13/13	6
Beryllium	0.11	0.22	0.22	1/12	0
Cadmium	0.31	0.61	0.04J - 15J	10/10	1
Calcium	534	1,069	604J - 49,500J	13/13	10
Chromium	2.38	4.77	1.9 - 98.1	11/13	6
Cobalt	1.17	2.35	1.3 - 4.3	3/13	1
Copper	4.51	9.02	2 - 58.3	12/13	2
Iron	1,257	2,515	1,250 - 29,900J	13/13	6
Lead	12.1	24.2	7.2 - 71J	13/13	7
Magnesium	84.7	169	58.7 - 951	13/13	11
Manganese	7.04	14.1	4.1 - 66.7	13/13	4
Nickel	1.55	3.09	1.3 - 17.2	10/13	1
Selenium	0.37	0.74	0.94J - 1.2J	2/13	2
Thallium	0.4	0.8	0.06 - 0.53J	11/13	0
Vanadium	3.27	6.54	3.6 - 20.7	13/13	6
Zinc	4.92	9.84	138 - 430	2/2	2

Notes: Concentrations expressed in milligram per kilogram (mg/kg).
(1) Soil background concentrations are based on reference background soil samples collected from MCB Camp Lejeune investigations.
ND - Not Detected
J - Estimated value
All rejected results have been removed from the data. Frequencies of detection are adjusted accordingly.

TABLE 6-3

ORGANIC DATA SUMMARY
SUBSURFACE SOIL
OPERABLE UNIT NO. 10 (SITE 35)
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Subsurface Soil	
	Range of Positive Detections	No. of Positive Detects/ No. of Samples
Methylene Chloride	7J	5/19
Acetone	11J - 144J	5/19
Tetrachloroethene	8 - 60	4/19
Pyrene	283J	1/8
Benzo(b)fluoranthene	425	1/8

Note: Concentrations expressed in microgram per kilogram (µg/kg).
J - Estimated value
All rejected results have been removed from the data.
Frequencies of detection are adjusted accordingly.

TABLE 6-4

INORGANIC DATA SUMMARY
SUBSURFACE SOIL
OPERABLE UNIT NO. 10 (SITE 35)
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Inorganic	Subsurface Soil				
	Average Base-Specific Background[1] Concentration	Twice the Average Base-Specific Background Concentration	Range of Positive Detections	No. of Positive Detects/ No. of Samples	No. of Times Exceeded Twice the Average Background Concentration
Aluminum	3,563	7,127	1,870J - 6,210	8/8	0
Arsenic	0.38	0.76	0.19J - 2.7J	7/8	1
Barium	5.65	11.3	4.8 - 25	8/8	3
Cadmium	0.37	0.74	0.03J - 0.49J	6/6	0
Calcium	277	554	361J - 2,420J	6/8	4
Chromium	4.19	8.37	3.1 - 14.4J	7/8	2
Cobalt	0.56	1.12	1.4	1/8	1
Copper	1.08	2.15	1.2 - 8.5	6/8	4
Iron	1,066	2,133	442J - 10,500J	8/8	3
Lead	3.64	7.27	4J - 144	8/8	6
Magnesium	106	212	63.5 - 403	7/8	2
Manganese	3.54	7.07	1.5 - 7.5	8/8	2
Nickel	1.31	2.61	1.2 - 2	4/8	0
Potassium	119	238	562	1/8	1
Selenium	0.4	0.79	0.17J - 0.67J	4/8	0
Silver	0.52	1.05	0.39J	1/8	0
Thallium	0.34	0.67	0.1 - 2.1	4/8	1
Vanadium	4.77	9.53	3J - 19.9J	8/8	2
Zinc	2.16	4.32	16.3	1/3	1

Notes: Concentrations expressed in milligram per kilogram (mg/kg).
(1) Soil background concentrations are based on reference background soil samples collected from MCB Camp Lejeune investigations.
ND - Not Detected
J - Estimated value
All rejected results have been removed from the data. Frequencies of detection are adjusted accordingly.

TABLE 6-5

GROUNDWATER DATA SUMMARY
OPERABLE UNIT NO. 10 (SITE 35)
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Groundwater Criteria				Frequency/Range		Comparison to Criteria			
	NCWQS(1)	MCL(2)	Federal Health Advisories(3)		Concentration Range	No. of Positive Detects/ No. of Samples	No. of Detects Above NCWQS	No. of Detects Above MCL	No. of Detects Above Health Advisories	
			10 kg Child	70 kg Adult					10 kg Child	70 kg Adult
1,1,2,2-Tetrachloroethane	NE	NE	NE	NE	20.5 - 64.7	2/50	NA	NA	NA	NA
1,1,2-Trichloroethane	NE	5	400	1,000	1 - 1.9	2/50	NA	0	0	0
1,1-Dichloroethane	700	NE	NE	NE	2.5 - 7.6	3/50	0	NA	NA	NA
1,1-Dichloroethene	7	7	1,000	4,000	0.8 - 6.9	4/50	0	0	0	0
Chloroform	0.19	100	100	400	0.6	1/50	1	0	0	0
Tetrachloroethene	0.7	5	1,000	5,000	1.9	1/50	1	0	0	0
cis-1,2-Dichloroethene	70	70	3,000	11,000	3.2 - 973	22/50	12	12	0	0
trans-1,2-Dichloroethene	70	100	2,000	6,000	0.4 - 176	18/50	5	5	0	0
Trichloroethene	2.8	5	NE	NE	0.4 - 900	20/50	17	16	NA	NA
Benzene	1	5	NE	NE	0.2 - 1,660	29/50	17	10	NA	NA
Toluene	1,000	1,000	2,000	7,000	0.3 - 984	42/50	0	0	0	0
Ethylbenzene	29	700	1,000	3,000	0.3 - 824	42/50	8	1	0	0
Methyl Tertiary Butyl Ether	200	NE	500	2,000	6.6J - 319	15/50	4	NA	0	0
Xylenes (Total)	530	10,000	40,000	100,000	0.6 - 1,700	45/50	3	0	0	0
Phenol	NE	NE	6,000	20,000	11 - 23	2/24	NA	NA	0	0
2-Methylphenol	NE	NE	NE	NE	17	1/24	NA	NA	NA	NA
4-Methylphenol	NE	NE	NE	NE	6J	1/24	NA	NA	NA	NA
2,4-Dimethylphenol	NE	NE	NE	NE	74	1/24	NA	NA	NA	NA
Naphthalene	NE	NE	400	1,000	7J - 499	6/24	NA	NA	1	0
2-Methylnaphthalene	NE	NE	NE	NE	70 - 668	5/24	NA	NA	NA	NA
Dibenzofuran	NE	NE	NE	NE	8J - 23	3/24	NA	NA	NA	NA
Fluorene	NE	NE	NE	NE	8J - 22	3/24	NA	NA	NA	NA
Phenanthrene	NE	NE	NE	NE	10J - 52	3/24	NA	NA	NA	NA

TABLE 6-5 (Continued)

GROUNDWATER DATA SUMMARY
OPERABLE UNIT NO. 10 (SITE 35)
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Groundwater Criteria				Frequency/Range		Comparison to Criteria			
	NCWQS(1)	MCL(2)	Federal Health Advisories(3)		Concentration Range	No. of Positive Detects/ No. of Samples	No. of Detects Above NCWQS	No. of Detects Above MCL	No. of Detects Above Health Advisories	
			10 kg Child	70 kg Adult					10 kg Child	70 kg Adult
Anthracene	NE	NE	NE	NE	7J	1/24	NA	NA	NA	NA
Carbazole	NE	NE	NE	NE	12 - 13	2/24	NA	NA	NA	NA
beta-BHC	NE	NE	NE	NE	0.022J - 0.023J	3/7	NA	NA	NA	NA
delta-BHC	NE	NE	NE	NE	0.05J	1/7	NA	NA	NA	NA
Heptachlor	0.008	0.4	5	5	0.011J - 0.013J	2/7	2	0	0	0
Aldrin	NE	NE	0.3	0.3	0.013J - 0.017J	2/7	NA	NA	0	0
4,4'-DDD	NE	NE	NE	NE	0.21J	1/7	NA	NA	NA	NA
4,4'-DDT	NE	NE	NE	NE	0.014J	1/7	NA	NA	NA	NA
Aluminum	NE	NE	NE	NE	215 - 380,000	23/24	NA	NA	NA	NA
Antimony	NE	6	10	15	3.8J - 10.2J	2/10	NA	1	1	0
Arsenic	50	50	NE	NE	1.9J - 165J	21/23	3	3	NA	NA
Barium	2,000	2,000	NE	NE	20.7 - 3,440	24/24	4	4	NA	NA
Beryllium	NE	4	4,000	20,000	0.14J - 63.5	22/24	NA	10	0	0
Calcium	NE	NE	NE	NE	13,510 - 2,050,000	24/24	NA	NA	NA	NA
Chromium	50	100	200	800	4.6 - 1,540	22/24	19	14	13	4
Cadmium	5	5	5	20	0.31 - 340	22/24	8	8	0	1
Cobalt	NE	NE	NE	NE	12J - 281	13/24	NA	NA	NA	NA
Copper	1,000	1,300	NE	NE	2 - 140	23/24	0	0	NA	NA
Iron	300	NE	NE	NE	67.7 - 255,000	24/24	23	NA	NA	NA
Lead	15	15	NE	NE	1.2J - 64	21/24	7	7	NA	NA
Magnesium	NE	NE	NE	NE	2,560 - 42,600	24/24	NA	NA	NA	NA
Manganese	50	50(4)	NE	NE	13.3 - 1,420	24/24	19	19	NA	NA
Mercury	1.1	2	NE	2	0.15J - 0.84J	5/24	0	0	NA	0

TABLE 6-5 (Continued)

GROUNDWATER DATA SUMMARY
OPERABLE UNIT NO. 10 (SITE 35)
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Groundwater Criteria				Frequency/Range		Comparison to Criteria			
			Federal Health Advisories[3]						No. of Detects Above Health Advisories	
	NCWQS[1]	MCL[2]	10 kg Child	70 kg Adult	Concentration Range	No. of Positive Detects/ No. of Samples	No. of Detects Above NCWQS	No. of Detects Above MCL	10 kg Child	70 kg Adult
Nickel	100	100	500	1,700	13.4 - 524	19/24	9	9	1	0
Potassium	NE	NE	NE	NE	2,740 - 22,300	17/24	NA	NA	NA	NA
Selenium	50	50	NE	NE	1.4J - 13.5J	8/16	0	0	NA	NA
Silver	18	NE	200	200	4 - 20	3/24	1	NA	0	0
Sodium	NE	NE	NE	NE	4,470 - 68,200	23/24	NA	NA	NA	NA
Thallium	NE	2	7	20	0.9 - 5	15/24	NA	8	0	0
Vanadium	NE	NE	NE	NE	8J - 886	22/24	NA	NA	NA	NA
Zinc	2,100	5,000[4]	3,000	10,000	41.9 - 1,850	16/18	0	0	0	0

Notes: Concentrations expressed in microgram per liter (µg/L).
[1] NCWQS = North Carolina Water Quality Standards for Groundwater
[2] MCL = Safe Drinking Water Act Maximum Contaminant Level
[3] Longer Term Health Advisories for a 10 kg Child and 70 kg Adult
[4] SMCL = Secondary Maximum Contaminant Level
NE - No Criteria Established
NA - Not Applicable
NJ - Estimated/tentative value
J - Estimated value
All rejected results have been removed from the data. Frequencies of detection are adjusted accordingly.

TABLE 6-6

SURFACE WATER DATA SUMMARY
OPERABLE UNIT NO. 10 (SITE 35)
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Water Criteria			Average Reference Station Background Concentration	Twice the Average Reference Station Average Concentration	Contaminant Frequency/Range		Comparison to Criteria			No. of Times Exceeded Twice the Average Background Concentration
	NCWQS[1]	Federal Health AWQCs[2]				No. of Positive Detects/ No. of Samples	Contaminant Range	Positive Detects Above NCWQS	Positive Detects Above AWQC		
		Water & Organisms	Organisms Only						Water & Organisms	Organisms Only	
luminum	NE	NE	NE	333.17	666.3	4/10	1 - 6,580	NA	NA	NA	1
ntimony	NE	14	4300	ND	ND	4/10	1.5 - 3.9	NA	0	0	NA
rsenic	NE	0.018	0.14	ND	ND	1/10	2.7J	NA	1	1	NA
arium	NE	2,000	NE	25.7	51.4	7/10	16.7 - 48.5J	NA	0	NA	0
alcium	NE	NE	NE	17,566	35,132	10/10	41,700 - 63,900	NA	NA	NA	10
hromium	NE	NE	NE	ND	ND	2/10	1J - 1.2J	NA	NA	NA	NA
obalt	NE	NE	NE	ND	ND	4/10	9J - 16.8J	NA	NA	NA	NA
on	NE	300	NE	575.7	1,151.4	10/10	764J - 9,500	NA	10	NA	4
ead	NE	NE	NE	ND	ND	5/10	1.4 - 97J	NA	NA	NA	NA
lagnesium	NE	NE	NE	1,744.7	3,489.4	10/10	2,380 - 17,900	NA	NA	NA	5
langanese	NE	50	100	ND	ND	10/10	24.5 - 113	NA	2	1	NA
lercury	NE	0.14	0.15	ND	ND	2/10	3J - 3.2J	NA	2	2	NA
otassium	NE	NE	NE	ND	ND	10/10	2,170 - 8,210	NA	NA	NA	NA
elenium	NE	NE	NE	0.82	1.66	1/10	1.3J	NA	NA	NA	0
odium	NE	NE	NE	9,830	19,660	10/10	42,600 - 192,000	NA	NA	NA	10
hallium	NE	1.7	6.3	ND	ND	1/10	1J	NA	0	0	NA
anadium	NE	NE	NE	ND	ND	4/10	4.5 - 14.8J	NA	NA	NA	NA
inc	NE	NE	NE	ND	ND	1/10	129J	NA	NA	NA	NA

Notes: Concentrations expressed in microgram per liter (μg/L).
[1] NCWQS = North Carolina Water Quality Criteria for Surface Water
[2] AWQC = Ambient Water Quality Standard
NE - Not Established
NA - Not Applicable
J - Estimated value
All rejected results have been removed from the data. Frequencies of detection are adjusted accordingly.

TABLE 6-7

SEDIMENT DATA SUMMARY
OPERABLE UNIT NO. 10 (SITE 35)
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	Sediment Screening Values (SSVs)		Average Reference Station Background Concentration	Twice the Average Reference Station Concentration	Contaminant Frequency/Range		Comparison to Screening Values		No. of Times Exceeded Twice the Average Concentration
	ER-L	ER-M			No. of Positive Detects/No. of Samples	Range of Positive Detections	No. of Positive Detects Above ER-L	No. of Positive Detects Above ER-M	
Acetone	NE	NE	NE	NE	1/20	128J	NA	NA	NA
Toluene	NE	NE	NE	NE	1/20	8J	NA	NA	NA
Diethylphthalate	NE	NE	NE	NE	4/20	352J - 2,135J	NA	NA	NA
Di-n-butyl phthalate	NE	NE	NE	NE	1/20	218J	NA	NA	NA
Bis-(2-ethylhexyl)phthalate	NE	NE	NE	NE	3/20	469J - 704J	NA	NA	NA
beta-BHC	NE	NE	2.51	5.02	1/20	0.59J	NA	NA	0
delta-BHC	NE	NE	0.64*	1.28	2/20	0.92J - 1J	NA	NA	0
Heptachlor	NE	NE	1.18	2.36	2/20	0.91J - 2.3J	NA	NA	0
Heptachlor epoxide	NE	NE	ND	ND	7/20	0.43J - 1.4J	NA	NA	NA
Dieldrin	0.02	8	1.50*	3.0	7/20	1.4J - 52	7	2	3
4,4'-DDD	2	20	1.57	3.14	17/20	1.1J - 1,140	16	14	15
4,4'-DDT	1	7	2.20	4.40	15/20	0.66J - 46J	13	4	7
4,4'-DDE	2	15	2.42	4.84	17/20	1J - 1,200	15	14	15
Endrin	0	45	ND	ND	5/20	0.44J - 0.85J	5	0	NA
Endosulfan II	NE	NE	ND	ND	8/20	0.84J - 3.5J	NA	NA	NA
Methoxychlor	NE	NE	0.94*	1.88	6/20	0.49J - 3.4J	NA	NA	3
Endrin aldehyde	NE	NE	0.59*	1.18	5/20	1J - 7.6J	NA	NA	3
Endrin Ketone	NE	NE	ND	ND	2/20	2.8J - 3.1J	NA	NA	NA
alpha-Chlordane	0.5[(1)]	6[(1)]	1.20	2.40	10/20	0.51J - 13J	10	5	9
gamma-Chlordane	0.5[(1)]	6[(1)]	1.44	2.88	6/20	3.6 - 9.7	6	4	6

TABLE 6-7 (Continued)

SEDIMENT DATA SUMMARY
OPERABLE UNIT NO. 10 (SITE 35)
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	Sediment Screening Values (SSVs)		Average Reference Station Background Concentration	Twice the Average Reference Station Concentration	Contaminant Frequency/Range		Comparison to Screening Values		No. of Times Exceeded Twice the Average Concentration
	ER-L	ER-M			No. of Positive Detects/No. of Samples	Range of Positive Detections	No. of Positive Detects Above ER-L	No. of Positive Detects Above ER-M	
Aluminum	NE	NE	1,165.6	2,331.2	20/20	484 - 37,300	NA	NA	12
Arsenic	33	85	0.37	0.74	15/16	0.34J - 3.7J	0	0	11
Barium	NE	NE	6.46	12.9	20/20	2.4 - 129	NA	NA	13
Beryllium	NE	NE	0.09	0.18	4/14	0.27 - 1.1	NA	NA	4
Calcium	NE	NE	1,967.1	3,934.2	19/20	301J - 17,500J	NA	NA	12
Chromium	80	145	1.86	3.72	17/20	2.4 - 28.6	0	0	13
Cobalt	NE	NE	ND	ND	9/20	1.4 - 7.8	NA	NA	NA
Copper	70	390	0.75	1.50	16/20	3.4 - 24.8	0	0	16
Iron	NE	NE	433.7	867.4	20/20	1,050J - 15,900	NA	NA	20
Lead	35	110	0.79	1.58	18/18	4.7 - 15,100	9	2	18
Magnesium	NE	NE	45.25	90.5	20/20	88.1 - 3,830	NA	NA	19
Manganese	NE	NE	3.63	7.26	20/20	3.2J - 62.8	NA	NA	14
Mercury	0	1	0.14	0.28	1/1	0.07J	0	0	0
Nickel	30	50	ND	ND	12/20	2.1B - 13.6B	0	0	NA
Potassium	NE	NE	ND	ND	3/20	498 - 2,610	NA	NA	NA
Selenium	NE	NE	0.19	0.38	4/20	0.23J - 1.6J	NA	NA	1
Sodium	NE	NE	ND	ND	11/20	461 - 4,980	NA	NA	NA

TABLE 6-7 (Continued)

SEDIMENT DATA SUMMARY
OPERABLE UNIT NO. 10 (SITE 35)
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	Sediment Screening Values (SSVs)		Average Reference Station Background Concentration	Twice the Average Reference Station Concentration	Contaminant Frequency/Range		Comparison to Screening Values		No. of Times Exceeded Twice the Average Concentration
	ER-L	ER-M			No. of Positive Detects/No. of Samples	Range of Positive Detections	No. of Positive Detects Above ER-L	No. of Positive Detects Above ER-M	
Thallium	NE	NE	0.10	0.20	14/20	0.15 - 0.96	NA	NA	13
Vanadium	NE	NE	1.52	3.04	20/20	0.94J - 39.3	NA	NA	15
Zinc	120	270	0.11	10.22	3/3	60.4J - 104J	0	0	3

Notes: (1) Values for Total Chlordane.
Organic concentrations expressed in microgram per kilogram (µg/kg).
Inorganic concentrations expressed in milligram per kilogram (mg/kg).
NE - Not Established
NA - Not Applicable
J - Estimated value
* - Maximum Concentration
All rejected results have been removed from the data. Frequencies of detection are adjusted accordingly.

TABLE 6-8

ORGANIC AND INORGANIC FISH FILLET AND CRAB TISSUE DATA SUMMARY
OPERABLE UNIT NO. 10 (SITE 35)
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Range of Positive Detection	Frequency of Detection	Bioconcentration Factor (L/kg)	Contaminant Detected in Surface Water?	Contaminant Detected in Sediment?
ORGANICS (μg/kg)					
Methylene Chloride	26 - 16,317	6/18	0.9[1]	No	No
Acetone	58 - 372,323	11/18	NA	No	Yes
Carbon Disulfide	196 - 1,328	15/18	NA	No	No
2-Butanone	63 - 5108	2/18	NA	No	No
Toluene	24	1/18	26[2]	No	Yes
PESTICIDES/PCBS (μg/kg)					
beta-BHC	4.2 - 11	7/22	130[1]	No	Yes
gamma-BHC	2.1 - 5.5	6/22	130[1]	No	No
Heptachlor	2.6 - 4.3	3/22	11,200[1]	No	Yes
Aldrin	2.3 - 6.6	3/22	4,670[1]	No	No
Heptachlor Epoxide	3.9	1/22	11,200[1]	No	Yes
Dieldrin	4.3 - 48	18/22	4,670[1]	No	Yes
4,4'-DDE	39 - 572	22/22	53,600[1]	No	Yes
Endrin	2.5 - 52	9/22	3,970[1]	No	Yes
Endosulfan II	3.6 - 9.6	4/22	NA	No	Yes

TABLE 6-8 (Continued)

ORGANIC AND INORGANIC FISH FILLET AND CRAB TISSUE DATA SUMMARY
OPERABLE UNIT NO. 10 (SITE 35)
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Range of Positive Detection	Frequency of Detection	Bioconcentration Factor (L/kg)	Contaminant Detected in Surface Water?	Contaminant Detected in Sediment?
PESTICIDES/PCBS (µg/kg) (continued):					
4,4'-DDD	19 - 256	22/22	53,600(1)	No	Yes
4,4'-DDT	2.5 - 15	11/13	53,600(1)	No	Yes
Endrin Ketone	3.6 - 3.8	2/13	NA	No	Yes
Endrin Aldehyde	2.8 - 4	2/13	3,970(1)	No	Yes
alpha-Chlordane	3.6 - 38	9/13	14,100(1)*	No	Yes
INORGANICS (mg/kg)					
Aluminum	19.3 - 27.3	6/13	231(2)	Yes	Yes
Arsenic	1.4	1/13	44(1)	Yes	Yes
Barium	0.41 - 2.2	8/13	8(2)	Yes	Yes
Cadmium	0.16 - 0.8	5/13	64(1)	No	No
Calcium	676 - 13,300	12/13	NA	Yes	Yes
Chromium	3 - 4	2/22	16	Yes	Yes
Cobalt	6.9	1/13	40(2)	Yes	Yes
Copper	2.3 - 27.5	13/13	36(1)	No	Yes

TABLE 6-8 (Continued)

ORGANIC AND INORGANIC FISH FILLET AND CRAB TISSUE DATA SUMMARY
OPERABLE UNIT NO. 10 (SITE 35)
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Range of Positive Detection	Frequency of Detection	Bioconcentration Factor (L/kg)	Contaminant Detected in Surface Water?	Contaminant Detected in Sediment?
INORGANICS (mg/kg) (continued):					
Iron	20.4 - 48	8/13	NA	Yes	Yes
Lead	0.51 - 0.61	3/13	49[1]	Yes	Yes
Magnesium	833 - 1,550	13/13	NA	Yes	Yes
Manganese	1 - 3.1	10/13	35[2]	Yes	Yes
Mercury	0.3 - 0.98	4/4	5,500[1]	Yes	Yes
Potassium	9,180 - 19,000	13/13	NA	Yes	Yes
Selenium	0.72 - 0.8	2/13	6[1]	Yes	Yes
Silver	1 - 3.3	5/18	0.5	No	No
Sodium	1,970 - 21,900	13/13	NA	Yes	Yes
Vanadium	1.7	1/22	NA	Yes	Yes
Zinc	38 - 130	5/5	47[1]	Yes	Yes

* Value for Total Chlordane
(1) Region IV Water Quality Standards, 1992
(2) Region III, BTAG Screening Values
All rejected results have been removed from the data. Frequencies of detection are adjusted accordingly.

TABLE 6-9

SUMMARY OF COPCs IN ENVIRONMENTAL MEDIA OF CONCERN
OPERABLE UNIT NO. 10 (SITE 35)
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil		Subsurface Soil		Ground-water		Surface Water		Sediment		Fish	
VOCs												
Acetone				X						X	•	X
1,1,2,2-Tetrachloroethane						X						
Chloroform						X						
Methylene Chloride				X								X
1,1,2-Trichloroethane						X						
1,1-Dichloroethane						X						
1,1-Dichloroethene					•	X						
2-butanone												X
Benzene					•	X						
Carbon disulfide		X										X
cis-1,2-Dichloroethene					•	X						
Ethylbenzene					•	X						
Methyl Tertiary Butyl Ether					•	X						
Tetrachloroethane				X		X						
Toluene		X			•	X				X		X
trans-1,2-Dichloroethene					•	X						
Trichloroethene					•	X						
Xylenes (Total)		X			•	X						
SVOCs												
Benzo(a) pyrene		X										
Indeno(1,2,3-cd) pyrene		X										
Dibenz(a,h) anthracene		X										
Benzo(g.h,i) perylene	•	X										
4-Methylphenol						X						
2,4-Dimethylphenol						X						
Naphthalene					•	X						
Dibenzofuran					•	X						
Fluorene						X						
Anthracene						X						
Carbazole						X						
Diethylphthalate									•	X		
Di-n-butylphthalate										X		
Bis(2-ethylhexyl)phthalate		X								X		
Phenol		X				X						
2-Methylnaphthalene					•	X						

TABLE 6-9 (Continued)

SUMMARY OF COPCs IN ENVIRONMENTAL MEDIA OF CONCERN
OPERABLE UNIT NO. 10 (SITE 35)
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil		Subsurface Soil		Ground-water		Surface Water		Sediment		Fish	
2-Methylphenol						X						
Acenaphthene		X										
Phenanthene	•	X			•	X						
Carbazole		X										
Fluoranthene		X										
Pyrene		X		X								
Butylbenzlphthalate		X										
Benzo(a)anthracene		X										
Chrysene		X										
Benzo(b) fluoranthene	•	X	•	X								
Pesticides												
Aldrin						X						X
gamma-BHC												X
alpha-Chlordane		X							•	X	•	X
beta-BHC		X				X				X	•	X
Dieldrin	•	X							•	X	•	X
Endosulfan II	•	X							•	X	•	X
Endrin Ketone	•	X							•	X	•	X
Endrin Aldehyde	•	X							•	X	•	X
Endrin		X							•	X	•	X
delta-BHC					•	X				X		X
gamma-Chlordane		X							•	X		
Heptachlor					•	X				X	•	X
Heptachlor Epoxide									•	X		X
Methoxychlor									•	X		
4,4'-DDE		X							•	X	•	X
4,4'-DDT		X				X			•	X	•	X
4,4'-DDD	•	X				X			•	X	•	X
Inorganics												
Aluminum		X		X		X		X		X	•	X
Antimony		X			•	X	•	X				
Arsenic	•	X	•	X	•	X	•	X	•	X		
Barium		X		X	•	X		X	•	X	•	X
Beryllium		X			•	X			•	X		
Cadmium		X		X	•	X						X
Calcium		X		X		X		X		X		

TABLE 6-9 (Continued)

SUMMARY OF COPCs IN ENVIRONMENTAL MEDIA OF CONCERN
OPERABLE UNIT NO. 10 (SITE 35)
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil		Subsurface Soil		Ground-water		Surface Water		Sediment		Fish	
Chromium		X		X	•	X	•	X	•	X		
Cobalt		X		X	•	X	•	X	•	X		
Copper		X		X		X			•	X	•	X
Lead	•	X	•	X	•	X	•	X	•	X	•	X
Magnesium		X		X		X		X		X		
Manganese	•	X		X	•	X	•	X	•	X	•	X
Mercury						X	•	X		X	•	X
Nickel		X		X	•	X			•	X		
Potassium				X		X		X		X		
Selenium		X		X		X		X	•	X	•	X
Silver				X	•	X						
Sodium						X		X		X		
Thallium		X	•	X	•	X	•	X	•	X		
Vanadium		X		X	•	X	•	X	•	X		
Zinc		X		X	•	X	•	X	•	X	•	X
Iron		X		X		X		X		X		

• = Selected as COPC
X = Positively detected in media

TABLE 6-10

MATRIX OF POTENTIAL HUMAN EXPOSURE
OPERABLE UNIT NO. 10 (SITE 35)
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Exposure Medium/ Exposure Route	Current Military Personnel	Future Construction Worker	Future Residential Adult & Child	Current Recreational Adult & Child
Soil				
Incidental Ingestion	M	W	A, C	NE
Dermal Contact	M	W	A, C	NE
Groundwater				NE
Ingestion	NE	NE	A, C	NE
Dermal Contact	NE	NE	A, C	NE
Surface Water				
Ingestion	NE	NE	NE	A, C
Dermal Contact	NE	NE	NE	A, C
Sediment				
Incidental Ingestion	NE	NE	NE	A, C
Dermal Contact	NE	NE	NE	A, C
Air				
Inhalation of Vapor Phase Chemicals Indoor	NE	NE	A, C	NE
Inhalation of Particulates Outdoor	M	W	A, C	NE
Biota				
Fish Ingestion	NE	NE	NE	A

A = Adult
C = Child
M = Military lifetime exposure
W = Construction duration exposure
NE = Not Exposed

TABLE 6-11

EXPOSURE ASSESSMENT SUMMARY
INCIDENTAL INGESTION OF SOIL CONTAMINANTS
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Future Residential Child and Adult, Current Military Personnel, Future Construction Worker				
Input Parameter	Description	Value		Reference
C	Exposure Concentration	95% UCL	(mg/kg)	USEPA, May 1992d
IR	Ingestion Rate	Child Adult Military Personnel Construction Worker	200 mg/day 100 mg/day 100 mg/day 480 mg/day	USEPA, December 1989a USEPA, March 1991
CF	Conversion Factor	1E-6 kg/mg		USEPA, December 1989a
Fi	Fraction Ingested from Contaminated Source	100%		Conservative Professional Judgement
EF	Exposure Frequency	Child Adult Military Personnel Construction Worker	350 days/yr 350 days/yr 350 days/yr 90 days/yr	USEPA, December 1989a USEPA, March 1991
ED	Exposure Duration	Child Adult Military Personnel Construction Worker	6 years 24 years 4 years 1 year	USEPA, March 1991 USEPA, December 1989a
BW	Body Weight	Child Adult Military Personnel Construction Worker	15 kg 70 kg 70 kg 70 kg	USEPA, December 1989a
AT_c	Averaging Time Carcinogen	All	25,550 days	USEPA, December 1989a
AT_{nc}	Averaging Time Noncarcinogen	Child Adult Military Personnel Construction Worker	2,190 days 8,760 days 1,460 days 365 days	USEPA, December 1989a

TABLE 6-12

EXPOSURE ASSESSMENT SUMMARY
DERMAL CONTACT WITH SOIL CONTAMINANTS
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Future Residential Child and Adult, Current Military Personnel, Future Construction Worker			
Input Parameter	Description	Value	Reference
C	Exposure Concentration	95% UCL (mg/kg)	USEPA, May 1992d
CF	Conversion Factor	1E-6 kg/mg	USEPA, December 1989a
SA	Exposed Surface Area of Skin Available for Contact	Child 2,300 cm^2 Adult 5,800 cm^2 Military Personnel 5,800 cm^2 Construction Worker 4,300 cm^2	USEPA, January 1992a Reasonable worst case: individual skin area limited to head, hands, forearms, lower legs
AF	Soil-to-Skin Adherence Factor	1.0 mg/cm^2	USEPA, Region IV, 1992c
ABS	Fraction Absorped (unitless)	Organics 1.0% Inorganics 0.1%	USEPA, Region IV, 1992c
EF	Exposure Frequency	Child 350 days/yr Adult 350 days/yr Military Personnel 350 days/yr Construction Worker 90 days/yr	USEPA, December 1989a USEPA, March 1991
ED	Exposure Duration	Child 6 years Adult 24 years Military Personnel 4 years Construction Worker 1 year	USEPA, March 1991 USEPA, December 1989a
BW	Body Weight	Child 15 kg Adult 70 kg Military Personnel 70 kg Construction Worker 70 kg	USEPA, December 1989a
AT_c	Averaging Time Carcinogen	All 25,550 days	USEPA, December 1989a
AT_{nc}	Averaging Time Noncarcinogen	Child 2,190 days Adult 8,760 days Military Personnel 1,460 days Construction Worker 365 days	USEPA, December 1989a

TABLE 6-13

EXPOSURE ASSESSMENT SUMMARY
INHALATION OF FUGITIVE PARTICULATES
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Future Residential Child and Adult, Current Military Personnel, Construction Worker			
Input Parameter	Description	Value	Reference
C	Exposure Concentration	95% UCL (mg/kg)	USEPA, May 1992d
EF	Exposure Frequency	Child 350 days/yr Adult 350 days/yr Military Personnel 350 days/yr Construction Worker 90 days/yr	USEPA, December 1989a
ED	Exposure Duration	Child 6 years Adult 24 years Military Personnel 4 years Construction Worker 1 year	USEPA, March 1991
IR	Inhalation Rate	Child 10 m^3 Adult 20 m^3 Military Personnel 20 m^3 Construction Worker 20 m^3	USEPA, March 1991 USEPA, May 1989b
BW	Body Weight	Child 15 kg Adult 70 kg Military Personnel 70 kg Construction Worker 70 kg	USEPA, December 1989a
AT_c	Averaging Time Carcinogen	All 25,550 days	USEPA, December 1989a
AT_{nc}	Averaging Time Noncarcinogens	Child 2,190 days Adult 8,760 days Military Personnel 1,460 days Construction Worker 365 days	USEPA, December 1989a
PEF	Site-Specific Particulate Emission Factor	4.63E09 m^3/kg	Cowherd, USEPA, December 1989a

TABLE 6-14

EXPOSURE ASSESSMENT SUMMARY
INGESTION OF GROUNDWATER CONTAMINANTS
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Future Residential Child and Adult				
Input Parameter	Description	Value		Reference
C	Exposure Concentration	95% UCL	(mg/L)	USEPA, May 1992d
IR	Ingestion Rate	Child Adult	1 L/day 2 L/day	USEPA, March 1991 USEPA, December 1989a
EF	Exposure Frequency	Child Adult	350 days/yr 350 days/yr	USEPA, December 1989a
ED	Exposure Duration	Child Adult	6 years 30 years	USEPA, March 1991
BW	Body Weight	Child Adult	15 kg 70 kg	USEPA, December 1989a
AT_c	Averaging Time Carcinogen	All	25,550 days	USEPA, December 1989a
AT_{nc}	Averaging Time Noncarcinogen	Child Adult	2,190 days 10,950 days	USEPA, December 1989a

TABLE 6-15

EXPOSURE ASSESSMENT SUMMARY
DERMAL CONTACT WITH GROUNDWATER CONTAMINANTS
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Future Residential Child and Adult			
Input Parameter	Description	Value	Reference
C	Exposure Concentration	95% UCL (mg/L)	USEPA, May 1992d
SA	Exposed Surface Area of Skin Available for Contact	Child 10,000 cm^2 Adult 23,000 cm^2	USEPA, January 1992a
PC	Permeability Constant	Chemical Specific	USEPA, January 1992a
ET	Exposure Time	All 0.25 hr/day	USEPA, January 1992a
EF	Exposure Frequency	Child 350 days/yr Adult 350 days/yr	USEPA, March 1991
ED	Exposure Duration	Child 6 years Adult 30 years	USEPA, December 1989a
CF	Conversion Factor	1 L/1000 cm^3	USEPA, December 1989a
BW	Body Weight	Child 15 kg Adult 70 kg	USEPA, December 1989a
AT_c	Averaging Time Carcinogen	All 25,550 days	USEPA, December 1989a
AT_{nc}	Averaging Time Noncarcinogen	Child 2,190 days Adult 10,950 days	USEPA, December 1989a

TABLE 6-16

EXPOSURE ASSESSMENT SUMMARY
INHALATION OF GROUNDWATER VOLATILE CONTAMINANTS
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Input Parameter	Description	Value		Reference
Future Residential Child and Adult				
C	Exposure Concentration	95% UCL	(mg/m^3)	USEPA, May 1992d
IR	Inhalation Rate	Child Adult	0.6 m^3/hr 0.6 m^3/hr	USEPA, December 1989a
ET	Exposure Time	All	0.25 hr/day	USEPA, January 1992a
EF	Exposure Frequency	All	350 day/yr	USEPA, December 1989a
ED	Exposure Duration	Child Adult	6 years 30 years	USEPA, December 1989a
BW	Body Weight	Child Adult	15 kg 70 kg	USEPA, December 1989a
AT_c	Averaging Time Carcinogen	All	25,550 days	USEPA, December 1989a
AT_{nc}	Averaging Time Noncarcinogens	Child Adult	2,190 days 10,950 days	USEPA, December 1989a

TABLE 6-17

EXPOSURE ASSESSMENT SUMMARY
INGESTION OF SURFACE WATER
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Current Recreational Child and Adult			
Input Parameter	Description	Value	Reference
C	Exposure Concentration	95% UCL (mg/L)	USEPA, May 1992d
IR	Ingestion Rate	Child 0.05 L/hr Adult 0.05 L/hr	USEPA, December 1989a
EF	Exposure Frequency	Child 20 events/yr Adult 20 events/yr	Site-Specific Professional Judgement (4 days/month x 5 months/year)
ED	Exposure Duration	Child 6 years Adult 30 years	USEPA, December 1989a
BW	Body Weight	Child 15 kg Adult 70 kg	USEPA, December 1989a
AT_c	Averaging Time Carcinogen	All 25,550 days	USEPA, December 1989a
AT_{nc}	Averaging Time Noncarcinogens	Child 2,190 days Adult 10,950 days	USEPA, December 1989a

TABLE 6-18

EXPOSURE ASSESSMENT SUMMARY
DERMAL CONTACT WITH SURFACE WATER
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Current Recreational Child and Adult			
Input Parameter	Description	Value	Reference
C	Exposure Concentration	95% UCL (mg/L)	USEPA, May 1992d
SA	Exposed Surface Area of Skin Available for Contact	Child 4,600 cm^2 Adult 11,500 cm^2	50 percent whole body (head, arms, hands, forearms, lower extremities)
ET	Exposure Time	Child 2.6 hr/day Adult 2.6 hr/day	USEPA, January 1992a
EF	Exposure Frequency	Child 20 days/yr Adult 20 days/yr	Site-Specific Professional Judgement (4 days/month x 5 months/year)
ED	Exposure Duration	Child 6 years Adult 30 years	USEPA, December 1989a
CF	Volumetric Conversion Factor for Water	1 L/1000 cm^3	USEPA, December 1989a
BW	Body Weight	Child 15 kg Adult 70 kg	USEPA, December 1989a
AT_c	Averaging Time Carcinogen	All 25,550 days	USEPA, December 1989a
AT_{nc}	Averaging Time Noncarcinogen	Child 2,190 days Adult 10,950 days	USEPA, December 1989a
PC	Permeability Constant	Chemical-Specific	USEPA, January 1992a

TABLE 6-19

EXPOSURE ASSESSMENT SUMMARY
INGESTION OF SEDIMENT
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Current Recreational Child and Adult			
Input Parameter	Description	Value	Reference
C	Exposure Concentration	95% UCL (mg/kg)	USEPA, May 1992d
IR	Soil Ingestion Rate	Child 100 mg/day Adult 100 mg/day	USEPA, December 1989a
EF	Exposure Frequency	Child 20 days/yr Adult 20 days/yr	Site-Specific Professional Judgement (4 days/month x 5 months/year)
ED	Exposure Duration	Child 6 years Adult 30 years	USEPA, December 1989a
BW	Body Weight	Child 15 kg Adult 70 kg	USEPA, December 1989a
AT_c	Averaging Time Carcinogen	All 25,550 days	USEPA, December 1989a
AT_{nc}	Averaging Time Noncarcinogen	Child 2,190 days Adult 10,950 days	USEPA, December 1989a
CF	Conversion Factor	1E-06 kg/mg	USEPA, December 1989a

TABLE 6-20

EXPOSURE ASSESSMENT SUMMARY
DERMAL CONTACT WITH SEDIMENT
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Current Recreational Child and Adult			
Input Parameter	Description	Value	Reference
C	Exposure Concentration	95% UCL (mg/kg)	USEPA, May 1992d
SA	Surface Area of Skin Available for Contact	Child 4,600 cm^2 Adult 11,500 cm^2	50 percent whole body (head, arms, hands, forearms, lower extremities) USEPA, January 1992a
AF	Sediment Adherence Factor	1.0 mg/cm^2	USEPA, Region IV, 1992c
ABS	Absorption Factor (dimensionless)	Organics 1.0% Inorganics 0.1%	USEPA, Region IV, 1992c
EF	Exposure Frequency	Child 20 events/yr Adult 20 events/yr	Site-Specific Professional Judgement (4 days/month x 5 months/year)
ED	Exposure Duration	Child 6 years Adults 30 years	USEPA, December 1989a
BW	Body Weight	Child 15 kg Adult 70 kg	USEPA, December 1989a
AT_c	Averaging Time Carcinogen	All 70 years	USEPA, December 1989a
AT_{nc}	Averaging Time Noncarcinogen	Child 6 years Adult 30 years	USEPA, December 1989a
CF	Conversion Factor	1E-06 kg/mg	USEPA, December 1989a

TABLE 6-21

EXPOSURE ASSESSMENT SUMMARY
FISH FILLET INGESTION
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Current Recreational Adult			
Input Parameter	Description	Value	Reference
C	Exposure Concentration	95% UCL (mg/kg)	USEPA, May 1992d
IR	Ingestion Rate	0.145 kg/meal	USEPA, 1993b
Fi	Fraction Ingested from Contaminated Source	1.0	90th Percentile Consumption Rate
EF	Exposure Frequency	48 meal/year	USEPA, December 1989a
ED	Exposure Duration	9 years	USEPA, 1993b
BW	Body Weight	70 kg	USEPA, December 1989a
AT_c	Averaging Time Carcinogen	25,550 days	USEPA, December 1989a
AT_{nc}	Averaging Time Noncarcinogen	10,950 days	USEPA, December 1989a

TABLE 6-22

TOXICITY FACTORS
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

	RfD	RfC	CSF	CSFI	WOE	Reference
Volatiles:						
Benzene	3.0E-04	1.7E-03	2.9E-02	2.9E-02	A	EPA/ECAO
cis-1,2-Dichloroethene	1.0E-02	--	--	--	--	IRIS, 1994
Tetrachloroethene	1.0E-02	ND	5.2E-02	2.0E-03	--	IRIS, 1994; USEPA, 1992b
1,1-Dichloroethene	9.0E-03	--	6.0E-01	1.75E-01	C	IRIS,1994
Toluene	2.0E-01	4.0E-01	--	--	D	IRIS, 1994
trans-1,2-Dichloroethene	2.0E-02	--	--	--	--	
Trichloroethene	6E-03	PDG	1.1E-02	6.0E-03	B2	IRIS, 1994; USEPA 1992b
Xylenes (total)	2.0E+00	PDG	--	--	D	IRIS, 1994
Acetone	1.00E-1	--	--	--	--	IRIS, 1994
Ethylbenzene	1.0E-1	2.9E-01	--	--	F	IRIS, 1994
Methyl Tertiary Butyl Ether	5.0E-03	8.6E-01	--	--	D	IRIS, 1994, EPA/ECAO
Semivolatiles:						
Benzo(b)fluoranthene	--	--	7.30E-01	6.10E-01	B2	IRIS, 1994
Diethylphthalate	8.0E-01	--	--	--	--	IRIS, 1994
Dibenzofuran	4.0E-03	--	--	--	--	EPA/ECAO
Pesticides/PCBs:						
4,4'-DDD	ND	ND	2.4E-01	--	B2	IRIS, 1994
4,4'-DDE	ND	ND	3.4E-01	--	B2	IRIS, 1994
4,4'-DDT	5.0E-04	ND	3.4E-01	3.4E-01	B2	IRIS, 1994
Dieldrin	5.0E-05	--	1.6E+01	1.6E+01	B2	IRIS, 1994
Heptachlor	5.0E-05	--	4.5E+00	4.55E+00	B2	IRIS, 1994
Heptachlor Epoxide	5.0E-05	ND	4.5E+00	9.1E+00	B2	IRIS, 1994
Endrin	5.0E-04	--	--	--	D	IRIS, 1994
Methoxychlor	5.0E-03	--	--	--	D	IRIS, 1994
Total Chlordane	6.0E-05	UR	1.3E+00	1.3E+00	B2	IRIS, 1994
beta-BHC	--	--	1.8E+00	1.8E+00	--	IRIS, 1994
Inorganics:						
Arsenic	3.0E-04	ND	1.7E+00	1.5E+01	A_I	IRIS, 1994
Antimony	4.0E-04	--	--	--	--	
Barium	7.0E-02	--	--	--	--	IRIS, 1994
Beryllium	5.0E-03	ND	4.3E+00	8.4E+00	B2	IRIS, 1994
Cadmium	5.0E-04	PDG	--	6.3E+00	B1	IRIS, 1994
Chromium	5.0E-03	--	--	--	--	IRIS, 1994
Cobalt	6.0E-02	--	--	--	--	
Copper	3.7E-02	--	--	--	D	
Manganese	5.0E-03	1.4E-05	--	--	D	IRIS, 1994
Mercury	3.0E-04	8.6E-05	--	--	D	HEAST, 1994
Nickel	2.0E-02	PDG	--	--	--	IRIS, 1994
Selenium	5.0E-03	ND	--	--	D	IRIS, 1994
Vanadium	7.0E-03	--	--	--	--	HEAST, 1994
Zinc	3.0E-01	--	--	--	D	IRIS, 1994

TABLE 6-22 (Continued)

TOXICITY FACTORS
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Notes:	RfD	Oral Reference Dose (mg/kg - day)
	RfC	Inhalation Reference Concentration $(mg/kg\text{-}day)^{-1}$
	CSF	Oral Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$
	CSFI	Inhalation Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$
	WOE	Weight of Evidence
	IRIS	Integrated Risk Information System
	HEAST	Health Effects Assessment Summary Tables
	USEPA	United States Environmental Protection Agency
	ND	Not Determined
	PDG	Pending
	WOE	Weight of Evidence
	PDG	Pending
	UR	Under Review by USEPA
	A	Human Carcinogen
	B1	Probable Human Carcinogen - Limited Evidence
	B2	Probable Human Carcinogen - Sufficient Evidence
	C	Possible Human Carcinogen
	D	Not Classifiable as to Human Carcinogenicity
	I	Ingestion

TABLE 6-23

INCREMENTAL LIFETIME CANCER RISKS (ICRs) AND HAZARD INDICES (HIs)
OPERABLE UNIT NO. 10 (SITE 35)
SOIL
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Exposure Route	Receptor Group							
	Future Residential Child		Future Residential Adult		Current Military Personnel		Future Construction Worker	
	ICR	HI	ICR	HI	ICR	HI	ICR	HI
Incidental Ingestion	4.0E-05	0.91	1.71E-05	0.10	2.9E-06	0.09	1.2E-07	0.02
Dermal Contact	4.6E-06	0.02	9.9E-06	<0.01	1.7E-07	<0.01	1.1E-09	<0.01
Inhalation of Particulates	3.3E-09	5.5E-15	5.6E-09	9.5E-15	9.3E-10	2.8E-14	8.9×10^{-12}	NA
Total	4.5E-05	0.93	2.7E-05	0.10	3.1E-06	0.09	1.2E-07	0.02

NA - Not Applicable

TABLE 6-24

INCREMENTAL LIFETIME CANCER RISKS (ICRs) AND HAZARD INDICES (HIs)
OPERABLE UNIT NO. 10 (SITE 35)
GROUNDWATER
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Exposure Route	Receptor Group			
	Future Residential Child		Future Residential Adult	
	ICR	HI	ICR	HI
Ingestion	2.0E-03	101	4.3E-03	43
Dermal Contact	1.1E-04	2.1	2.0E-05	1.0
Inhalation of Vapors	1.0E-05	<0.01	2.3E-05	<0.01
Total	2.1E-03	103	4.3E-03	44

TABLE 6-25

INCREMENTAL LIFETIME CANCER RISKS (ICRs) AND HAZARD INDICES (HIs)
OPERABLE UNIT NO. 10 (SITE 35)
SURFACE WATER
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Exposure Route	Receptor Group			
	Current Recreational Child		Current Recreational Adult	
	ICR	HI	ICR	HI
Ingestion	1.1E-07	<0.01	1.1E-07	<0.01
Dermal Contact	3.2E-09	<0.01	8.6E-09	<0.01
Total	1.1E-07	<0.01	1.2E-07	<0.01

TABLE 6-26

INCREMENTAL LIFETIME CANCER RISKS (ICRs) AND HAZARD INDICES (HIs)
OPERABLE UNIT NO. 10 (SITE 35)
SEDIMENT
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Exposure Route	Receptor Group			
	Current Recreatoinal Child		Current Recreational Adult	
	ICR	HI	ICR	HI
Ingestion	2.3E-07	0.01	2.4E-07	<0.01
Dermal Contact	1.0E-07	<0.01	2.1E-07	<0.01
Total	3.3E-07	0.01	4.5E-07	<0.01

TABLE 6-27

INCREMENTAL LIFETIME CANCER RISKS (ICRs) AND HAZARD INDICES (HIs)
OPERABLE UNIT NO. 10 (SITE 35)
FISH
REMEDIAL INVESTIGATION, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

	Current Recreational Adult	
Exposure Route	ICR	HI
Ingestion	1.8E-05	1.8
Total	1.8E-05	1.8

TABLE 6-28

TOTAL SITE RISK
OPERABLE UNIT NO. 10 (SITE 35)
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Receptors	Soil		Groundwater		Surface Water		Sediment		Fish		TOTALS	
	ICR	HI	ICR	HI	ICR	HI	ICR	HI	ICR	HI	ICR	HI
Future Child Resident	4.5E-05 (<1)	0.93 (1)	2.1E-03 (99)	103 (99)	NA	NA	NA	NA	NA	NA	2.1E-03	104
Future Adult Resident	2.7E-05 (<1)	0.10 (<1)	4.3E-03 (99)	44 (99)	NA	NA	NA	NA	NA	NA	4.3E-03	44
Future Construction Worker	1.2E-07 (100)	0.02 (100)	NA	NA	NA	NA	NA	NA	NA	NA	1.2E-07	0.02
Current Military Personnel	3.1E-06 (100)	0.09 (100)	NA	NA	NA	NA	NA	NA	NA	NA	3.1E-06	0.09
Current Recreational Child	NA	NA	NA	NA	1.1E-07 (27)	<0.01 (<1)	3.3E-07 (73)	0.01 (99)	NA	NA	4.4E-07	0.01
Current Recreational Adult	NA	NA	NA	NA	1.2E-07 (<1)	<0.01 (<1)	4.5E-07 (<1)	<0.01 (<1)	1.8E-05 (99)	1.8 (99)	1.9E-05	1.8

Notes: ICR = Incremental Lifetime Cancer Risk
HI = Hazard Index
ND = Not Determined
NA = Not Applicable
( ) = Percent Contribution to Total Risk

8.0 CONCLUSIONS AND RECOMMENDATIONS

This section presents conclusions based on the information presented in Sections 1.0 through 7.0 and outlines recommendations for follow-up actions, as deemed appropriate, to fill informational gaps and provide a sound engineering basis for the development of remedial responses.

8.1 Conclusions

- VOCs were detected in surface soil samples 35-SS05-00, 35-SS13-00 and 35-SS07-00. Sample 35-SS05-00 contained low concentrations of toluene, sample 35-SS07-00 contained carbon disulfide and sample 35-SS13-00 contained detectable levels of total xylenes.

- SVOCs were detected in surface soil samples collected within the study area. Contamination detected in samples 35-SS11-00 and 35-SS04-00 may be related to past activities associated with the Fuel Farm or the oil/water separator located near the ASTs.

- Tetrachloroethene was the only VOC detected in the subsurface soils that could be attributed to site conditions. It was detected in four borings (35-MW37BM, 35-MW30B, 35-MW32B and 35-MW33B) drilled south of Fourth Street. The contamination may be attributed to contaminants residing in the groundwater beneath the site.

- Sample 35-MW35B was the only subsurface soil sample containing SVOC contamination. A source for the SVOC contamination detected in sample 35-MW35B is neither obvious nor suspected in the vicinity of the soil boring.

- Inorganic levels in surface and subsurface soil were similar to base-wide inorganic levels. Surface soil samples 35-SS04-00 and 35-SS13-00 as well as subsurface soil sample 35-GWDS05-03 exhibited inorganics at levels higher than two times the base background average or the maximum base background detection. One of two reasons may be responsible for these apparent results. The elevated concentrations may be due to past activities at Building TC474 (formerly a vehicle maintenance garage) or simply outside the estimated range of base background. The number of samples used to establish a background range for inorganics is small, therefore may not be completely representative of background conditions.

BTEX compounds were detected in nearly every well that was sampled during the RI. However, the only compounds detected at the site which exhibited concentrations above groundwater standards were benzene and ethylbenzene. The wells containing the highest levels of benzene are concentrated in the areas where petroleum leaks or spills were suspected to have occurred. Monitoring wells MW-16, MW-22 and EMW-7 contained concentrations of benzene which exceeded the federal MCL and NCWQS. Ethylbenzene concentrations in MW-16 and MW-22 exceeded the NCWQS standard, but did not exceed the federal MCL. The following paragraphs describe the four plumes of nonhalogenated organics observed in the surficial.

flow, it is likely that the contamination may be attributed to the storage of chemicals within this area. However, not enough data exists at this time to determine the true origin of this contamination.

- Well 35MW-32A exhibited elevated concentrations of TCE and cis-1,2-DCE exceeding the Federal MCL and the NCWQS. The well is located east of warehouse TC462. Enough data has not been gathered to determine the source area for these contaminants.

- Semivolatile compounds were detected in monitoring wells MW-21, EMW-05, MW-29A, MW-16, and MW-22. These compounds appear to be related to petroleum contamination and correlate with the previously identified plumes.

- The only pesticide detected in the shallow groundwater which exceeded the NCWQS was heptachlor. It was detected in MW-29A with no apparent source for the contaminant. The concentration is low enough to indicate that it may have originated from the application of pest controls to the surface soils.

- Inorganic contamination was detected within the upper portion of the water table aquifer throughout the site. Since the distribution of the contaminants does not reflect a particular trend or pattern, it is difficult to assess the entire extent of metals contamination and identify specific source areas. The data suggests that the elevated total metals are due to suspended particulates in the sample.

- Nonhalogenated organic contamination (e.g., BTEX) was detected at low levels in the lower portion of the water table aquifer in nearly every intermediate well location. However, the concentrations of the contaminants detected were much lower than the concentrations detected in the upper portion of the aquifer. This trend complies with the properties of the compounds (i.e., specific gravity). The only exception to the trend is MTBE. The concentration of MTBE increased in the lower portion of the aquifer rather than decreased. A reason for this exception cannot be determined at this time and may require more information to formulate an explanation.

The primary nonhalogenated organic compounds that were detected at levels exceeding the Federal MCL and/or NCWQS were benzene, ethylbenzene and MTBE. Two primary plumes of nonhalogenated compounds were identified within the study area.

- The first to be discussed is located in the western, southwestern and southern portions of the site. The highest concentrations were centered around MW-10D. Benzene was not detected in this well but ethylbenzene and MTBE were detected at concentrations which exceeded the NCWQS. The surrounding wells (MW-09D, 35MW-31B, 35MW-32B, 35MW-30B, 35MW-29B and 35MW-37B) contained benzene at concentrations which exceeded the NCWQS. Three of the wells possessed concentrations which exceeded the federal MCL.

- The second plume is located in the eastern portion of the study area. Monitoring wells MW-19D, MW-22D and 35MW-33B contain concentrations of benzene, ethylbenzene and MTBE in excess of Federal and state groundwater standards.

flow, it is likely that the contamination may be attributed to the storage of chemicals within this area. However, not enough data exists at this time to determine the true origin of this contamination.

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The primary nonhalogenated organic compounds that were detected at levels exceeding the Federal MCL and/or NCWQS were benzene, ethylbenzene and MTBE. Two primary plumes of nonhalogenated compounds were identified within the study area.

- The first to be discussed is located in the western, southwestern and southern portions of the site. The highest concentrations were centered around MW-10D. Benzene was not detected in this well but ethylbenzene and MTBE were detected at concentrations which exceeded the NCWQS. The surrounding wells (MW-09D, 35MW-31B, 35MW-32B, 35MW-30B, 35MW-29B and 35MW-37B) contained benzene at concentrations which exceeded the NCWQS. Three of the wells possessed concentrations which exceeded the federal MCL.

- The second plume is located in the eastern portion of the study area. Monitoring wells MW-19D, MW-22D and 35MW-33B contain concentrations of benzene, ethylbenzene and MTBE in excess of Federal and state groundwater standards.

During Law's investigation of the site, samples were collected from monitoring well MW-19D and MW-22D. Results from the samples indicate that greater concentrations of total BTEX resided within monitoring well MW-22D than was detected by Baker and no BTEX compounds were detected in MW-19D. This information lends credibility to the theory that dissolved nonhalogenated contamination in this area of the study area is migrating with the direction of groundwater flow toward Brinson Creek.

In addition to nonhalogenated compounds, halogenated organics such as TCE, cis-1,2-DCE and trans-1,2-DCE were detected in 10 intermediate wells within the study area. The concentrations of the halogenated organics contamination is greater in the lower portion of the aquifer than the upper portion of the aquifer. This trend is typical when halogenated hydrocarbons, such as those listed previously are identified within an aquifer system. Due to the compounds specific gravity, it is common for higher concentrations of the compound to reside within the deeper portions of the aquifer. The following paragraphs discuss the nonhalogenated oganic plumes in the lower portion of the surficial aquifer.

- Two plumes of halogenated organics have been identified at the site. The first of the two plumes is located in the area of the former Vehicle Maintenance Garage (warehouse TC474) in the eastern portion of the study area. The highest concentrations of TCE were detected in wells MW-19D and 35MW-33B. TCE, cis-1,2-DCE and trans-1,2-DCE concentrations exceeded the federal MCL and NCWQS. These concentrations correlate well to the corresponding shallow wells. The concentrations detected in MW-19D are similar to the concentrations detected by Law in their previous investigation. Based on the concentrations detected in the shallow and intermediate wells, the former Vehicle Maintenance Garage is the suspected source for the halogenated organic contamination is this portion of the study area.

- A larger plume of halogenated organics originates on the southern edge of the study area trending northeast toward Brinson Creek. Elevated TCE concentrations exceeding the Federal MCL and the NCWQS were detected in monitoring wells 35MW-30B, 35MW-32B, 35MW-29B, MW-10D, MW-09D, MW-14D and MW-21D. The highest TCE concentration was detected in MW-10D, however this does not appear to be the source area for the contamination. The southern and northeastern edge of the plume is not defined and it is Baker's belief that the contamination source is located outside of the boundaries of the study area.

- No semivolatiles were detected in the lower portion of the shallow aquifer.

- Heptachlor was detected in monitoring well 35MW-33B at a concentration that exceeded the NCWQS. The source of this contamination is unknown.

- Inorganic contamination was detected within the lower portion of the water table aquifer. In comparison to the upper portion of the aquifer, inorganic concentrations were generally lower in the lower portion of the aquifer. Since the distribution of the contaminants do not reflect a particular trend or pattern, it is difficult to assess the entire extent of metals contamination and identify specific source areas. The data suggests that suspended solids in the sample may be contributing to elevated total metals.

- No significant organic or inorganic contamination was detected in the samples collected from the deep wells (Figure 4-10). The absence of TCE in the Castle Hayne Aquifer indicates that the unit identified as a semi-confining unit is retarding the vertical migration of the contaminates. Although the unit possesses very little clay and is not the "typical" semi-confining unit, the high permeability of the soils above and below the unit as well as the groundwater gradient exhibited at the site provide for the surficial aquifer waters to flow along the top of the unit instead of passing through the unit. Vertical migration may be occurring at the site but at a very slow rate such that the contamination has not been detected in the upper portion of the Castle Hayne Aquifer.

- No VOCs were detected in surface water samples. Toluene was the only volatile organic compound detected in the sediments obtained from station 35-SW/SD03 within Brinson Creek (Figure 4-11). Although VOCs generally were not detected, heavy sheens and hydrocarbon odors were noted during sampling. During sample validation, it was noted that an unusually high number of Tentatively Identified Compounds (TICs) were identified in the samples.

- Although no SVOCs were detected in the surface water samples, a number of SVOCs were detected in the sediment samples collected from Brinson Creek. The SVOCs were detected in greater frequency in the samples collected from 6 to 12 inches. SVOCs were detected both upgradient and downgradient of Site 35. However, the highest levels of SVOCs were detected in samples obtained adjacent to Site 35.

- Pesticides were detected at all 10 sediment sample locations; however, no pesticides were observed in the surface water samples. The application of pest control to the surfaces Camp Geiger leads to pesticide detections in the sediments of Brinson Creek. The pesticides are carried from the surface soil to the creek via surface runoff and natural erosion. This statement can be further supported by the large number of pesticides detected in the surface soils at the site. PCBs were not detected in any of the surfaced water or sediment samples collected from Brinson Creek.

- Inorganics above the Federal Screening Values (WQSVs and NOAA standards) and/or NCWQS are present in one surface water and seven sediment locations. The only compound to exceed the NOAA standards in sediments was lead. The greatest concentration was detected in sample number 36-SD06-06 collected from the 0 to 6 inch interval. The detected lead is prevalent adjacent to and downstream of Site 35 and could be related to past site activities. Mercury, lead and zinc were detected at levels exceeding the Federal and North Carolina Standards in surface water samples 35-SW01, 35-SW04 and 35-SW07. The mercury was detected in two samples (35-SW01 and 35-SW04) located upstream of Site 35 which indicates contamination may originate from an upgradient location. The concentrations of lead and zinc detected in sample 35-SW07 may be attributed to past practices at

Site 35 due to its geographic location with respect to Site measurements of groundwater.

- Baker calculated that the human health risk associated with pesticides dieldrin and DDD in surface soil samples demonstrates a risk range within acceptable levels.

- Baker calculated that the overall human health risk associated with Site 35 is in excess of the acceptable range. The total risk was driven by future potential exposure to groundwater and current potential exposure to fish. However, only noncarcinogenic risks were likely with exposure to fish.

- Overall, metals and pesticides appear to be the most significant site related COPCs that have the potential to affect the integrity of the aquatic and terrestrial receptors at Site 35. Although the American alligator have been observed at Site 35, potential adverse impacts to this species could not be quantitatively evaluated.

- Surface water quality showed exceedances of aquatic reference values for lead, mercury, and zinc. In addition, iron, cobalt and manganese were above the concentration that caused adverse impacts to aquatic species in a few studies. However, most of the studies did not meet the criteria for reliability, and other studies indicated that potential impacts to aquatic organisms did not occur at the concentrations detected in the surface water at Brinson Creek. For sediments, concentrations of lead and the organics dieldrin, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endrin, alpha-chlordane, and gamma-chlordane exceeded the aquatic reference values. In the surface water, mercury exceeded aquatic reference values in the upstream stations. Although these levels were indicative of a high potential for risk (QI > 100), mercury is not believed to be site related. Zinc only exceeded unity slightly and was only found at a single station. Lead has a single exceedance of the aquatic reference value by slightly greater than 10 indicating a moderate potential for risk to aquatic receptors. Lead also was found in the groundwater samples at similar levels and is site related.

- In the sediments, lead exceeded the lower sediment aquatic reference value throughout Brinson Creek. The only exceedances of the higher sediment aquatic reference value occurred downstream of Site 35 with the highest QI of 137 representing a high potential for risk to aquatic receptors. The lead detected in the sediments is likely site related, the result of past reported surface spills/runoff and past and ongoing groundwater discharges to surface water.

- Pesticides exceeded the sediment aquatic reference values throughout Brinson Creek. The highest QI, 2,600 for dieldrin, represents a high potential for risk to aquatic receptors. There is no documented pesticide disposal or storage/preparation activities at Site 35. The pesticide levels detected in the sediments probably are a result of routine application in the general vicinity of Site 35.

- Although, the pesticides in the sediments were found at levels indicating contamination throughout the watershed, the highest levels were observed in the lower reaches of Brinson Creek. This deposition tread may be related to the higher organics in the sediments in the lower reach, which would accumulate more of these types of contaminants.

- The fish community sampled in Brinson Creek was representative of an estuarine ecosystem with both freshwater and marine species present. In addition, the presence of blue crabs, grass shrimp, and crayfish support the active use of Brinson Creek by aquatic species.

- The absence of pathologies observed in the fish collected from Brinson Creek indicates that the surface water and sediment quality may not adversely impact the fish community.

- The benthic macroinvertebrate community demonstrated the typical tidal/freshwater species trend of primarily chironmids and oligochaetes in the upper reaches and polychaetes and amphipods in the lower reaches. Species representative of both tolerant and intolerant taxa were present. Species richness and densities were representative of an estuarine ecosystem.

- The aquatic community in Brinson Creek is representative of an estuarine community and does not appear to be significantly impacted by surface water and sediment quality.

- Surface soil quality indicated a potential for adversely impacting the terrestrial receptors that have indirect contact with the surface soils and copper in the tissue samples. This adverse impact is primarily due to cadmium in the surface soils. The cadmium in the surface soil is overestimating the adverse impacts since it was detected at a relatively high concentration in only one out of ten samples. In addition, the copper in the tissue samples does not appear to be site-related.

8.2 Recommendations

Based on the data obtained it is recommended that:

- The remedial investigation at Site 35 be extended south of Fifth Street as needed to define the extent and locate the source(s) of solvent-related groundwater contamination in the surficial aquifer.

- The monitoring wells screened within the surficial aquifer that were sampled under the RI be resampled for inorganic contaminants (total phase only) using low-flow pumping techniques in order to more accurately quantify total metals contamination. Based on past experiences with the technique at Camp Lejeune, it is anticipated that using the low-flow technique will result in lower total metals concentrations due to reduced sediment disturbances while sampling.

- Surface soils and sediments be resampled for mercury and zinc in order to replace that data which was rejected during validation. The data generated from the additional sampling of soils and sediments combined with the results of the low-flow groundwater sampling for metals should enable Baker to determine whether or not Site 35 is the source of elevated zinc and/or mercury concentrations in

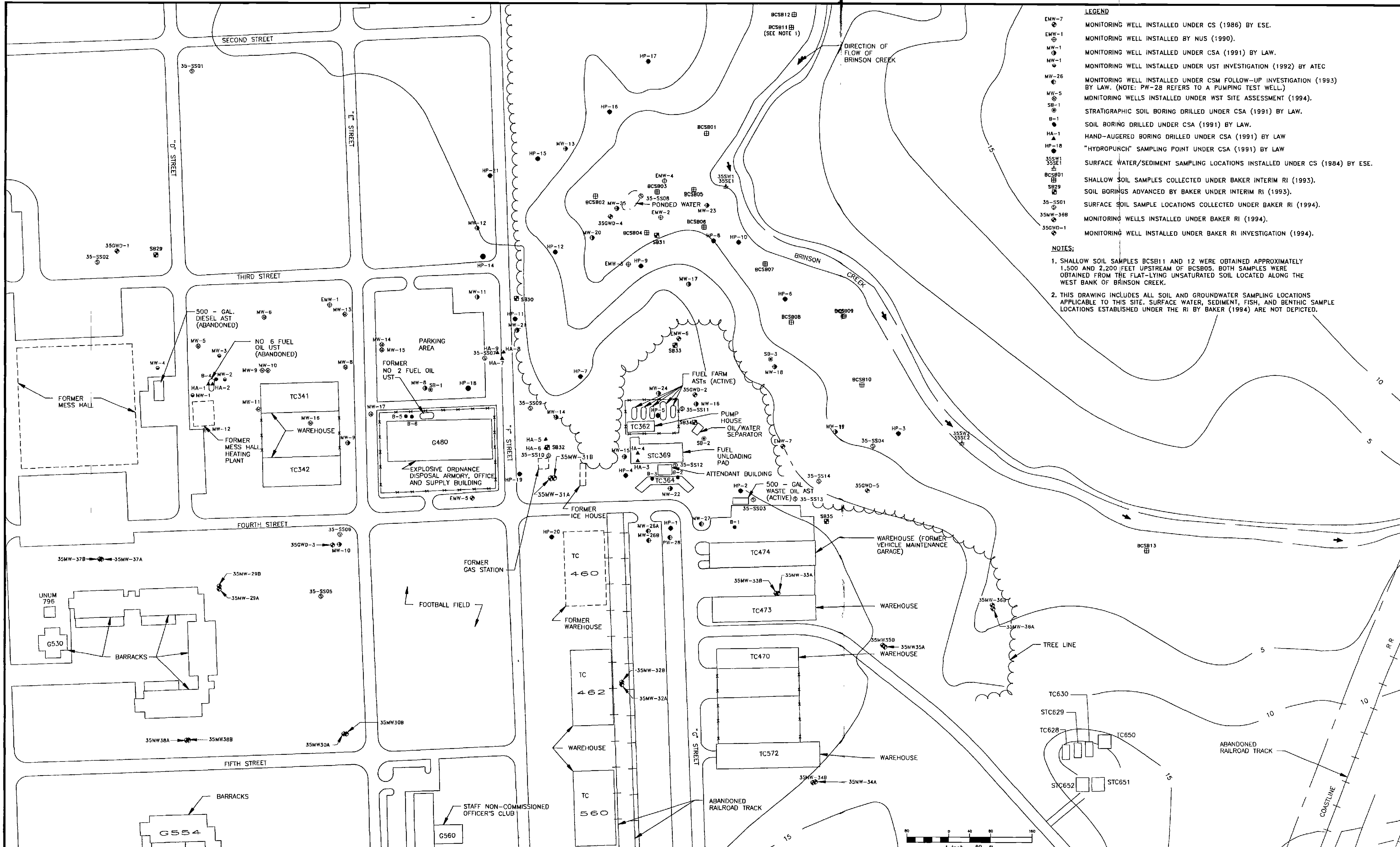
Brinson Creek surface water and fish. In addition, new information regarding metals concentrations in Site 35 media will be used to further evaluate the human health and environmental risks associated with the site. The soils and sediment data and any associated analyses will be incorporated into an addendum to the RI Report.

- Sediment samples along Brinson Creek be obtained at locations adjacent to and downstream of Site 35 and analyze for TPH (EPA Methods 5030 and 3550) so as to provide data regarding the extent of organic contamination that was "masked" by TICs in results obtained under the RI.

- An Interim Remedial Action Feasibility Study be prepared that focuses on the groundwater in the vicinity of the Fuel Farm and north of Fourth Street. The purpose of this Interim FS will be to address groundwater contamination in this area which may be a continuing source of contamination to Brinson Creek.

- The northeastern edge of the halogenated organic plume has not been delineated. Therefore soil and groundwater samples should be collected on the northern side of Brinson Creek in order to determine if Brinson Creek is acting as a barrier to groundwater contamination that may be migrating off-site.

- Special precautions be taken when soil excavation is performed during the construction of the new highway. Specifically, it is recommended that the written construction workplans reference the need for monitoring of volatile organic contaminant concentrations in the breathing zone of the workers, and that institutional and engineering controls be established to minimize human exposure to both VOCS and fugitive dust particulates. Although the calculated risk to human health for future construction workers on Site 35 is well below the EPA acceptable range, adverse exposure to a volatilized fraction of contaminants in the subsurface soil or inhalation of airborne contaminants is possible.



LEGEND
—x— - FENCE LINE
—15— - CONTOUR LINES DEPICTING SURFICIAL RELIEF

DATE	OCT. 1994
SCALE	1"= 80'
DRAWN	WJH
REVIEWED	JSC
S O #	62470-232-0000-07000
CADD#	232521RI

NORTH

SITE 35, CAMP GEIGER AREA FUEL FARM RI/FS
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc

POST RI/FS SAMPLING LOCATIONS
CONTRACT TASK ORDER - 0232

SCALE 1"= 80'   DATE OCT. 1994

FIGURE No
2-4

00161FF01X

APPENDIX B
INTERIM ACTION FEASIBILITY STUDY FOR SHALLOW GROUNDWATER IN THE VICINITY OF THE FORMER FUEL FARM

FINAL

INTERIM FEASIBILITY STUDY FOR SURFICIAL GROUNDWATER FOR A PORTION OF OPERABLE UNIT NO. 10 SITE 35 - CAMP GEIGER AREA FUEL FARM

MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

CONTRACT TASK ORDER 0232

MAY 31, 1995

Prepared For:

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES
ENGINEERING COMMAND
Norfolk, Virginia

Under:

LANTDIV CLEAN Program
Contract N62470-89-D-4814

Prepared by:

BAKER ENVIRONMENTAL, INC.
Coraopolis, Pennsylvania

EXECUTIVE SUMMARY

This report presents the Draft Interim Feasibility Study (FS) for groundwater in the vicinity of the Fuel Farm at Operable Unit (OU) No. 10, Site 35 - Camp Geiger Area Fuel Farm, located at Marine Corps Base (MCB), Camp Lejeune, North Carolina. The Interim FS is based on data collected during the Remedial Investigation (RI) conducted at Site 35 (Baker, 1994), as well as data collected under previous investigations.

Purpose of the Interim FS

The purpose of this Interim FS is to identify and evaluate various remedial actions for contaminated groundwater in the vicinity of the Fuel Farm at Site 35. The results of the RI indicate that the extent of groundwater contamination has not been adequately defined to date, although contaminated groundwater is present in the area of the proposed highway downgradient from the Fuel Farm. It is a known source of ongoing contamination to Brinson Creek. The Interim FS is intended to develop potential remedial actions that will provide for the protection of human health and the environment from contaminated groundwater in this area prior to the completion of a comprehensive FS that considers remedial actions for the entire area of contaminated groundwater as well as other media including surface water and sediments. The comprehensive FS will not be initiated until additional data is obtained from Site 35 to more clearly define the extent and possible sources of contaminated groundwater.

Site Description and Location

Camp Geiger is located at the extreme northwest corner of MCB Camp Lejeune and contains a mixture of troop housing, personnel support and training facilities. The main entrance is located along U.S. Route 17, approximately 3.5 miles southwest of the City of Jacksonville, North Carolina. Site 35, the Camp Geiger Area Fuel Farm, refers primarily to five, 15,000-gallon aboveground storage tanks (ASTs), a pump house, a fuel loading/unloading pad, an oil water separator, and a distribution island situated just north of the intersection of Fourth and "G" Streets.

Site History

Construction of Camp Geiger was completed in 1945, four years after construction of MCB, Camp Lejeune was initiated. Originally, the Fuel Farm ASTs were used for the storage of No. 6 fuel oil, but were later converted for storage of other petroleum products including unleaded gasoline, diesel fuel, and kerosene. The date of their conversion is not known.

Routinely, the ASTs at Site 35 supply fuel to an adjacent dispensing pump. A leak in an underground line at the station was reportedly responsible for the loss of roughly 30 gallons per day of gasoline over an unspecified period (Law, 1992). The leaking line was subsequently sealed and replaced.

The ASTs at Site 35 are currently used to dispense gasoline, diesel, and kerosene to government vehicles, and to supply underground storage tanks (USTs) in use at Camp Geiger and the nearby New River Marine Corps Air Station. The ASTs are supplied by commercial carrier trucks which deliver product to fill ports located on the fuel loading/unloading pad located south of the ASTs. Six, short-run (120 feet maximum), underground fuel lines are currently utilized to distribute the product from the unloading pad to the ASTs. Product is dispensed from the ASTs via trucks and underground piping.

Reports of a release from an underground distribution line near one of the ASTs date back to 1957-58 (ESE, 1990). Apparently, the leak occurred as the result of damage to a dispensing pump. At that time the Camp Lejeune Fire Department estimated that thousands of gallons of fuel were released although no records of the incident are available. The fuel reportedly migrated to the east and northeast toward Brinson Creek. Interceptor trenches were excavated and the captured fuel was ignited and burned.

In April 1990, an undetermined amount of fuel was discovered by Camp Geiger personnel along two unnamed drainage channels north of the Fuel Farm. Apparently, the source of the fuel, believed to diesel or jet fuel, was an unauthorized discharge from a tanker truck that was never identified. The Activity reportedly initiated an emergency clean-up which included the removal of approximately 20 cubic yards of soil.

The Fuel Farm is scheduled to be decommissioned in 1995. Plans are currently being prepared to empty, clean, dismantle, and remove the ASTs along with all concrete foundations, slabs on grade, berms, and associated underground piping. The Fuel Farm will be removed to make way for a six-lane divided highway proposed by the North Carolina Department of Transportation (NCDOT). Construction of the highway is also scheduled to commence in 1995.

In addition to the Fuel Farm dismantling, soil remediation activities will take place along the highway right-of-way as per an Interim Record of Decision executed on September 15, 1994. The soil remediation work is scheduled to commence following the demolition of the Fuel Farm.

Previous Investigations and Findings

Previous investigations conducted at Site 35 include the Initial Assessment Study of Marine Corps Base, Camp Lejeune, North Carolina (WAR, 1983), Final Site Summary Report, MCB Camp Lejeune (ESE, 1990) Draft Field Investigation/Focused Feasibility Study, Camp Geiger Fuel Spill Site (NUS, 1990), Underground Fuel Investigation and Comprehensive Site Assessment (Law, 1992) and the Addendum Report of Underground Fuel Investigation and Comprehensive Site Assessment (Law, 1993), the Interim Remedial Action Remedial Investigation/Feasibility Study (Baker, 1994), and the Remedial Investigation Report (Baker, 1994).

The Initial Assessment Study identified Site 35 as one of 23 sites warranting further investigation. Environmental media were not sampled as part of this study.

ESE performed the Confirmation Study at the Fuel Farm between 1984 and 1987. Soil, groundwater, surface water, and sediment samples were obtained and analyzed for lead and oil and grease. Groundwater was also analyzed for volatile organics. Oil and grease results indicated that soils northeast of the Fuel Farm were potentially impacted by site activities.

Additional wells were installed by NUS Corporation during the Focused Feasibility Study, which was conducted in 1990. Soil cuttings obtained from two of the four well boreholes contained hydrocarbon related contamination.

Law conducted the Comprehensive Site Assessment in 1991. A total of 18 soil borings were drilled, sampled and converted to nested wells that monitor the water table aquifer at two depths. An additional three soil borings were drilled to provide stratigraphic data. Five more soil borings were drilled to provide data regarding vadose zone contamination. Nine hand-auger samples were also obtained. A follow-up study was conducted subsequent to the Comprehensive Site Assessment. Three additional borings were drilled, sampled and converted to wells.

Law identified areas of impacted soil and groundwater directly beneath and apart from the Fuel Farm. The nature of the contamination included both chlorinated organic compounds (e.g., TCE, trans-1,2-DCE, and vinyl chloride) and petroleum hydrocarbons (e.g., TPH, MTBE, BTEX). The majority of the soil contamination encountered appeared to be associated with a fluctuating groundwater table. Two plumes of shallow groundwater contaminated with petroleum constituents and two plumes contaminated with chlorinated organics were identified. All four plumes were located north of Fourth Street and east of E Street except for a portion of a TCE plume extending southwest of Fourth Street.

The Interim Remedial Action RI conducted by Baker in 1993 and 1994 consisted of drilling seven additional soil borings including five in those areas where groundwater contamination plumes were suspected. In general, the Interim Remedial Action RI data confirm the findings of the CSA (Law, 1992) that indicated contaminated soil conditions at Site 35 are primarily associated with a fluctuating shallow groundwater plume.

The Interim Remedial Action RI/FS culminated with an executed Interim Record of Decision (ROD), signed on September 15, 1994, for the remediation of contaminated soil along and adjacent to the proposed highway right-of-way at Site 35. Three areas of contaminated soil have been identified. The first area is located in the vicinity of the Fuel Farm ASTs, and the two other areas are located north of the Fuel Farm. The larger of these two areas is located along "F" Street in the vicinity of monitoring well MW-25. Baker has estimated that approximately 3,600 cubic yards (4,900 tons) of contaminated soil is present in these areas. Contaminated soil located in these areas is scheduled for removal and disposal at an off-site recycling facility beginning July 1995.

A fourth area of soil contamination, located immediately north of Building G480, was also identified in the Interim ROD. Additional data pertaining to this fourth area became available subsequent to the execution of the Interim ROD. This data indicated that contaminated soil was encountered in this area during the removal of a UST there in January 1994. The contaminated soil was excavated and reportedly disposed off site; however, no documentation is available regarding how or where the soil was disposed. An additional soil investigation will be conducted in this area to confirm that the contaminated soil was not returned to the excavation and that follow-up soil remediation in this area is not necessary.

A comprehensive RI was conducted by Baker in 1994 to evaluate the nature and extent of the threat to public health and the environment caused by the release of hazardous substances, pollutants, or contaminants, and to support a Feasibility Study evaluation of potential remedial alternatives. The RI field program was initiated on April 11, 1994. Data gathering activities were derived from: a soil gas survey and groundwater screening investigation, a soil investigation, a groundwater investigation, a surface water and sediment investigation, and an ecological investigation. The results of this investigation are discussed in the following sections: "Nature and Extent of Contamination" and "Summary of Site Risks."

Two USTs located near the Fuel Farm have been the subject of previous investigations conducted under an Activity-wide UST program. The two USTs include a No. 6 fuel oil UST situated adjacent to the former Mess Hall Heating Plant, and a No. 2 fuel oil UST situated adjacent to the Explosive Ordnance and Disposal Armory, Office, and Supply Building. The former UST was abandoned in place years ago (date unknown) and has been the subject of previous environmental investigations performed by ATEC Associates, Inc. and Law. The latter UST was removed in January 1994, and is the UST associated with the fourth area of soil contamination identified in the Interim ROD signed September 15, 1994, which is mentioned above.

Nature and Extent of Contamination

The nature and extent of contamination was determined based on the analytical results of the various media considered under the RI (Baker, 1994), including soil, groundwater, sediment, surface water, and fish tissue.

Surface and Subsurface Soil

Relatively few detections of VOCs and SVOCs were observed in surface and subsurface soil samples obtained under the RI. Pesticides were detected in surface soil samples only, but, are not deemed to be site related. No PCBs were detected in surface or subsurface soil samples. Detected inorganics were generally similar to background surface and subsurface soil concentrations at Camp Lejeune.

Groundwater

The nature and extent of groundwater contamination was considered based on the interval of groundwater monitored and included the upper portion of the surficial aquifer, the lower portion of the surficial aquifer, and the upper portion of the Castle Hayne aquifer.

No significant contamination was detected in the upper portion of the Castle Hayne aquifer. This indicates that, to date, the suspected semi-confining layer that separates the surficial aquifer from the Castle Hayne aquifer has served effectively as an aquitard.

Extensive groundwater contamination was observed in the surficial aquifer along both the upper and lower monitored intervals. Fuel-related organic contaminants, when encountered, appear more prevalent in the upper portion of the surficial aquifer. Conversely, solvent-related organic contaminants, when encountered, appear more prevalent in the lower portion of the surficial aquifer. This is likely due to the fact that the latter have specific gravities that are greater than one, while fuel-related contaminants have specific gravities less than one.

The extent of fuel-related contamination appears to be adequately defined based on the data obtained to date. It is limited to the area north of Fourth Street in the vicinity of obvious suspected sources such as the Fuel Farm, and nearby former UST sites.

The extent of solvent-related contamination has not been completely defined to date nor have all of its sources been identified. A plume appears to extend from north of Fourth Street south to Fifth Street beyond which the RI did not extend in the southerly direction. The source of this plume has not been determined. A second smaller plume is present in the vicinity of the Former Vehicle

Maintenance Garage (Building TC474). This plume appears to be adequately defined with Building TC474 and the immediate vicinity as the likely source of contamination.

Elevated levels of inorganic contaminants (total and dissolved) were detected in groundwater samples obtained from within the surficial aquifer. It is questionable whether this contamination is due to past site activities because the results are similar to those obtained by Baker at other Camp Lejeune sites. The elevated total metals are believed to be caused by suspended particulates in the samples.

Surface Water and Sediment

Significant levels of organic and inorganic contaminants were detected in sediment samples obtained from locations adjacent to and downstream of Site 35. The results of VOC analyses were "masked" by the presence of high levels of Tentatively Identified Compounds (TICs), and consequently, few VOC detections were reported. Nevertheless, the Baker field team commented during sampling that the sediment samples appeared to contain elevated levels of fuel-related contaminants which could also explain the presence of TICs. Lead at elevated levels was also detected in these sediment samples, and like the organic contaminants, could be related to Site 35.

Surface water contamination was limited to a single detection of lead and zinc downstream of Site 35 at levels in excess of the WQSVs and the NCWQS. No organic contaminants were detected in surface water samples.

Fish

A variety of organic and inorganic contaminants were detected in fillet and whole body samples analyzed under the RI. The most significant contaminants detected were the pesticides dieldrin and 4,4-DDD, and a single inorganic mercury. These contaminants were primarily responsible for the calculated risk to human health in excess of EPA guidelines.

Summary of Site Risks

As part of the RI Baker calculated that the human health risk associated with Site 35 is in excess of the acceptable range. The total risk was driven by future potential exposure to groundwater (specifically driven by the contaminants: cis-1,2-dichloroethene, trichloroethene, benzene, antimony, arsenic, barium, beryllium, chromium, cadmium, manganese, and vanadium) and current potential exposure to fish (due to mercury).

The ecological risk assessment indicated that the aquatic community within Brinson Creek was representative of an estuarine community and does not appear to be adversely impacted by surface water and sediment quality. Additionally, there are no significant adverse impacts to terrestrial receptors from site-related contaminants.

Remediation Levels

This section presents the remediation levels (RLs) chosen for OU No. 10. RLs are chosen by the risk manager for the COCs and are included in the Interim FS and the Interim ROD. These numbers derived from the RGOs are no longer goals and should be considered required levels for the remedial actions to achieve.

The RLs associated with OU No. 10 are presented on Table ES-1. This list was based on a comparison of contaminant-specific ARARs (or ARAR-based RGOs) and the site-specific risk-based RGOs. If a COC had an ARAR, the most limiting (or conservative) ARAR was selected as the RL for that contaminant. If a COC did not have an ARAR, the most conservative risk-based RGO was selected for the RL.

In order to determine the final COCs for OU No. 10, the contaminant concentrations detected at each site were compared to the RLs presented on Table ES-1. The contaminants which exceed at least one of the RLs have been retained as final COCs. The contaminants that did not exceed any of the RLs are no longer considered as COCs with respect to this Interim FS. The final COCs and their associated RLs are presented on Table ES-2.

Several inorganic COCs, including arsenic, beryllium, antimony, barium, cadmium, manganese, nickel, and vanadium, were detected in concentrations that exceeded remediation levels. However, these inorganics will not be addressed in this Interim FS because it is unlikely that their presence is a result of past site activities. (The inorganic concentrations are similar to those detected at other Camp Lejeune sites.) Recently, Baker has employed new sampling techniques for inorganics in groundwater utilizing low-flow pumps. The low-flow pumps minimize particle disturbance and have resulted in reduced levels of total inorganics in groundwater analytical results. As recommended in the RI, inorganics at OU No. 10 will be re-sampled using this low-flow sampling technique. Based on previous experience on other sites at this Activity, it is probable that detected concentrations for some inorganic COCs will then fall below remediation levels. Thus, inorganic COCs exceeding remediation levels will not be addressed at this time and Table ES-3 presents a final list of COCs to be addressed in this Interim FS.

Summary of Alternatives

Various technologies and process options were screened and evaluated under the Interim Remedial Action FS. Ultimately, five Remedial Action alternatives (RAAs) were developed and are listed as follows:

- RAA 1 - No Action
- RAA 2 - No Action with Institutional Controls
- RAA 3 - Groundwater Collection and On-Site Treatment
- RAA 4 - In Situ Air Sparging and Off-Gas Carbon Adsorption
- RAA 5 - In Well Aeration and Off-Gas Carbon Adsorption

A brief description of each alternative as well as the estimated cost and timeframe to implement the alternative are as follows:

- RAA 1: No Action

  Total Net Present Worth (30 years): $0
  Months to Implement: 0

  Under the No action RAA, no remedial actions will be performed to reduce the toxicity, mobility, or volume of the contaminated surficial groundwater at Site 35. This method assumes that passive remediation will occur via natural attenuation processes and that the contaminant levels will be reduced over an indefinite period of time. However, the achievable reductions versus time are difficult, if not impossible to predict.

The No Action RAA is required by the NCP to provide a baseline for comparison with other alternatives. Since contaminants will remain at the site under this alternative, USEPA is required by the NCP [40 CFR 300.515(e) (ii)] to review the effects of this alternative no less often than every five years.

- RAA 2: No Action with Institutional Controls

  Total Net Present Worth (30 years): $299,800
  Months to Implement: 2

Under RAA No. 2, no remedial actions will be performed to reduce the toxicity, mobility, or volume of the contaminated surficial groundwater at Site 35. This RAA provides for the revision of the Base Master Plan to include restrictions on the use of the surficial aquifer in the vicinity of the Fuel Farm. This will reduce the risk to human health and the environment posed by this media by eliminating one exposure pathway; however, the impacted surficial groundwater will remain a potential source of contamination to Brinson Creek.

In addition to the aquifer-use restrictions, long-term groundwater monitoring is to be included under this RAA to provide data regarding the impact of natural attenuation and the progress of contaminant migration. Long-term groundwater monitoring includes the semi-annual collection and analysis (TCL VOCs) of groundwater samples from 11 monitoring wells, the development of a semi-annual monitoring report, and the replacement of one monitoring well every five years.

Since contaminants will remain at the site under this alternative, the USEPA is required by the NCP [40 CFR 300.515(e) (iii)] to review the effects of this alternative no less often than every five years.

- RAA 3: Groundwater Collection and On-Site Treatment

  Total Net Present Worth (30 years): $3,000,500
  Months to Implement: 3

RAA 3 is a source collection and treatment alternative, the source being the contaminated surficial groundwater in the vicinity of the Fuel Farm at Site 35. Under this alternative a vertical interceptor trench, approximately two feet wide, by 30 feet deep, by 1,080 feet long, will be installed at the downgradient edge of the contaminated plume in the area between the proposed highway and Brinson Creek. The interceptor trench will be constructed from the ground surface to the semi-confining layer at the base of the surficial aquifer. The purpose of the interceptor trench is to collect contaminated surficial groundwater for transfer to an on-site treatment facility prior to it being discharged to Brinson Creek.

The type of interceptor trench proposed under RAA 4 is termed a "biopolymer slurry drainage trench." This type of trench can be installed without dewatering or structural bracing. Through the use of a natural, biodegradable slurry, the walls of a trench excavation can be supported and the trench can be installed without personnel entering an excavation.

compared to other trenching methods, this technique is safer and cost-effective in areas with a high groundwater and unstable soil because there are no costs for dewatering and water disposal or shoring.

A biopolymer slurry drainage trench is constructed in much the same manner as a typical slurry cut-off wall. However, unlike a bentonite-clay slurry, a biodegradable biopolymer slurry supports the walls of the trench while excavated materials are removed and drainage structures are installed. The biopolymer slurry then naturally biodegrades after the trench is backfilled. In the end, a permeable wall is left intact. In this case an impermeable geomembrane will be installed along the downgradient side of the trench so that groundwater will enter the trench from only the upgradient direction.

The interceptor trench will be designed to collect groundwater at a rate roughly equal to the groundwater flow (5 to 10 gpm) across the upgradient face of the trench (31,900 square feet). Flow across the downgradient face of the trench will be restricted by an impermeable geomembrane barrier. Drawdown of the groundwater surface will be minimized so as to mitigate the potential of excessive ground settlement beneath the highway. The collected groundwater will be conveyed to an on-site treatment plant located just east of the proposed highway right-of-way, creek-side, where it appears that adequate space and firm foundation material is available.

Baker, LANTDIV, and MCB, Camp Lejeune will negotiate with NC DOT regarding the specifics for site access to the creek-side of the new highway. The EPA and NC DEHNR will be kept abreast of developments on this subject. In this FS, Baker proposes an access road running along the east side of the highway from the south.

The collected groundwater will be treated sufficiently to allow for its discharge to Brinson Creek at a point downstream of Site 35. It is anticipated that the groundwater treatment system will include filtration for the removal of suspended solids, a settling tank for the removal of metals, sludge collection and disposal, volatilization (air stripping) for the removal of VOCs, and secondary treatment of VOC emissions from the air stripper and of the treated groundwater (i.e., via carbon adsorption). The treatment plant effluent will be sampled once a month to insure that water discharged to Brinson Creek meets all applicable water quality standards.

RAA 3 assumes that the Base Master Plan will be modified to include restrictions on the use of the surficial aquifer in the vicinity of the Fuel Farm. This will reduce the risk to human health and the environment posed by this media by eliminating one exposure pathway.

In addition to aquifer-use restrictions, long-term groundwater monitoring is to be included under this RAA to provide date regarding the impact of natural attenuation and the progress of contaminant migration. Long-term groundwater monitoring includes the semi-annual collection and analysis (TCL VOCs) of groundwater samples from 11 monitoring wells, the development of a semi-annual monitoring report, and the replacement of one monitoring well every five years.

Since contaminants will remain at the site under this alternative, the USEPA is required by the NCP {40 CFR 300.515(e) (iii)] to review the effects of this alternative no less often than every five years.

- RAA 4: In Situ Air Sparging and Off-Gas Carbon Adsorption

  Total Net Present Worth (30 years): $2,459,600
  Months to Implement: 3

In situ air sparging (IAS) is a technique in which air is injected into water saturated zones for the purpose of removing organic contaminants primarily via volatilization and secondarily via aerobic biodegradation. IAS systems introduce contaminant-free air into an impacted aquifer near the base of the zone of contamination, forcing VOC contaminants to transfer from the groundwater into sparged air bubbles. The air bubbles are then transported into soil pore spaces in the unsaturated zone where they are typically collected via soil vapor extraction (SVE) and conveyed to an on-site, off-gas treatment system.

An IAS system typically is comprised of the following components: 1) air injection wells; 2) an air compressor; 3) air extraction wells; 4) a vacuum pump; 5) associated piping and valving for air conveyance; and 6) an off-gas treatment system (e.g., activated carbon, combustion, or oxidation). Under RAA 4 a line of air sparging wells will be installed between the proposed highway and Brinson Creek in order to treat and contain the contaminated plume near its downgradient extreme. Based on empirical data from similar sites, the radius of influence of an air sparging well ranges from five to almost 200 feet, but is typically on the order of 25 feet (EPA, 1992). For the purpose of the FS, Baker estimates that 43 sparging wells, 30 feet deep, and 43 SVE wells, 4 feet deep, would be required. The proposed off-gas treatment system (activated carbon) will be located just east of the proposed highway right-of-way, creek-side, where it appears that there is adequate space and firm foundation material available. The air emissions from the off-gas treatment system will be sampled monthly to insure that all applicable air emissions standards are being met.

Air sparging systems are most effective in sandy soils, but, can be adversely impacted by high levels of inorganic compounds in the groundwater which oxidize and precipitate when contacted by the sparged air. These organics can form a heavy scale on well screens and clog the well space of the sand pack surrounding the well screen resulting in a reduction in permeability. A field pilot test is recommended to determine the loss of efficiency over time as a result of inorganics precipitation and oxidation, the radius of influence of the wells under various heads of injection air pressure, and the rate of off-gas organic contaminant removal via carbon adsorption and carbon breakthrough.

Baker, LANTDIV, and MCB, Camp Lejeune will negotiate with NC DOT regarding the specifics for site access to the creek side of the new highway. The EPA and NC DEHNR will be kept abreast of developments on this subject. In this FS, Baker proposes an access road running along the east side of the highway from the south.

RAA 4 assumes that the Base Master Plan will be modified to include restrictions on the use of the surficial aquifer in the vicinity of the Fuel Farm. This will reduce the risk to human health and the environment posed by this media by eliminating one exposure pathway.

In addition to aquifer-use restrictions, long-term groundwater monitoring is to be included under this RAA to provide data regarding the impact of natural attenuation and the progress of contaminant migration. Long-term groundwater monitoring includes the semi-annual collection and analysis (TCL VOCs) of groundwater samples from 11 monitoring wells, the development of a semi-annual monitoring report, and the replacement of one monitoring well every five years.

Since contaminants will remain at the site under this alternative, the USEPA is required by the NCP [40 CFR 300.515 (e) (iii)] to review the effects of this alternative no less often than every five years.

- RAA 5: In Well Aeration and Off-Gas Carbon Adsorption

  Total Net Present Worth (30 years): $2,519,700
  Months to Implement: 3

In well aeration is a new technology that utilizes circulating air flow within a groundwater well that, in effect, turns the well into an air stripper. In well aeration differs from air sparging in that volatilization occurs outside the well via air sparging and within the well via in well aeration. Similar to air sparging, this technique removes organic contaminants from groundwater primarily via volatilization and secondarily via aerobic biodegradation. Under RAA 5 a line of in well aeration wells will be installed between the proposed highway and Brinson Creek in order to treat and contain the contaminated plume near its downgradient extreme. The radius of influence, or capture zone, of an in well aeration well is reportedly much greater than that of a typical air sparging well system. Using modeling equations and graphical solutions, the developers of this technology have calculated a radius of influence of over 100 feet at Site 35.

For the purpose of the FS, Baker estimates that six in well aeration wells would be required. Volatilized organics collected by this technology, unlike air sparging, will be treated at each in well aeration well by independent air treatment/carbon adsorption systems which will rest adjacent to the wells. The air emissions from the off-gas treatment system will be sampled monthly to insure that all applicable air emissions standards are being met. Each well and aboveground off-gas treatment system will be housed in a small prefabricated building.

In well aeration systems, like IAS systems, are most effective in sandy soils, but, can be adversely impacted by high levels of inorganic compounds in the groundwater which oxidize and precipitate when contacted by air. These inorganics can form a heavy scale on well screens and clog the well space of the sand pack surrounding the well screen resulting in a reduction in permeability. A field pilot test is recommended to determine the loss of efficiency over time as a result of inorganics precipitation and oxidation, the radius of influence of the wells under various heads of injection air pressure, and the rate of off-gas organic contaminant removal via carbon adsorption and carbon breakthrough.

Baker, LANTDIV, and MCB, Camp Lejeune will negotiate with NC DOT regarding the specifics for site access to the creek side of the new highway. The EPA and NC DEHNR will be kept abreast of developments on this subject. In this FS, Baker proposes an access road running along the east side of the highway from the south.

RAA 5 assumes that the Base Master Plan will be modified to include restrictions on the use of the surficial aquifer in the vicinity of the Fuel Farm. This will reduce the risk to human health and the environment posed by this media by eliminating one exposure pathway.

In addition to aquifer-use restrictions, long-term groundwater monitoring is to be included under this RAA to provide data regarding the impact of natural attenuation and the progress of contaminant migration. Long-term groundwater monitoring includes the semi-annual collection and analysis (TCL VOCs) of groundwater samples from 11 monitoring wells, the development of a semi-annual monitoring report, and the replacement of one monitoring well every five years.

Since contaminants will remain at the site under this alternative, the USEPA is required by the NCP [40 CFR 300.515 (e) (iii)] to review the effects of this alternative no less often than every five years.

Comparative Analysis of Alternatives

This Interim FS has identified and evaluated a range of RAAs potentially applicable to the groundwater concerns at Site 35 (OU No. 10). Table ES-4 presents a summary of this evaluation. A comparative analysis in which the alternatives are evaluated in relation to one another with respect to the nine evaluation is presented below. The purpose of this analysis is to identify the relative advantages and disadvantages of each RAA.

Overall Protection of Human Health and the Environment

RAA 1 (No Action) and RAA 2 (No Action With Institutional Controls) are similar in that neither alternative involves active treatment. RAA 2 provides for some overall protection to human health through the incorporation of aquifer-use restrictions which are not included under RAA 1.

RAA 3 (Groundwater Collection and On-Site Treatment), RAA 4 (In Situ Air Sparging And Off-Gas Carbon Adsorption), and RAA 4 (In Well Aeration And Off-Gas Carbon Adsorption) have a common element in that each is intended to reduce groundwater contamination at the downgradient extreme of the contaminated plume and to serve as a barrier to future contaminated groundwater discharge to Brinson Creek. RAA 3 would likely be the most effective barrier in that it is designed to span the entire length and depth of the contaminated portion of the surficial aquifer and will be equipped with an impermeable geomembrane along its downgradient face. RAA 3 is the only treatment alternative that will impact both organic and inorganic contaminants which could be important if it is determined in the future that inorganic contaminants in groundwater are still a concern.

Compliance With ARARs

RAA 1 (No action) and RAA 2 (No Action With Institutional Controls) are no action alternatives that will not comply with ARARs. RAA 3 (Groundwater Collection and On-Site Treatment), RAA 4 (In Situ Air Sparging And Off-Gas Carbon Adsorption), and RAA 5 (In Well Aeration And Off-Gas Carbon Adsorption) are primarily source control measures that will reduce contaminant levels over a limited area defined as the particular zone of influence of each system.

Wetlands disturbance will be an issue with RAA 3, 4, and 5, but, most significantly with RAA 3 which includes the excavation of an approximately two-foot wide, by 30-foot deep, by 1,080-foot interceptor trench. The disturbance associated with RAA 4 and 5 is limited primarily to drilling and well installations, although of the two, RAA 4 will have the greater impact due to the large number of wells to be installed.

Treated air and groundwater discharge are provisions of RAA 3, whereas, only air emissions are a part of RAA 4 and 5. These discharges will need to comply with applicable ARARs.

Long-Term Effectiveness and Permanence

In the case of all five RAAs, contamination will remain at the site and require a USEPA review on five year basis. RAA 1 (No Action) and RAA 2 (No Action With Institutional Controls) provide for no active means of contaminant reduction although, under RAA 2, aquifer-use restrictions will provide a permanent means for protection against direct human exposure to the contaminated surficial groundwater.

The effectiveness of RAA 3 (Groundwater Collection and On-Site Treatment), RAA 4 (In Situ Air Sparging And Off-Gas Carbon Adsorption), and RAA 5 (In Well Aeration and Off-Gas Carbon Adsorption) can be assumed to be roughly equivalent without the benefit of the results of field pilot-scale testing. RAA 3 may be the most difficult of the three to install, however, once installed it will likely be the most reliable and easiest to control. RAA 4 and 5 may encounter clogging problems if dissolved metals precipitate out of solution when placed in contact with forced air. At a minimum the metals problem will prompt increased maintenance which could lead to complete well replacement. RAA 4 has the additional problem of releasing toxic vapors to the atmosphere during operation because it is difficult to apply sufficient vacuum to the vadose zone where the groundwater surface is within a few feet of the ground surface.

Reduction of Toxicity, Mobility, or Volume Through Treatment

No reduction of contaminants will occur under RAA 1 (No Action) and RAA 2 (No Action With Institutional Controls) as the result of active treatment because active treatment is not provided for under these RAAs.

RAA 3 (Groundwater Collection and On-Site Treatment) provides for on-site treatment of the collected contaminated groundwater (organics and inorganics) using standard wastewater treatment technology. Conversely, RAA 4 (In Situ Air Sparging And Off-Gas Carbon Adsorption) and RAA 5 (In Well Aeration And Off-Gas Carbon Adsorption) provide for treatment of the organic phase of contaminated groundwater in-situ. Both RAA 4 and 5 utilize primarily volatilization technology and biodegradation technology secondarily. The principle difference between the two is that under RAA 4 both volatilization and biodegradation occur outside the well and within the soil column. Under RAA 5, volatilization occurs within the well while biodegradation occurs outside the well within the soil column. Under RAA 4 it may be difficult to efficiently collect all of the volatilized organic contaminants via conventional soil vapor extraction because of the proximity of the groundwater surface to the ground surface at this site. Without an efficient means of collecting the volatilized organics under RAA 4, toxic vapors may be released to the atmosphere. Under RAA 5 this is not a concern because the volatilization is conducted within the well and conveyed to an adjacent activated carbon unit via piping which means the system is essentially a closed loop.

RAA 3 will produce the highest volume of residual waste during operation because it is the only alternative involving groundwater treatment. However, the volume of air treatment under RAA 3 will be less than that under RAAs 4 and 5 because the latter are specifically designed as air volatilization systems. Under RAAs 4 and 5 a small volume of contaminated water will be generated because extracted air contains water which condenses and collects in a knock-out tank at the treatment facility.

Short-Term Effectiveness

Worker protection against exposure will not be a significant issue for any of the RAAs. Each system provided for under RAA 3 (Groundwater Collection and On-Site Treatment), RAA 4 (In Situ Air Sparging and Off-Gas Carbon Adsorption), and RAA 5 (In Well Aeration and Off-Gas Carbon Adsorption) will require approximately 30 to 60 days to install with the total time in the field for construction being a little longer. It has also been assumed that system start-up and testing operations will require an additional 90 days.

Under RAA 1 (No Action) and RAA 2 (No Action With Institutional Controls) there will be no increase in the risks to the community resulting from implementation of the RAA. RAAs 3 and 5 will likely present minimal risk of community exposure during implementation and operation because they are, in essence, closed loop systems. RAA 4 has the potential for releases of toxic vapors to the atmosphere because of close proximity of the groundwater surface to the ground surface will make efficient soil vapor extraction difficult.

Some disturbance of the wetlands is expected under RAAs 3, 4, and 5. The greatest disturbance will be associated with RAA 3.

Implementability

Aside from RAAs 1 and 2, which are no action or essentially no action alternatives, RAA 3 (Groundwater Collection And On-Site Treatment) will present greater technical challenges during construction than RAA 4 (In Situ Air Sparging and Off-Gas Carbon Adsorption), and RAA 5 (In Well Aeration and Off-Gas Carbon Adsorption). This is because RAA 3 involves the construction of a two foot wide by 30 foot deep by 1,080 feet long interceptor trench while RAAs 4 and 5 involve primarily well installation.

The interceptor trench under RAA 3 represents specialized technology that is available from a limited number of vendors, whereas, the air sparging technology of RAA 4 is relatively commonplace, and in well aeration (RAA 5) is a proprietary technology offered by a single vendor.

The proposed groundwater monitoring plan coupled with routine system maintenance and monitoring should be sufficient to provide sufficient notice of a system failure under either RAA 3, 4 or 5. The purpose of the monitoring is to provide for system adjustments with sufficient time so that a significant contaminant release to the environment will not occur.

Because each system under RAA 3, 4, and 5 will require construction within a wetlands area and because air and water discharges are incorporated into the designs, the intent of federal and state wetlands and air and water discharge permits must be met.

Cost

The estimated total present worth costs of the alternatives, excluding RAA 1: No Action, range from \$299,800 for RAA 2: No Action with Institutional Controls to \$3,000,500 for RAA 3: Groundwater Collection and On-Site Treatment. These costs are based on the assumption of 30 years of active use, with an annual interest rate of five percent. The ranking of the alternatives in terms of costs is as follows:

RAA	1:	No Action	$0
RAA	2:	No Action with Institutional Controls	$299,800
RAA	4:	In Situ Air Sparging and Off-Gas Carbon Adsorption	$2,459,600
RAA	5:	In Well Aeration and Off-Gas Carbon Adsorption	$2,519,700
RAA	3:	Groundwater Collection and On-Site Treatment	$3,000,500

USEPA/State Acceptance

The USEPA and NC DEHNR have indicated their concurrence with the RAAs developed under this FS, in general, and with RAA 5 as the proposed alternative, in particular. The ROD also identified RAA 3 as the proposed alternative should RAA 5 be determined to be technically infeasible based on the results of a field pilot test.

Community Acceptance

Based on the lack of community participation at a public meeting held on May 10, 1995, no adverse community reaction to the proposed remedial action is anticipated.

TABLE ES-1

REMEDIATION LEVELS FOR COCs
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY CTO-232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant of Concern	RL[1]	Basis of Goal	Corresponding Risk
Benzene	1	NCWQS[2]	
Trichloroethene	2.8	NCWQS	
Arsenic	50	NCWQS	
Beryllium	4	MCL[3]	
cis-1,2-Dichloroethene	70	NCWQS	
trans-1,2-Dichloroethene	70	NCWQS	
Ethyl Benzene	29	NCWQS	
Methyl Tertiary Butyl Ether	200	NCWQS	
Toluene	1,000	NCWQS	
Xylenes	530	NCWQS	
Naphthalene	626	Risk-Ingestion	HI[4]=1
Antimony	6	MCL[5]	
Barium	2,000	NCWQS	
Cadmium	5	NCWQS	
Cobalt	939	Risk-Ingestion	HI=1
Copper	1,000	NCWQS	
Manganese	50	NCWQS	
Mercury	1.1	NCWQS	
Nickel	100	NCWQS	
Selenium	50	NCWQS	
Vanadium	110	Risk-Ingestion	HI=1
Zinc	2,100	NCWQS	

Notes: Concentrations expressed in microgram per liter (ug/L)
(1) RL = Remediation Level
(2) NCWQS = North Carolina Water Quality Standards for Groundwater
(3) MCL = Maximum Contaminant Level
(4) HI = Hazard Index

TABLE ES-2

COCs THAT EXCEED REMEDIATION LEVELS
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY CTO-232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant of Concern	RL[1,2]
Benzene	1
Trichloroethene	2.8
Arsenic	50
Beryllium	4
cis-1,2-Dichloroethene	70
trans-1,2-Dichloroethene	70
Ethyl Benzene	29
Methyl Tertiary Butyl Ether	200
Xylenes	530
Antimony	6
Barium	2,000
Cadmium	5
Manganese	50
Nickel	100
Vanadium	110

[1] RL = Remediation Level
[2] Groundwater RLs expressed as ug/L (ppb)

TABLE ES-3

ORGANIC COCs THAT EXCEED REMEDIATION LEVELS
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY CTO-232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant of Concern	RL[1,2]
Benzene	1
Trichloroethene	2.8
cis-1,2-Dichloroethene	70
trans-1,2-Dichloroethene	70
Ethyl Benzene	29
Methyl Tertiary Butyl Ether	200
Xylenes	530

(1) RL = Remediation Level
(2) Groundwater RLs expressed as ug/L (ppb)

TABLE ES-4

SUMMARY OF DETAILED ANALYSIS
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Evaluation Criteria	RAA 1 No Action	RAA 2 No Action with Institutional Controls	RAA 3 Groundwater Collection and On-Site Treatment	RAA 4 In Situ Air Sparging and Off-Gas Carbon Adsorption	RAA 6 In Well Aeration and Off-Gas Carbon Adsorption
OVERALL PROTECTIVENESS					
• Human Health	Potential risks associated with groundwater exposure will remain. Some reduction in contaminant levels may result from natural attenuation.	Aquifer-use restrictions mitigate risks from direct groundwater exposure.	Active collection and treatment will reduce contaminant levels in groundwater within capture zone of interceptor trench (estimated at 100 feet upgradient maximum). Aquifer-use restrictions will also mitigate risks from direct groundwater exposure.	Active in situ volatilization and biodegradation will reduce contaminant levels in groundwater within radius of influence of wells (estimated at 25 feet). Aquifer-use restrictions will also mitigate risks from direct groundwater exposure.	Active in-well volatilization and in situ biodegradation will reduce contaminant levels in groundwater within radius of influence of wells (estimated 100 feet). Aquifer-use restrictions will also mitigate risks from direct groundwater exposure.
• Environment	Contaminated groundwater will continue to be a source of future contamination to Brinson Creek.	Contaminated groundwater will continue to be a source of future contamination to Brinson Creek.	Interceptor trench serves as a barrier to contaminated groundwater discharge to Brinson Creek.	Air sparging wells serve as a barrier to contaminated groundwater discharge to Brinson Creek.	Aeration wells serve as a barrier to contaminated groundwater discharge to Brinson Creek.
COMPLIANCE WITH ARARs					
• Chemical-Specific	No active effort made to reduce groundwater contaminant levels to below federal or state ARARs.	No active effort made to reduce groundwater contaminant levels to below federal or state ARARs.	Reductions in groundwater contaminant levels to below federal or state ARARs can be expected within capture zone of interceptor trench. Reductions upgradient will be less substantial if at all.	Reductions in groundwater contaminant levels to below federal or state ARARs can be expected within radius of influence of wells. Reductions upgradient will be less substantial if at all.	Reductions in groundwater contaminant levels to below federal or state ARARs can be expected within radius of influence of wells. Reductions upgradient will be less substantial if at all.
• Location-Specific	Not Applicable.	Not Applicable.	Wetlands and alligators (endangered species) are concerns because of proposed location of interceptor trench. It is assumed that necessary approvals can be obtained.	Wetlands and alligators (endangered species) are concerns because of proposed location of interceptor trench. It is assumed that necessary approvals can be obtained.	Wetlands and alligators (endangered species) are concerns because of proposed location of interceptor trench. It is assumed that necessary approvals can be obtained.
• Action-Specific	Not Applicable.	Not Applicable.	Can be designed to meet these ARARs.	Can be designed to meet these ARARs.	Can be designed to meet these ARARs.

TABLE ES-4 (Continued)

SUMMARY OF DETAILED ANALYSIS
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Evaluation Criteria	RAA 1 No Action	RAA 2 No Action with Institutional Controls	RAA 3 Groundwater Collection and On-Site Treatment	RAA 4 In Situ Air Sparging and Off-Gas Carbon Adsorption	RAA 6 In Well Aeration and Off-Gas Carbon Adsorption
LONG-TERM EFFECTIVENESS AND PERFORMANCE					
• Magnitude of Residual Risk	Any long-term effect on contamination will be the result of natural attenuation processes only.	Any long-term effect on contamination will be the result of natural attenuation processes only. Aquifer-use restrictions will provide a permanent means for protection against direct exposure to the contaminated surficial groundwater.	Provides an effective means of intercepting contaminated groundwater and blocking its discharge to Brinson Creek for as long as it remains in operation. Aquifer-use restrictions will provide a permanent means for protection against direct exposure to the contaminated surficial groundwater.	Provides an effective means of intercepting and treating contaminated groundwater prior to its discharge to Brinson Creek for as long as it remains in operation. Toxic vapors escaping to the air due to poor vapor extraction may increase risk to community. Aquifer-use restrictions will provide a permanent means for protection against direct exposure to the contaminated surficial groundwater.	Provides an effective means of intercepting and treating contaminated groundwater prior to its discharge to Brinson Creek for as long as it remains in operation. Aquifer-use restrictions will provide a permanent means for protection against direct exposure to the contaminated surficial groundwater.
• Adequacy and Reliability of Controls	Not Applicable.	Aquifer-use restrictions are reliable if enforced. Enforcement is likely as Camp Geiger is a controlled military installation	Interceptor trench involves basic technology and should be adequate and reliable for an indefinite period.	Air sparging has a long track record of commercial use and should be able to be controlled adequately and reliably for an indefinite period. High levels of metals in groundwater could short circuit the system prompting frequent maintenance. Well replacement over several years may result.	In well aeration is a relatively new technology without a substantial commercial track record. High levels of metals could short circuit the system prompting frequent maintenance. Well replacement over several years may result.
• Estimated Period of Operation	30 Years	30 Years	30 years unless additional active treatment actions are implemented upgradient.	30 years unless additional active treatment actions are implemented upgradient.	30 years unless additional active treatment actions are implemented upgradient.
• Need for 5-Year Review	Review required because no active treatment is included	Review required because no active treatment is included.	Review required because area impacted by treatment will be limited.	Review required because area impacted by treatment will be limited.	Review required because area impacted by treatment will be limited.

TABLE ES-4 (Continued)

SUMMARY OF DETAILED ANALYSIS
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Evaluation Criteria	RAA 1 No Action	RAA 2 No Action with Institutional Controls	RAA 3 Groundwater Collection and On-Site Treatment	RAA 4 In Situ Air Sparging and Off-Gas Carbon Adsorption	RAA 5 In Well Aeration and Off-Gas Carbon Adsorption
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT					
• Treatment Process Used	No active treatment process applied.	No active treatment process applied.	On-site groundwater treatment includes filtration, metals precipitation, air stripping, air and water carbon adsorption.	In situ volatilization and biodegradation. Off-gas carbon adsorption.	In situ volatilization and biodegradation. Off-gas carbon adsorption.
• Reduction of Toxicity, Mobility or Volume	No reduction except by natural attenuation.	No reduction except by natural attenuation.	Reduction of organic and inorganic contaminants expected within capture zone of trench.	Reduction of organic contaminants expected within radius of influence of wells.	Reduction of organic contaminants expected within radius of influence of wells.
• Residuals Remaining After Treatment	No active treatment process applied.	No active treatment process applied.	Residuals include metals sludge and spent carbon which would have to be disposed of properly.	Residuals requiring disposal include spent carbon and a small volume of condensed contaminated vapor (water).	Residuals requiring disposal include spent carbon and a small volume of condensed contaminated vapor (water).
• Statutory Preference for Treatment	Not satisfied.	Not satisfied.	Satisfied except that area impacted by treatment is limited and does not include entire plume of contaminated surficial groundwater.	Satisfied except that area impacted by treatment is limited and does not include entire plume of contaminated surficial groundwater.	Satisfied except that area impacted by treatment is limited and does not include entire plume of contaminated surficial groundwater.
SHORT-TERM EFFECTIVENESS					
• Community Protection	Risks to community not increased by remedy implementation.	Risks to community not increased by remedy implementation.	Minimal, if any, risks during collection and treatment.	Possible migration of toxic vapors through ground surface because vapor extraction is difficult to control when groundwater surface is within several feet of ground surface.	Minimal, if any, risks during operation and treatment.
• Worker Protection	None.	Protection required during well installation and sampling.	Trench installation procedure limits worker exposure by design.	Minimal potential for worker exposure.	Minimal potential for worker exposure.
• Environmental Impacts	Continued impacts from unchanged existing conditions.	Continued impacts from unchanged existing conditions.	Wetlands disturbance during installation could be significant. Trench will serve as a barrier for contaminated groundwater discharge to Brinson Creek.	Minimal wetlands disturbance. System will serve as a barrier for contaminated groundwater discharge to Brinson Creek.	Minimal wetlands disturbance. System will serve as a barrier for contaminated groundwater discharge to Brinson Creek.
• Installation Period	Not Applicable.	Less than 30 days required to install additional groundwater monitoring wells.	60 to 90 days estimated to install trench and treatment system.	60 to 90 days estimated to install aeration wells and treatment system.	60 to 90 days estimated to install aeration wells and treatment system.

TABLE ES-4 (Continued)

SUMMARY OF DETAILED ANALYSIS
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Evaluation Criteria	RAA 1 No Action	RAA 2 No Action with Institutional Controls	RAA 3 Groundwater Collection and On-Site Treatment	RAA 4 In Situ Air Sparging and Off-Gas Carbon Adsorption	RAA 5 In Well Aeration and Off-Gas Carbon Adsorption
IMPLEMENTABILITY					
• Ability to Construct and Operate	No construction or operation activities.	Involves standard well installation and sampling only.	Soft ground in wetlands areas may hamper construction and result in delays. Once installed, operating is straight-forward using commercially proven technology. Approximately 2,000 to 3,000 cubic yards of potentially contaminated soil excavated from the trench will require disposal. Lack of access may be a significant cost factor.	Construction of activities involve primarily well installation which has been previously executed successfully in this area. Disposal of drill cuttings required. Thin vadose zone may hamper effective vapor extraction which could result in the release of toxic vapors to atmosphere. High metals in groundwater could clog well screens which would require frequent maintenance or well replacement.	Construction of activities involve primarily well installation which has been previously executed successfully in this area. Disposal of drill cuttings required. High metals in groundwater could clog well screens which would require frequent maintenance or well replacement.
• Ability to Monitor Effectiveness	No monitoring.	Proposed monitoring will provide an indication of effects of natural attenuation and progress of contaminants migration.	Proposed monitoring will give notice of failure so that system can be adjusted before a significant contaminant release occurs.	Proposed monitoring will give notice of failure so that system can be adjusted before a significant contaminant release occurs.	Proposed monitoring will give notice of failure so that system can be adjusted before a significant contaminant release occurs.
• Availability of Services and Equipment	None required.	Well installation and sampling services available from multiple vendors.	Biopolymer trench technology available from a limited number of vendors.	Air sparging technology is available from multiple vendors.	In well aeration is a patented priority technology currently available from only one vendor.
• Requirements for Agency Coordination	None required.	Must submit semi-annual reports to document sampling reports.	None required, provided the intent of wetlands and air and water discharge permits is met.	None required, provided the intent of wetlands and air and water discharge permits is met.	None required, provided the intent of wetlands and air and water discharge permits is met.
COSTS					
• Net Present Worth (30 years)	$0	$299,800	$3,000,500	$2,459,600	$2,519,700

1.0 INTRODUCTION

This report presents the Draft Interim Feasibility Study (FS) for groundwater in the vicinity of the Fuel Farm at Operable Unit (OU) No. 10, Site 35 - Camp Geiger Area Fuel Farm, located at Marine Corps Base (MCB), Camp Lejeune, North Carolina. It has been prepared by Baker Environmental, Inc. (Baker) under contract with the Naval Facilities Engineering Command, Atlantic Division (LANTDIV).

This Interim FS has been conducted in accordance with the guidelines and procedures delineated in the National Oil and Hazardous Substance Pollution Contingency Plan (NCP) for remedial actions (40 CFR 300.430). These NCP regulations were promulgated under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), commonly referred to as Superfund, and amended by the Superfund Amendments and Reauthorization Act (SARA) signed into law on October 17, 1986. The United States Environmental Protection Agency's (USEPA's) document Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1988b) has been used as guidance for preparing this document.

This Interim FS is based on data collected during the Remedial Investigation (RI) conducted at Site 35 (Baker, 1994), as well as data collected under previous investigations. The FS focuses on contaminated groundwater in the vicinity of the Fuel Farm.

1.1 Purpose of the Interim FS

The purpose of this Interim FS is to identify and evaluate various remedial actions for contaminated groundwater in the vicinity of the Fuel Farm at Site 35. Contaminated groundwater is present in the area of the proposed highway and is a source of ongoing contamination to Brinson Creek. The results of the RI indicate that the extent of groundwater contamination has not been adequately defined to date. The Interim FS is intended to develop potential remedial actions that will provide for the protection of human health and the environment from contaminated groundwater in this area prior to the completion of a comprehensive FS that considers remedial actions for the entire area of contaminated groundwater as well as other media including surface water and sediments. The comprehensive FS will be not initiated until additional data is obtained from Site 35 to define the extent and possible sources of contaminated groundwater.

The FS process under CERCLA serves to ensure that appropriate remedial alternatives are developed and evaluated, such that relevant information concerning the remedial action options can be presented, and an appropriate remedy selected. The FS involves two major phases:

- Development and screening of remedial action alternatives, and
- Detailed analysis of remedial action alternatives.

The first phase includes the following major activities: (1) developing remedial action objectives, (2) developing general response actions, (3) identifying volumes or areas of affected media, (4) identifying and screening potential technologies and process options, (5) evaluating process options, (6) assembling alternatives, (7) defining alternatives, and (8) screening and evaluating alternatives. Section 121(b)(1) of CERCLA requires that an assessment of permanent solutions and alternative treatment technologies or resource recovery technologies that, in whole or in part, will result in a permanent and significant decrease in the toxicity, mobility, or volume of the hazardous substance, pollutant, or contaminant be conducted. In addition, according to CERCLA, treatment alternatives should be developed ranging from an alternative that, to the degree possible, would eliminate the need for long-term management to alternatives involving treatment that would reduce toxicity, mobility, or volume as their principal element. A containment option involving little or no treatment and a no action alternative should also be developed.

The second phase of the FS consists of: (1) evaluating the potential alternatives in detail with respect to nine evaluation criteria to address statutory requirements and preferences of CERCLA, and (2) performing a comparative analysis of the evaluated alternatives.

1.2 Report Organization

This Interim FS Report is organized in five sections. The Introduction (Section 1.0) presents a brief discussion of the FS process, and site background information including a summary of the nature and extent of contamination at the site. Section 2.0 contains the remedial action objectives, remediation goal options, and remediation levels. Section 3.0 contains the identification and preliminary screening of the remedial action technologies. In addition, Section 3.0 discusses the general response actions. Section 4.0 contains the development and preliminary screening of remedial action alternatives. Section 5.0 presents the results of the detailed analysis of the remedial alternatives (both individual analysis and comparative analysis). The detailed analysis is based on a set of nine criteria including short- and long-term effectiveness, implementability, cost, state and local acceptance, compliance with applicable regulations, and overall protection of human health and the environment. The references for Sections 1.0 through 5.0 are listed at the end of each section.

1.3 Background Information

This section presents background information pertaining to Site 35 including the site description and location, site history, previous investigations and findings, physical characteristics of the study are, nature and extent of contamination, and conclusions and recommendations from the RI.

1.3.1 Site Description and Location

MCB, Camp Lejeune (also referred to as the "Activity") is located in Onslow County, North Carolina (Figure 1-1). The Activity currently covers approximately 234 square miles and is bisected by the New River, which flows in a southeasterly direction and forms a large estuary before entering the Atlantic Ocean. The borders of the Activity are defined by the U.S. Route 17 and State Route 24 to the west and northwest, respectively. The eastern border is defined by the Atlantic Ocean shoreline and the City of Jacksonville, North Carolina, borders the Activity to the north.

Camp Geiger is located at the extreme northwest corner of MCB Camp Lejeune and contains a mixture of troop housing, personnel support and training facilities. The main entrance is located along U.S. Route 17, approximately 3.5 miles southeast of the City of Jacksonville, North Carolina. Site 35, the Camp Geiger Area Fuel Farm, refers primarily to five, 15,000-gallon aboveground storage tanks (ASTs), a pump house, a fuel loading/unloading pad, an oil water separator, and a distribution island situated just north of the intersection of Fourth and "G" Streets. Results of previous investigations have expanded the study area beyond the confines of the Fuel Farm. To date, the study area is bounded on the west by D Street, on the north by Second Street, on the east by Brinson Creek, and on the south by Fifth Street and Building No. TC572 (Figure 1-2). However,

2.0 REMEDIAL ACTION OBJECTIVES, REMEDIATION GOAL OPTIONS, AND REMEDIATION LEVELS

This section presents the remedial objectives and the development of remediation goal options (RGOs) and remediation levels (RLs). Section 2.1 presents the media of concern, Section 2.2 presents remedial action objectives, and Section 2.3 presents contaminants of concern for OU No. 10. RGOs, which are presented in Section 2.4, are chemical-specific concentration goals established for medium and land use combinations for the protection of human health and the environment. There are two general sources of chemical-specific RGOs: (1) concentrations based on applicable or relevant and appropriate requirements (ARARs) and, (2) risk-based concentrations for the protection of public health and the environment. The selection of RGOs includes: identifying the media(s) of concern, selection of contaminants of concern (COCs), evaluation of ARARs, and identification of site-specific information for the exposure pathway information (i.e., exposure frequency, duration, or intake rate data). Thus, the development of RGOs for OU No. 10 is detailed in Sections 2.1 through 2.4. In addition, Section 2.5 presents a comparison of risk-based remediation goal options to maximum contaminant concentrations in groundwater, while Section 2.6 discusses the uncertainty associated with risk-based RGOs. Finally, Section 2.7 presents the RLs chosen for OU No. 10 during this Interim FS.

2.1 Media of Concern

The results of the baseline human health RA presented in the RI Report (Baker, 1994) indicate that the total site risk (carcinogenic and non-carcinogenic) exceeds the generally accepted range established by the EPA and is driven by future potential exposure to surficial groundwater and current potential exposure to fish and noncarcinogenic risks. The other media (soil, sediment, surface water, and air) had ICRs less than 1.0E-04 and HIs less than 1.0. However, the evaluation of sediment media was based on the analytical results whereby volatile organic compound (VOC) levels were masked by the presence of Tentatively Identified Compounds at high levels. These results, along with observations by Baker field staff that the sediment samples appeared to contain fuel-related contaminants, prompted a recommendation in the RI Report that additional sediment samples be obtained and analyzed for TPH (via EPA Methods 5030 and 3550).

The focus of this Interim FS is surficial groundwater in the vicinity of the Fuel Farm with the emphasis placed on that contamination extending downgradient towards Brinson Creek. The contaminated surficial groundwater has been identified as a source of continued contamination to Brinson Creek. Remedial actions focused on contaminated surficial groundwater south and west of the Fuel Farm, and sediments in Brinson Creek, are subject to additional investigation and will be addressed in a comprehensive FS to be prepared following the completion of additional follow-up remedial investigation activities.

2.2 Remedial Action Objectives

Remedial action objectives are medium-specific or operable unit-specific goals established for protecting human health and the environment.

At Site 35, the specific media to be addressed by the Interim Remedial Action is contaminated surficial groundwater in the vicinity of the Fuel Farm extending downgradient towards Brinson Creek. The remedial action objectives for this surficial groundwater aquifer are:

- Mitigate the potential for direct exposure to the contaminated groundwater in the surficial aquifer.
- Minimize or prevent the horizontal and vertical migration of contaminated groundwater in the surficial aquifer.
- Restore the surficial aquifer to the remediation levels established for the groundwater COCs.

2.3 Contaminants of Concern

Contaminants of Potential Concern (COPCs) initially selected and evaluated in the RA (Table 1-1) were selected on the basis of frequency of detection, toxicity, and comparison to established criteria or standards. The final list of COPCs identified in the RA are termed Contaminants of Concern (COCs) for groundwater in this Interim FS (see Table 2-1). COCs from this list that were detected at levels not exceeding a regulatory or a risk-based remediation goal will be eliminated from further consideration later in Section 2.0. This final set of COCs will then become the basis for a set of remedial action objectives applicable to OU No. 10.

2.4 Remediation Goal Options

RGOs are based on federal and state criteria or risk-based concentrations. Federal and state criteria will be identified and evaluated in Section 2.4.1. Site-specific, risk-based RGOs for the COCs at OU No. 10 will be developed in Section 2.4.2. The results from both of these sections will be used to develop the initial set of RGOs for the operable unit.

2.4.1 Applicable or Relevant and Appropriate Federal and State Requirements

Under Section 121(d)(1) of CERCLA, remedial actions must attain a degree of cleanup which assures protection of human health and the environment. Additionally, CERCLA remedial actions that leave any hazardous substances, pollutants, or contaminants on site must meet, upon completion of the remedial action, a level or standard of control that at least attains standards, requirements, limitations, or criteria that are "applicable or relevant and appropriate" under the circumstances of the release. These requirements are known as "ARARs" or applicable or relevant and appropriate requirements. ARARs are derived from both federal and state laws. CERCLA's definition of "Applicable Requirements" is:

> ...cleanup standards, standards of control, or other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant or contaminant, remedial action, location, or other circumstance at a CERCLA site. Drinking water criteria may be an applicable requirement for a site with contaminated groundwater that is used as a drinking water source.

CERCLA's definition of "Relevant and Appropriate Requirements" is:

> ...cleanup standards, standards of control and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

EPA has also indicated that "other" federal and state criteria, advisories, and guidelines may have To Be Considered (TBC) during the development of remedial alternatives. TBCs are not promulgated, not enforceable, and do not have the same status as ARARs. Yet, they may be useful in establishing a cleanup level or in designing the remedial action, especially when no specific ARARs exist or they are not sufficiently protective. Examples of such other criteria include EPA Drinking Water Health Advisories, Carcinogenic Potency Factors, and Reference Doses.

There are three types of ARARs. The first type, chemical-specific ARARs, are requirements which set health or risk-based concentration limits or ranges for specific hazardous substances, pollutants, or contaminants. Federal Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act (SDWA) are examples of chemical-specific ARARs.

The second type of ARAR, location-specific, sets restrictions on activities based upon the characteristics of the site and/or the nearby suburbs. Examples of this type of ARAR include federal and state siting laws for hazardous waste facilities and sites on the National Register of Historic Places.

The third classification of ARARs, action-specific, refers to the requirements that set controls or restrictions on particular activities related to the management of hazardous substances, pollutants, or contaminants. RCRA regulations for closure of hazardous waste storage units, RCRA incineration standards, and pretreatment standards under the Clean Water Act (CWA) for discharges to publicly-owned treatment works (POTWs) are examples of action specific ARARs.

Subsection 121(d) of CERCLA requires that federal and state substantive requirements that qualify as ARARs be complied with by remedies. Federal, state, or local permits do not need to be obtained for removal or remedial actions implemented on site but their substantive requirement must be obtained. "On site" is interpreted by the USEPA to include the areal extent of contamination and all suitable areas in reasonable proximity to the contamination necessary for implementation of the response action.

ARARs can be identified only on a site-specific basis. They depend on the detected contaminants at a site, site-specific characteristics, and particular remedial actions proposed for the site. Chemical-specific, location-specific, and action-specific ARARs identified for OU No. 10 are presented in the following section.

2.4.1.1 Chemical-Specific ARARs

The following chemical-specific ARARs were identified for Site 35: the North Carolina Water Quality Standards (NCWQSs) applicable to groundwaters, the federal MCLs, and Secondary MCLs. A brief description of each of these standards/guidelines is presented below.

North Carolina Water Quality Standards (Groundwater) - Under the North Carolina Administrative Code (NCAC), Title 15A, Subchapter 2L, Section .0200, (15A NCAC 2L.0200) the NC DEHNR has established water quality standards (NCWQSs) for three classifications of groundwater within the state: GA, GSA, and GC. Class GA waters are those groundwaters in the state naturally containing 250 milligram per liter (mg/L) or less of chloride. These waters are an existing or potential source of drinking water supply for humans. Class GSA waters are those groundwaters in the State naturally containing greater than 250 mg/L of chloride. These waters are an existing or potential source of water supply for potable mineral water and conversion to fresh water. Class GC water is defined as a source of water supply for purposes other than drinking. The NCAC T15A:02L.0300 has established sixteen river basins within the state as Class GC groundwaters (15A NCAC 2L.0201 and 2L.0300).

The water quality standards for groundwater are the maximum allowable concentrations resulting from any discharge of contaminants to the land or water of the state that may be tolerated without creating a threat to human health or that would otherwise render the groundwater unsuitable for its intended best usage. If the water quality standard of a substance is less than the limit of detectability, the substance shall not be permitted in detectable concentrations. If naturally occurring substances exceed the established standard, the standard will be the naturally occurring concentration as determined by the State. Substances which are not naturally occurring, and for which no standard is specified, are not permitted in detectable concentrations for Class GA or Class GSA groundwaters (15A NCAC 2L.0202).

The NCWQSs for substances in Class GA and Class GSA groundwaters are established as the lesser of:

- Systemic threshold concentration (based on reference dose and average consumption)
- Concentration which corresponds to an incremental lifetime cancer risk of 1.0E-6
- Taste threshold limit value
- Odor threshold limit value
- Federal MCL
- National Secondary Drinking Water Standard (or secondary MCL)

Note that the water quality standards for Class GA and Class GSA groundwaters are the same except for chloride and total dissolved solids concentrations (15A NCAC 2L.0202).

The Class GA groundwater NCWQSs for the groundwater COCs for OU No. 10 are listed on Table 2-2. As shown on the table, the majority of the state standards are the same or more stringent than the federal MCLs.

Federal Maximum Contaminant Levels - MCLs are enforceable standards for public water supplies promulgated under the SDWA and are designed for the protection of human health. MCLs are based on laboratory or epidemiological studies and apply to drinking water supplies consumed by a minimum of 25 persons. These standards are designed for prevention of human health effects associated with a lifetime exposure (70-year lifetime) of an average adult (70 kg) consuming two liters of water per day. MCLs also consider the technical feasibility of removing the contaminant from the public water supply.

Secondary MCLs are nonenforceable guidelines established under the SDWA. The secondary MCLs are set to control contaminants in drinking water that primarily affect the aesthetic qualities relating to public acceptance of drinking water.

Table 2-2 presents MCLs for groundwater COCs. For manganese and zinc, the secondary MCL has been listed.

2.4.1.2 Location-Specific ARARs

Potential location-specific ARARs identified for OU No. 10 are listed on Table 2-3. An evaluation determining the applicability of these location-specific ARARs with respect to OU No. 10 is also presented and summarized on Table 2-3. Based on this evaluation, specific sections of the following location-specific ARARs may be applicable to OU No. 10:

- Fish and Wildlife Coordination Act
- Federal Endangered Species Act
- North Carolina Endangered Species Act
- Executive Order 11990 on Protection of Wetlands
- Executive Order 11988 on Floodplain Management
- RCRA Location Requirements

Please note that the citations listed on Table 2-3 should not be interpreted to indicate that the entire citation is an ARAR. The citation listing is provided on the table as a general reference.

2.4.1.3 Action-Specific ARARs

Action-specific ARARs are typically evaluated following the development of alternatives since they are dependent on the type of action being considered. Therefore, at this step in the FS process, potential action-specific ARARs have only been identified and not evaluated for OU No. 10. A set of potential action-specific ARARs are listed on Table 2-4. These ARARs are based on RCRA, CWA, SDWA, and Department of Transportation (DOT) requirements. Note that the citations listed on Table 2-4 should not be interpreted to indicate that the entire citation is an ARAR. The citation listing is provided on the table as a general reference.

These ARARs will be evaluated after the remedial action alternatives have been identified for OU No. 10. Additional action-specific ARARs may also be identified and evaluated at that time.

2.4.2 - Risk-Based Remediation Goal Options

In conjunction with the RGOs based on federal and state ARARs (Section 2.4.1), risk-based RGOs were developed for the groundwater COCs. The methodology used to derive the RGOs was in accordance with USEPA risk assessment guidance (USEPA, 1989a) (USEPA, 1991a). For noncarcinogenic effects, an action level was calculated that corresponds to an HI of 1.0, or unity, which is the level of exposure to a contaminant from all significant exposure pathways in a given medium below which it is unlikely for even sensitive populations to experience health effects. For carcinogenic effects, an action level was calculated that corresponds to 1.0E-04 (one in ten thousand) ICR over a lifetime as a result of exposure to the potential carcinogen from all significant exposure pathways for a given medium. A 1.0E-04 risk level was used as an end point for determining action levels for remediation. Based on the NCP (40 CFR 300.430), for known or suspected carcinogens, acceptable exposure levels are generally concentrations that represent an ICR between 1.0E-04 and 1.0E-06. The action levels for OU No. 10 are representative of acceptable incremental risks based on current and probable future use of the area.

Three steps were involved in estimating the risk-based RGOs for OU No. 10 COCs. These steps are generally conducted for a medium and land-use combination and involved identifying: (1) the most significant exposure pathways and routes, (2) the most significant exposure parameters, and (3) equations. The equations included calculations of total intake from a given medium and were based on identified exposure pathways and associated parameters.

2.4.2.1 Derivation of Risk Equations

The determination of chemical-specific RGOs was performed in accordance with USEPA guidance (USEPA, 1989a). Reference doses (RfDs) were used to evaluate noncarcinogenic contaminants, while cancer slope factors (CSFs) were used to evaluate carcinogenic contaminants.

Potential exposure pathways and receptors used to determine RGOs are site-specific and consider the current and/or future land use of a site. The following exposure scenarios were used in the determination of RGOs for OU No. 10:

- Ingestion of groundwater (future resident)

The potential risk estimated in the human health risk assessment indicated that the majority of the site-specific risk is likely to occur from exposure to groundwater. Groundwater does not appear to pose an appreciable risk with respect to both dermal contact and inhalation. For this Interim FS, the most conservative exposure pathway (i.e., groundwater ingestion) was used in the development of RGOs. The RGOs were calculated for future (adult and children) receptors in order to provide site-specific RGOs from which remedial alternatives could be generated.

Consistent with USEPA guidance, noncarcinogenic health effects were estimated using the concept of an average annual exposure. The action level incorporated the exposure time and/or frequency that represented the number of days per year and number of years that exposure occurs. This is used with a term known as the averaging time, which converts the daily exposure to an annual exposure. Carcinogenic health effects were calculated as an incremental lifetime cancer risk, and therefore represented the exposure duration (years) over the course of a potentially exposed individual's lifetime (70 years).

The estimation methods and models used in this section were consistent with current USEPA risk assessment guidance (USEPA, 1989a) (USEPA, 1991a). Exposure estimates associated with each exposure route are presented below. RGOs were developed, with site-specific inputs, for groundwater COCs presented in the human health risk assessment. However, in order to determine if a medium at a site requires remediation, estimated RGOs were compared to site-specific contaminant levels. This assessment was conducted to assure that media and contamination at each site would be addressed on a site-specific basis. The following sections present the equations and inputs used in the estimation of groundwater RGOs developed for OU No. 10.

Ingestion of Groundwater

Currently there are no receptors who are exposed to groundwater contamination in this area. Since groundwater is obtained from "noncontaminated" supply wells, pumped to water treatment plants, and distributed via a potable water system. However, it is assumed for the purposes of calculating remediation goals, that potable wells would pump groundwater from the site area for public consumption. Groundwater ingestion RGOs are characterized using the following equation:

$$Cw = \frac{TR \ or \ THI \times BW \times AT_c \ or \ AT_{nc} \times DY}{CSF \ or \ 1/RfD \times EF \times ED \times IR \times (1{,}000 \ \mu g/mg)}$$

Where:

Cw	=	contaminant concentration in groundwater (μg/L)
TR	=	total lifetime risk
THI	=	total hazard index
BW	=	body weight (kg)
ATc	=	averaging time carcinogens (yr)
ATnc	=	averaging time noncarcinogens (yr)
DY	=	days per year (day/year)
CSF	=	cancer slope factor $(mg/kg\text{-}day)^{-1}$
RfD	=	reference dose (mg/kg-day)
EF	=	exposure frequency (day/year)
ED	=	exposure duration (yr)
IR	=	ingestion rate (L/day)

Future On-Site Residents

Exposure to COCs via ingestion of groundwater was retained as a potential future exposure pathway for both children and adults.

An ingestion rate (IR) of 1.0 liter/day was used for the amount of water consumed by a 1 to 6 year old child weighing 15 kg. This ingestion rate provides a health conservative exposure estimate (for systemic, noncarcinogenic toxicants) designed to protect young children who could potentially be more affected than adolescents, or adults. This value assumes that children obtain all the tap water they drink from the same source for 350 days/year [which represents the exposure frequency (EF)]. An averaging time (AT) of 2,190 days (6 years x 365 days/year) is used for noncarcinogenic compound exposure.

The IR for adults was 2 liters/day (USEPA, 1989a). The exposure duration (ED) used for the estimation of adult CDIs was 30 years (USEPA, 1989a), which represents the national upper-bound (90th percentile) time at one residence. The averaging time for noncarcinogens was 10,950 days (30 years x 365 days/year). An AT of 25,550 days (70 years x 365 days/year) was used to evaluate exposure for both children and adults to potential carcinogenic compounds.

Table 2-5 presents a summary of the input parameters for the ingestion of groundwater scenarios.

2.4.2.2 Summary of Site-Specific Risk-Based Remediation Goal Options

COCs were chosen based on available toxicity data and frequency of detection and available ARARs. RGOs were generated for contaminants with available toxicity data. A summary of the risk-based RGOs calculated for the exposure scenarios is presented below. Separate RGOs for future adult residents and children have been calculated. In addition, both carcinogenic and noncarcinogenic RGOs have been calculated. Calculations are provided in Appendix A of this report.

Ingestion of Groundwater

The groundwater ingestion RGOs were estimated for the groundwater within the entire operable unit. Currently, there are no known receptors who are exposed to contaminated groundwater. Base personnel receive potable water via a base water distribution. However, a hypothetical future ingestion RGO was estimated for the COCs. In order to estimate conservative RGOs for subpopulations (i.e., adult resident and child resident), specific input variables were developed for each subpopulation. Tables 2-6 and 2-7 present the RGOs calculated for the carcinogenic and noncarcinogenic COCs in the groundwater, respectively.

2.5 Comparison of Risk-Based Remediation Goal Options to Maximum Contaminant Concentrations in Groundwater

Generally, RGOs are not required for any contaminants in a medium with a cumulative cancer risk of less than 1.0E-04, where an HI is less than or equal to 1.0, or where the RGOs are clearly defined by ARARs. In order to decrease uncertainties in the estimation of the reasonable maximum exposure (RME), which is the maximum exposure that is reasonably expected to occur at the site, the maximum concentration of a contaminant in a media can be compared to the estimated risk-based RGO if chemical-specific criteria are not available.

In Table 2-8, the carcinogenic and non-carcinogenic risk-based RGOs for groundwater ingestion with respect to future residential receptors (adult and children) are compared to the maximum groundwater contaminant concentrations detected at Site 35 during the RI. The NCWQSs and MCLs are also presented in this table.

2.6 Uncertainty Associated with Risk-Based RGOs

The uncertainties associated with calculating risk-based RGOs are summarized below. The RGO estimations presented in this section are quantitative in nature, and their results are highly dependent upon the accuracy of the input. The accuracy with which input values can be quantified is critical to the degree of confidence that the decision maker has in the action levels.

Most scientific computation involves a limited number of input variables, which are tied together by a scenario to provide a desired output. Some RGO inputs are based on literature values rather than measured values. In such cases the degree of certainty may be expressed as whether the estimate was based on literature values or measured values, not on how well defined the distribution of the input was. Some RGOs are based on parameters; the qualitative statement that the RGO was based on estimated inputs defines the certainty in a qualitative manner.

The toxicity factors, CSFs and RfDs, have uncertainties built into the assumptions used to calculate these values. Because the toxicity factors are determined from high doses administered to experimental animals and extrapolated to low doses to which humans may be exposed, uncertainties exist. Thus, toxicity factors could either overestimate or underestimate the potential effects on humans. However, because human data exists for very few chemicals, risks are based on these values. In addition, the exposure assumptions (e.g., 10 events per year, etc.) also have uncertainties associated with them.

Although RGOs are believed to be full protective for the RME individual(s), the existence of the same contaminants in multiple media or of multiple chemicals affecting the same populations(s), may lead to a situation where, even after attainment of all RGOs, protectiveness is not freely achieved (i.e., cumulative risk may fall outside the risk range).

2.7 Remediation Levels

This section presents the remediation levels (RLs) chosen for OU No. 10. RLs are chosen by the risk manager for the COCs and are included in the Interim FS and the Interim ROD. These numbers derived from the RGOs are no longer goals and should be considered required levels for the remedial actions to achieve.

The RLs associated with OU No. 10 are presented on Table 2-9. This list was based on a comparison of contaminant-specific ARARs (or ARAR-based RGOs) and the site-specific risk-based RGOs. If a COC had an ARAR, the most limiting (or conservative) ARAR was selected as the RL for that contaminant. If a COC did not have an ARAR, the most conservative risk-based RGO was selected for the RL. For all contaminants but arsenic, beryllium, and barium the most limiting ARAR was more conservative than the risk-based RGO. In the cases of arsenic, beryllium and barium, the federal MCLs wee selected in lieu of more conservative RGO values because the MCLs are generally based on the capacity of the best available technology to achieve reductions in groundwater contaminant concentrations.

In order to determine the final COC for OU No. 10, the contaminant concentrations detected at each site were compared to the RLs presented on Table 2-9. The contaminants which exceed at least one of the RLs have been retained as final COCs. The contaminants that did not exceed any of the RLs are no longer considered as COCs with respect to this Interim FS. The final COCs and their associated RLs are presented on Table 2-10.

Several inorganic COCs, including arsenic, beryllium, antimony, barium, cadmium, manganese, nickel, and vanadium, were detected in concentrations that exceeded remediation levels. However, these inorganics will not be addressed in this Interim FS because it is unlikely that their presence is a result of past site activities. (The inorganic concentrations are similar to those detected at other Camp Lejeune sites.) Recently, Baker has employed new sampling techniques for inorganics in groundwater utilizing low-flow pumps. The low-flow pumps minimize particle disturbance and have resulted in reduced levels of total inorganics in groundwater analytical results. As recommended in the RI, inorganics at OU No. 10 will be re-sampled using this low-flow sampling technique. Based on previous experience on other sites at this Activity, it is probable that detected concentrations for some inorganics will then fall below remediation levels. Thus, inorganic COCs exceeding remediation levels will not be addressed at this time and Table 2-11 presents a final list of COCs to be addressed in this Interim FS.

SECTION 2.0 TABLES

TABLE 2-1

PRELIMINARY GROUNDWATER CONTAMINANTS OF CONCERN
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

COCs
Benzene
cis-1,2-Dichloroethene
Ethylbenzene
Methyl Tertiary Butyl Ether
Naphthalene
Toluene
trans-1,2-Dichloroethene
Trichloroethene
Xylenes (Total)
Antimony
Arsenic
Barium
Beryllium
Cadmium
Cobalt
Copper
Lead
Manganese
Mercury
Nickel
Selenium
Thallium
Vanadium
Zinc
2-Methylnaphthalene

TABLE 2-2

CHEMICAL-SPECIFIC ARARs EVALUATED FOR OPERABLE UNIT NO. 10 (SITE 35) INTERIM FEASIBILTIY STUDY CTO-232 MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	NCWQS (1)	Federal MCL (2)
Benzene	1	5
Trichloroethene	2.8	5
Arsenic	50	50
Beryllium	NE	4
cis-1,2-Dichloroethene	70	70
trans-1,2-Dichloroethene	70	100
Ethyl Benzene	29	700
Methyl Tertiary Butyl Ether	200	NE
Toluene	1,000	1,000
Xylenes	530	10,000
Naphthalene	NE	NE
Antimony	NE	6
Barium	2,000	2,000
Cadmium	5	5
Cobalt	NE	NE
Copper	1,000	1,300(3)
Manganese	50	50(4)
Mercury	1.1	2
Nickel	100	100
Selenium	50	50
Vanadium	NE	NE
Zinc	2,100	5,000(4)

Notes: Concentrations expressed in microgram per liter (ug/L)

(1) NCWQS = North Carolina Water Quality Standards for Groundwater

(2) MCL = Safe Drinking Water Act Maximum Contaminant Level

(3) Action Level for Copper

(4) Secondary Maximum Contaminant Level (SMCL)

NE = No Criteria Established

TABLE 2-3

LOCATION-SPECIFIC ARARs EVALUATED FOR OPERABLE UNIT NO. 10 (SITE 35) INTERIM FEASIBILITY STUDY CTO-0232 MCB CAMP LEJEUNE, NORTH CAROLINA

Potential Location-Specific ARAR	General Citation	ARAR Evaluation
National Historic Preservation Act of 1966 - requires action to take into account effects on properties included in or eligible for the National Register of Historic Places and to minimize harm to National Historic Landmarks.	16 USC 470, 40 CFR 6.301(b), and 36 CFR 800	No known historic properties are within or near OU No. 10, therefore, this act will not be considered an ARAR
Archeological and Historic Preservation Act - establishes procedures to provide for preservation of historical and archeological data which might be destroyed through alteration of terrain.	16 USC 469, and 40 CFR 6.301(c)	No known historical or archeological data is known to be present at the sites, therefore, this act will not be considered an ARAR.
Historic Sites, Buildings and Antiquities Act - requires action to avoid undesirable impacts on landmarks on the National Registry of Natural Landmarks.	16 USC 461467, and 40 CFR 6.301(a)	No known historic sites, buildings or antiquities are within or near OU No. 10, therefore, this act will not be considered as an ARAR.
Fish and Wildlife Coordination Act - requires action to protect fish and wildlife from actions modifying streams or areas affecting streams.	16 USC 661-666	Brinson Creek is located near and within the operable unit boundaries. If remedial actions are implemented that modify this creek, this will be an applicable ARAR.
Federal Endangered Species Act - requires action to avoid jeopardizing the continued existence of listed endangered species or modification of their habitat.	16 USC 1531, 50 CFR 200, and 50 CFR 402	Many protected species have been sited near and on MCB Camp Lejeune such as the American alligator, the Bachmans sparrow, the Black skimmer, the Green turtle, the Loggerhead turtle, the piping plover, the Red-cockaded woodpecker, and the rough-leaf loosestrife (LeBlond, 1991),(Fussell, 1991),(Walters, 1991). In addition, the alligator has been sighted on Base (in Wallace Creek). Therefore, this will be considered an ARAR.

TABLE 2-3 (Continued)

LOCATION-SPECIFIC ARARs EVALUATED
FOR OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Potential Location-Specific ARAR	General Citation	ARAR Evaluation
North Carolina Endangered Species Act - per the North Carolina Wildlife Resources Commission. Similar to the Federal Endangered Species Act, but also includes State special concern species, State significantly rate species, and the State watch list.	GS 113-331 to 113-337	Since the American alligator has been sighted within MCB Camp Lejeune (in Wallace Creek), this will be considered an ARAR.
Rivers and Harbors Act of 1899 (Section 10 Permit) - requires permit for structures or work in or affecting navigable waters.	33 USC 403	No remedial actions will affect the navigable waters of the New River. Therefore, this act will not be considered an ARAR.
Executive Order 11990 on Protection of Wetlands - establishes special requirements for Federal agencies to avoid the adverse impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands if a practicable alternative exists.	Executive Order Number 11990, and 40 CFR 6	Based on a review of Wetland Inventory Maps, Brinson Creek has areas of wetlands. Therefore, this will be an applicable ARAR.
Executive Order 11988 on Floodplain Management - establishes special requirements for Federal agencies to evaluate the adverse impacts associated with direct and indirect development of a floodplain.	Executive Order Number 11988, and 40 CFR 6	Based on the Federal Emergency Management Agency's Flood Insurance Rate Map for Onslow County, OU No. 10 is primarily within a minimal flooding zone (outside the 500-year floodplain). However, the immediate areas around Brinson Creek are within the 100-year floodplain (FEMA, 1987). Therefore, this may be an ARAR for the operable unit.
Wilderness Act - requires that federally owned wilderness area are not impacted. Establishes nondegradation, maximum restoration, and protection of wilderness areas as primary management principles.	16 USC 1131, and 50 CFR 35.	No known federally-owned wilderness areas are located near the operable unit, therefore, this act will not be considered an ARAR.

TABLE 2-3 (Continued)

LOCATION-SPECIFIC ARARs EVALUATED
FOR OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Potential Location-Specific ARAR	General Citation	ARAR Evaluation
National Wildlife Refuge System - restricts activities within a National Wildlife Refuge.	16 USC 668, and 50 CFR 27	No known National Wildlife Refuge areas are located near the operable unit, therefore, this will not be considered an ARAR.
Scenic Rivers Act - requires action to avoid adverse effects on designated wild or scenic rivers.	16 USC 1271, and 40 CFR 6.302(e)	No known wild or scenic rivers are located near the operable unit, therefore, this act will not be considered an ARAR.
Coastal Zone Management Act - requires activities affecting land or water uses in a coastal zone to certify noninterference with coastal zone management.	16 USC 1451	No activities at the site will affect land or water uses in a coastal zone, therefore, this act will not be considered an ARAR.
Clean Water Act (Section 404) - prohibits discharge of dredged or fill material into wetland without a permit.	33 USC 404	No actions to discharge dredged or fill material into wetlands will be considered for the operable unit, therefore, this act will not be considered an ARAR.
RCRA Location Requirements - limitations on where on-site storage, treatment, or disposal of RCRA hazardous waste may occur.	40 CFR 264.18	These requirements may be applicable if the remedial actions for the operable unit include the on-site storage, treatment, or disposal of RCRA hazardous waste. Therefore, these requirements may be an applicable ARAR for the operable unit.

TABLE 2-4

ACTION-SPECIFIC ARARs
EVALUATED FOR OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Standard (1)	Action	General Citation
RCRA	Capping	40 CFR 264
	Closure	40 CFR 264, 244
	Container Storage	40 CFR 264, 268
	New Landfill	40 CFR 264
	New Surface Impoundment	40 CFR 264
	Dike Stabilization	40 CFR 264
	Excavation, Groundwater Diversion	40 CFR 264, 268
	Incineration	40 CFR 264, 761
	Land Treatment	40 CFR 264
	Land Disposal	40 CFR 264, 268
	Slurry Wall	40 CFR 264, 268
	Tank Storage	40 CFR 264, 268
	Treatment	40 CFR 264, 265, 268; 42 USC 6924; 51 FR 40641; 52 FR 25760
	Waste Pile	40 CFR 264, 268
CWA	Discharge to Water of United States	40 CFR 122, 125, 136
	Direct Discharge to Ocean	40 CFR 125
	Discharge to POTW	40 CFR 403, 270
	Dredge/Fill	40 CFR 264; 33 CFR 320-330; 33 USC 403
CAA (NAAQS)	Discharge to Air	40 CFR 50
SDWA	Underground Injection Control	40 CFR 144, 146, 147, 268
TSCA	PCB Regulations	40 CFR 761
DOT	DOT Rules for Transportation	49 CFR 107

(1) RCRA = Resource Conservation Recovery Act
CWA = Clean Water Act
CAA = Clean Air Act
(NAAQS) = National Ambient Air Quality Standards
SDWA = Safe Drinking Water Act
DOT = Department of Transportation

TABLE 2-5

INGESTION OF GROUNDWATER
RGO PARAMETERS
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Ingestion of Groundwater Input Parameters			
Input Parameter	Description	Value	Rationale
C_w	Exposure Concentration	Calculated	USEPA, 1989a
TR	Total Lifetime Risk	1.0E-04	USEPA, 1991a
THI	Total Hazard Index	1.0	USEPA, 1991a
BW	Body Weight	Child 15 kg Adult 70 kg	USEPA, 1989a
ATc	Averaging Time Carcinogen	All 70 yr	USEPA, 1989a
ATnc	Averaging Time Noncarcinogen	Child 6 yr Adult 30 yr	USEPA, 1989a
DY	Days Per Year	365 days/yr	USEPA, 1989a
CSF	Carcinogenic Slope Factor	Chemical Specific	IRIS, HEAST, USEPA
RfD	Reference Dose	Chemical Specific	IRIS, HEAST, USEPA
EF	Exposure Frequency	Child 350 days/yr Adult 350 days/yr	USEPA, 1989a
ED	Exposure Duration	Child 6 yr Adult 30 yr	USEPA, 1991b
IR	Ingestion Rate	Child 1 L/day Adult 2 L/day	USEPA, 1989a

TABLE 2-6

INGESTION OF GROUNDWATER CARCINOGENIC RGOs
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY CTO-232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant of Concern	Carcinogenic RGO	
	Adult Resident	Child Resident
Benzene	294	629
Trichloroethene	774	1,659
Arsenic	5	11
Beryllium	2	4

Notes: RGO = Remedial Goal Options
Remediation Goal Options concentrations expressed in ug/L (ppb)
Remediation Goal Options based on a risk of 1.0E-04

TABLE 2-7

INGESTION OF GROUNDWATER NONCARCINOGENIC RGOs
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY CTO-232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant of Concern	Noncarcinogenic RGO	
	Adult Resident	Child Resident
Trichloroethene	219	94
cis-1,2-Dichloroethene	365	156
trans-1,2-Dichloroethene	730	313
Ethyl Benzene	3,650	1,564
Methyl Tertiary Butyl Ether	183	78
Toluene	7,300	3,129
Xylenes	73,000	31,286
Naphthalene	1,460	626
Antimony	15	6
Arsenic	11	5
Barium	2,555	1,095
Beryllium	183	78
Cadmium	18	8
Cobalt	2,190	939
Copper	1,354	580
Manganese	183	78
Mercury	11	5
Nickel	730	313
Selenium	183	78
Vanadium	256	110
Zinc	10,950	4,693

Notes: RGO = Remedial Goal Options
Remediation Goal Options concentrations expressed in ug/L (ppb)
Remediation Goal Options based on a HI of 1.0

TABLE 2-8

COMPARISON OF GROUNDWATER INGESTION RISK-BASED RGOs AND GROUNDWATER CRITERIA TO MAXIMUM GROUNDWATER CONTAMINANT LEVELS
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILTIY STUDY CTO-232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	NCWQS (1)	Federal MCL (2)	RGO (3)		Maximum Groundwater Concentration
			Adult	Child	
Benzene	1	5	294	629	1,660
Trichloroethene	2.8	5	774(4) 219(5)	1,659(4) 94(5)	900
Arsenic	50	50	5(4) 11(5)	11(4) 5(5)	165
Beryllium	NE	4	2(4) 183(5)	4(4) 78(5)	63.5
cis-1,2-Dichloroethene	70	70	365	156	973
trans-1,2-Dichloroethene	70	100	730	313	176
Ethyl Benzene	29	700	3,650	1,564	824
Methyl Tertiary Butyl Ether	200	NE	183	78	319
Toluene	1,000	1,000	7,300	3,129	984
Xylenes	530	10,000	73,000	31,286	1,700
Naphthalene	NE	NE	1,460	626	499
Antimony	NE	6	15	6	10.2
Barium	2,000	2,000	2,555	1,095	3,440
Cadmium	5	5	18	8	340
Cobalt	NE	NE	2,190	939	281
Copper	1,000	1,300(7)	1,354	580	140
Manganese	50	50(6)	183	78	1,420
Mercury	1.1	2	11	5	0.84
Nickel	100	100	730	313	524
Selenium	50	50	183	78	13.5
Vanadium	NE	NE	256	110	886
Zinc	2,100	5,000(6)	10,950	4,693	1,850

Notes: Concentrations expressed in microgram per liter (ug/L)
(1) NCWQS = North Carolina Water Quality Standards for Groundwater
(2) MCL = Safe Drinking Water Act Maximum Contaminant Level
(3) RGO = Risk-based Remediation Goal Options
(4) Carcinogenic RGO
(5) Noncarcinogenic RGO
(6) SMCL = Secondary Maximum Contaminant Level
(7) Action Level
NE = No Criteria Established

TABLE 2-9

REMEDIATION LEVELS FOR COCs
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY CTO-232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant of Concern	RL[1]	Basis of Goal	Corresponding Risk
Benzene	1	NCWQS[2]	
Trichloroethene	2.8	NCWQS	
Arsenic	50	NCWQS	
Beryllium	4	MCL[3]	
cis-1,2-Dichloroethene	70	NCWQS	
trans-1,2-Dichloroethene	70	NCWQS	
Ethyl Benzene	29	NCWQS	
Methyl Tertiary Butyl Ether	200	NCWQS	
Toluene	1,000	NCWQS	
Xylenes	530	NCWQS	
Naphthalene	626	Risk-Ingestion	HI[4]=1
Antimony	6	MCL[5]	
Barium	2,000	NCWQS	
Cadmium	5	NCWQS	
Cobalt	939	Risk-Ingestion	HI=1
Copper	1,000	NCWQS	
Manganese	50	NCWQS	
Mercury	1.1	NCWQS	
Nickel	100	NCWQS	
Selenium	50	NCWQS	
Vanadium	110	Risk-Ingestion	HI=1
Zinc	2,100	NCWQS	

Notes: Concentrations expressed in microgram per liter (ug/L)
[1] RL = Remediation Level
[2] NCWQS = North Carolina Water Quality Standards for Groundwater
[3] MCL = Maximum Contaminant Level
[4] HI = Hazard Index

TABLE 2-10

COCs THAT EXCEED REMEDIATION LEVELS
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY CTO-232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant of Concern	RL[1,2]
Benzene	1
Trichloroethene	2.8
Arsenic	50
Beryllium	4
cis-1,2-Dichloroethene	70
trans-1,2-Dichloroethene	70
Ethyl Benzene	29
Methyl Tertiary Butyl Ether	200
Xylenes	530
Antimony	6
Barium	2,000
Cadmium	5
Manganese	50
Nickel	100
Vanadium	110

[1] RL = Remediation Level
[2] Groundwater RLs expressed as ug/L (ppb)

TABLE 2-11

ORGANIC COCs THAT EXCEED REMEDIATION LEVELS
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY CTO-232
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant of Concern	RL[1,2]
Benzene	1
Trichloroethene	2.8
cis-1,2-Dichloroethene	70
trans-1,2-Dichloroethene	70
Ethyl Benzene	29
Methyl Tertiary Butyl Ether	200
Xylenes	530

[1] RL = Remediation Level
[2] Groundwater RLs expressed as ug/L (ppb)

3.0 IDENTIFICATION AND PRELIMINARY SCREENING OF REMEDIAL TECHNOLOGIES

This section covers the identification and preliminary screening of remedial action technologies that may be applicable for the remediation of the groundwater in the vicinity of the Fuel Farm at OU No. 10. Section 3.1 identifies a set of general response actions which correspond to the remedial action objectives. Section 3.2 identifies a set of remedial technologies and process options applicable to groundwater. Section 3.3 presents the preliminary screening of the remedial technologies and process options. Section 3.4 presents a summary of the preliminary screening, and Section 3.5 presents the process option evaluation.

3.1 General Response Actions

General response actions are broad-based, medium-specific categories of actions that can be identified to satisfy the remedial action objectives of an FS. Five general response actions have been identified that may satisfy the groundwater remedial action objectives at OU No. 10 including no action, institutional controls, containment actions, collection/discharge actions, and treatment actions.

A brief description of each of the above-mentioned general response actions follows.

3.1.1 No Action

The NCP requires the evaluation of the no action response as part of the FS process. A no action response provides the baseline assessment for comparison with other remedial alternatives that have a greater level of response. A no action alternative may be considered appropriate when there is no adverse or unacceptable risks to human health or the environment, or when the response action may cause a greater environmental or health danger than the no action alternative itself.

3.1.2 Institutional Controls

Institutional controls are actions that can be implemented at a site as part of a complete remedial alternative to minimize exposure to potential hazards. With respect to groundwater, institutional controls may include monitoring programs or ordinances which restrict aquifer use and placement of supply wells.

3.1.3 Source Containment Actions

Source containment actions include various technologies which contain and/or isolate the contaminants at a site. These measures are designed to isolate so as to prevent direct exposure to or migration of the contaminated media without disturbing or removing the waste/contaminants from the site. Source containment actions generally serve to cover, seal, chemically stabilize, or provide an effective barrier around specific areas of contamination.

3.1.4 Collection/Discharge Actions

Collection/discharge actions are typically associated with groundwater or surface water and are used to control the movement of contaminants through these media or to covey contaminated portions of these media to treatment units. For this Interim FS, groundwater collection/discharge actions at

OU No. 10 are addressed. Collection actions may include extraction wells or subsurface drains. Discharge actions are those means for discharging groundwater that has been treated. Discharge actions may be directed on site or off site.

3.1.5 Treatment Actions

3.1.5.1 Ex Situ Treatment

Ex situ treatment actions, as defined herein, involve physical and/or chemical means of reducing toxicity or destroying contaminants that are present in groundwater once it has been collected and conveyed above the ground surface. Ex situ treatment actions for groundwater are normally conducted on site, but off-site treatment actions are also considered.

3.1.5.2 In Situ Treatment

In situ treatment in groundwater refers to a process whereby groundwater contaminants are reduced or eliminated via technologies applied primarily below the ground surface. This type of treatment may involve groundwater extraction, treatment, and reinjection, as long as primary treatment occurs below the ground surface.

3.2 Identification of Remedial Action Technologies and Process Options

In this step, an extensive set of potentially applicable technology types and process options is identified for each of the general response actions identified for the media of concern at OU No. 10. The term "technology type" refers to general categories of technologies such as chemical treatment, thermal treatment, biological treatment, and in situ treatment. The term "technology process option" refers to specific processes within each technology type. For example, rotary kiln, fluidized bed, and multiple hearth incineration are process options of thermal treatment. Several technology types may be identified for each general response action, and numerous technology process options may exist within each technology type.

Remedial action technologies potentially applicable to OU No. 10 are listed in Table 3-1 with respect to their corresponding general response action. The applicable process options associated with each of the listed technologies are also listed in the table.

3.3 Preliminary Screening of Remedial Action Technologies and Process Options

In this step, the set of remedial action technologies and process options identified in the previous section is reduced (or screened) by evaluating the technologies with respect to technical implementability and site-specific factors. This screening step is site-specific and is accomplished by using readily available information from the RI, with respect to contaminant types, contaminant concentrations, and on-site characteristics, to screen out technologies and process options that cannot be effectively implemented at the site (USEPA, 1988). In general, all technologies/options which appear to be applicable to the site contaminants and to the site conditions are retained for further evaluation. The preliminary screening is presented in Table 3-2. Each of the process options remaining after the preliminary screening is evaluated in Section 3.4.

As shown in Table 3-2, several technologies and/or process options were eliminated from further evaluation since they were determined to be inappropriate for the site-specific characteristics and/or contaminant-specific characteristics of OU No. 10.

3.4 Process Options Evaluation

The objective of the process option evaluation is to select only one process option for each applicable remedial technology type to simplify the subsequent development and evaluation of alternatives without limiting flexibility during remedial design. More than one process option may be selected for a technology type if the processes are sufficiently different in their performance that one would not adequately represent the other. The representative process provides a basis for developing performance specifications during preliminary design. However, the specific process option used to implement the remedial action may not be selected until the remedial design phase.

The retained process options are evaluated based on effectiveness, implementability, and relative cost. The effectiveness evaluation focuses on: the potential effectiveness of process options in meeting the remedial action objectives, the potential impacts to human health and the environment during the construction and implementation phase, and how reliable the process is with respect to the contaminants of concern. The implementability evaluation focuses on the administrative feasibility of implementing a technology as well as the technical implementability. The cost evaluation plays a limited role in this screening. Only relative capital and operating and maintenance (O&M) costs are used instead of detailed estimates. Per the USEPA FS guidance, the cost analysis is made on the basis of engineering judgment.

A summary of the groundwater process option evaluation is presented in Table 3-3. It is important to note that the elimination of a process option does not mean that the process option/technology can never be reconsidered for the site. As previously stated, the purpose of this part of the Interim FS process is to simplify the development and evaluation of potential alternatives.

SECTION 3.0 TABLES

TABLE 3-1

POTENTIAL SET OF REMEDIAL ACTION TECHNOLOGIES AND PROCESS OPTIONS IDENTIFIED FOR OPERABLE UNIT NO. 10 (SITE 35) INTERIM FEASIBILITY STUDY, CTO-0232 MCB CAMP LEJEUNE, NORTH CAROLINA

Media	General Response Action	Remedial Action Technology	Process Option
Groundwater	No Action	No Action	Natural Attenuation
	Institutional Controls	Monitoring	Groundwater and Surface Water Monitoring
		Aquifer-Use Limitations	Restrictions in Base Master Plan
			Deed Restrictions
	Containment Actions	Capping	Clay/Soil Cap
			Asphalt/Concrete Cap
			Soil Cover
			Multilayered Cap
		Vertical Barriers	Grout Curtain
			Slurry Wall
			Sheet Piling
			Rock Grouting
		Horizontal Barriers	Grout Injection
			Block Displacement
	Collection/Discharge Actions	Extraction	Extraction Wells
			Extraction/Injection Wells
		Subsurface Drains	Interceptor Trenches
		On-Site Discharge	Reinjection
			Infiltration Galleries
			Surface Water
		Off-Site Discharge	POTW
			Base STP
			Surface Water
	Treatment Actions	Biological Treatment	Aerobic
			Anaerobic
		Physical/Chemical Treatment	Air Stripping
			Steam Stripping
			Carbon Adsorption
			Reverse Osmosis
			Ion Exchange
			Chemical Reduction
			Chemical Oxidation
			UV Oxidation
			Electrochemical Iron Generation

TABLE 3-1 (Continued)

POTENTIAL SET OF REMEDIAL ACTION TECHNOLOGIES AND
PROCESS OPTIONS IDENTIFIED FOR OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Media	General Response Action	Remedial Action Technology	Process Option
Groundwater (Cont.)	Treatment Actions (Cont.)	Physical/Chemical Treatment (Cont.)	Neutralization
			Precipitation
			Oil/Water Separator
			Filtration
			Flocculation
			Sedimentation
			Chemical Dechlorination
		Engineered Wetland Treatment	Constructed Wetlands
		Off-Site Treatment	POTW
			RCRA Facility
			Sewage Treatment Plant
		In-Situ Treatment	Biodegradation
			Air Sparging
			In Well Aeration
			Passive Treatment Wall

TABLE 3-2

PRELIMINARY SCREENING OF GROUNDWATER TECHNOLOGIES AND PROCESS OPTIONS
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

General Response Action	Remedial Action Technology	Process Option	Description	Site-Specific Applicability	Screening Results
No Action	No Action	Natural Attenuation	Contaminated groundwater remains as is and natural subsurface process (for example, biodegradation, adsorption, and volatilization) reduce contaminant levels.	Potentially applicable to any site; the NCP requires a "no action" process option.	Retained
Institutional Controls	Monitoring	Groundwater or Surface Water Monitoring	Ongoing monitoring of groundwater or surface water.	Potentially applicable.	Retained
	Aquifer-Use Restrictions	Restrictions in Base Master Plan	Prohibit the use of the contaminated aquifer as a drinking water source.	Potentially applicable.	Retained
		Deed Restrictions	Limit the future use of land including placement of wells.	Not applicable to a military installation not on a closure list.	Eliminated
Containment Actions	Capping	Clay/Soil Cap Asphalt/Concrete Cap Soil Cover Multilayered Cap	Capping material placed over areas of contamination.	Not implementable due to the proposed highway that will span the Fuel Farm area and because the horizontal limits of the plume have not been defined to date.	Eliminated
	Vertical Barriers	Grout Curtain	Pressure injection of grout in a regular pattern of drilled holes to contain contamination.	Not applicable because the horizontal limits of the plume have not been defined to date.	Eliminated
		Slurry Wall	Trench around areas of contamination. The trench is filled with a soil bentonite slurry to limit migration of contaminants.	Not applicable due to the obstruction posed by the proposed highway.	Eliminated
		Sheet Piling	Interlocking sheet pilings installed via drop hammer around areas of contamination.	Not applicable due to the obstruction posed by the proposed highway.	Eliminated
		Rock Grouting	Specialty operation for sealing fractures, fissures, solution cavities, or other voids in rock to control flow of groundwater.	Not applicable because rock is not present within several hundred feet of the ground surface at the site.	Eliminated

TABLE 3-2 (Continued)

PRELIMINARY SCREENING OF GROUNDWATER TECHNOLOGIES AND PROCESS OPTIONS
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

General Response Action	Remedial Action Technology	Process Option	Description	Site-Specific Applicability	Screening Results
Containment Actions (Continued)	Horizontal Barriers	Grout Injection	Pressure injection of grout to form a bottom seal across a site at a specific depth.	Generally used in conjunction with vertical barriers which have been primarily deemed not applicable at this site due to the presence of the proposed highway.	Eliminated
		Block Displacement	Continued pumping of grout into specially notched holes causing displacement of a block of contaminated groundwater.	Technique is experimental. Large area over which grout would be required limits this technique.	Eliminated
Collection Actions	Extraction	Extraction/Injection Wells	Extraction wells pull water from the aquifer. Injection wells inject uncontaminated groundwater to enhance collection of contaminated groundwater via the extraction wells. Or the injection wells can also inject material into an aquifer to remediate groundwater.	Not applicable because the extraction/injection process may induce intolerable ground settlement on the highway resulting from fluctuations in the groundwater table.	Eliminated
	Subsurface Drains	Interceptor Trenches	Perforated pipe installed in trenches backfilled with porous media to collect contaminated groundwater.	Potentially applicable because contamination is limited to a shallow zone and rate of extraction can be to limit effects on groundwater level.	Retained
Treatment Actions	Biological Treatment	Aerobic	Degradation of organics using microorganisms in an aerobic environment.	Potentially applicable to nonhalogenated organic COCs.	Retained
		Anaerobic	Degradation of organics using microorganisms in an anaerobic environment.	Potentially applicable to halogenated and nonhalogenated organic COCs. Development is in pilot-scale and is not commercially available.	Eliminated

TABLE 3-2 (Continued)

PRELIMINARY SCREENING OF GROUNDWATER TECHNOLOGIES AND PROCESS OPTIONS
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

General Response Action	Remedial Action Technology	Process Option	Description	Site-Specific Applicability	Screening Results
Treatment Actions (Continued)	Physical/Chemical Treatment	Volatilization (Air/Stream Stripping)	Mixing large volumes of air/steam with water in a packed column to promote transfer of VOCs to air. Applicable to volatile organics.	Potentially applicable to halogenated and nonhalogenated organic COCs.	Retained
		Carbon Adsorption	Adsorption of contaminants onto activated carbon by passing water through carbon column. Applicable to wide range of organics.	Potentially applicable to most organic COCs.	Retained
		Reverse Osmosis	Using high pressure to force water through a membrane leaving contaminants behind. Applicable to dissolved solids (organic and inorganic).	Not applicable because dissolved solids are not anticipated to be a primary treatment concern at this site.	Eliminated
		Ion Exchange	Contaminated water is passed through a resin bed where ions are exchanged between resin and water. Applicable for inorganics, not organics.	Not applicable to the organic COCs. Inorganic compounds are not a primary treatment concern at this site.	Eliminated
		Chemical Reduction	Addition of a reducing agent to lower the oxidation state of a substance to reduce toxicity/solubility. Mainly applicable to inorganic wastes, phenols, pesticides, and sulfur-containing compounds	Not applicable to the organic COCs. Inorganic compounds are not a primary treatment concern at this site.	Eliminated
		Chemical Oxidation	Addition of an oxidizing agent to raise the oxidation state of a substance. Applicable to organics and some metals, primarily iron and manganese.	Not applicable to the organic COCs. Inorganic compounds are not a primary treatment concern at this site.	Eliminated
		Electrochemical Iron Generation	Electrical currents are used to put ferrous and hydroxyl ions into solution for subsequent removal via precipitation. Applicable to metals removal.	Not applicable to the organic COCs. Inorganic compounds are not a primary treatment concern at this site.	Eliminated

TABLE 3-2 (Continued)

PRELIMINARY SCREENING OF GROUNDWATER TECHNOLOGIES AND PROCESS OPTIONS
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

General Response Action	Remedial Action Technology	Process Option	Description	Site-Specific Applicability	Screening Results
Treatment Actions (Continued)	Physical/Chemical Treatment (Continued)	Neutralization	Addition of an acid or base to a waste in order to adjust its pH. Applicable to acidic or basic waste streams.	Not applicable because pH adjustment is not a concern at this site.	Eliminated
		Precipitation	Materials in solution are transferred into a solid phase for removal. Applicable to particulates and metals.	Not applicable to the organic COCs. Inorganic compounds are not a primary treatment concern at this site.	Eliminated
		Oil/Water Separation	Materials in solution are transferred into a separate phase for removal. Applicable to petroleum hydrocarbons.	Not applicable because no free phase product was detected at the site.	Eliminated
		Filtration	Removal of suspended solids from solution by forcing the liquid through a porous medium. Applicable to suspended solids.	Not applicable because the removal of suspended solids and inorganic compounds is not a primary treatment concern at this site.	Eliminated
		UV Oxidation	Ultraviolet (UV) radiation, ozone, and/or hydrogen peroxide are used to destroy organic contaminants as water flows into a treatment tank; an ozone destruction unit treats off-gases from the treatment tank.	Potentially applicable to the organic COCs.	Retained
		Flocculation	Small, unsettleable particles suspended in a liquid medium are made to agglomerate into larger particles by the addition of flocculating agents. Applicable to particulates and inorganics.	Not applicable to the organic COCs. Particulates and inorganic compounds are not anticipated to be a primary treatment concern at this site.	Eliminated
		Sedimentation	Removal of suspended solids in an aqueous waste stream via gravity separation.	Not applicable to the organic COCs. Particulates and inorganic compounds are not anticipated to be a primary treatment concern at this site.	Eliminated

TABLE 3-2 (Continued)

PRELIMINARY SCREENING OF GROUNDWATER TECHNOLOGIES AND PROCESS OPTIONS
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

General Response Action	Remedial Action Technology	Process Option	Description	Site-Specific Applicability	Screening Results
Treatment Actions (Continued)	Physical/Chemical Treatment (Continued)	Chemical Dechlorination (KPEG)	Process which uses specially synthesized chemical reagents to destroy hazardous chlorinated molecules or to toxify them to form other less harmful compounds. Applicable to PCBs, chlorinated hydrocarbons and dioxins.	Not applicable to the organic COCs.	Eliminated
	Thermal Treatment	Incineration/ Thermal Desorption	Combustion of waste at high temperatures. Different incinerator types can be applicable to pumpable organic wastes, combustible liquids, soils, slurries, or sludges.	Not applicable to non-combustible liquids such as the groundwater.	Eliminated
	Engineered Wetland Treatment	Constructed Wetlands	An engineered complex of plants, substrates, water, and microbial populations. Contaminants are removed via plant uptake, biodegradation (organics only), precipitation, and sorption processes.	Not applicable to the halogenated organic COCs.	Eliminated
	Off-site Treatment	POTW	Extracted groundwater discharged to Jacksonville POTW for treatment.	Not implementable since this POTW will not accept contaminated groundwater.	Eliminated
		RCRA Facility	Extracted groundwater discharged to licensed RCRA facility for treatment and/or disposal.	Not implementable due to large volume of groundwater.	Eliminated
		Sewage Treatment Plant	Extracted groundwater discharged to Base STP for treatment.	Not implementable since Base STP cannot effectively treat highly concentrated VOCs.	Eliminated

TABLE 3-2 (Continued)

PRELIMINARY SCREENING OF GROUNDWATER TECHNOLOGIES AND PROCESS OPTIONS
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

General Response Action	Remedial Action Technology	Process Option	Description	Site-Specific Applicability	Screening Results
Treatment Actions (Continued)	In Situ Treatment	Bioventing	System of introducing nutrients and oxygen to waste for the stimulation or augmentation of microbial activity to degrade contamination. Applicable to nonhalogenated organic compounds.	Potentially applicable to the nonhalogenated COCs.	Retained
		Air Sparging	The injection of air under pressure in groundwater to remove VOCs via volatilization. Air bubbles migrate into the vadose zone where they can be extracted or treated by other methods. Introduction of air also may promote degradation of contaminants through biological transformation.	Potentially applicable using horizontal or angled drilling techniques.	Retained
		Dual-Phase Vacuum Extraction	Extraction of a two-phase air-water stream under high vacuum using wells screened above and below the water table.	Not applicable because the proposed highway serves as obstruction to the vertical wells required for the implementation of this type of system.	Eliminated
		In-Well Aeration (a.k.a. UVB, vacuum vaporizer well, in-situ air stripping)	Process of inducing air into a well by applying a vacuum. Results in an in-well airlift pump effect that serves to strip volatiles from groundwater inside the well.	Similar to air sparging. Potentially applicable.	Retained
		Passive Treatment Wall	A permeable reaction wall is installed across the flow path of a contaminant plume, allowing the plume to passively more through the wall.	Potentially applicable to the halogenated organic COCs.	Retained

TABLE 3-2 (Continued)

PRELIMINARY SCREENING OF GROUNDWATER TECHNOLOGIES AND PROCESS OPTIONS
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

General Response Action	Remedial Action Technology	Process Option	Description	Site-Specific Applicability	Screening Results
Discharge Actions	On-Site Discharge	Reinjection • Injection Wells • InfiltrationGalleries	Treated water reinjection into the site aquifer via use of shallow infiltration galleries (trenches) or injection wells.	Not applicable. Could induce intolerable ground settlement above the highway from fluctuations in the groundwater table.	Eliminated
		Surface Water	Treated water discharged to Brinson Creek.	Potentially applicable.	Retained
	Off-Site Discharge	POTW	Treated water discharged to Jacksonville POTW.	Not implementable due to distance.	Eliminated
		Surface Water	Treated water discharged to New River.	Potentially applicable.	Retained
		Base STP	Treated water discharged to closest Base STP.	Not implementable due to distance.	Eliminated

TABLE 3-3

SUMMARY OF GROUNDWATER PROCESS OPTION EVALUATION
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

General Response Action	Remedial Action Technology	Process Option	Evaluation			Evaluation Results
			Effectiveness	Implementability	Cost	
No Action	No Action	Natural Attenuation	• Evaluation not necessary since it is the only option under this general response action category.	• Evaluation not necessary since it is the only option under this general response action category.	• Evaluation not necessary since it is the only option under this general response action category.	Retained
Institutional Controls	Monitoring	Groundwater Monitoring	• Provides a means for evaluating impact of natural attenuation processes and monitoring contaminant migration.	• Readily implementable, but, will likely require additional monitoring well installation to replace those wells abandoned due to the highway.	• Low capital. • Low to moderate O&M.	Retained
	Aquifer-Use Restrictions	Restrictions in Base Master Plan	• Reduces future direct exposure to contaminated groundwater.	• Readily implementable by Camp Lejeune staff.	• Low capital. • No O&M.	Retained
Collection Actions	Subsurface Drains	Interceptor Trenches	• Commercial track record for collecting and containing a contaminated groundwater plume. • Applicable only for shallow groundwater plumes • Area of influence is limited	• Requires an experienced specialty contractor • May require handling and disposal of a substantial volume if contaminated soil is encountered during excavation • Potential exposures during installation • May require a special permit to install in a wetlands	• Low to moderate to high capital. • Low to moderate O&M	Retained

TABLE 3-3 (Continued)

SUMMARY OF GROUNDWATER PROCESS OPTION EVALUATION
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

General Response Action	Remedial Action Technology	Process Option	Evaluation: Effectiveness	Evaluation: Implementability	Evaluation: Cost	Evaluation Results
Treatment Actions	Biological Treatment	Aerobic	• Not effective treatment for halogenated organics • High levels of halogenated organics may adversely impact treatment of nonhalogenated organics • Contaminants are converted to carbon dioxide and water	• Commercially available technology • Will require bench-scale testing	• Moderate capital. • Moderate O&M.	Eliminated
	Physical/ Chemical Treatment	Volatilization (Air/System Stripping)	• Can potentially remove all organic contaminants • Commercially proven and widely used technology • Contaminant transfer rather than destruction technology	• Commercially available technology • Secondary treatment of off gas may be required • May require air emissions treatment	• Low to moderate capital. • Low to moderate O&M.	Retained
		Carbon Adsorption	• Can potentially remove all organic contaminants • Commercially proven and widely used technology • Contaminant transfer rather than destruction technology	• Commercially available technology • Spent carbon must be properly regenerated or disposed • May require bench-scale testing	• Low to moderate capital. • Low to high O&M (dependent on loading rates and carbon life).	Eliminated
		UV Oxidation	• Can potentially remove all organic contaminants • Commercially proven technology • Contaminant destruction rather than transfer technology • Effectiveness is reduced by high iron and other organic levels in groundwater	• Commercially available technology • Secondary treatment of off gas may be required • May require bench-scale testing	• Moderate to high capital. • Moderate to high O&M.	Eliminated
	In Situ Treatment	Air Sparging	• Can potentially remove all organic contaminants • Commercially proven technology • Contaminant transfer rather than destruction technology	• Commercially available technology • Secondary treatment of off gas may be required • May require air emissions permit	• Moderate to high capital. • Low to moderate O&M.	Retained

TABLE 3-3 (Continued)

SUMMARY OF GROUNDWATER PROCESS OPTION EVALUATION
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

General Response Action	Remedial Action Technology	Process Option	Evaluation			Evaluation Results
			Effectiveness	Implementability	Cost	
Treatment Actions (cont'd)	In Situ Treatment (cont'd)	In-Well Aeration	• Can potentially remove all organic contaminants. • Limited commercial track record. • Contaminant transfer rather than destruction technology.	• Patented technology licensed by a single vendor. • Secondary treatment of off gas may be required. • May require air emissions permit.	• Moderate to high capital. • Low to moderate O&M.	Retained
		Passive Treatment Wall	• Not effective treatment for BTEX contaminants. • Innovative technology with minimal long-term applications. • Contaminant destruction technology.	• Technology currently provided by a single vendor. • May require retrofit after prolonged remediation.	• Moderate to high capital. • Low O&M.	Eliminated

4.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

In this section, general response actions and the process options chosen to represent the various technology types applicable for the contaminated surficial groundwater in the vicinity of the Fuel Farm at Site 35 will be combined to form remedial action alternatives. Following development, each alternative will be evaluated against the short-term and long-term aspects of three criteria (effectiveness, implementability, and cost). The alternatives with the most favorable composite evaluation of all criteria will be retained for further consideration during the detailed evaluation (Section 5.0).

4.1 Development of Alternatives

The general response actions and process options chosen to represent the various applicable technologies identified on Table 3-3 have been combined into five remedial action alternatives (RAAs) potentially applicable for the contaminated surficial aquifer near the Fuel Farm at Site 35.

These RAAs combine one or more of the previously screened process options as follows:

- RAA 1: No Action
- RAA 2: No Action with Institutional Controls
- RAA 3: Groundwater Collection and On-Site Treatment
- RAA 4: In Situ Air Sparging and Off Gas Carbon Adsorption
- RAA 5: In Well Aeration and Off Gas Carbon Adsorption

As indicated by their titles, RAAs 1 and 2 do not include provisions for the active treatment while RAAs 3, 4 and 5 are treatment alternatives. As part of the RAA development process an evaluation is made as to precisely where at a particular site it would be best to install any remediation system designed for shallow groundwater. This is particularly an issue at Site 35 because of the proposed highway which is scheduled for completion prior to implementation of the remediation and will be constructed over a substantial area of previously identified shallow groundwater contamination.

The remedial alternatives developed are considered to be interim in nature because they provide for additional protection to human health and the environment, but are not necessarily intended to represent the final solution for site. This Interim Remedial Action FS does not seek to remediate groundwater contamination across the entire Site 35 because, based on the results of the RI, it has not been adequately defined to date. Since the entire area of shallow contamination cannot be addressed, the alternatives developed for the Interim FS focused on remediating the shallow groundwater contamination along the downgradient extreme of the plume; that is, in the area between the proposed highway and Brinson Creek. A remediation system installed in this area would ideally contain the groundwater contamination from Site 35 prior to its being discharged to Brinson Creek. Additional remediation beneath the proposed highway and further upgradient may be necessary, but should be part of an overall site-wide groundwater remedial action to be considered under a future comprehensive FS.

The proposed highway also represents an access constraint that directly impacts the cost of remediation. Access during construction and operation to the area between the proposed highway and Brinson Creek is critical to this project and can be provided three ways including: 1) via emergency on and off ramps from and to the proposed highway; 2) via a tunnel or culvert through and beneath the proposed highway; or 3) via a dedicated access road constructed parallel to the proposed highway. Although much of the area on the creek side of the highway is marshy, it has been determined that adequate space and firm foundation material will likely be available for any treatment facilities associated with RAAs 3, 4, and 5. In this case, an access road constructed parallel to the new highway on the creek side would be sufficient.

Baker, LANTDIV, and MCB, Camp Lejeune will negotiate with NC DOT regarding the specifics for site access to the creek side of the new highway. The EPA and NC DEHNR will be kept abreast of developments on this subject. In this FS, Baker proposes an access road running along the east side of the highway from the south.

4.1.1 RAA 1: No Action

Under the No Action RAA, no remedial actions will be performed to reduce the toxicity, mobility, or volume of the contaminated surficial groundwater at Site 35. This method assumes that passive remediation will occur via natural attenuation processes and that the contaminant levels will be reduced over an indefinite period of time. However, the achievable reductions versus time is difficult if not impossible to predict.

The No Action RAA is required by the NCP to provide a baseline for comparison with other alternatives. Since contaminants will remain at the site under this alternative, USEPA is required by the NCP [40 CFR 300.515(e)(ii)] to review the effects of this alternative no less often than every five years.

4.1.2 RAA 2: No Action with Institutional Controls

Under RAA No.2, no remedial actions will be performed to reduce the toxicity, mobility, or volume of the contaminated surficial groundwater at Site 35. This RAA assumes that the Base Master Plan will be modified to include restrictions on the use of the surficial aquifer in the vicinity of the Fuel Farm. This will reduce the risk to human health and the environment posed by this media by eliminating one exposure pathway; however, without additional remediation the contaminated surficial groundwater will remain a future source of contamination for Brinson Creek.

In addition to aquifer-use restrictions, long-term groundwater monitoring is to be included under this RAA to provide data regarding the impact of natural attenuation and the progress of contaminant migration. Long-term groundwater monitoring includes the semi-annual collection and analysis (TCL VOCs) of groundwater samples from 11 monitoring wells, the development of a semi-annual monitoring report, and the replacement of one monitoring well every five years. Figure 4-1 depicts possible locations of additional monitoring wells.

Since contaminants will remain at the site under this alternative, the USEPA is required by the NCP [40 CFR 300.515(e)(iii)] to review the effects of this alternative no less often than every five years.

4.1.3 RAA 3: Groundwater Collection and On-Site Treatment

RAA 3 is a source collection and treatment alternative, the source being the contaminated surficial groundwater in the vicinity of the Fuel Farm at Site 35. Under this alternative a vertical interceptor trench will be installed at the downgradient edge of the contaminated plume in the area between the proposed highway and Brinson Creek (see Figure 4-2). The interceptor trench will be installed from the ground surface to the semi-confining layer at the base of the surficial aquifer (see Figures 4-3 and 4-4). The purpose of the interceptor trench is to collect contaminated surficial groundwater for transfer to an on-site treatment facility prior to it being discharged to Brinson Creek.

The type of interceptor trench proposed under RAA 4 is termed a "biopolymer slurry drainage trench." This type of trench can be installed without dewatering or structural bracing. Through the use of a natural, biodegradable slurry, the walls of a trench excavation can be supported and the trench can be installed without personnel entering an excavation. Compared to other trenching methods, this technique is safer and cost-effective in areas with a high groundwater and unstable soil because there are no costs of dewatering and water disposal or shoring.

A biopolymer slurry drainage trench is constructed in much the same manner as a typical slurry cut-off wall. However, unlike a bentonite-clay slurry, a biodegradable biopolymer slurry supports the walls of the trench while excavated materials are removed and drainage structures are installed. The biopolymer slurry then naturally biodegrades after the trench is backfilled. In the end, a permeable wall is left intact (see Appendix B for additional information on this technology).

The interceptor trench will be designed to collect groundwater at a rate roughly equal to the rate of groundwater flow (i.e., roughly 5 to 10 gpm. See calculations contained in Appendix C) across the upgradient face of the trench (31,900 square feet). Flow across the downgradient face of the trench will be restricted by an impermeable geomembrane barrier. Drawdown of the groundwater surface will be minimized so as to mitigate the potential of excessive ground settlement beneath the highway. The collected groundwater will be conveyed to an on-site treatment plant located just east of the proposed highway right-of-way, creek-side, where it appears that adequate space and firm foundation material is available.

Baker, LANTDIV, and MCB, Camp Lejeune will negotiate with NC DOT regarding the specifics for site access to the creek-side of the new highway. The EPA and NC DEHNR will be kept abreast of developments on this subject. In this FS, Baker proposes an access road running along the east side of the highway from the south.

The collected groundwater will be treated sufficiently to allow for its discharge to Brinson Creek at a point downstream of Site 35. It is anticipated that the groundwater treatment system will include filtration for the removal of suspended solids, precipitation for the removal of inorganics, sludge collection and disposal, volatilization (air stripping) for the removal of VOCs, and secondary treatment of VOC emissions from the air stripper and of the treated groundwater (i.e., via carbon adsorption). The treatment plant effluent will be sampled once a month to insure that water discharged to Brinson Creek meets all applicable water quality standards. The process flow diagram is depicted in Figure 4-5.

RAA 3 assumes that the Base Master Plan will be modified to include restrictions on the use of the surficial aquifer in the vicinity of the Fuel Farm. This will reduce the risk to human health and the environment posed by this media by eliminating one exposure pathway.

In addition to aquifer-use restrictions, long-term groundwater monitoring is to be included under this RAA to provide data regarding the impact of natural attenuation and the progress of contaminant migration. Long-term groundwater monitoring includes the semi-annual collection and analysis (TCL VOCs) of groundwater samples from 11 monitoring wells, the development of a semi-annual monitoring report, and the replacement of one monitoring well every five years.

Since contaminants will remain at the site under this alternative, the USEPA is required by the NCP [40 CFR 300.515(e)(iii)] to review the effects of this alternative no less often than every five years.

4.1.4 RAA 4: In Situ Air Sparging And Off-Gas Carbon Adsorption

In situ air sparging (IAS) is a technique in which air is injected into water saturated zones for the purpose of removing organic contaminants primarily via volatilization and secondarily via aerobic biodegradation. IAS systems introduce contaminant-free air into an impacted aquifer near the base of the zone of contamination, forcing contaminants to transfer from the groundwater into sparged air bubbles. The air bubbles are then transported into soil pore spaces in the unsaturated zone where they are typically collected via soil vapor extraction (SVE) and conveyed to an on-site off-gas treatment system.

An IAS system typically is comprised of the following components: 1) air injection wells; 2) an air compressor; 3) air extraction wells; 4) a vacuum pump; 5) associated piping and valving for air conveyance; and 6) an off-gas treatment system (e.g., activated carbon, combustion, or oxidation). Under RAA 4 a line of air sparging wells will be installed between the proposed highway and Brinson Creek in order to treat and contain the contaminated plume near its downgradient extreme (see Figure 4-6). Based on empirical data from similar sites, the radius of influence of an air sparging well ranges from five to almost 200 feet, but is typically on the order of 25 feet (EPA, 1992). A typical well detail and process flow diagram for the IAS system proposed under RAA 4 is depicted in Figure 4-7. The proposed off-gas treatment system, consisting primarily of activated carbon units, will be located east of the proposed highway where it appears that there is adequate space and firm foundation material available for its construction. The air emissions from the off-gas treatment system will be sampled monthly to insure that all applicable air emissions standards are being met.

Air sparging systems are most effective in sandy soils, but, can be adversely impacted by high levels of inorganic compounds in the groundwater which oxidized and precipitate when contacted by the sparged air. These organics can form a heavy scale on well screens and clog the well space of the sand pack surrounding the well screen resulting in a reduction in permeability. A field pilot test is recommended to determine the loss of efficiency over time as a result of inorganics precipitation and oxidation, the radius of influence of the wells under various heads of injection air pressure, and the rate of off-gas organic contaminant removal via carbon adsorption and carbon breakthrough (see Appendix D for additional information on this technology).

Baker, LANTDIV, and MCB, Camp Lejeune will negotiate with NC DOT regarding the specifics for site access to the creek side of the new highway. The EPA and NC DEHNR will be kept abreast of developments on this subject. In this FS, Baker proposes an access road running along the east side of the highway from the south.

RAA 4 assumes that the Base Master Plan will be modified to include restrictions on the use of the surficial aquifer in the vicinity of the Fuel Farm. This will reduce the risk to human health and the environment posed by this media by eliminating one exposure pathway.

In addition to aquifer-use restrictions, long-term groundwater monitoring is to be included under this RAA to provide data regarding the impact of natural attenuation and the progress of contaminant migration. Long-term groundwater monitoring includes the semi-annual collection and analysis

(TCL VOCs) of groundwater samples from 11 monitoring wells, the development of a semi-annual monitoring report, and the replacement of one monitoring well every five years.

Since contaminants will remain at the site under this alternative, the USEPA is required by the NCP [40 CFR 300.515(e)(iii)] to review the effects of this alternative no less often than every five years.

4.1.5 RAA 5: In Well Aeration and Off-Gas Carbon Adsorption

In well aeration is a new technology that utilizes circulating air flow within a groundwater well that, in effect, turns the well into an air stripper. In well aeration differs from air sparging in that volatilization occurs outside the well via air sparging and within the well via in well aeration. Similar to air sparging, this technique removes organic contaminants from groundwater primarily via volatilization and secondarily via aerobic biodegradation. Under RAA 5 a line of in well aeration wells will be installed between the proposed highway and Brinson Creek in order to treat the contaminated plume near its downgradient extreme and contain the migration the plume toward Brinson Creek (see Figure 4-8). The radius of influence or capture zone, of an in well aeration well is reportedly much greater than that of a typical air sparging well. At Site 35, the radius of influence has been calculated by the technology's developers to be over 100 feet. This radius of influence is based upon site specific geological and hydrogeological parameters. Volatilized organic contaminants collected by the in well aeration system, unlike air sparging, will be treated at each in well aeration well by independent carbon adsorption systems which will rest adjacent to the wells. The air emissions from the off-gas treatment system will be sampled monthly to insure that all applicable air emissions standards are being met. Each well and above-ground off-gas treatment system will be housed in a small prefabricated building.

In well aeration systems, like IAS systems, are most effective in sandy soils, but can be adversely impacted by high levels of inorganic compounds in the groundwater which oxidize and precipitate when contacted by air. These inorganics can form a heavy scale on well screens and clog the well space of the sand pack surrounding the well screen resulting in a reduction in permeability. A field pilot test is recommended to determine the loss of efficiency over time as a result of inorganics precipitation and oxidation, the radius of influence of the wells under various heads of injection air pressure, and the rate of off-gas organic contaminant removal via carbon adsorption and carbon breakthrough (see Appendix E for additional information on this technology).

Baker, LANTDIV, and MCB, Camp Lejeune will negotiate with NC DOT regarding the specifics for site access to the creek side of the new highway. The EPA and NC DEHNR will be kept abreast of developments on this subject. In this FS, Baker proposes an access road running along the east side of the highway from the south.

RAA 5 assumes that the Base Master Plan will be modified to include restrictions on the use of the surficial aquifer in the vicinity of the Fuel Farm. This will reduce the risk to human health and the environment posed by this media by eliminating one exposure pathway.

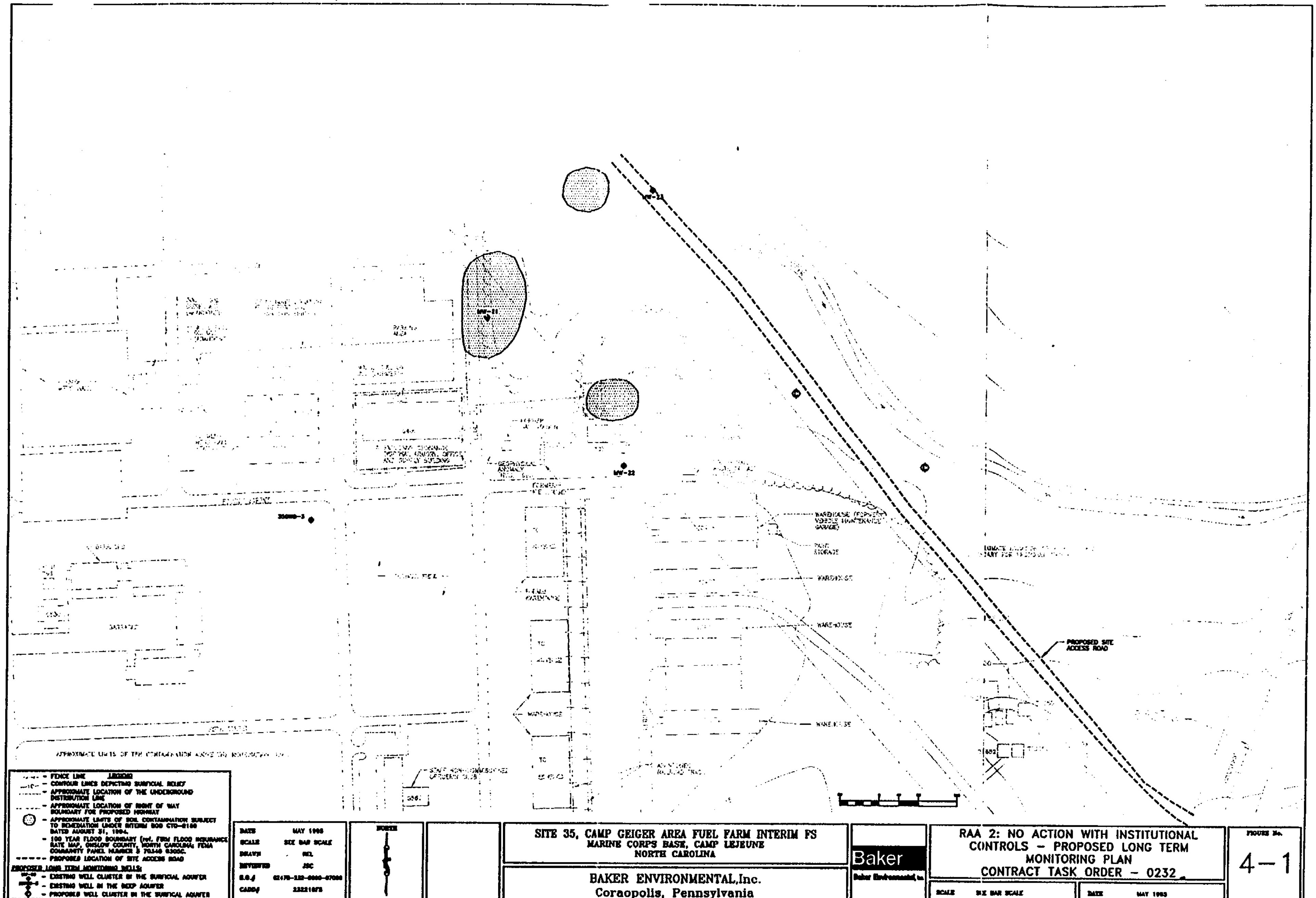
In addition to aquifer-use restrictions, long-term groundwater monitoring is to be included under this RAA to provide data regarding the impact of natural attenuation and the progress of contaminant migration. Long-term groundwater monitoring includes the semi-annual collection and analysis (TCL VOCs) of groundwater samples from 11 monitoring wells, the development of a semi-annual monitoring report, and the replacement of one monitoring well every five years.

Since contaminants will remain at the site under this alternative, the USEPA is required by the NCP [40 CFR 300.515(e)(iii)] to review the effects of this alternative no less often than every five years.

4.2 Screening of Alternatives

Typically, this section of the FS presents the initial screening of the potential RAAs. The objective of this screening is to make comparisons between similar alternatives, so that only the most promising ones are carried forward for further evaluation (USEPA, 1988a). This screening is an optional step in the FS process, and is usually conducted if there are too many RAAs to perform the detailed evaluation on. In the case of Site 35 (OU No. 10), the decision was made not to conduct this preliminary RAA screening step, and therefore, all of the developed RAAs will undergo the detailed evaluation presented in the next section.

SECTION 4.0 FIGURES



DATE	MAY 1995
SCALE	SEE BAR SCALE
DRAWN	RCL
REVIEWED	JSC
S.O.#	02470-232-0000-07000
CADD#	2322107S

SITE 35, CAMP GEIGER AREA FUEL FARM INTERIM FS
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

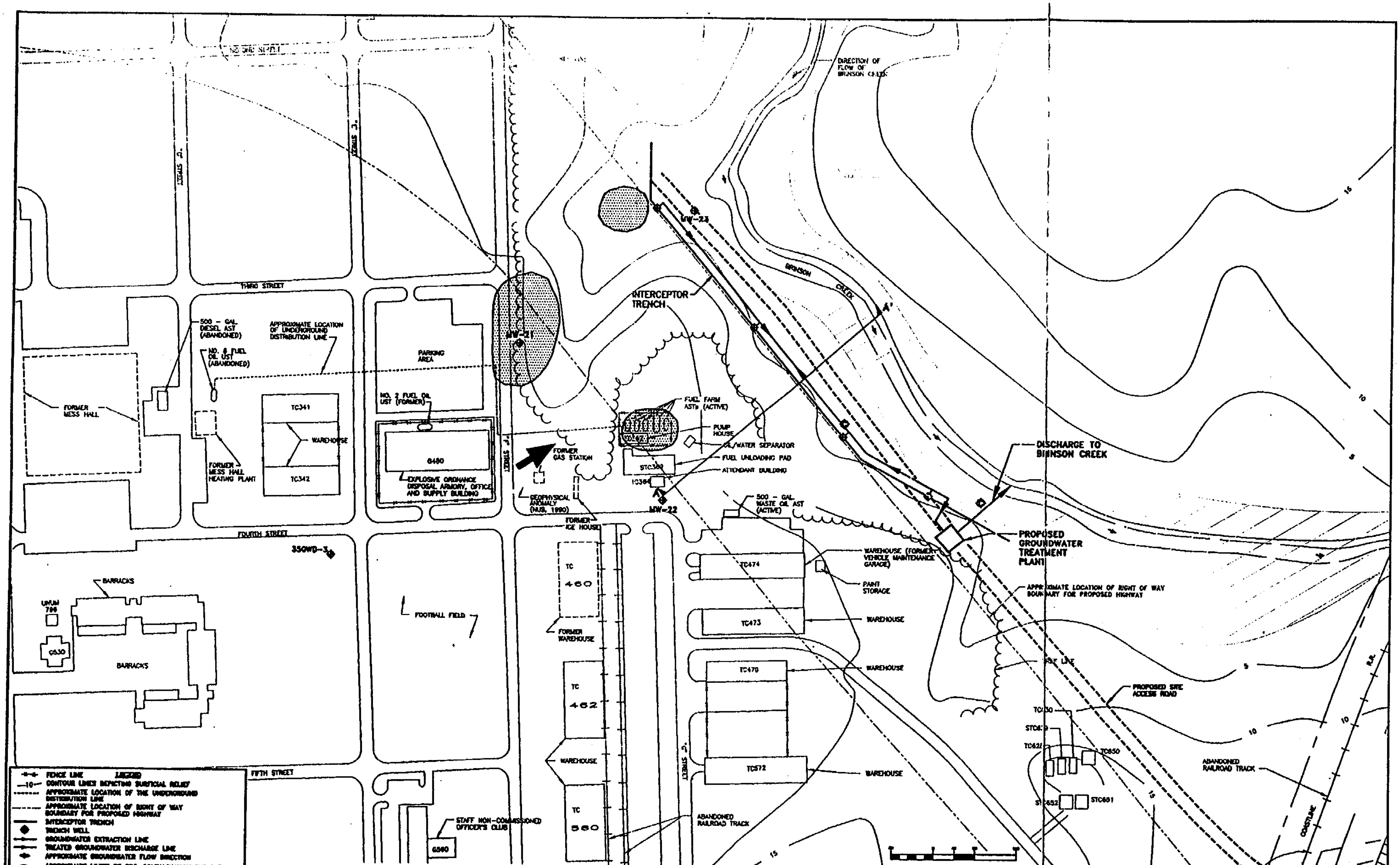
BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

RAA 2: NO ACTION WITH INSTITUTIONAL CONTROLS - PROPOSED LONG TERM MONITORING PLAN
CONTRACT TASK ORDER - 0232

SCALE SEE BAR SCALE
DATE MAY 1995

FIGURE No.
4-1



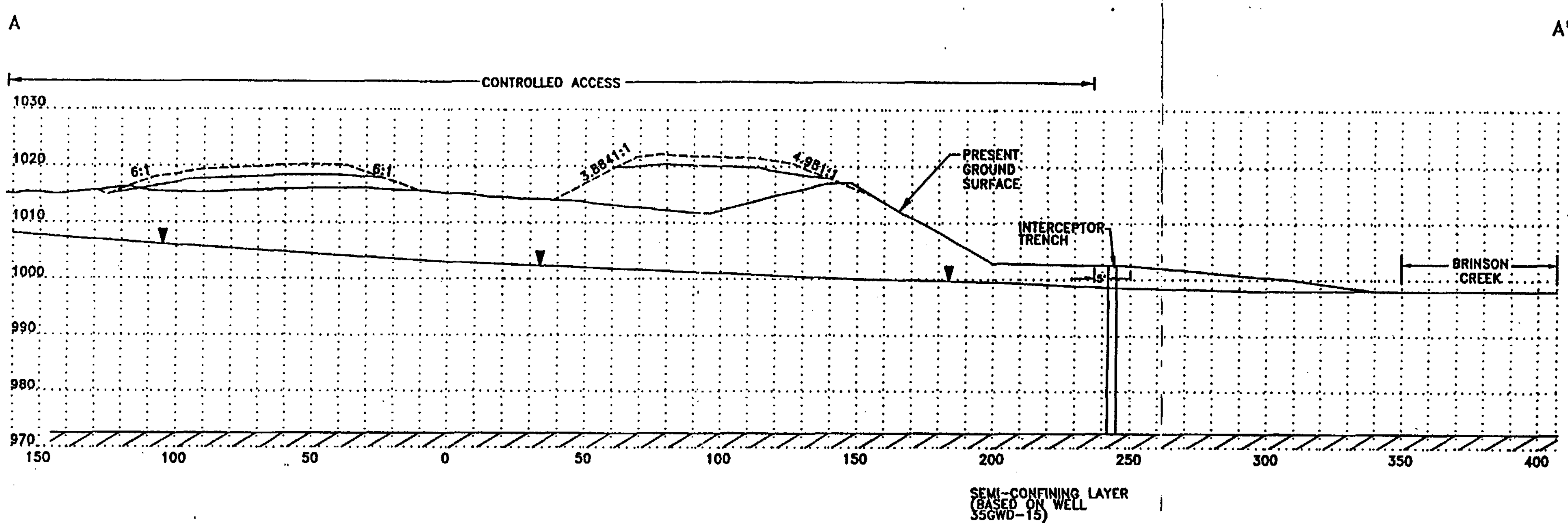
SITE 35, CAMP GEIGER AREA FUEL FARM INTERIM FS
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

RAA 3: GROUNDWATER COLLECTION AND ON-SITE TREATMENT – PLAN VIEW
CONTRACT TASK ORDER – 0232

DATE MAY 1996

FIGURE No. 4-2



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232108FS

LEGEND

▼ GROUNDWATER LEVEL IN THE SURFICIAL AQUIFER

---- SURFACE OF PROPOSED HIGHWAY

SOURCE: LANTDIV, FEB. 1992

Horizontal Scale: 1 inch = 40 ft.

Vertical Scale: 1 inch = 20 ft.

FIGURE 4-3
RAA 3: GROUNDWATER COLLECTION AND ON-SITE TREATMENT - CROSS-SECTION A-A'
SITE 35, CAMP GIEGER FUEL FARM INTERIM FS
CONTRACT TASK ORDER - 0232
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

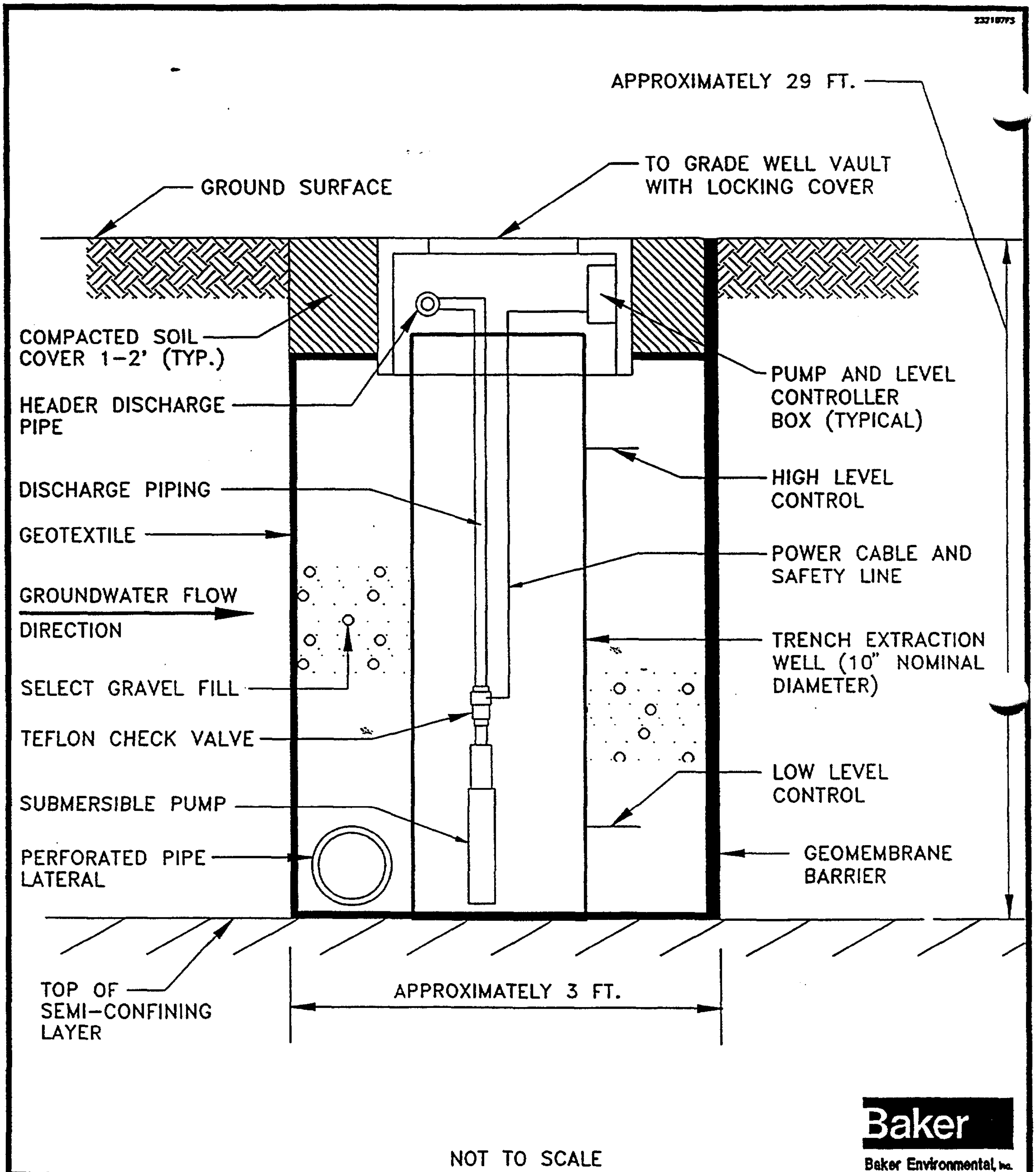
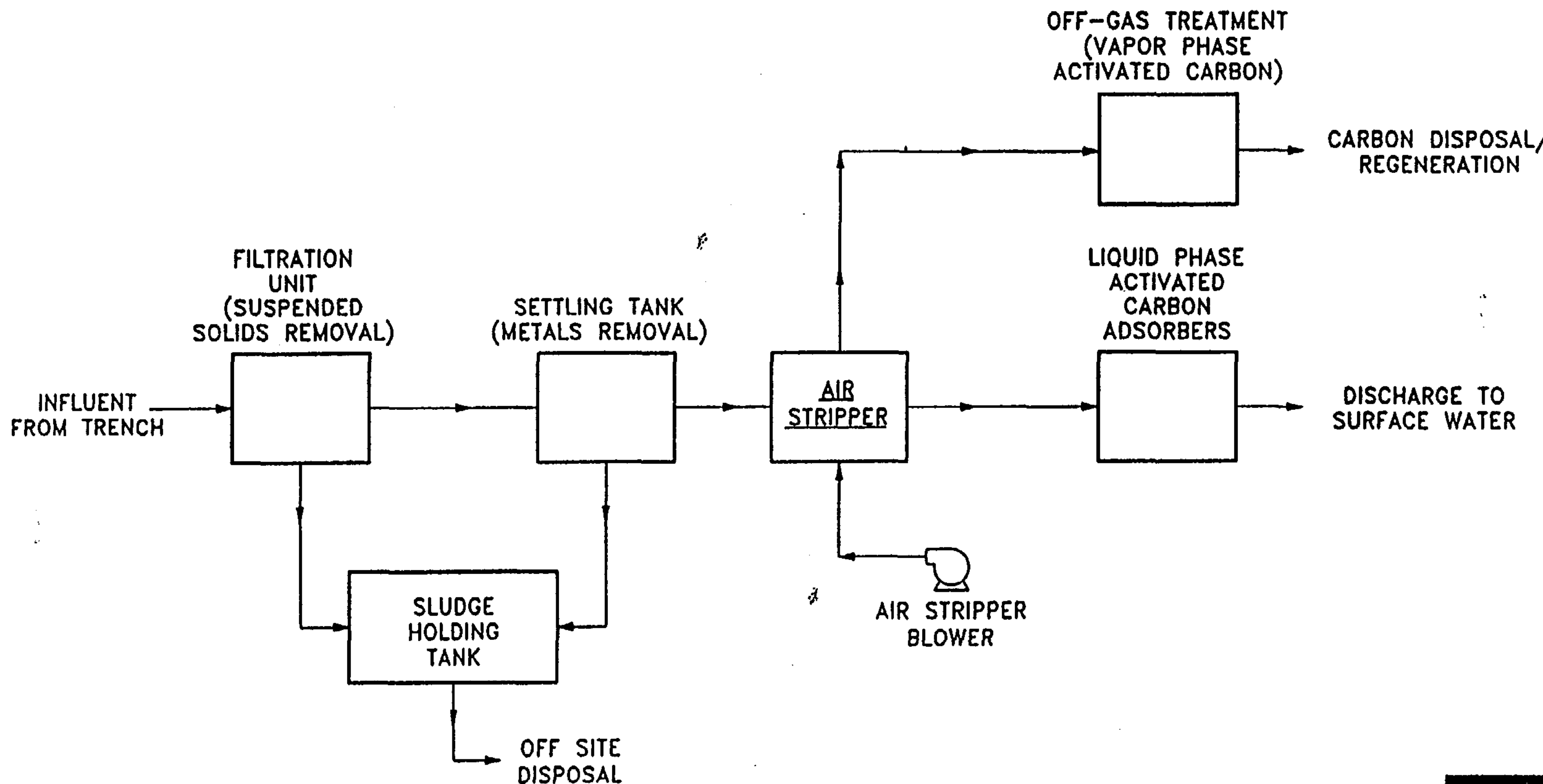


FIGURE 4-4
RAA 3: GROUNDWATER COLLECTION AND ON-SITE TREATMENT-
TYPICAL TRENCH WELL CONSTRUCTION DIAGRAM
SITE 35, CAMP GEIGER AREA FUEL FARM INTERIM FS
CONTRACT TASK ORDER - 0232
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

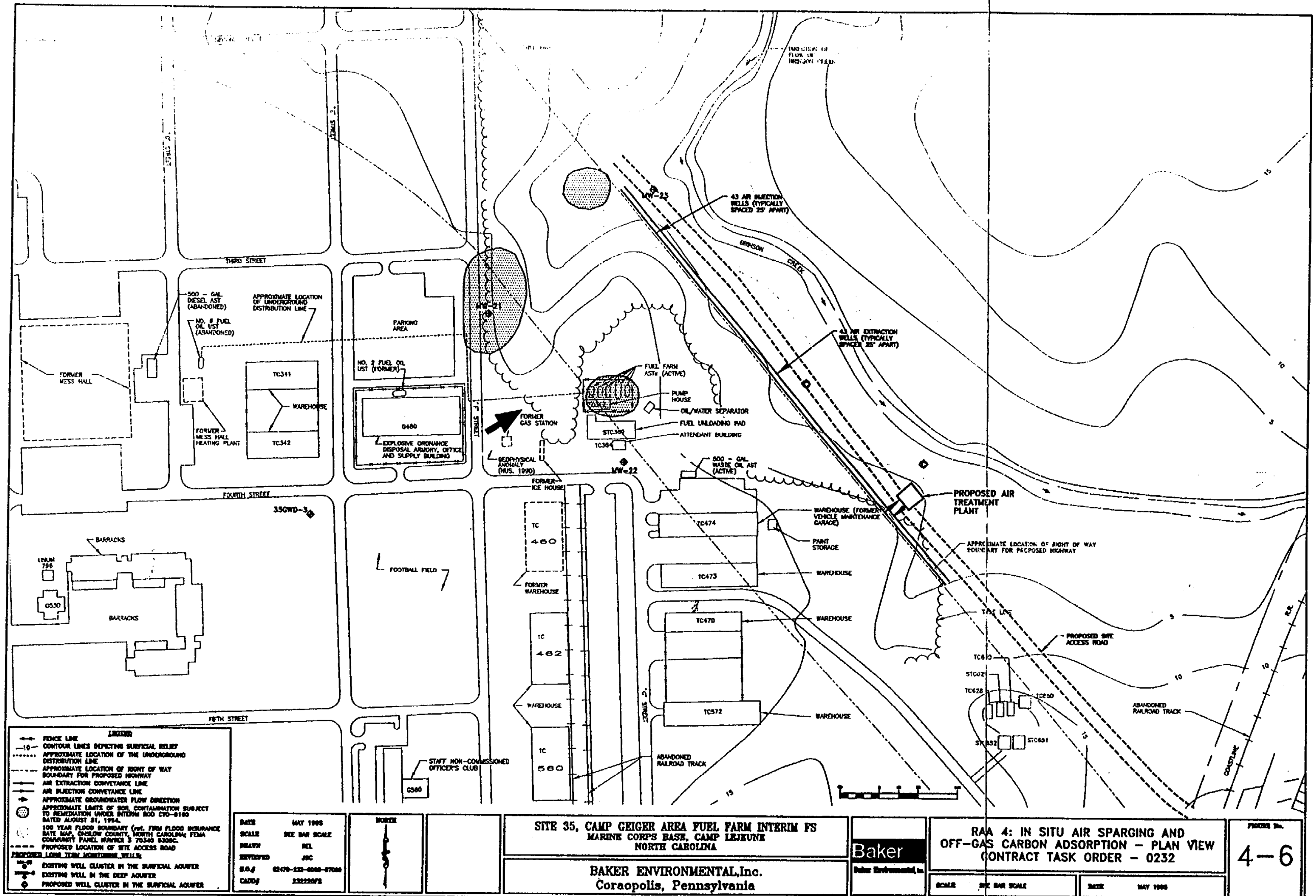


Baker

Baker Environmental, Inc.

FIGURE 4-5
RAA 3: GROUNDWATER COLLECTION AND ON-SITE TREATMENT-
PROCESS FLOW DIAGRAM
SITE 35, CAMP GEIGER AREA FUEL FARM INTERIM FS
CONTRACT TASK ORDER - 0232
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

232109FS


THIRD STREET
FOURTH STREET
FIFTH STREET
500 - GAL DIESEL AST (ABANDONED)
NO. 6 FUEL OIL UST (ABANDONED)
APPROXIMATE LOCATION OF UNDERGROUND DISTRIBUTION LINE
FORMER MESS HALL
FORMER MESS HALL HEATING PLANT
TC341
WAREHOUSE
TC342
PARKING AREA
NO. 2 FUEL OIL UST (FORMER)
G480
EXPLOSIVE ORDNANCE DISPOSAL ARMORY, OFFICE AND SUPPLY BUILDING
MW-21
MW-23
MW-22
43 AIR INJECTION WELLS (TYPICALLY SPACED 25' APART)
43 AIR EXTRACTION WELLS (TYPICALLY SPACED 25' APART)
BRINSON CREEK
FORMER GAS STATION
GEOPHYSICAL ANOMALY (NUS, 1990)
FUEL FARM ASTs (ACTIVE)
PUMP HOUSE
OIL/WATER SEPARATOR
FUEL UNLOADING PAD
ATTENDANT BUILDING
STC360
TC364
500 - GAL WASTE OIL AST (ACTIVE)
FORMER ICE HOUSE
35GWD-3
PROPOSED AIR TREATMENT PLANT
WAREHOUSE (FORMER VEHICLE MAINTENANCE GARAGE)
PAINT STORAGE
TC474
TC473
TC470
TC572
WAREHOUSE
APPROXIMATE LOCATION OF RIGHT OF WAY BOUNDARY FOR PROPOSED HIGHWAY
TREE LINE
PROPOSED SITE ACCESS ROAD
ABANDONED RAILROAD TRACK
BARRACKS
796
G530
FOOTBALL FIELD
TC 460
FORMER WAREHOUSE
TC 462
TC 560
STAFF NON-COMMISSIONED OFFICER'S CLUB
G560
COASTLINE
LEGEND
FENCE LINE
CONTOUR LINES DEPICTING SURFICIAL RELIEF
APPROXIMATE LOCATION OF THE UNDERGROUND DISTRIBUTION LINE
APPROXIMATE LOCATION OF RIGHT OF WAY BOUNDARY FOR PROPOSED HIGHWAY
AIR EXTRACTION CONVEYANCE LINE
AIR INJECTION CONVEYANCE LINE
APPROXIMATE GROUNDWATER FLOW DIRECTION
APPROXIMATE LIMITS OF SOIL CONTAMINATION SUBJECT TO REMEDIATION UNDER INTERIM ROD CTO-0160 DATED AUGUST 31, 1994.
100 YEAR FLOOD BOUNDARY (ref. FIRM FLOOD INSURANCE RATE MAP, ONSLOW COUNTY, NORTH CAROLINA; FEMA COMMUNITY PANEL NUMBER 3 70340 0305C.
PROPOSED LOCATION OF SITE ACCESS ROAD
PROPOSED LONG TERM MONITORING WELLS:
EXISTING WELL CLUSTER IN THE SURFICIAL AQUIFER
EXISTING WELL IN THE DEEP AQUIFER
PROPOSED WELL CLUSTER IN THE SURFICIAL AQUIFER
DATE MAY 1996
SCALE SEE BAR SCALE
DRAWN REL
REVIEWED JSC
NORTH
SITE 35, CAMP GEIGER AREA FUEL FARM INTERIM FS
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA
BAKER ENVIRONMENTAL,Inc.
Coraopolis, Pennsylvania
Baker
RAA 4: IN SITU AIR SPARGING AND OFF-GAS CARBON ADSORPTION - PLAN VIEW
CONTRACT TASK ORDER - 0232
SCALE SEE BAR SCALE
DATE MAY 1996
FIGURE No.
4-6

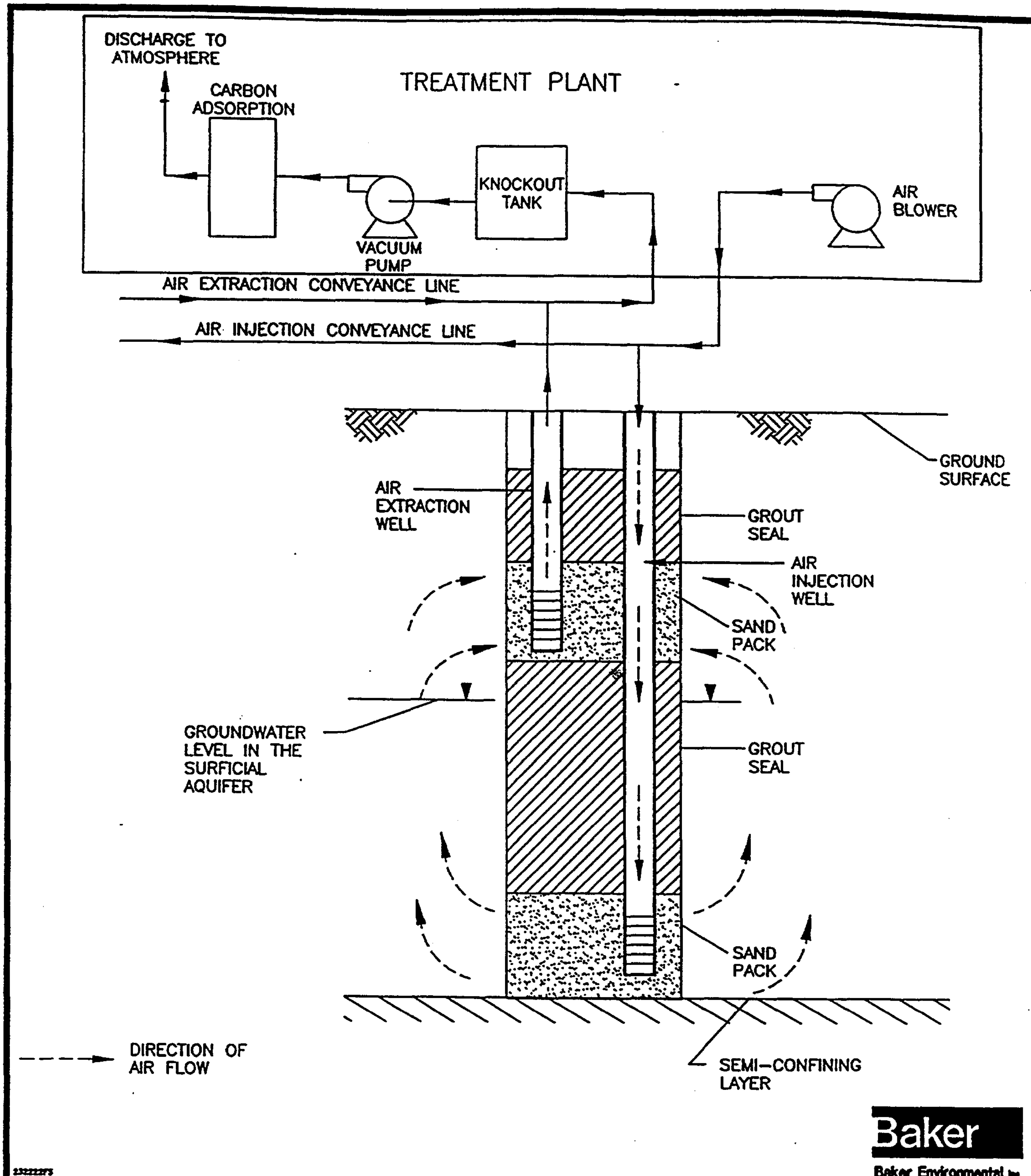
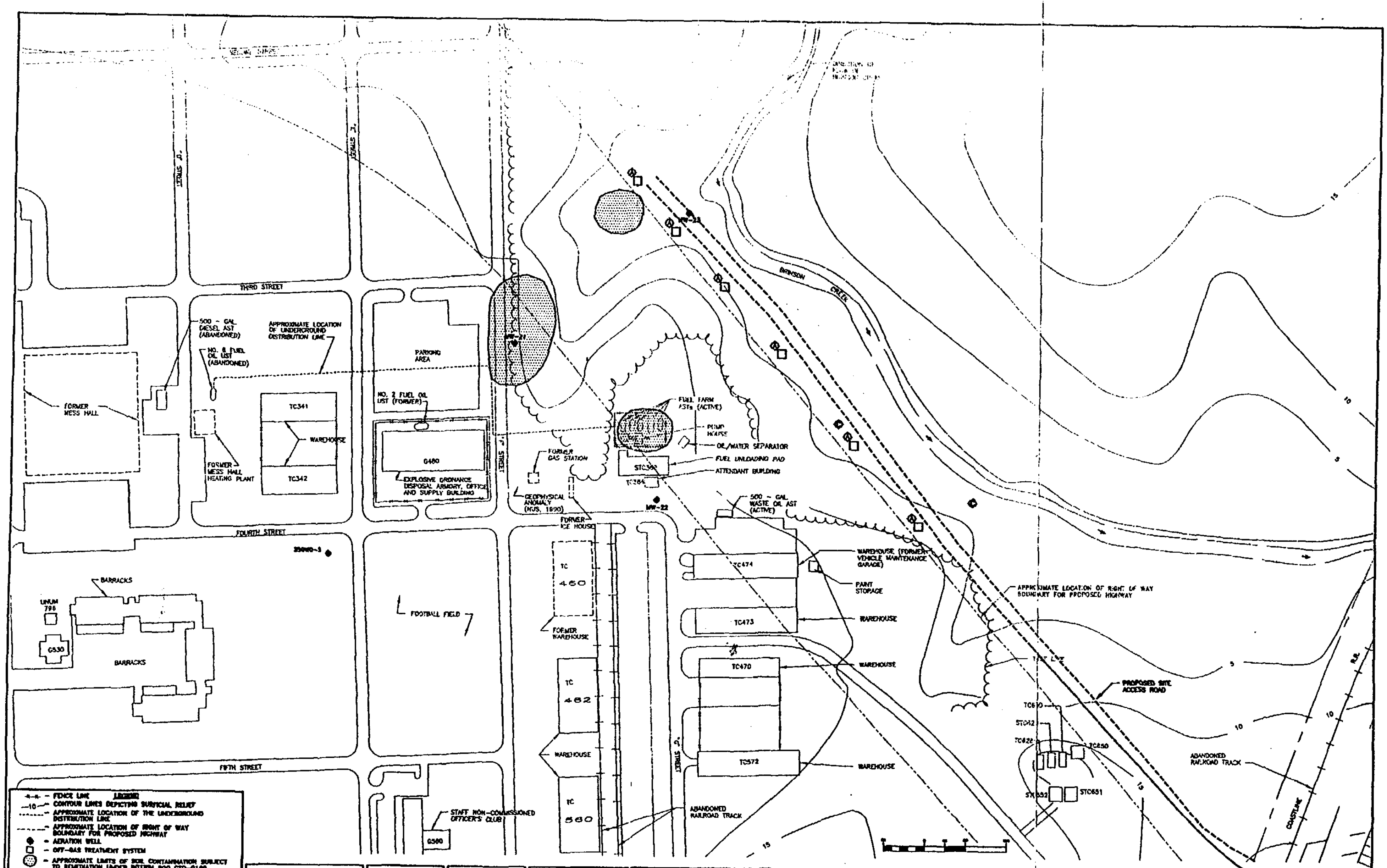


FIGURE 4-7
RAA 4: IN SITU AIR SPARGING AND OFF-GAS CARBON ADSORPTION - TYPICAL WELL DETAIL AND PROCESS FLOW DIAGRAM
SITE 35, CAMP GEIGER AREA FUEL FARM INTERIM FS
CONTRACT TASK ORDER - 0232
MARINR CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



DATE	MAY 1995
SCALE	SEE BAR SCALE
DRAWN	BEL
REVIEWED	JSC
S.O.#	02470-232-0000-07000
CADD#	23222173

SITE 35, CAMP GEIGER AREA FUEL FARM INTERIM FS
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

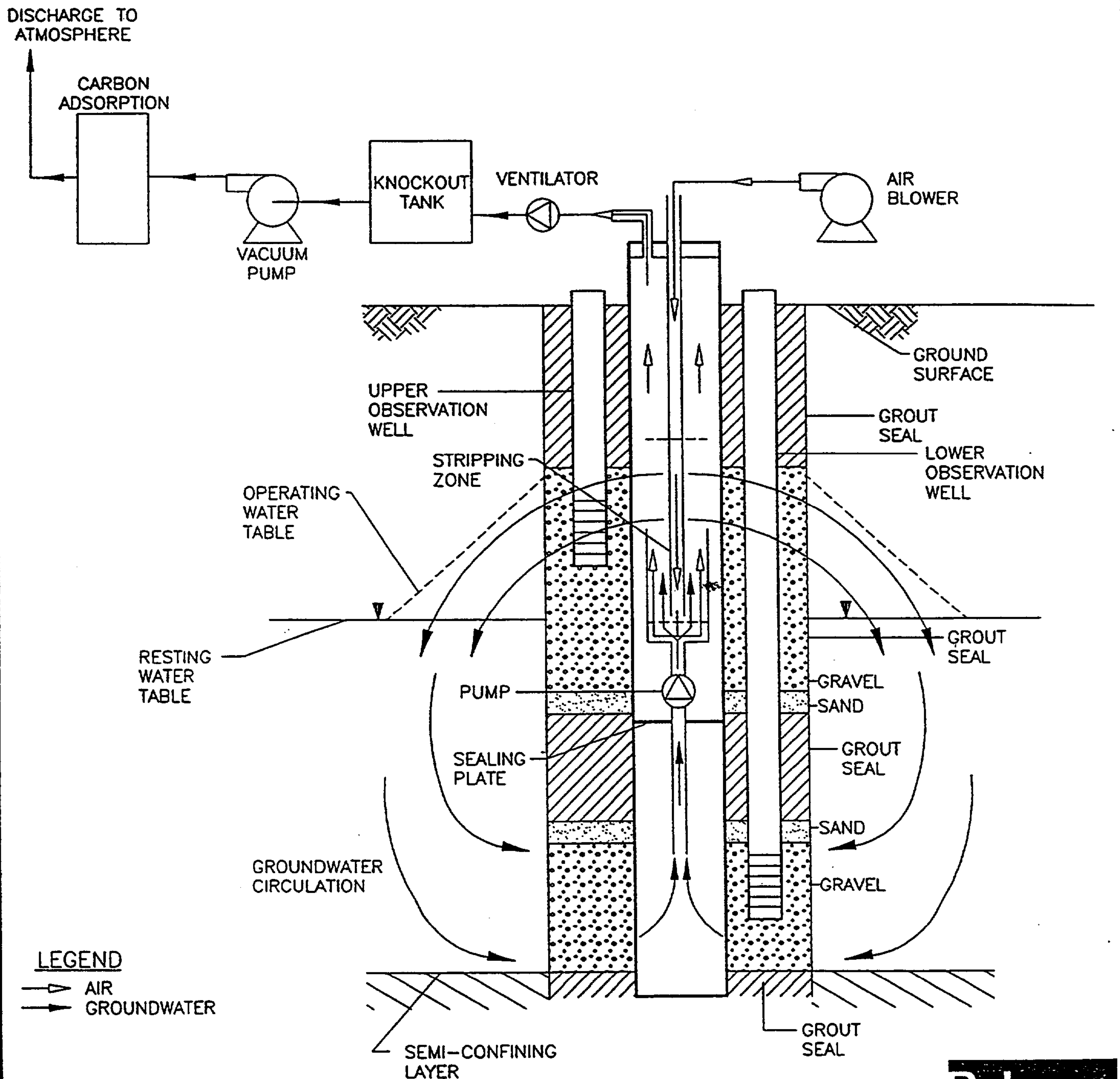
BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

RAA 5: IN WELL AERATION AND OFF-GASS CARBON ADSORPTION - - PLAN VIEW
CONTRACT TASK ORDER - 0232

SCALE: SEE BAR SCALE | DATE: MAY 1995

FIGURE No. 4-8



REFERENCE: HERRLING, B., ET AL., FIGURE 1.(a), P.59.
232223FS

FIGURE 4-9
RAA 5: IN WELL AERATION AND OFF-GAS CARBON ADSORPTION -
TYPICAL WELL DETAIL AND PROCESS FLOW DIAGRAM
SITE 35, CAMP GEIGER AREA FUEL FARM INTERIM FS
CONTRACT TASK ORDER - 0232
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

5.0 -DETAILED ANALYSIS OF ALTERNATIVES

This section of the FS contains the detailed analysis of the set of RAAs developed in Section 4.0. This analysis has been conducted to provide sufficient information to adequately compare the alternatives, select an appropriate remedy for the site, and demonstrate satisfaction of the CERCLA remedy selection requirements in the ROD (USEPA, 1988a).

The extent to which alternatives are assessed during this detailed analysis is influenced by the available data, the number and types of alternatives being analyzed, and the degree to which alternatives were previously analyzed during their development and screening (USEPA, 1988a).

The following nine evaluation criteria serve as the basis for conducting the detailed analysis:

1. Overall protection of human health and the environment
2. Compliance with ARARs
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, or volume
5. Short-term effectiveness
6. Implementability
7. Cost
8. USEPA/State acceptance
9. Community acceptance

The first two criteria (referred to as the Threshold Criteria) relate directly to statutory findings; the next five criteria (referred to as the Primary Balancing Criteria) are the primary criteria upon which the analysis is based; and the final two criteria (referred to as the Modifying Criteria) are typically evaluated following comment on the RI/FS report and the proposed plan.

5.1 Individual Analysis of Alternatives

The individual analysis of the RAAs is presented in the following subsections. This analysis includes an assessment and a summary profile of each of the RAAs against the evaluation criteria, and a comparative analysis among the alternatives to assess the relative performance of each with respect to each of the evaluation criterion.

The cost estimates that have been developed for each of the alternatives include both capital and operational expenditures. The cost evaluation presents the net present worth (NPW) values for each of the alternatives such that the options can be easily compared. The accuracy of each cost estimate depends upon the assumptions made and the availability of costing information. The present worth costs were calculated assuming a 30-year operational period (based on USEPA guidance) for all of the alternatives, a five percent discount factor, and a zero percent inflation rate. All costs presented in the following sections have been updated to 1995 dollar values.

For this FS, it has been assumed that groundwater monitoring will be conducted semiannually for 30 years. This assumption has been made for costing purposes only.

5.1.1 -RAA 1: No Action

5.1.1.1 Description

Under the No action RAA, no remedial actions will be performed to reduce the toxicity, mobility, or volume of the contaminated surficial groundwater at Site 35. This method assumes that passive remediation will occur via natural attenuation processes and that the contaminant levels will be reduced over an indefinite period of time. However, the achievable reductions versus time are difficult, if not impossible to predict.

The No Action RAA is required by the NCP to provide a baseline for comparison with other alternatives. Since contaminants will remain at the site under this alternative, USEPA is required by the NCP [40 CFR 300.515(e) (ii)] to review the effects of this alternative no less often than every five years.

5.1.1.2 Assessment

Overall Protection of Human Health and the Environment

The No Action RAA does not provide for any protection to human health or to the environment with respect to exposure to contaminated surficial groundwater in the vicinity of the Fuel Farm at Site 35. Contaminants in the surficial groundwater will continue to be the source of future contamination via direct discharge to Brinson Creek. Reductions in contaminant levels may occur over time as a result of natural attenuation processes; however, the extent of the attenuation and time required to achieve any reductions is impossible to predict.

Compliance with ARARs

Under the No Action RAA, no active effort will be made to reduce the levels of various organic contaminants in the surficial groundwater to achieve the remediation goals. Therefore, this alternative will not achieve the remediation levels for the COCs identified in Section 2.7.

Long-Term Effectiveness and Permanence

Under the No Action RAA, any long-term or permanent effect on contamination in the surficial aquifer in the vicinity of the Fuel Farm is dependent on reductions achieved via natural attenuation processes. The extent and degree of natural attenuation and time required to achieve it is impossible to predict. Since contaminants will remain at the site under this alternative, USEPA is required by the NCP [40 CFR 300.515(e) (ii)] to review the effects of this alternative no less often than every five years.

Reduction of Toxicity, Mobility, or Volume

The No Action RAA does not provide for any form of active treatment with the exception of natural attenuation processes. Natural attenuation may reduce the toxicity, mobility, or volume of organic contaminants in the surficial groundwater at Site 35; however, the extent and degree of the natural attenuation and time required to achieve it is impossible to predict.

Short-Term Effectiveness

Under the No Action RAA, no construction or treatment activities will be implemented and, consequently, there will be no workers placed at risk to exposure to toxic chemicals. The risks to the public health and the environment will remain unchanged unless natural attenuation processes result in a substantial reduction in contaminant levels.

Implementability

The No Action RAA is easily implementable since no remediation or monitoring activities are required. In terms of administrative feasibility, this RAA should not require coordination with other agencies. The availability of services and materials is not applicable to this alternative.

Cost

There are no capital or operation and maintenance (O&M) costs associated with the No Action RAA.

USEPA/State Acceptance

The No Action RAA is a required component of an FS. It has historically not been deemed acceptable by the USEPA or NC DEHNR at contaminated sites with nearby receptors such as Brinson Creek.

Community Acceptance

There seems to be little public interest in this decision process. Although it can be assumed that the distinct odor which is occasionally prevalent around Brinson Creek due to contaminants would not be desirable to the local community. Under the No Action RAA this odor would persist and likely render this alternative unacceptable to the community.

5.1.2 RAA 2: No Action With Institutional Controls

5.1.2.1 Description

Under RAA No. 2, no remedial actions will be performed to reduce the toxicity, mobility, or volume of the contaminated surficial groundwater at Site 35. This RAA provides for the revision of the Base Master Plan to include restrictions on the use of the surficial aquifer in the vicinity of the Fuel Farm. This will reduce the risk to human health and the environment posed by this media by eliminating one exposure pathway; however, the impacted surficial groundwater will remain a potential source of contamination to Brinson Creek.

In addition to the aquifer-use restrictions, long-term groundwater monitoring is to be included under this RAA to provide data regarding the impact of natural attenuation and the progress of contaminant migration. Long-term groundwater monitoring includes the semi-annual collection and analysis (TCL VOCs) of groundwater samples from 11 monitoring wells, the development of a semi-annual monitoring report, and the replacement of one monitoring well every five years.

Since contaminants will remain at the site under this alternative, the USEPA is required by the NCP [40 CFR 300.515(e) (iii)] to review the effects of this alternative no less often than every five years.

5.1.2.2 Assessment

Overall Protection of Human Health and the Environment

The incorporation of aquifer-use restrictions into the Base Master Plan will provide for protection of human health and the environment to direct exposure to the contaminated surficial groundwater at Site 35. Since no active means of treatment or contaminant reduction is provided for under this RAA, contaminated surficial groundwater discharge to Brinson Creek can be expected to continue. Reductions in contaminant levels may occur over time as a result of natural attenuation processes; however, the extent and degree of the attenuation and time required to achieve it is impossible to predict.

RAA 2 includes long-term groundwater monitoring to provide data regarding the impact of natural attenuation and the progress of contaminant migration.

Compliance With ARARs

Under RAA 2 no effort will be made to reduce the levels of various organic contaminants in the surficial groundwater to achieve the remediation goals. Therefore, this alternative will not achieve the remediation levels for COCs identified in Section 2.7.

Long-Term Effectiveness and Permanence

Upon the implementation of aquifer-use restrictions, RAA 2 provides a permanent means for protecting human health from direct exposure to contaminants within the surficial aquifer at Site 35. However, the impacted surficial aquifer will remain a potential source of contaminant discharge to Brinson Creek. Reductions in contaminant levels may occur over time as a result of natural attenuation processes; however, the extent and degree of the attenuation and time required to achieve it is impossible to predict. Since contaminants will remain at the site under this alternative, USEPA is required by the NCP [40 CFR 300.515(e) (ii)] to review the effects of this alternative no less often than every five years.

Reduction of Toxicity, Mobility, or Volume

RAA 2 does not provide for any form of active treatment of the surficial groundwater at Site 35. Natural attenuation may reduce the toxicity, mobility, or volume of organic contaminants in the surficial groundwater at Site 35; however, the extent and degree of the attenuation and time required to achieve it is impossible to predict.

Short-Term Effectiveness

Under RAA 2, on-site activities will include the installation of four new groundwater monitoring wells and the semi-annual sampling of 11 wells. The potential for worker exposure is limited as these activities will be carried out by trained environmental professionals.

Upon implementation aquifer-use restrictions will reduce the risk of direct exposure to groundwater contamination by civilian and military personnel. However, the surficial aquifer will remain a potential future source contamination via direct discharge to Brinson Creek.

Implementability

RAA 2 will be relatively easy to implement since no remediation activities are involved. Some effort will be required to modify the Base Master Plan and prepare a long-term groundwater monitoring plan. The latter document will be subject to review and some agency interaction can be expected. It is anticipated that four new groundwater monitoring wells will need to be installed primarily as replacements for those wells abandoned when the proposed highway is constructed in 1955. In addition to these four new wells, seven existing wells will be sampled on a semi-annual basis. The results of sample analyses from these 11 wells will be presented in a report prepared semi-annually for agency review. This data will be used to monitor the effects of natural attenuation and the progress of contaminant migration.

Cost

The projected cost of RAA 2 is presented in Table 5-1.

USEPA/State Acceptance

This RAA, No Action with Institutional Controls, is a required component of an FS. It has historically not been deemed acceptable by the USEPA and NC DEHNR at contaminated sites with nearby receptors such as Brinson Creek.

Community Acceptance

There seems to be little public interest in this decision process. Although it can be assumed that the distinct odor which is occasionally prevalent around Brinson Creek due to contaminants would not be desirable to the local community. Under RAA 2 this odor would persist and likely render this alternative unacceptable to the community.

5.1.3 RAA 3: Groundwater Collection and On-Site Treatment

5.1.3.1 Description

RAA 3 is a source collection and treatment alternative, the source being the contaminated surficial groundwater in the vicinity of the Fuel Farm at Site 35. Under this alternative a vertical interceptor trench, approximately two-feet wide, by 30-feet deep, by 1,080 feet long, will be installed at the downgradient edge of the contaminated plume in the area between the proposed highway and Brinson Creek. The interceptor trench will be constructed from the ground surface to the semi-confining layer at the base of the surficial aquifer. The purpose of the interceptor trench is to collect contaminated surficial groundwater for transfer to an on-site treatment facility prior to it being discharged to Brinson Creek.

The type of interceptor trench proposed under RAA 3 is termed a "biopolymer slurry drainage trench." This type of trench can be installed without dewatering or structural bracing. Through the use of a natural, biodegradable slurry, the walls of a trench excavation can be supported and the trench can be installed without personnel entering an excavation. compared to other trenching methods, this technique is safer and cost-effective in areas with a high groundwater and unstable soil because there are not costs of dewatering and water disposal or shoring.

A biopolymer slurry drainage trench is constructed in much the same manner as a typical slurry cut-off wall. However, unlike a bentonite-clay slurry, a biodegradable biopolymer slurry supports the walls of the trench while excavated materials are removed and drainage structures are installed. The biopolymer slurry then naturally biodegrades after the trench is backfilled. In the end, a permeable wall is left intact. In this case an impermeable geotextile will be installed along the downgradient side of the trench so that groundwater will enter the trench from only the upgradient direction.

The interceptor trench will be designed to collect groundwater at a rate roughly equal to the groundwater flow (i.e., roughly 5 to 10 gpm. See calculations contained in Appendix C) across the upgradient face of the trench (31,900 square feet). Flow across the downgradient face of the trench will be restricted by an impermeable geomembrane barrier. Drawdown of the groundwater surface will be minimized so as to mitigate the potential of excessive ground settlement beneath the highway. The collected groundwater will be conveyed to an on-site treatment plant located just east of the proposed highway right-of-way, creek-side, where it appears that adequate space and firm foundation material is available.

Baker, LANTDIV, and MCB, Camp Lejeune will negotiate with NC DOT regarding the specifics for site access to the creek-side of the new highway. The EPA and NC DEHNR will be kept abreast of developments on this subject. In this FS, Baker proposes an access road running along the east side of the highway from the south.

The collected groundwater will be treated sufficiently to allow for its discharge to Brinson Creek at a point downstream of Site 35. It is anticipated that the groundwater treatment system will include filtration for the removal of suspended solids, a settling tank for the removal of metals, sludge collection and disposal, volatilization (air stripping) for the removal of VOCs, and secondary treatment of VOC emissions from the air stripper and of the treated groundwater (i.e., via carbon adsorption). The treatment plant effluent will be sampled once a month to insure that water discharged to Brinson Creek meets all applicable water quality standards.

RAA 3 assumes that the Base Master Plan will be modified to include restrictions on the use of the surficial aquifer in the vicinity of the Fuel Farm. This will reduce the risk to human health and the environment posed by this media by eliminating one exposure pathway.

In addition to aquifer-use restrictions, long-term groundwater monitoring is to be included under this RAA to provide date regarding the impact of natural attenuation and the progress of contaminant migration. Long-term groundwater monitoring includes the semi-annual collection and analysis (TCL VOCs) of groundwater samples from 11 monitoring wells, the development of a semi-annual monitoring report, and the replacement of one monitoring well every five years.

Since contaminants will remain at the site under this alternative, the USEPA is required by the NCP {40 CFR 300.515(e) (iii)] to review the effects of this alternative no less often than every five years.

5.1.3.2-Assessment

Overall Protection of Human Health and the Environment

RAA 3 provides for the overall protection of human health and the environment by intercepting contaminated surficial groundwater prior to its discharge to Brinson Creek and by restricting future use of the surficial aquifer. A reduction of contaminants in the surficial aquifer will result from the collection of groundwater via the interceptor trench and subsequent treatment. Contaminant reduction due to this system will be limited primarily to the zone of capture of the interceptor trench which, based on Baker's experience, will extend 100 feet or less upgradient of the trench.

Aquifer-use restrictions will serve to provide additional protection against direct exposure to contaminated surficial groundwater at the site.

Compliance With ARARs

Under RAA 3 substantial reductions of the levels of organic contaminants in the surficial groundwater can be expected within the capture zone of the interceptor trench. Upgradient of the capture zone some additional reductions can be expected from natural attenuation processes and because contaminants can be expected to continue to flow downgradient toward the interceptor trench. However, no direct means of treatment will be applied in this upgradient area under RAA 3 and it is unlikely that the remediation levels will be achieved upgradient of the capture zone of the interceptor trench.

This RAA proposes that the interceptor trench be installed in the wetlands area between the highway and Brinson Creek. Wetlands are specifically protected by ARARs as is the endangered alligator, one of which has been reported in this area. It is assumed that the intent of federal and state wetlands regulations will be met while conducting RAA 3 activities.

RAA 3 provides for treated groundwater discharge to Brinson Creek and for treated air discharge to the atmosphere. It is assumed that the intent of air and water discharge regulation will be met.

Long-Term Effectiveness and Permanence

RAA 3 will provide an effective and permanent means of intercepting and treating contaminated surficial groundwater and mitigating the risk of future discharges of contaminants to Brinson Creek for as long as the system operates. Additional reductions in contaminant levels may occur over time as a result of natural attenuation processes; however, the extent and degree of the attenuation and time required to achieve any reductions is impossible to predict. Aquifer-use restrictions will provide a permanent means of protection against direct exposure to the surficial aquifer.

The interceptor trench represents technology that requires special skills and experience to install and, consequently, is offered by a limited number of vendors. Once installed, the trench requires standard proven and reliable technology to operate and maintain. Routine maintenance and equipment replacement will be required, but, should be able to be completed without compromising the environmental protection component of the system.

Since contaminants will remain at the site under this alternative, USEPA is required by the NCP [40 CFR 300.515(e) (ii)] to review the effects of this alternative no less often than every five years.

Reduction of Toxicity, Mobility, or Volume

RAA 3 utilizes groundwater collection and on-site, aboveground treatment as the means for reducing contaminant levels in the surficial aquifer at Site 35. Within the capture zone of the interceptor trench a reduction of toxicity, mobility, and volume of organic contaminants in the surficial aquifer can be expected. Upgradient of this capture zone RAA 3 does not provide for any form of active treatment other than natural attenuation processes. Natural attenuation may reduce the toxicity, mobility, or volume of organic contaminants in the surficial groundwater at Site 35; however, the extent and degree of the attenuation and time required to achieve it is impossible to predict.

The on-site treatment process under RAA 3 will produce residual wastes that will require proper handling and disposal. These wastes include solids and metals sludge, and spent activated carbon. Excavated soil will be a residual waste of the trench installation process that will need proper disposal.

RAA 3 satisfies the statutory preference for treatment alternatives.

Short-Term Effectiveness

The installation procedure for the interceptor trench is designed to minimize worker exposure to contaminated groundwater and toxic vapors. During operation the collection and treatment of contaminated surficial groundwater is conducted essentially within a closed loop. The system allows minimal potential for community exposure to contaminants provided air emissions and treated groundwater ARARs are adhered to.

The installation of the trench will result in some disturbance of the wetlands area within which it is proposed to be placed. It has been reported that an alligator, identified as an endangered species, inhabits Brinson Creek. It is assumed that the Contractor will be able to satisfy the intentions of all regulations regarding protection of the wetlands and any endangered species.

RAA 3 will provide short-term protection against the discharge of groundwater contaminants to Brinson Creek. Aquifer-use restrictions will be in effect within a relatively short period; however, no short-term effect will be apparent because the surficial aquifer is not presently utilized at the Activity.

Implementability

RAA 3 will present technical and perhaps regulatory challenges to its implementation. These challenges will stem from the proposed location of the interceptor trench within a wetlands area situated between Brinson Creek and the proposed highway. In addition, biopolymer slurry trench installation is not widely performed and the number of contractors experienced with this method is limited.

Access to the area between the highway and Brinson Creek for construction equipment is limited and will possibly require the cooperation of NCDOT to incorporate access features into the proposed highway design. The proposed trench will be located in a soft soil area which may be difficult for heavy construction equipment to maneuver on. The construction of the trench will temporarily disturb the wetlands area although if proper steps are taken during installation, extraordinary restoration efforts may be avoided. It is assumed that the intent of wetlands regulations and all applicable air and water discharge regulations will be met.

The proposed groundwater monitoring program coupled with regular system operation and maintenance checks should be sufficient to provide notice of a system failure so that adjustments can be made before a significant contaminant release would occur.

Cost

The project cost of RAA 3 is presented in Table 5-2.

USEPA /State Acceptance

The USEPA and NC DEHNR have expressed their concurrence with the inclusion of this RAA. RAA 3 is a treatment technology and therefore acceptable to these agencies. Because RAA 3 is an above-ground technology, it is not as preferable as in situ alternatives, therefore, RAA 3 has been identified as the proposed alternative should RAA 5 be determined to be technically infeasible based on the results of a field test.

Community Acceptance

Based on the lack of community participation at a public meeting held on May 10, 1995, no adverse community reaction to the proposed remedial action is anticipated.

5.1.4 RAA 4: In Situ Air Sparging and Off-Gas Carbon Adsorption

5.1.4.1 Description

In situ air sparging (IAS) is a technique in which air is injected into water saturated zones for the purpose of removing organic contaminants primarily via volatilization and secondarily via aerobic biodegradation. IAS systems introduce contaminant-free air into an impacted aquifer near the base of the zone of contamination, forcing contaminants to transfer from the groundwater into sparged air bubbles. The air bubbles are then transported into soil pore spaces in the unsaturated zone where they are typically collected via soil vapor extraction (SVE) and conveyed to an on-site, off-gas treatment system.

An IAS system typically is comprised of the following components: 1) air injection wells; 2) an air compressor; 3) air extraction wells; 4) a vacuum pump; 5) associated piping and valving for air conveyance; and 6) an off-gas treatment system (e.g., activated carbon, combustion, or oxidation). Under RAA 4 a line of air sparging wells will be installed between the proposed highway and Brinson Creek in order to treat and contain the contaminated plume near its downgradient extreme. Based on empirical data from similar sites, the radius of influence of an air sparging well range from five to almost 200 feet, but is typically on the order of 25 feet (EPA, 1992). For the purpose of the FS, Baker estimates that 43 sparging wells, 30 feet deep, and 43 SVE wells, 4 feet deep, would be required. The proposed off-gas treatment system (activated carbon) will be located just east of the proposed highway where it appears that there is adequate space and firm foundation material available. The air emissions from the off-gas treatment system will be sampled monthly to insure that all applicable air emissions standards are being met.

Air sparging systems are most effective in sandy soils, but, can be adversely impacted by high levels of inorganic compounds in the groundwater which oxidized and precipitate when contacted by the sparged air. These organics can form a heavy scale on well screens and clog the well space of the sand pack surrounding the well screen resulting in a reduction in permeability. A field pilot test is recommended to determine the loss of efficiency over time as a result of inorganics precipitation and oxidation, the radius of influence of the wells under various heads of injection air pressure, and the rate of off-gas organic contaminant removal via carbon adsorption and carbon breakthrough.

Baker, LANTDIV, and MCB, Camp Lejeune will negotiate with NC DOT regarding the specifics for site access to the creek side of the new highway. The EPA and NC DEHNR will be kept abreast of developments on this subject. In this FS, Baker proposes an access road running along the east side of the highway from the south.

RAA 4 assumes that the Base Master Plan will be modified to include restrictions on the use of the surficial aquifer in the vicinity of the Fuel Farm. This will reduce the risk to human health and the environment posed by this media by eliminating one exposure pathway.

In addition to aquifer-use restrictions, long-term groundwater monitoring is to be included under this RAA to provide data regarding the impact of natural attenuation and the progress of contaminant migration. Long-term groundwater monitoring includes the semi-annual collection and analysis (TCL VOCs) of groundwater samples from 11 monitoring wells, the development of a semi-annual monitoring report, and the replacement of one monitoring well every five years.

Since contaminants will remain at the site under this alternative, the USEPA is required by the NCP [40 CFR 300.515 (e) (iii)] to review the effects of this alternative no less often than every five years.

5.1.4.2 Assessment

Overall Protection of Human Health and the Environment

This RAA will provide for the overall protect of human health and the environment by the application of in situ treatment technology to reduce the level of organic contaminants in the surficial aquifer and to provide, in essence, a barrier to minimize the potential for the discharge of organic contaminated groundwater to Brinson Creek. Contaminant reduction due to this system will be limited primarily to the radius of influence of the air sparging wells (estimated at approximately 25 feet).

Aquifer-use restrictions will serve to provide additional protection against direct exposure to contaminated surficial groundwater at the site.

Compliance With ARARs

Under RAA 4 substantial reductions of the levels of organic contaminants in the surficial groundwater can be expected within the radius of influence of the IAS system. Further upgradient some additional reductions can be expected from natural attenuation processes and because contaminants can be expected to continue to flow downgradient toward the air sparging wells.

However, no direct means of treatment will be applied in this upgradient area under RAA 4 and it is unlikely that the remediation levels will be achieved upgradient of the radius of influence of the IAS system.

This RAA proposes that the air sparging wells and much of the associated piping and appurtenances will be installed in the wetlands area between the highway and Brinson Creek. Wetlands are specifically protected by ARARs as is the endangered alligator, one of which has been reported in this area. It is assumed that the intent of federal and state wetlands regulation will be met while conducting RAA 4 activities.

It is also assumed that the intent of air emissions regulations be met during the implementation and operation of RAA 4.

Long-Term Effectiveness and Permanence

This RAA involves in situ treatment technology designed to permanently remove organic contaminants from the surficial aquifer. As an interim action, however, it will be confined to a limited area in the vicinity of the Fuel Farm at Site 35. Based on data obtained under the RI, contaminated surficial groundwater located upgradient of the proposed in situ air sparging system will continue to be a source of contamination to Brinson Creek, however, the organic contaminants should be effectively cut off from discharging to this surface water body by the IAS system.

Air sparging has a significant track record of commercial use and should be able to be controlled adequately and reliably for an indefinite period. High dissolved metals could be precipitated out of solution by the system and cause clogging. This would force frequent maintenance and equipment replacement.

Since contaminants will remain at the site under this alternative USEPA is required by the NCP [40 CFR 300.515 (e) (ii)] to review the effects of this alternative no less often than every five years.

Reduction of Toxicity, Mobility, or Volume

This RAA involves the application of in-situ air sparging technology which, by design, is intended to reduce the volume of volatile organic contaminants in the surficial aquifer where applied by a combination of volatilization and biodegradation. The technology, in essence, works like an in-situ air stripper by injecting air below the groundwater table and, in turn extracting air, presumably laden with volatile organics, from the vadose zone. The contaminants are collected and, in this case, transferred to activated carbon for ultimate disposal. Reductions of contaminants will be limited primarily to the zone defined by the radius of influence of the air sparging wells. Natural attenuation may reduce contaminant levels further over time.

System installation will result in drill cuttings (soil) for which proper disposal will be required. The on-site air treatment will produce residual wastes including spent activated carbon, and a small volume of contaminated water (i.e., condensed vapor collected in a knock-out tank).

RAA 4 satisfies the statutory preference for treatment alternatives.

Short-Term Effectiveness

The primary activity in constructing an IAS system is installing the air injection/extraction wells. This involves standard environmental drilling techniques which, when executed by experienced professionals, should involve minimal risk of exposure to workers. The potential exists for the release of toxic vapors to the atmosphere if the vapor extraction portion of the IAS system is not as efficient as the air sparging portion. This concern increases when IAS systems are installed in areas where the groundwater surface is within a few feet of the ground surface as is the case at Site 35. The release of toxic vapors to the atmosphere during operation of the IAS system could increase the risk of exposure to the surrounding community.

Relative to environmental impacts, the installation of the IAS system should result in minimal disturbance to the wetlands. Furthermore, the line of air sparging wells should serve as a barrier to organic contaminated groundwater discharge to Brinson Creek.

Implementability

IAS technology is widely used and commercially available. Nevertheless, a field pilot-scale study would be appropriate to ensure its effectiveness at Site 35 and to determine critical design parameters. In any in situ system where oxygen is injected, a concern is the effect on the system operation of metals precipitation and oxidation. At high enough levels the metals can clog the well screens, prompting frequent maintenance or even well replacement.

The implementation of this technology will require the installation of multiple air sparging wells in the area between the highway and Brinson Creek. Access to this area for construction equipment is limited and will require the cooperation of NCDOT to incorporate special access features into the proposed highway design.

The construction activities in the wetlands area may result in some disturbance and require restoration efforts. Meeting the intent of air emissions regulations will be necessary.

The proposed groundwater monitoring program coupled with regular system operation and maintenance checks including ambient air monitoring should be sufficient to provide notice of a system failure so that adjustments can be made before a significant contaminant release would occur.

Cost

The project cost of RAA 4 is presented in Table 5-3.

USEPA/State Acceptance

Based on comments received to date, USEPA and NC DEHNR appear to concur that RAA 4, In Situ Air Sparging and Off-Gas Carbon Adsorption, will present unacceptable risks due to uncontrolled vapor emissions. This in situ treatment technology is therefore not preferred.

Community Acceptance

There seems to be little public interest in this decision process. Although it can be assumed that the distinct odor which is occasionally prevalent around Brinson Creek due to contaminants would not be desirable to the local community. Under RAA 4 this odor may even be exaggerated and therefore likely render this alternative unacceptable to the community.

5.1.5 RAA 5: In Well Aeration and Off-Gas Carbon Adsorption

5.1.5.1 Description

In well aeration is a new technology that utilizes circulating air flow within a groundwater well that, in effect, turns the well into an air stripper. In well aeration differs from air sparging in that volatilization occurs outside the well via air sparging and within the well via in well aeration. Similar to air sparging, this technique removes organic contaminants from groundwater primarily via volatilization and secondarily via aerobic biodegradation. Under RAA 5 a line of in well aeration wells will be installed between the proposed highway and Brinson Creek in order to treat the contaminated plume near its downgradient extreme. The radius of influence, or capture zone, of an in well aeration well is reportedly much greater than that of a typical air sparging well system. Using modeling equations and graphical solutions, the developers of this technology have calculated a radius of influence of over 100 feet at Site 35.

For the purpose of the FS, Baker estimates that six in well aeration wells would be required to create a containment/remediation line spanning approximately 1,000 feet with wells spaced 180 feet apart. Volatilized organics collected by this technology, unlike air sparging, will be treated at each in well aeration well by independent carbon adsorption systems which will rest on skids adjacent to the wells. The air emissions from the off-gas treatment system will be sampled monthly to insure that all applicable air emissions standards are being met. Each well and aboveground off-gas treatment system will be housed in a small prefabricated building.

In well aeration systems, like IAS systems, are most effective in sandy soils, but, can be adversely impacted by high levels of inorganic compounds in the groundwater which oxidize and precipitate when contacted by air. These inorganics can form a heavy scale on well screens and clog the well space of the sand pack surrounding the well screen resulting in a reduction in permeability. A field pilot test is recommended to determine the loss of efficiency over time as a result of inorganics precipitation and oxidation, the radius of influence of the wells under various heads of injection air pressure, and the rate of off-gas organic contaminant removal via carbon adsorption and carbon breakthrough.

Baker, LANTDIV, and MCB, Camp Lejeune will negotiate with NC DOT regarding the specifics for site access to the creek side of the new highway. The EPA and NC DEHNR will be kept abreast of developments on this subject. In this FS, Baker proposes an access road running along the east side of the highway from the south.

RAA 5 assumes that the Base Master Plan will be modified to include restrictions on the use of the surficial aquifer in the vicinity of the Fuel Farm. This will reduce the risk to human health and the environment posed by this media by eliminating one exposure pathway.

In addition to aquifer-use restrictions, long-term groundwater monitoring is to be included under this RAA to provide data regarding the impact of natural attenuation and the progress of contaminant migration. Long-term groundwater monitoring includes the semi-annual collection and analysis (TCL VOCs) of groundwater samples from 11 monitoring wells, the development of a semi-annual monitoring report, and the replacement of one monitoring well every five years.

Since contaminants will remain at the site under this alternative, the USEPA is required by the NCP [40 CFR 300.515 (e) (iii)] to review the effects of this alternative no less often than every five years.

5.1.5.2 Assessment

Overall Protection of Human Health and the Environment

This RAA will provide for the overall protection of human health and the environment by the application of in situ treatment technology to reduce the level of organic contaminants in the surficial aquifer and to provide, in essence, a barrier to minimize the potential for the discharge of organic contaminated groundwater to Brinson Creek. Contaminant reduction due to this system will be limited primarily to the radius of influence of the in well aeration wells (estimated at slightly greater than 100 feet).

Aquifer-use restrictions will serve to provide additional protection against direct exposure to contaminated surficial groundwater at the site.

Compliance With ARARs

Under RAA 5 substantial reductions to the levels of organic contaminants in the surficial groundwater can be expected within the radius of influence of the in well aeration system. Further upgradient some additional reductions can be expected from natural attenuation processes and because contaminants can be expected to continue to flow downgradient toward the in well aeration system. However, no direct means of treatment will be applied in this upgradient area under RAA 5 and it is unlikely that the remediation levels will be achieved upgradient of the radius of influence of the in well aeration system.

This RAA proposes that the in well aeration wells and much of the associated piping and appurtenances will be installed in the wetlands area between the highway and Brinson Creek. Wetlands are specifically protected by ARARs as is the endangered alligator, one of which has been reported in this area. It is assumed that the intent of federal and state wetlands regulations will be met while conducting RAA 5 activities.

It is also assumed that the intent of all air emissions regulation be met during the implementation and operation of RAA 5.

Long-Term Effectiveness and Permanence

This RAA involves in situ treatment technology designed to permanently remove organic contaminants from the surficial aquifer. As an interim action, however, it will be confined to a limited area in the vicinity of the Fuel Farm at Site 35. Based on data obtained under the RI, contaminated surficial groundwater located upgradient of the proposed in well aeration system will continue to be a source of contamination to Brinson Creek, however, the organic contaminants should be effectively cut off from discharging to this surface water body by the in well aeration system.

In well aeration is a relatively new technology without a substantial commercial track record in the United States. Nevertheless, it is similar to air sparging and should be able to be fitted with adequate controls to ensure reliability. High dissolved metals could be precipitated out of solution by the system and cause clogging. This could force frequent maintenance and equipment replacement.

Since contaminants will remain at the site under this alternative, USEPA is required by the NCP [40 CFR 300.515 (e) (ii)] to review the effects of this alternative no less often than every five years.

Reduction of Toxicity, Mobility, or Volume

This RAA involves the application of in-situ volatilization and biodegradation technology which, by design, is intended to reduce the volume of organic contaminants in the surficial aquifer where applied. The technology, in essence, works like an in well air stripper by injecting air below the groundwater surface and, in turn extracting air, presumably laden with volatile organics, from the vadose zone. The contaminants are collected and, in this case, transferred to activated carbon for ultimate disposal. Reductions of contaminants will be limited primarily to the zone defined by the radius of influence of the air sparging wells. Natural attenuation may reduce contaminant levels further over time.

System installation will result in drill cuttings (soil) for which proper disposal will be required. The on-site air treatment will produce residual wastes including spent activated carbon and a small volume of contaminated water (i.e., condensed vapor collected in a knock-out tank).

RAA 5 satisfies the statutory preference for treatment alternatives.

Short-Term Effectiveness

The primary activity in constructing an in well aeration system is installing the wells. This involves standard environmental drilling techniques which, when executed by experience professionals, should involved minimal risk of exposure to workers. During operation, the collection and treatment of toxic vapors is conducted within essentially a closed loop. The system allows minimal potential for community exposure to contaminants provided air emission ARARs are adhered to.

Relative to environmental impacts, the installation of the in well aeration system should result in minimal disturbance to the wetlands. The wells should serve as a barrier to organic contaminated groundwater discharge to Brinson Creek.

Implementability

In well aeration is a relatively new technology. Baker has identified two companies which have developed remediation systems utilizing in well aeration. These companies are IEG Technologies Corporation and EG&G Environmental. The IEG systems have been commercially applied extensively in Germany, and are now beginning to find in-roads to the United States. EG&G in well aeration systems are currently operating at several sites overseas and here in the United States as well. Because this technology is still quite new to industry in the United States, a field pilot-scale study should be performed to determine its effectiveness and identify critical design parameters.

Such a study managed by Baker at Site 69 at Camp Lejeune is about to begin. The results of that pilot study should be sufficient and applicable at Site 35.

In any in situ system where oxygen is injected, a concern is the effect on the system operation of metals precipitation and oxidation. At high enough levels the metals can clog the well screens, prompting frequent maintenance or even well replacement.

The implementation of this technology will require the installation of multiple, custom-designed groundwater wells in the area between the highway and Brinson Creek. Access to this area for construction equipment is limited and might require the cooperation of NC DOT to incorporate special access features into the proposed highway design.

The construction activities in the wetlands area may result in some disturbance and require restoration efforts. Meeting the intentions of air emissions regulations will also be necessary.

The proposed groundwater monitoring program coupled with regular system operation and maintenance checks should be sufficient to provide notice of a system failure so that adjustments can be made before a significant contaminant release would occur.

Cost

The projected cost of RAA5 is presented in Table 5-4.

USEPA/State Acceptance

The USEPA and NE DEHNR have indicated their concurrence with the RAAs developed under this FS, in general, and with RAA 5 as the proposed alternative, in particular. The ROD also identified RAA 3 as the proposed alternative should RAA 5 be determined to be technically infeasible based on the results of a field pilot test.

Community Acceptance

Based on the lack of community participation at a public meeting held on May 10, 1995, no adverse community reaction to the proposed remedial action is anticipated.

5.2 Comparative Analysis

This interim FS has identified and evaluated a range of RAAs potentially applicable to the groundwater concerns at Site 35 (OU No. 10). Table 5-5 presents a summary of this evaluation. A comparative analysis in which the alternatives are evaluated in relation to one another with respect to the nine evaluation is presented below. The purpose of this analysis is to identify the relative advantages and disadvantages of each RAA.

5.2.1 Overall Protection of Human Health and the Environment

RAA 1 (No Action) and RAA 2 (No Action With Institutional Controls) are similar in that neither alternative involves active treatment. RAA 2 provides for some overall protection to human health through the incorporation of aquifer-use restrictions which are not included under RAA 1.

RAA 3 (Groundwater Collection and On-Site Treatment), RAA 4 (In Situ Air Sparging And Off-Gas Carbon Adsorption), and RAA 5 (In Well Aeration And Off-Gas Carbon Adsorption) have a common element in that each is intended to reduce groundwater contamination at the downgradient extreme of the contaminated plume and to serve as a barrier to future contaminated groundwater discharge to Brinson Creek. RAA 3 would likely be the most effective barrier in that it is designed to span the entire length and depth of the contaminated portion of the surficial aquifer and will be equipped with an impermeable geomembrane along its downgradient face. RAA 3 is the only treatment alternative that will impact both organic and inorganic contaminants which could be important if it is determined in the future that inorganic contaminants in groundwater are still a concern.

5.2.2 Compliance With ARARs

RAA 1 (No action) and RAA 2 (No Action With Institutional Controls) are no action alternatives that will not comply with ARARs. RAA 3 (Groundwater Collection and On-Site Treatment), RAA 4 (In Situ Air Sparging And Off-Gas Carbon Adsorption), and RAA 5 (In Well Aeration And Off-Gas Carbon Adsorption) are primarily source control measures that will reduce contaminant levels over a limited area defined as the particular zone of influence of each system.

Wetlands disturbance will be an issue with RAA 3, 4, and 5, but, most significantly with RAA 3 which includes the excavation of an approximately two-foot wide, by 30-foot deep, by 1,080-foot interceptor trench. The disturbance associated with RAA 4 and 5 is limited primarily to drilling and well installations, although of the two, RAA 4 will have the greater impact due to the large number of wells to be installed.

Treated air and groundwater discharge are provisions of RAA 3, whereas, only air emissions are a part of RAA 4 and 5. These discharges will need to meet the intentions of applicable regulations.

5.2.3 Long-Term Effectiveness and Permanence

In the case of all five RAAs, contamination will remain at the site and require a USEPA review on five year basis. RAA 1 (No Action) and RAA 2 (No Action With Institutional Controls) provide for no active means of contaminant reduction although, under RAA 2, aquifer-use restrictions will provide a permanent means for protection against direct human exposure to the contaminated surficial groundwater.

The effectiveness of RAA 3 (Groundwater Collection and On-Site Treatment), RAA 4 (In Situ Air Sparging And Off-Gas Carbon Adsorption), and RAA 5 (In Well Aeration and Off-Gas Carbon Adsorption) can be assumed to be roughly equivalent without the benefit of the results of field pilot-scale testing. RAA 3 may be the most difficult of the three to install, however, once installed it will likely be the most reliable and easiest to control. RAA 4 and 5 may encounter clogging problems if dissolved metals precipitate out of solution when placed in contact with forced air. At a minimum the metals problem will prompt increased maintenance which could lead to complete well replacement. RAA 4 has the additional problem of releasing toxic vapors to the atmosphere during operation because it is difficult to apply sufficient vacuum to the vadose zone where the groundwater surface is within a few feet of the ground surface.

5.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

No reduction of contaminants will occur under RAA 1 (No Action) and RAA 2 (No Action With Institutional Controls) as the result of active treatment because active treatment is not provided for under these RAAs.

RAA 3 (Groundwater Collection and On-Site Treatment) provides for on-site treatment of the collected contaminated groundwater (organics and inorganics) using standard wastewater treatment technology. Conversely, RAA 4 (In Situ Air Sparging And Off-Gas Carbon Adsorption) and RAA 5 (In Well Aeration And Off-Gas Carbon Adsorption) provide for treatment of the organic phase of contaminated groundwater in-situ. Both RAA 4 and 5 utilize primarily volatilization technology and biodegradation technology secondarily. The principle difference between the two is that under RAA 4 both volatilization and biodegradation occur outside the well and within the soil column. Under RAA 5, volatilization occurs within the well while biodegradation occurs outside the well within the soil column. Under RAA 4 it may be difficult to efficiently collect all of the volatilized organic contaminants via conventional soil vapor extraction because of the proximity of the groundwater surface to the ground surface at this site. Without an efficient means of collecting the volatilized organics under RAA 4, toxic vapors may be released to the atmosphere. Under RAA 5 this is not a concern because the volatilization is conducted within the well and conveyed to an adjacent activated carbon unit via piping which means the system is essentially a closed loop.

RAA 3 will produce the highest volume of residual waste during operation because it is the only alternative involving groundwater treatment. However, the volume of air treatment under RAA 3 will be less than that under RAAs 4 and 5 because the latter are specifically designed as air volatilization systems. Under RAAs 4 and 5 a small volume of contaminated water will be generated because extracted air contains water which condenses and collects in a knock-out tank at the treatment facility.

5.2.5 Short-Term Effectiveness

Worker protection against exposure will not be a significant issue for any of the RAAs. Each system provided for under RAA 3 (Groundwater Collection and On-Site Treatment), RAA 4 (In Situ Air Sparging and Off-Gas Carbon Adsorption), and RAA 5 (In Well Aeration and Off-Gas Carbon Adsorption) will require approximately 30 to 60 days to install with the total time in the field for construction being a little longer. It has also been assumed that system start-up and testing operations will require an additional 90 days.

Under RAA 1 (No Action) and RAA 2 (No Action With Institutional Controls) there will be no increase in the risks to the community resulting from implementation of the RAA. RAAs 3 and 5 will likely present minimal risk of community exposure during implementation and operation because they are, in essence, closed loop systems. RAA 4 has the potential for releases of toxic vapors to the atmosphere because of close proximity of the groundwater surface to the ground surface will make efficient soil vapor extraction difficult.

Some disturbance of the wetlands is expected under RAAs 3, 4, and 5. The greatest disturbance will be associated with RAA 3.

5.2.6 Implementability

Aside from RAAs 1 and 2, which are no action or essentially no action alternatives, RAA 3 (Groundwater Collection And On-Site Treatment) will present greater technical challenges during construction than RAA 4 (In Situ Air Sparging and Off-Gas Carbon Adsorption), and RAA 5 (In Well Aeration and Off-Gas Carbon Adsorption). This is because RAA 3 involves the construction of a two-foot wide by 30-foot deep by 1,080 foot long interceptor trench while RAAs 4 and 5 involve primarily well installation.

The interceptor trench under RAA 3 represents specialized technology that is available from a limited number of vendors, whereas, the air sparging technology of RAA 4 is relatively commonplace, and in well aeration (RAA 5) is a relatively new technology offered by two vendors, IEG Technologies Corporation and EG&G Environmental.

The proposed groundwater monitoring plan coupled with routine system maintenance and monitoring should be sufficient to provide sufficient notice of a system failure under either RAA 3, 4 or 5. The purpose of the monitoring is to provide for system adjustments with sufficient time so that a significant contaminant release to the environment will not occur.

Because each system under RAA 3, 4, and 5 will require construction within a wetlands area and because air and water discharges are incorporated into the designs, federal and state agency interaction will be required.

5.2.7 Cost

The estimated total present worth costs of the alternatives, excluding RAA 1: No Action, range from $299,800 for RAA 2: No Action with Institutional Controls to $3,000,500 for RAA 3: Groundwater Collection and On-Site Treatment. These costs are based on the assumption of 30 years of active use. The ranking of the alternatives in terms of costs is as follows:

RAA	1:	No Action	$0
RAA	2:	No Action with Institutional Controls	$299,800
RAA	4:	In Situ Air Sparging and Off-Gas Carbon Adsorption	$2,459,600
RAA	5:	In Well Aeration and Off-Gas Carbon Adsorption	$2,519,700
RAA	3:	Groundwater Collection and On-Site Treatment	$3,000,500

Figure 5-1 graphically displays a comparison of costs for RAAs 2, 3, 4, and 5.

5.2.8 USEPA/State Acceptance

The USEPA and NE DEHNR have indicated their concurrence with the RAAs developed under this FS, in general, and with RAA 5 as the proposed alternative, in particular. The ROD also identified RAA 3 as the proposed alternative should RAA 5 be determined to be technically infeasible based on the results of a field pilot test.

5.2.9 Community Acceptance

Based on the lack of community participation at a public meeting held on May 10, 1995, no adverse community reaction to the proposed remedial action is anticipated.

SECTION 5.0 TABLES

TABLE 5 - 1
ESTIMATED COSTS

RAA 2: INSTITUTIONAL CONTROLS WITH GROUNDWATER MONITORING
SITE 35 - CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
O & M AND CAPITAL COST ESTIMATE

7 - EXISTING MONITORING WELLS
+ 2 - NEW MONITORING CLUSTER WELLS

COST COMPONENT	UNIT	QUANTITY	UNIT COST	SUBTOTAL COST	TOTAL COST	SOURCE	BASIS / COMMENTS
O & M COST ESTIMATE (SEMI-ANNUAL SAMPLING YEARS 1 - 30)							Cluster Well: 1-25' deep well, 1-40' deep well
Groundwater Monitoring							
Labor	Hours	110	$ 40	$ 4,440		Engineering Estimate	Semi-annual sampling of 6 locations (11 wells): 2 samplers, 5 hours (avg.) each location, 2 events per year.
Laboratory Analyses - TCL VOCs	Sample	32	$ 175	$ 5,600		Baker Average 1994 BOAs	Semi-annual sampling of 11 wells: GW Samples - 11 from wells, 5 QA/QC = 16 samples
Misc. Expenses	Sample Event	2	$ 2,780	$ 5,560		1994 JTR, Vendor Quotes	Includes travel, lodging, air fare, supplies, truck rental, equipment, cooler shipping
Report	Sample Event	2	$ 1,500	$ 3,000		Engineering Estimate	1 - report per sampling event
Well Maintenance	Year	1	$ 500	$ 500		Engineering Estimate	Includes repainting and annualized cost of replacing 1 - well every 5 - years
					$ 19,100		
CAPITAL COST ESTIMATE							
New Monitoring Wells	Cluster Well	2	$ 3,100	$ 6,200		Engineering Estimate	Cluster Well: 1 - 25' deep 2" well & 1 - 40' deep 2" well
Revise Base Master Plan				$ -			No cost - by Camp Lejeune EMD
					$ 6,200		
ANNUAL GROUNDWATER MONITORING O & M COSTS (Years 1 - 30)					$ 19,100		
GROUNDWATER MONITORING CAPITAL COSTS					$ 6,200		
TOTAL COST (PW) - RAA 2 (5 YEAR TREATMENT PLANT OPERATION)					$ 88,900		
TOTAL COST (PW) - RAA 2 (30 YEAR TREATMENT PLANT OPERATION)					$ 299,800		

TABLE 5 - 2

ESTIMATED COSTS

RAA 3: GROUNDWATER COLLECTION WITH ON-SITE TREATMENT
SITE 35 - CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
O & M AND CAPITAL COST ESTIMATE

BIOPOLYMER TRENCH
7 - EXISTING MONITORING WELLS
+ 2 - NEW MONITORING CLUSTER WELLS

COST COMPONENT	UNIT	QUANTITY	UNIT COST	SUBTOTAL COST	TOTAL COST	SOURCE	BASIS / COMMENTS
O & M COST ESTIMATE (SEMI-ANNUAL SAMPLING YEARS 1 - 30)							Cluster Well: 1-25' deep well, 1-40' deep well
Groundwater Monitoring							
Labor	Hours	110	$ 40	$ 4,440		Engineering Estimate	Semi-annual sampling of 6 locations (11 wells) 2 samplers, 5 hours (avg.) each location, 2 events per year.
Laboratory Analyses - TCL VOCs	Sample	32	$ 175	$ 5,600		Baker Average 1994 BOAs	Semi-annual sampling of 11 wells: GW Samples - 11 from wells, 5 QA/QC = 16 samples
Misc. Expenses	Sample Event	2	$ 2,780	$ 5,560		1994 JTR, Vendor Quotes	Includes travel, lodging, air fare, supplies, truck rental, equipment, cooler shipping
Report	Sample Event	2	$ 1,500	$ 3,000		Engineering Estimate	1 - report per sampling event
Well Maintenance	Year	1	$ 500	$ 500		Engineering Estimate	Includes repainting and annualized cost of replacing 1 - well every 5 - years
					$ 19,100		
CAPITAL COST ESTIMATE							
New Monitoring Wells	Cluster Well	2	$ 3,100	$ 6,200		Engineering Estimate	Cluster Well: 1 - 25' deep 2" well & 1 - 40' deep 2" well
Revise Base Master Plan				$ -			No cost - by Camp Lejeune EMD
					$ 6,200		

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TABLE 5 - 2

ESTIMATED COSTS

(CONTINUED)

RAA 3: GROUNDWATER COLLECTION WITH ON-SITE TREATMENT
SITE 35 - CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
O & M AND CAPITAL COST ESTIMATE

BIOPOLYMER TRENCH
7 - EXISTING MONITORING WELLS
+ 2 - NEW MONITORING CLUSTER WELLS

COST COMPONENT	UNIT	QUANTITY	UNIT COST	SUBTOTAL COST	TOTAL COST	SOURCE	BASIS / COMMENTS
O & M COST ESTIMATE							
Treatment Plant O & M (Years 1 - 30)							
Electricity	Month	12	$ 150	$ 1,800		Means 010-034-0160 & Engineering Estimate	24 hr/day, 365 days/year operation
Carbon Regeneration/ Replacement	Unit	6	$ 875	$ 5,250		Engineering Estimate	Four 350 #/GAC Unit@$2.50/# = $875/unit Based on approx. 8-month carbon "life".
Chemicals - Polymer, Caustic	Month	12	$ 100	$ 1,200		Engineering Estimate	
Analytical (Effluent)	Sample	24	$ 200	$ 4,800		Engineering Estimate	1 sample/month/GAC unit
(Air)	Sample	24	$ 300	$ 7,200		Engineering Estimate	1 sample/month/GAC unit
Sludge Disposal	Month	12	$ 300	$ 3,600		Engineering Estimate	2 drums/month at $150/drum disposal costs.
Labor							
Operating	Week	52	$ 120	$ 6,200		Engineering Estimate	4 hr/week, 52 weeks/year, at $30/hr.
Plant Maintenance & Sampling	Month	12	$ 240	$ 2,900		Engineering Estimate	8 hr/month, 12 months/year, at $30/hr.
Administration & Reports	Hour	100	$ 50	$ 5,000		Engineering Estimate	25 hrs/quarter at $50/hr
					$ 38,000		

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TABLE 5-2

ESTIMATED COSTS

(CONTINUED)

RAA 3: GROUNDWATER COLLECTION WITH ON-SITE TREATMENT

SITE 35 - CAMP GEIGER AREA FUEL FARM

MCB CAMP LEJEUNE, NORTH CAROLINA

O & M AND CAPITAL COST ESTIMATE

BIOPOLYMER TRENCH

7 - EXISTING MONITORING WELLS

+ 2 - NEW MONITORING CLUSTER WELLS

COST COMPONENT	UNIT	QUANTITY	UNIT COST	SUBTOTAL COST	TOTAL COST	SOURCE	BASIS / COMMENTS
CAPITAL COST ESTIMATE (BIOPOLYMER TRENCH)							
SITE PREPARATION							
Equipment Mobilization	LS	1	200	200		Rental company & Means	1 trailer, 1 forklift, 1 utility tractor w/backhoe
Personnel Mobilization	LS	1	860	860		1994 JTR, Eng'r.Est.	(Does not include biopolymer trench
Pre-Construction Submittals	LS	1	14,830	14,830		Engineering Estimate	subcontractor mob/demob.)
Office Trailer Setup	LS	1	120	120		Engineering Estimate	
Laydown Area / Staging Area	LS	1	7,950	7,950		Engineering Estimate	60' x 100' staging/laydown area
Decontamination Area	LS	1	1,580	1,580		Means & Eng'r. Estimate	Steel pans
Site Access	LS	1	69,490	69,490		Means & Eng'r. Estimate	3,000 ft access road parallel to highway
Miscellaneous	LS	1	81,440	81,440		Means & Eng'r. Estimate	Utilities Materials and Hookup, (incl. Treatment Bldg. and Wells) Erosion Control, Safety Fencing, Sediment Fencing
GROUNDWATER COLLECTION / ON-SITE TREATMENT / DISCHARGE / SOIL DISPOSAL							
Biopolymer Trench Construction	LS	1	1,148,650	1,148,650		Means, Vendor & Eng'r. Est.	Includes sub mob/demob, soil disposal.
Groundwater Collection	LS	1	23,380	23,380		Means, Vendor & Eng'r. Est.	
Treatment Plant Construction	LS	1	193,170	193,170		Means, Vendor & Eng'r. Est.	
SITE RESTORATION							
General Site Cleanup	LS	1	1,500	1,500		Engineering Estimate	
Wetlands Revegetation	LS	1	14,810	14,810		Engineering Estimate	
Equipment Decon	LS	1	500	500		Engineering Estimate	
DEMOBILIZATION							
Equipment & Trailer Demob	LS	1	200	200		Rental company & Means	Same as Mobilization
Personnel Demob	LS	1	860	860		1994 JTR, Eng'r.Est.	Same as Mobilization
Post-Construction Submittals	LS	1	7,240	7,240		Engineering Estimate	
Miscellaneous	LS	1	9,750	9,750		Engineering Estimate	Remove Utilities (not incl. Treatment Bldg.), Erosion Control,Safety Fencing

(Continued Next Page)

TABLE 5 - 2

ESTIMATED COSTS

(CONTINUED)

RAA 3: GROUNDWATER COLLECTION WITH ON-SITE TREATMENT
SITE 35 - CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
O & M AND CAPITAL COST ESTIMATE

BIOPOLYMER TRENCH
7 - EXISTING MONITORING WELLS
+ 2 - NEW MONITORING CLUSTER WELLS

COST COMPONENT	UNIT	QUANTITY	UNIT COST	SUBTOTAL COST	TOTAL COST	SOURCE	BASIS / COMMENTS
CAPITAL COST ESTIMATE (BIOPOLYMER TRENCH Continued)							
DISTRIBUTIVE COSTS							
Supervision	LS	1	56,880	56,880		Engineering Estimate	Site Supervisor, Foreman (3 months) Mechanical Engineer (2 weeks)
Per Diem	LS	1	20,720	20,720		Engineering Estimate	at $66/day: Site Supervisor, Foreman, Mechanical Engineer, Plant Operators
Home Office/Eng'r/H & S/QA/QC	LS	1	8,530	8,530		Engineering Estimate	15 % of Supervision
Trailer, Portable Toilet Rental	LS	1	540	540		MEANS, 1994: 015-904-1350 MEANS, 1994: 016-420-7200	Trailer 3 months at $102/month Portable toilet 3 months at $78/month
Vehicles	LS	1	3,330	3,330		MEANS, 1994: 016-420-7200	Pickup Trucks - 2 @ $555/month each (3 months)
SUBTOTAL CAPITAL COST					$ 1,666,500		
Engineering & Design @ 12 %		0.12		200,000			
Contingencies @ 15 %		0.15		250,000			
TOTAL CAPITAL COST					$ 2,116,500		

ANNUAL GROUNDWATER MONITORING O & M COSTS (Years 1 - 30)	$ 19,100
ANNUAL TREATMENT PLANT O & M COSTS (YEARS 1 - 30)	$ 38,000
GROUNDWATER MONITORING CAPITAL COSTS	$ 6,200
TREATMENT PLANT CAPITAL COSTS	$ 2,116,500
TOTAL CAPITAL COSTS	$ 2,122,700
TOTAL COST (PW) - RAA 3 (5 YEAR TREATMENT PLANT OPERATION)	$ 2,580,800
TOTAL COST (PW) - RAA 3 (30 YEAR TREATMENT PLANT OPERATION)	$ 3,000,500

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TABLE 5-3

ESTIMATED COSTS

RAA 4: IN SITU AIR SPARGING AND OFF-GAS CARBON ADSORPTION
SITE 35 - CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
O & M AND CAPITAL COST ESTIMATE

43 - NEW AIR INJECTION WELLS
+ 43 - NEW AIR EXTRACTION WELLS
7 - EXISTING MONITORING WELLS
+ 2 - NEW MONITORING CLUSTER WELLS

COST COMPONENT	UNIT	QUANTITY	UNIT COST	SUBTOTAL COST	TOTAL COST	SOURCE	BASIS / COMMENTS
O & M COST ESTIMATE (SEMI-ANNUAL SAMPLING YEARS 1 - 30)							Cluster Well: 1-25' deep well, 1-40' deep well
Groundwater Monitoring							
Labor	Hours	110	$ 40	$ 4,440		Engineering Estimate	Semi-annual sampling of 6 locations (11 wells) 2 samplers, 5 hours (avg.) each location, 2 events per year.
Laboratory Analyses - TCL VOCs	Sample	32	$ 175	$ 5,600		Baker Average 1994 BOAs	Semi-annual sampling of 11 wells: GW Samples - 11 from wells, 5 QA/QC = 16 samples
Misc. Expenses	Sample Event	2	$ 2,780	$ 5,560		1994 JTR, Vendor Quotes	Includes travel, lodging, air fare, supplies, truck rental, equipment, cooler shipping
Report	Sample Event	2	$ 1,500	$ 3,000		Engineering Estimate	1 - report per sampling event
Well Maintenance	Year	1	$ 500	$ 500		Engineering Estimate	Includes repainting and annualized cost of replacing 1 - well every 5 - years
					$ 19,100		
CAPITAL COST ESTIMATE							
New Monitoring Wells	Cluster Well	2	$ 3,100	$ 6,200		Engineering Estimate	Cluster Well: 1 - 25' deep 2" well & 1 - 40' deep 2" well
Revise Base Master Plan				$ -			No cost - by Camp Lejeune EMD
					$ 6,200		

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TABLE 5 - 3

ESTIMATED COSTS

(CONTINUED)

RAA 4: IN SITU AIR SPARGING AND OFF - GAS CARBON ADSORPTION
SITE 35 - CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
O & M AND CAPITAL COST ESTIMATE

43 - NEW AIR INJECTION WELLS
+ 43 - NEW AIR EXTRACTION WELLS
7 - EXISTING MONITORING WELLS
+ 2 - NEW MONITORING CLUSTER WELLS

COST COMPONENT	UNIT	QUANTITY	UNIT COST	SUBTOTAL COST	TOTAL COST	SOURCE	BASIS / COMMENTS
O & M COST ESTIMATE							
Treatment Plant O & M (Years 1 - 30)							
Electricity	Month	12	$ 250	$ 3,000		Means 010-034-0160 & Engineering Estimate	24 hr/day, 365 days/year operation
Carbon Regeneration/ Replacement	Unit	3	$ 875	$ 2,625		Engineering Estimate	Two 350 #/GAC Unit@$2.50/# = $875/unit Based on approx. 8-month carbon "life".
Analytical (Water)	Sample	12	$ 200	$ 2,400		Engineering Estimate	1 sample/month
(Air)	Sample	72	$ 300	$ 21,600		Engineering Estimate	6 samples/month/GAC unit
Labor							
Operating	Week	52	$ 240	$ 12,500		Engineering Estimate	8 hr/week, 52 weeks/year, at $30/hr.
Plant Maintenance & Sampling	Month	12	$ 480	$ 5,800		Engineering Estimate	16 hr/month, 12 months/year, at $30/hr.
Disposal of Water							
Hazardous	Gal.	1500	$ 5	$ 7,500		Engineering Estimate	Assume $5/gal.
Non-Hazardous	Gal.	1500	$ 5	$ 7,500		Engineering Estimate	Assume $0.50/gal.
Transport Costs	Load	6	$ 500	$ 3,000		Engineering Estimate	Assume $500/trip
Administration & Reports	Hour	100	$ 50	$ 5,000		Engineering Estimate	25 hrs/quarter at $50/hr
					$ 71,000		

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TABLE 5 - 3

ESTIMATED COSTS

(CONTINUED)

RAA 4: IN SITU AIR SPARGING AND OFF - GAS CARBON ADSORPTION
SITE 35 - CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
O & M AND CAPITAL COST ESTIMATE

43 - NEW AIR INJECTION WELLS
+ 43 - NEW AIR EXTRACTION WELLS
7 - EXISTING MONITORING WELLS
+ 2 - NEW MONITORING CLUSTER WELLS

COST COMPONENT	UNIT	QUANTITY	UNIT COST	SUBTOTAL COST	TOTAL COST	SOURCE	BASIS / COMMENTS
CAPITAL COST ESTIMATE (AIR SPARGING)							
SITE PREPARATION							
Equipment Mobilization	LS	1	200	200		Rental company & Means	1 trailer, 1 forklift, 1 utility tractor w/backhoe
Personnel Mobilization	LS	1	860	860		1994 JTR, Eng'r.Est.	(Does not include biopolymer trench
Pre-Construction Submittals	LS	1	14,830	14,830		Engineering Estimate	subcontractor mob/demob.)
Office Trailer Setup	LS	1	120	120		Engineering Estimate	
Laydown Area / Staging Area	LS	1	7,950	7,950		Engineering Estimate	60' x 100' staging/laydown area
Decontamination Area	LS	1	1,580	1,580		Means & Eng'r. Estimate	Steel pans
Site Access	LS	1	69,490	69,490		Means & Eng'r. Estimate	3,000 ft access road parallel to highway
Miscellaneous	LS	1	26,410	26,410		Means & Eng'r. Estimate	Utilities Materials & Hookup (incl. Treatment Bldg.), Erosion Control, Safety Fencing, Sediment Fencing
VAPOR COLLECTION / VAPOR - WATER SEPARATION / DISPOSAL							
Treatment Plant Construction	LS	1	369,900	369,900		Means, Vendor & Eng'r. Est.	
Vapor Collection	LS	1	146,270	146,270		Means, Vendor & Eng'r. Est.	
SITE RESTORATION							
General Site Cleanup	LS	1	1,500	1,500		Engineering Estimate	
Wetlands Revegetation	LS	1	14,810	14,810		Engineering Estimate	
Equipment Decon	LS	1	500	500		Engineering Estimate	
DEMOBILIZATION							
Equipment & Trailer Demob	LS	1	200	200		Rental company & Means	Same as Mobilization
Personnel Demob	LS	1	860	860		1994 JTR, Eng'r.Est.	Same as Mobilization
Post-Construction Submittals	LS	1	7,240	7,240		Engineering Estimate	
Miscellaneous	LS	1	9,750	9,750		Engineering Estimate	Remove Utilities (not incl. Treatment Bldg.), Erosion Control,Safety Fencing

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TABLE 5-3

ESTIMATED COSTS

(CONTINUED)

RAA 4: IN SITU AIR SPARGING AND OFF-GAS CARBON ADSORPTION
SITE 35 - CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
O & M AND CAPITAL COST ESTIMATE

43 - NEW AIR INJECTION WELLS
+ 43 - NEW AIR EXTRACTION WELLS
7 - EXISTING MONITORING WELLS
+ 2 - NEW MONITORING CLUSTER WELLS

COST COMPONENT	UNIT	QUANTITY	UNIT COST	SUBTOTAL COST	TOTAL COST	SOURCE	BASIS / COMMENTS
CAPITAL COST ESTIMATE (Continued)							
DISTRIBUTIVE COSTS							
Supervision	LS	1	56,880	56,880		Engineering Estimate	Site Supervisor, Foreman (3 months) Mechanical Engineer (2 weeks)
Per Diem	LS	1	20,720	20,720		Engineering Estimate	at $66/day: Site Supervisor, Foreman, Mechanical Engineer, Plant Operators
Home Office/Eng'r/H & S/QA/QC	LS	1	8,530	8,530		Engineering Estimate	15 % of Supervision
Trailer, Portable Toilet Rental	LS	1	540	540		Means, 1994: 015-904-1350 Means, 1994: 016-420-7200	Trailer 3 months at $102/month Portable toilet 3 months at $78/month
Vehicles	LS	1	3,330	3,330		Means, 1994: 016-420-7200	Pickup Trucks - 2 @ $555/month each (3 months)
SUBTOTAL CAPITAL COST					$ 762,500		
Engineering & Design @ 12 %		0.12		91,500			
Contingencies @ 15 %		0.15		114,400			
Treatment Study				100,000			
TOTAL CAPITAL COST					$ 1,068,400		

ANNUAL GROUNDWATER MONITORING O & M COSTS (Years 1 - 30)	$ 19,100
ANNUAL TREATMENT PLANT O & M COSTS (YEARS 1 - 30)	$ 71,000
GROUNDWATER MONITORING CAPITAL COSTS	$ 6,200
TREATMENT PLANT CAPITAL COSTS	$ 1,068,400
TOTAL CAPITAL COSTS	$ 1,074,600
TOTAL COST (PW) - RAA 4 (5 YEAR TREATMENT PLANT OPERATION)	$ 1,675,600
TOTAL COST (PW) - RAA 4 (30 YEAR TREATMENT PLANT OPERATION)	$ 2,459,600

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TABLE 5 - 4

ESTIMATED COSTS

RAA 5: IN WELL AERATION AND OFF - GAS CARBON ADSORPTION
SITE 35 - CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
O & M AND CAPITAL COST ESTIMATE

? - NEW AERATION WELLS
7 - EXISTING MONITORING WELLS
+ 2 - NEW MONITORING CLUSTER WELLS

COST COMPONENT	UNIT	QUANTITY	UNIT COST	SUBTOTAL COST	TOTAL COST	SOURCE	BASIS / COMMENTS
O & M COST ESTIMATE (SEMI-ANNUAL SAMPLING YEARS 1 - 30)							Cluster Well: 1-25' deep well, 1-40' deep well
Groundwater Monitoring							
Labor	Hours	110	$ 40	$ 4,440		Engineering Estimate	Semi-annual sampling of 6 locations (11 wells): 2 samplers, 5 hours (avg.) each location, 2 events per year.
Laboratory Analyses - TCL VOCs	Sample	32	$ 175	$ 5,600		Baker Average 1994 BOAs	Semi-annual sampling of 11 wells: GW Samples - 11 from wells, 5 QA/QC = 16 samples
Misc. Expenses	Sample Event	2	$ 2,780	$ 5,560		1994 JTR, Vendor Quotes	Includes travel, lodging, air fare, supplies, truck rental, equipment, cooler shipping
Report	Sample Event	2	$ 1,500	$ 3,000		Engineering Estimate	1 - report per sampling event
Well Maintenance	Year	1	$ 500	$ 500		Engineering Estimate	Includes repainting and annualized cost of replacing 1 - well every 5 - years
					$ 19,100		
CAPITAL COST ESTIMATE							
New Monitoring Wells	Cluster Well	2	$ 3,100	$ 6,200		Engineering Estimate	Cluster Well: 1 - 25' deep 2" well & 1 - 40' deep 2" well
Revise Base Master Plan				$ -			No cost - by Camp Lejeune EMD
					$ 6,200		

(Continued Next Page)

TABLE 5-4

ESTIMATED COSTS

(CONTINUED)

RAA 5: IN WELL AERATION AND OFF-GAS CARBON ADSORPTION
SITE 35 - CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
O & M AND CAPITAL COST ESTIMATE

? - NEW AERATION WELLS
7 - EXISTING MONITORING WELLS
+ 2 - NEW MONITORING CLUSTER WELLS

COST COMPONENT	UNIT	QUANTITY	UNIT COST	SUBTOTAL COST	TOTAL COST	SOURCE	BASIS / COMMENTS
O & M COST ESTIMATE							
Independent Off-Gas Treatment Systems O & M (Years 1 - 30)							
Electricity	Month	12	$ 200	$ 2,400		Means 010-034-0160 & Engineering Estimate	24 hr/day, 365 days/year operation
Carbon Regeneration/ Replacement	Unit	9	$ 440	$ 3,960		Engineering Estimate	175#/GAC Unit@$2.50/# = $440/unit Based on approximately 8-month carbon "life".
Analytical (Air)	Sample	72	$ 300	$ 21,600		Engineering Estimate	1 sample/month/independent GAC unit
Labor							
Sampling	Month	12	$ 480	$ 5,760		Engineering Estimate	16 hr/month, 12 months/year, at $30/hr.
Aeration Equipment by Subcontractor	Event	2	$ 11,500	$ 23,000		Vendor Quote & Engineering Estimate	2 days maintenance by subcontractor - includes labor & travel costs
Disposal of Water							
Hazardous	Gal.	200	$ 5	$ 1,000		Engineering Estimate	Assume $5/gal.
Transport Costs	Load	1	$ 500	$ 500		Engineering Estimate	Assume $500/trip
Administration & Reports	Hour	100	$ 50	$ 5,000		Engineering Estimate	25 hrs/quarter at $50/hr
					$ 63,200		

(Continued Next Page)

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TABLE 5-4

ESTIMATED COSTS
(CONTINUED)

RAA 5: IN WELL AERATION AND OFF-GAS CARBON ADSORPTION
SITE 35 - CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
O & M AND CAPITAL COST ESTIMATE

? - NEW AERATION WELLS
7 - EXISTING MONITORING WELLS
+ 2 - NEW MONITORING CLUSTER WELLS

COST COMPONENT	UNIT	QUANTITY	UNIT COST	SUBTOTAL COST	TOTAL COST	SOURCE	BASIS / COMMENTS
CAPITAL COST ESTIMATE (IN WELL AERATION)							
SITE PREPARATION							
Equipment Mobilization	LS	1	200	200		Rental company & Means	1 trailer, 1 forklift, 1 utility tractor w/backhoe
Personnel Mobilization	LS	1	860	860		1994 JTR, Eng'r.Est.	(Does not include biopolymer trench
Pre-Construction Submittals	LS	1	14,830	14,830		Engineering Estimate	subcontractor mob/demob.)
Office Trailer Setup	LS	1	120	120		Engineering Estimate	
Laydown Area / Staging Area	LS	1	7,950	7,950		Engineering Estimate	60' x 100' staging/laydown area
Decontamination Area	LS	1	1,580	1,580		Means & Eng'r. Estimate	Steel pans
Site Access	LS	1	69,490	69,490		NC DOT Budget Quote	3,000 ft access road parallel to highway
Miscellaneous	LS	1	64,770	64,770		Means & Eng'r. Estimate	Utilities Hookup (incl. Treatment Bldg.), Erosion Control, Safety Fencing, Sediment Fencing
VAPOR COLLECTION / VAPOR - WATER SEPARATION / DISPOSAL							
Individual Off-Gas Treatment Systems	UNIT	6	12,600	75,600		Means, Vendor & Eng'r. Est.	Includes: Knockout Tank, Activated Carbon Unit, 5 HP Blower
In Well Aeration Wells	UNIT	6	91,887	551,320		Means, Vendor & Eng'r. Est.	UVB Custom Wells, 30' deep
SITE RESTORATION							
General Site Cleanup	LS	1	1,500	1,500		Engineering Estimate	
Wetlands Revegetation	LS	1	7,400	7,400		Engineering Estimate	
Equipment Decon	LS	1	500	500		Engineering Estimate	
DEMOBILIZATION							
Equipment & Trailer Demob	LS	1	200	200		Rental company & Means	Same as Mobilization
Personnel Demob	LS	1	860	860		1994 JTR, Eng'r.Est.	Same as Mobilization
Post-Construction Submittals	LS	1	7,240	7,240		Engineering Estimate	
Miscellaneous	LS	1	9,740	9,740		Engineering Estimate	Remove Utilities (not incl. Treatment Bldg.), Erosion Control,Safety Fencing

(Continued Next Page)

TABLE 5 - 4

ESTIMATED COSTS

(CONTINUED)

RAA 5: IN WELL AERATION AND OFF - GAS CARBON ADSORPTION
SITE 35 - CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
O & M AND CAPITAL COST ESTIMATE

? - NEW AERATION WELLS
7 - EXISTING MONITORING WELLS
+ 2 - NEW MONITORING CLUSTER WELLS

COST COMPONENT	UNIT	QUANTITY	UNIT COST	SUBTOTAL COST	TOTAL COST	SOURCE	BASIS / COMMENTS
CAPITAL COST ESTIMATE (Continued)							
DISTRIBUTIVE COSTS							
Supervision	LS	1	56,880	56,880		Engineering Estimate	Site Supervisor, Foreman (3 months) Mechanical Engineer (2 weeks)
Per Diem	LS	1	20,720	20,720		Engineering Estimate	at $66/day: Site Supervisor, Foreman, Mechanical Engineer, Plant Operators
Home Office/Eng'r/H & S/QA/QC	LS	1	8,530	8,530		Engineering Estimate	15 % of Supervision
Trailer, Portable Toilet Rental	LS	1	540	540		MEANS, 1994: 015-904-1350 MEANS, 1994: 016-420-7200	Trailer 3 months at $102/month Portable toilet 3 months at $78/month
Vehicles	LS	1	3,330	3,330		MEANS, 1994: 016-420-7200	Pickup Trucks - 2 @ $555/month each (3 months)
SUBTOTAL CAPITAL COST					$ 904,200		
Engineering & Design @ 12 %		0.12		108,500			
Contingencies @ 15 %		0.15		135,600			
Treatment Study				100,000			
TOTAL CAPITAL COST					$ 1,248,300		

ANNUAL GROUNDWATER MONITORING O & M COSTS (Years 1 - 30)	$ 19,100
ANNUAL TREATMENT PLANT O & M COSTS (YEARS 1 - 30)	$ 63,200
GROUNDWATER MONITORING CAPITAL COSTS	$ 6,200
TREATMENT PLANT CAPITAL COSTS	$ 1,248,300
TOTAL CAPITAL COSTS	$ 1,254,500
TOTAL COST (PW) - RAA 5 (5 YEAR TREATMENT PLANT OPERATION)	$ 1,821,700
TOTAL COST (PW) - RAA 5 (30 YEAR TREATMENT PLANT OPERATION)	$ 2,519,700

TABLE 5-5

SUMMARY OF DETAILED ANALYSIS
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Evaluation Criteria	RAA 1 No Action	RAA 2 No Action with Institutional Controls	RAA 3 Groundwater Collection and On-Site Treatment	RAA 4 In Situ Air Sparging and Off-Gas Carbon Adsorption	RAA 5 In Well Aeration and Off-Gas Carbon Adsorption
OVERALL PROTECTIVENESS					
• Human Health	Potential risks associated with groundwater exposure will remain. Some reduction in contaminant levels may result from natural attenuation.	Aquifer-use restrictions mitigate risks from direct groundwater exposure.	Active collection and treatment will reduce contaminant levels in groundwater within capture zone of interceptor trench (estimated at 100 feet upgradient maximum). Aquifer-use restrictions will also mitigate risks from direct groundwater exposure.	Active in situ volatilization and biodegradation will reduce contaminant levels in groundwater within radius of influence of wells (estimated at 25 feet). Aquifer-use restrictions will also mitigate risks from direct groundwater exposure.	Active in-well volatilization and in situ biodegradation will reduce contaminant levels in groundwater within radius of influence of wells (estimated at 45 to 60 feet). Aquifer-use restrictions will also mitigate risks from direct groundwater exposure.
• Environment	Contaminated groundwater will continue to be a source of future contamination to Brinson Creek.	Contaminated groundwater will continue to be a source of future contamination to Brinson Creek.	Interceptor trench serves as a barrier to contaminated groundwater discharge to Brinson Creek.	Air sparging wells and SVE wells serve as a barrier to contaminated groundwater discharge to Brinson Creek.	Aeration wells serve as a barrier to contaminated groundwater discharge to Brinson Creek.
COMPLIANCE WITH ARARs					
• Chemical-Specific	No active effort made to reduce groundwater contaminant levels to below federal or state ARARs.	No active effort made to reduce groundwater contaminant levels to below federal or state ARARs.	Reductions in groundwater contaminant levels to below federal or state ARARs can be expected within capture zone of interceptor trench. Reductions upgradient will be less substantial if at all.	Reductions in groundwater contaminant levels to below federal or state ARARs can be expected within radius of influence of wells. Reductions upgradient will be less substantial if at all.	Reductions in groundwater contaminant levels to below federal or state ARARs can be expected within radius of influence of wells. Reductions upgradient will be less substantial if at all.
• Location-Specific	Not Applicable.	Not Applicable.	Wetlands and alligators (endangered species) are concerns because of proposed location of interceptor trench. It is assumed that necessary approvals can be obtained.	Wetlands and alligators (endangered species) are concerns because of proposed location of interceptor trench. It is assumed that necessary approvals can be obtained.	Wetlands and alligators (endangered species) are concerns because of proposed location of interceptor trench. It is assumed that necessary approvals can be obtained.
• Action-Specific	Not Applicable.	Not Applicable.	Can be designed to meet these ARARs.	Can be designed to meet these ARARs.	Can be designed to meet these ARARs.

TABLE 5-5 (Continued)

SUMMARY OF DETAILED ANALYSIS
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Evaluation Criteria	RAA 1 No Action	RAA 2 No Action with Institutional Controls	RAA 3 Groundwater Collection and On-Site Treatment	RAA 4 In Situ Air Sparging and Off-Gas Carbon Adsorption	RAA 5 In Well Aeration and Off-Gas Carbon Adsorption
LONG-TERM EFFECTIVENESS AND PERFORMANCE					
• Magnitude of Residual Risk	Any long-term effect on contamination will be the result of natural attenuation processes only.	Any long-term effect on contamination will be the result of natural attenuation processes only. Aquifer-use restrictions will provide a permanent means for protection against direct exposure to the contaminated surficial groundwater.	Provides an effective means of intercepting contaminated groundwater and blocking its discharge to Brinson Creek for as long as it remains in operation. Aquifer-use restrictions will provide a permanent means for protection against direct exposure to the contaminated surficial groundwater.	Provides an effective means of intercepting and treating contaminated groundwater prior to its discharge to Brinson Creek for as long as it remains in operation. Toxic vapors escaping to the air due to poor vapor extraction may increase risk to community. Aquifer-use restrictions will provide a permanent means for protection against direct exposure to the contaminated surficial groundwater.	Provides an effective means of intercepting and treating contaminated groundwater prior to its discharge to Brinson Creek for as long as it remains in operation. Aquifer-use restrictions will provide a permanent means for protection against direct exposure to the contaminated surficial groundwater.
• Adequacy and Reliability of Controls	Not Applicable.	Aquifer-use restrictions are reliable if enforced. Enforcement is likely as Camp Geiger is a controlled military installation. The proposed highway right-of-way will continue to be controlled by the Marine Corps, indefinitely, under lease to NCDOT.	Interceptor trench involves basic technology and should be adequate and reliable for an indefinite period.	Air sparging has a long track record of commercial use and should be able to be controlled adequately and reliably for an indefinite period. High levels of metals in groundwater could short circuit the system prompting frequent maintenance. Well replacement over several years may result.	In well aeration is a relatively new technology without a substantial commercial track record. High levels of metals could short circuit the system prompting frequent maintenance. Well replacement over several years may result.
• Estimated Period of Operation	30 Years	30 Years	30 years unless additional active treatment actions are implemented upgradient.	30 years unless additional active treatment actions are implemented upgradient.	30 years unless additional active treatment actions are implemented upgradient.
• Need for 5-Year Review	Review required because no active treatment is included	Review required because no active treatment is included.	Review required because area impacted by treatment will be limited.	Review required because area impacted by treatment will be limited.	Review required because area impacted by treatment will be limited.

TABLE 5-5 (Continued)

SUMMARY OF DETAILED ANALYSIS
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Evaluation Criteria	RAA 1 No Action	RAA 2 No Action with Institutional Controls	RAA 3 Groundwater Collection and On-Site Treatment	RAA 4 In Situ Air Sparging and Off-Gas Carbon Adsorption	RAA 5 In Well Aeration and Off-Gas Carbon Adsorption
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT					
• Treatment Process Used	No active treatment process applied.	No active treatment process applied.	On-site groundwater treatment includes filtration, metals precipitation, air stripping, air and water carbon adsorption.	In situ volatilization and biodegradation. Off-gas carbon adsorption.	In situ volatilization and biodegradation. Off-gas carbon adsorption.
• Reduction of Toxicity, Mobility or Volume	No reduction except by natural attenuation.	No reduction except by natural attenuation.	Reduction of organic and inorganic contaminants expected within capture zone of trench.	Reduction of organic contaminants expected within radius of influence of wells.	Reduction of organic contaminants expected within radius of influence of wells.
• Residuals Remaining After Treatment	No active treatment process applied.	No active treatment process applied.	Residuals include metals sludge and spent carbon which would have to be disposed of properly.	Residuals requiring disposal include spent carbon and a small volume of condensed contaminated vapor (water).	Residuals requiring disposal include spent carbon and a small volume of condensed contaminated vapor (water).
• Statutory Preference for Treatment	Not satisfied.	Not satisfied.	Satisfied except that area impacted by treatment is limited and does not include entire plume of contaminated surficial groundwater.	Satisfied except that area impacted by treatment is limited and does not include entire plume of contaminated surficial groundwater.	Satisfied except that area impacted by treatment is limited and does not include entire plume of contaminated surficial groundwater.
SHORT-TERM EFFECTIVENESS					
• Community Protection	Risks to community not increased by remedy implementation.	Risks to community not increased by remedy implementation.	Minimal, if any, risks during collection and treatment.	Possible migration of toxic vapors through ground surface because vapor extraction is difficult to control when groundwater surface is within several feet of ground surface.	Minimal, if any, risks during operation and treatment.
• Worker Protection	None.	Protection required during well installation and sampling.	Trench installation procedure limits worker exposure by design.	Minimal potential for worker exposure.	Minimal potential for worker exposure.

TABLE 5-5 (Continued)

SUMMARY OF DETAILED ANALYSIS
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Evaluation Criteria	RAA 1 No Action	RAA 2 No Action with Institutional Controls	RAA 3 Groundwater Collection and On-Site Treatment	RAA 4 In Situ Air Sparging and Off-Gas Carbon Adsorption	RAA 5 In Well Aeration and Off-Gas Carbon Adsorption
• Environmental Impacts	Continued impacts from unchanged existing conditions.	Continued impacts from unchanged existing conditions.	Wetlands disturbance during installation could be significant. Trench will serve as a barrier for contaminated groundwater discharge to Brinson Creek.	Minimal wetlands disturbance. System will serve as a barrier for contaminated groundwater discharge to Brinson Creek.	Minimal wetlands disturbance. System will serve as a barrier for contaminated groundwater discharge to Brinson Creek.
• Installation Period	Not Applicable.	Less than 30 days required to install additional groundwater monitoring wells.	60 to 90 days estimated to install trench and treatment system.	60 to 90 days estimated to install sparging and SVE wells and treatment system.	60 to 90 days estimated to install aeration wells and treatment system.
IMPLEMENTABILITY					
• Ability to Construct and Operate	No construction or operation activities.	Involves standard well installation and sampling only.	Soft ground in wetlands areas may hamper construction and result in delays. Once installed, operating is straight-forward using commercially proven technology. Approximately 2,000 to 3,000 cubic yards of potentially contaminated soil excavated from the trench will require disposal. Lack of access may be a significant lost factor.	Construction of activities involve primarily well installation which has been previously executed successfully in this area. Disposal of drill cuttings required. Thin vadose zone may hamper effective vapor extraction which could result in the release of toxic vapors to atmosphere. High metals in groundwater could clog well screens which would require frequent maintenance or well replacement.	Construction of activities involve primarily well installation which has been previously executed successfully in this area. Disposal of drill cuttings required. High metals in groundwater could clog well screens which would require frequent maintenance or well replacement.
• Ability to Monitor Effectiveness	No monitoring.	Proposed monitoring will provide an indication of effects of natural attenuation and progress of contaminants migration.	Proposed monitoring will give notice of failure so that system can be adjusted before a significant contaminant release occurs.	Proposed monitoring will give notice of failure so that system can be adjusted before a significant contaminant release occurs.	Proposed monitoring will give notice of failure so that system can be adjusted before a significant contaminant release occurs.
• Availability of Services and Equipment	None required.	Well installation and sampling services available from multiple vendors.	Biopolymer trench technology available from a limited number of vendors.	Air sparging technology is available from multiple vendors.	In well aeration is a patented priority technology currently available from only one vendor.

TABLE 5-5 (Continued)

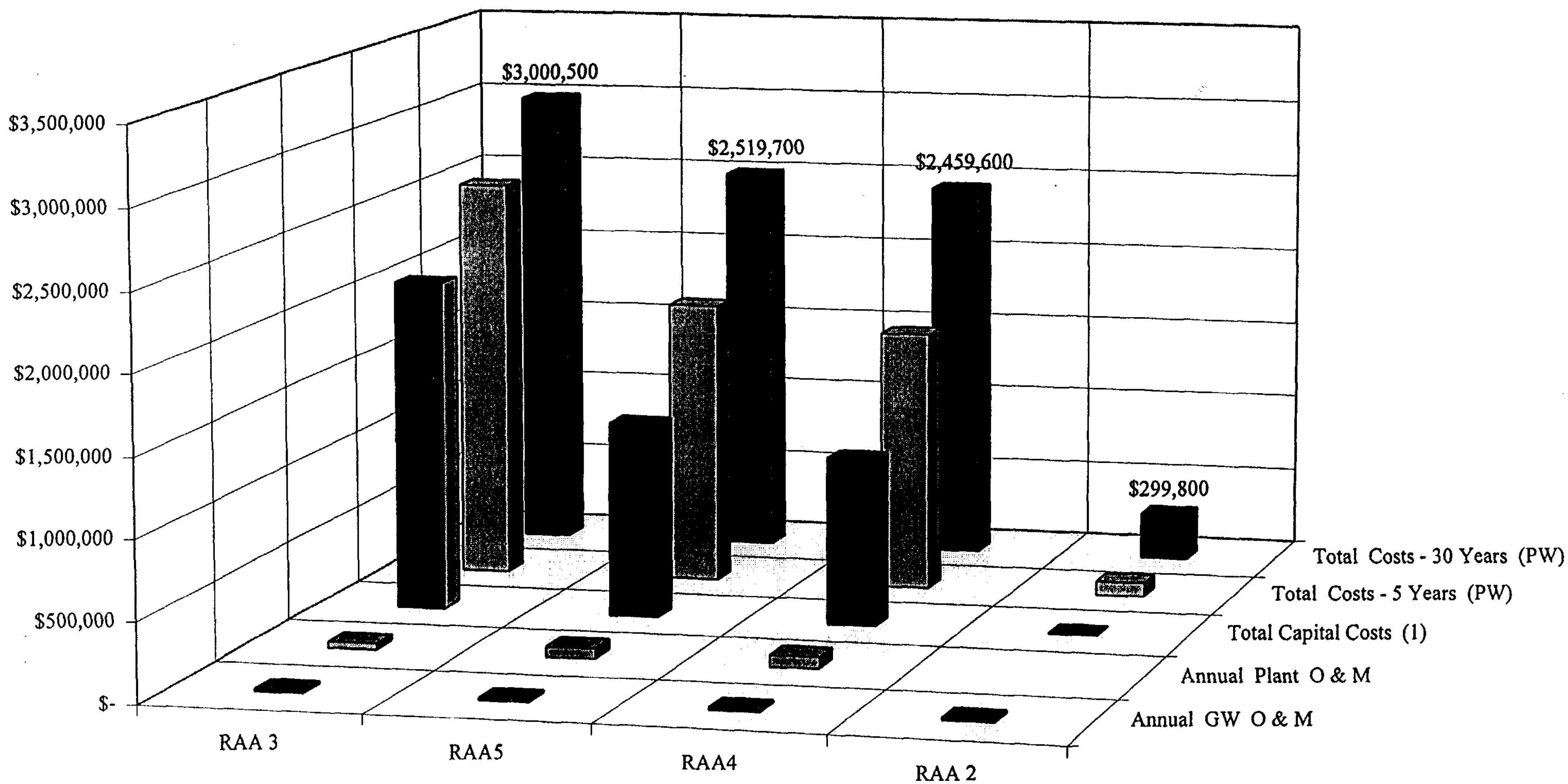
SUMMARY OF DETAILED ANALYSIS
OPERABLE UNIT NO. 10 (SITE 35)
INTERIM FEASIBILITY STUDY, CTO-0232
MCB CAMP LEJEUNE, NORTH CAROLINA

Evaluation Criteria	RAA 1 No Action	RAA 2 No Action with Institutional Controls	RAA 3 Groundwater Collection and On-Site Treatment	RAA 4 In Situ Air Sparging and Off-Gas Carbon Adsorption	RAA 5 In Well Aeration and Off-Gas Carbon Adsorption
• Requirements for Agency Coordination	None required.	Must submit semi-annual reports to document sampling reports.	None required, provided the intent of wetland and air and water discharge permits are met.	None required, provided the intent of wetland and air and water discharge permits are met.	None required, provided the intent of wetland and air and water discharge permits are met.
COSTS					
• Net Present Worth (30 years)	$0	$299,800	$3,000,500	$2,459,600	$2,519,700

SECTION 5.0 FIGURES

FIGURE 5 - 1

COMPARISON OF COSTS
RAAs 2, 3, 4, and 5
SITE 35 - CAMP GEIGER FUEL FARM
MCB CAMP LEJEUNE, NC



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APPENDIX C
TREATABILITY STUDY WORK PLAN, PILOT-SCALE EVALUATION OF IN-SITU AIR SPARGING

FINAL

TREATABILITY STUDY WORK PLAN PILOT-SCALE EVALUATION OF IN-SITU AIR SPARGING OPERABLE UNIT NO. 10 (SITE 35) MARINE CORPS BASE, CAMP LEJEUNE NORTH CAROLINA

CONTRACT TASK ORDER 0323

MAY 31, 1996

Prepared for:

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES
ENGINEERING COMMAND
Norfolk, Virginia

Under:

LANTDIV CLEAN PROGRAM
Contract N62470-89-D-4814

Prepared By:

BAKER ENVIRONMENTAL, INC.
Coraopolis, Pennsylvania

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APPENDICES

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1.0 INTRODUCTION

This Treatability Study Work Plan has been prepared by Baker Environmental, Inc. (Baker) under the United States Department of the Navy (DON), Atlantic Division, Naval Facilities Engineering Command (LANTDIV) Comprehensive Long-Term Environmental Action Navy (CLEAN) Program for Contract Task Order 0323, Operable Unit (OU) No. 10, Site 35 - Camp Geiger Area Fuel Farm, Marine Corps Base (MCB), Camp Lejeune, North Carolina. The treatability study is being conducted as part of the Remedial Design (RD) for surficial groundwater at Site 35. This document has been prepared in accordance with the requirements of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) for remedial actions [40 Code of Federal Regulations (CFR) 300.430]. The NCP regulations were promulgated under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly referred to as Superfund, and amended by the Superfund Amendments and Reauthorization Act (SARA) signed into law on October 17, 1986. The USEPA's document Guide for Conducting Treatability Studies Under CERCLA (USEPA, 1992) has been used as guidance for preparing this document.

MCB Camp Lejeune was placed on the CERCLA National Priorities List (NPL) on October 4, 1989 (54 Federal Register 41015, October 4, 1989). The United States Environmental Protection Agency (USEPA) Region IV, the North Carolina Department of Environment, Health and Natural Resources (NC DEHNR) and the DON then entered into a Federal Facilities Agreement (FFA) for MCB, Camp Lejeune. The primary purpose of the FFA is to ensure that environmental impacts associated with past and present activities at the MCB, Camp Lejeune are thoroughly investigated and appropriate CERCLA response/Resource Conservation and Recovery Act (RCRA) corrective action alternatives are developed and implemented as necessary to protect public health and the environment.

1.1 Purpose and Organization

This document presents Baker's approach to executing the pilot-scale Treatability Study of Air Sparging technology at Site 35. Its purpose is to detail the objectives and methodologies for conducting this work.

Section 1.0 of this document includes this introduction and site background information. Section 2.0 contains a description of in situ air sparging (IAS) technology and its limitations along with a discussion of remedial design/remedial action implementation considerations. The objectives of the treatability study are presented in Section 3.0. Test procedures are detailed in Section 4.0. Community relations efforts are discussed in Section 5.0. The proposed reports to be prepared as part of this project are discussed in Section 6.0, and, finally, the project schedule is presented in Section 7.0.

1.2 Site Background

1.2.1 Site Location and Description

Marine Corps Base (MCB), Camp Lejeune is a training base for the U.S. Marine Corps, located in Onslow County, North Carolina. The Activity, as the base is referred to, covers approximately 236 square miles and includes 14 miles of coastline. MCB, Camp Lejeune is bounded to the southeast by the Atlantic Ocean, to the northeast by State Route 24, and to the west by U.S. Route 17. The town of Jacksonville, North Carolina, is located north of the Activity (see Figure 1-1).

Camp Geiger is located at the extreme northwest corner of MCB, Camp Lejeune. The main entrance to Camp Geiger is off U.S. Route 17, approximately 3.5 miles southwest of the city of Jacksonville, North Carolina. Site 35, the decommissioned Camp Geiger Area Fuel Farm, refers primarily to five, 15,000-gallon aboveground storage tanks (ASTs), a pump house, and a fuel unloading pad formerly situated within Camp Geiger just north of the intersection of Fourth and G Streets (see Figure 1-2).

Site 35 is contained within Operable Unit (OU) No. 10, one of 17 operable units at MCB, Camp Lejeune. An "operable unit," as defined by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), is a discrete action that comprises an incremental step toward comprehensively addressing site problems.

The Interim Feasibility Study (FS) study area consists of a portion of OU No. 10 measuring approximately 18 acres. More specifically, the study area consists of contaminated groundwater in the portion of the surficial aquifer that is located roughly between the Fuel Farm and Brinson Creek (see Figure 1-2).

1.2.2 Site History

Construction of Camp Geiger was completed in 1945, four years after construction of MCB, Camp Lejeune was initiated. Originally, the ASTs were used for the storage of No. 6 fuel oil, but were later converted for storage of other petroleum products including unleaded gasoline, diesel fuel, and kerosene. The date of their conversion is not known. The ASTs at the site are reported to be the original tanks. Demolition of the Fuel Farm ASTs was completed in 1995.

Product was dispensed from the ASTs via trucks and underground piping. Routinely, the ASTs at Site 35 supplied fuel to an adjacent dispensing pump. A leak in the underground line from the ASTs to the dispensing island was reportedly responsible for the loss of roughly 30 gallons per day of gasoline over an unspecified period (Law, 1992). The leaking line was subsequently sealed and replaced.

The ASTs at Site 35 were used to dispense gasoline, diesel, and kerosene to government vehicles and to supply underground storage tanks (USTs) in use at Camp Geiger and the nearby New River Marine Corps Air Station until the spring of 1995. The ASTs were supplied by commercial carrier trucks which delivered product to fill ports located on the fuel unloading pad at the southern end of the facility. Six short-run (120 feet maximum), underground fuel lines were utilized to distribute the product from the unloading pad to the ASTs.

Reports of a release from an underground distribution line near one of the ASTs date back to 1957-58 (ESE, 1990). Apparently, the leak occurred as the result of damage to a dispensing pump. At that time, the Camp Lejeune Fire Department estimated that thousands of gallons of fuel were released, although records of the incident cannot be located. The fuel reportedly migrated to the east and northeast toward Brinson Creek. Interceptor trenches were excavated and the captured fuel was ignited and burned.

Another abandoned underground distribution line extended from the ASTs to the former Mess Hall Heating Plant, located adjacent to D Street, between Third and Fourth Streets. The underground line dispensed No. 6 fuel oil to a UST which fueled the Mess Hall boiler. The Mess Hall, located across "D" Street to the west, is believed to have been demolished along with its Heating Plant in the 1960s.

In April 1990, an undetermined amount of fuel had been discovered by Camp Geiger personnel along the unnamed drainage channels north of the Fuel Farm. Apparently, the source of the fuel, believed to be diesel or jet fuel, was an unauthorized discharge from a tanker truck that was never identified. The Activity reportedly initiated an emergency clean-up action that included the removal of approximately 20 cubic yards of soil.

Decommissioning of the Fuel Farm began in the spring of 1995 and was completed in July 1995. The ASTs were cleaned, dismantled and removed along with associated concrete foundations, slabs on grade, berms, and underground piping. The Fuel Farm was removed to make way for a six-lane, divided highway proposed by the North Carolina Department of Transportation (NC DOT) (see Figure 1-2).

In addition to the Fuel Farm dismantling, soil remediation activities began in August 1995 along the highway right-of-way as per an Interim Record of Decision (ROD) executed on September 15, 1994. To date, all identified contaminated soil has been excavated and removed from the site.

1.2.3 Previous Investigations and Findings

Previous investigations conducted at Site 35 include the Initial Assessment Study of Marine Corps Base, Camp Lejeune, North Carolina (WAR, 1983); Final Site Summary Report, MCB Camp Lejeune (ESE, 1990); Draft Field Investigation/Focused Feasibility Study, Camp Geiger Fuel Spill Site (NUS, 1990); Underground Fuel Investigation and Comprehensive Site Assessment (Law, 1992); Addendum Report of Underground Fuel Investigation and Comprehensive Site Assessment (Law, 1993); Interim Remedial Action Remedial Investigation/Feasibility Study for Soil (Baker, 1994); Comprehensive Remedial Investigation Report (Baker, 1995); and Interim Feasibility Study for Surficial Groundwater (Baker, 1995).

A comprehensive RI was conducted by Baker in 1994 to evaluate the nature and extent of the threat to public health and the environment caused by the release of hazardous substances, pollutants, or contaminants, and to support a Feasibility Study evaluation of potential remedial alternatives. The RI field program was initiated on April 11, 1994. Data gathering activities were derived from a soil gas survey and groundwater screening investigation, a soil investigation, a groundwater investigation, a surface water and sediment investigation, and an ecological investigation. In April 1996, Baker performed a supplemental field investigation to characterize the vertical and horizontal extent of fuel- and solvent-related contamination along the proposed IAS curtain boundary. This investigation consisted of installation and sampling of a total of 36 temporary monitoring wells. These wells were installed at 12 locations and as 3-well clusters designed to monitor the upper, middle, and lower regions of the surficial aquifer (see Figure 2-3).

Several areas of fuel- and solvent-related groundwater contamination were identified in the surficial aquifer in the area north of Fourth Street. Organic contaminant concentrations detected in the upper and lower portions of the surficial aquifer during the May 1994 sampling round, conducted by Baker, are shown in Figures 1-3 and 1-4, respectively. Additional figures depicting the nature and extent of groundwater contamination are provided in the Final RI Report (Baker, 1995). A water table contour map indicating general groundwater flow directions in the surficial aquifer is provided in Figure 1-5. As shown in Figures 1-6 and 1-7, a hydrogeologic cross-section was developed for the area paralleling Brinson Creek, which shows the various soil types for the area in which the IAS system would be installed. An additional hydrogeologic cross-section was developed from the temporary well boring logs, which is provided in Appendix A. This cross-section indicates that the

soil lithologies vary significantly between the southern and northern portions of the site. As shown in Appendix A, the surficial aquifer in the northern region north of temporary well TW-19 is comprised mainly of medium and fine-grained sands, whereas the region to the south of TW-19 contains at least one significant silt/clay lens of varying thickness.
Two additional areas of solvent-related groundwater contamination have been identified adjacent to Site 35. The extent and sources of this contamination have not been identified and additional RI activities are planned. In addition, significant levels of organic and inorganic contamination were identified in sediment samples.

Following the completion of the RI, a Final Interim Proposed Remedial Action Plan (PRAP) and Final Interim ROD for surficial groundwater at Site 35 were prepared (Baker, 1995). These documents detailed five potential Remedial Action Alternatives (RAAs) developed in the FS for the remediation of organic chemical contaminated surficial groundwater at Site 35. More specifically, the following Remedial Action Objectives (RAOs) were developed in the FS for the surficial aquifer:

- Mitigate the potential for direct exposure to the contaminated groundwater in the surficial aquifer.
- Minimize or prevent the horizontal and vertical migration of contaminated groundwater in the surficial aquifer.
- Restore the surficial aquifer to the remediation levels established for the groundwater contaminants of concern.

The remediation levels established for the contaminated of concern are provided in Table 1-1. These levels were based on the NC DEHNR Water Quality Standards for Groundwater (15A NCAC 2L.0202).

RAA 5, In Well Aeration with Off-Gas Carbon Adsorption, was selected in the Final Interim ROD contingent upon the successful execution of preliminary field pilot-scale tests. This RAA is interim in nature because it represents only one phase of a comprehensive investigation and remediation at Site 35 and is not intended to represent the final solution for OU No. 10. This particular interim action focuses on containment and remediation of organic groundwater contamination in the surficial aquifer located in the vicinity of the Fuel Farm and extending downgradient towards Brinson Creek. A remediation system installed in this area would be designed to mitigate the migration of groundwater contamination from OU No. 10 prior to its discharge into Brinson Creek.

Other media of concern such as sediment and groundwater in the upgradient portion of the surficial aquifer will be addressed during subsequent RI/FS activities that are scheduled to commence later this year. Soil contamination at Site 35 was excavated and removed as part of a separate Interim Remedial Action.

The viability of in-well aeration technology (RAA 5) at Camp Lejeune is being evaluated by means of a field pilot test currently underway at another site (OU No. 14, Site 69). Whether or not in-well aeration is applied at Site 35 is dependent on the results of the field pilot test at Site 69 and, subsequently, on field pilot testing at Site 35. If it is determined, based on the results of the field pilot test, that in-well aeration cannot perform as required, RAA 3 (Groundwater Collection and On-Site Treatment) will be selected as the Interim Preferred Remedial Action. To date, the field pilot test of an in-well aeration technology has experienced delays in being implemented at Site 69 which further delays field pilot-scale tests at Site 35. In the meantime, EPA, NC DEHNR, LANTDIV, Camp Lejeune, and Baker staff agreed that a field pilot test of in-situ air sparging (IAS) technology would be appropriate at this site. If the results of this test are sufficiently positive, a request may be made to prepare an Explanation of Significant Differences (ESD) document to modify the selected alternative.

2.0 INITIAL FEASIBILITY EVALUATION

2.1 Technology Description

IAS is a technology in which air is bubbled through a contaminated aquifer. Air bubbles traverse horizontally and vertically through the soil column, creating an underground stripper that removes contaminants by volatilization and, for some contaminants, particularly fuel-related compounds, by biodegradation. The air bubbles carry the contaminants upward until they can be recovered by a vapor extraction system or released to the atmosphere.

IAS is a commercially available technology for removing volatile organic chemicals from groundwater. Various technical papers have been published documenting its effectiveness at sites across the U.S. In general, the available literature indicates that IAS is most frequently used to remediate shallow groundwater (i.e., less than 20 feet below the ground surface bgs); however, in theory there is no limit to its application.

At Site 35, the area east of the former Fuel Farm, between Brinson Creek and the proposed divided highway, is located, for the most part, within the limits of the Brinson Creek 100-year floodplain. The area is characteristically marshy with the groundwater surface generally situated within three feet of the ground surface throughout the year. This type of site does not avail itself to vapor extraction due to the lack of a sufficiently thick unsaturated soil zone. Consequently, the contaminants removed from the shallow groundwater at Site 35 via IAS will be discharged to the atmosphere directly.

2.2 Technology Limitations

The effectiveness of IAS generally increases with increasing intrinsic permeability (k, cm^2). Soils should have an intrinsic permeability of at least 10^{-9} in order for air sparging to be effective (EPA/510/B-94/003). Silty sands generally have k values in the range of 10^{-10} to 10^{-8}. Therefore, the soils at Site 35, which are predominantly silty sands, are potentially amenable to IAS. Organic compounds with Henry's law constants greater than 0.01 atm-m^3/mol (EPA/542/B-94/013) or 100 atm (EPA/510/B-94/003) are typically considered amenable to stripping. All of the VOCs of concern have Henry's constants that are greater than these values.

As previously indicated, IAS is generally applied to remediate contamination in shallow groundwater (i.e., less than 20 feet bgs). At Site 35, the area of contamination is distributed throughout a shallow groundwater zone that varies in depth from approximately 32 to 40 feet. Lighter molecular weight fuel contaminants are more prevalent near the groundwater surface, while heavier halogenated compounds are concentrated atop a semi-confining layer at the base of the shallow groundwater zone. In general, the lighter contaminants near the groundwater surface should be easier and less costly to remove than the heavier contaminants at the base of the shallow zone. This is due, in part, to the higher volatility of the lighter compounds and, in part, because of the greater energy required to inject air in the deeper zone.

The track record for IAS shows that it has indeed been applied more at sites contaminated with fuels rather than solvents. This is probably due in part to the larger number of fuel-related versus solvent-contaminated sites, the biodegradability of fuel-related contaminants, and the fact that the majority of fuel-related sites are characterized by contamination at or near the groundwater surface. One IAS pilot study was performed in 1995 on solvent-related contamination (TCE) at Hill AFB in

Utah (Wheeless, et al., 1995). Significant contaminant removals were achieved by the IAS system, which was applied at a depth similar to Site 35. A copy of this paper, which discusses the results of this study, is included in Appendix B.

IAS systems utilize injected air and are often combined with vapor extraction systems to control the migration of contaminants. At Site 35, between Brinson Creek and the proposed divided highway, the groundwater surface is generally within three feet of the ground surface throughout the year. The available unsaturated soil zone is insufficiently thick to afford the application of vapor extraction. Without vapor extraction, the migration of contaminants in the vadose zone is uncontrolled. However, as illustrated by the following example calculations, vapor emissions are anticipated to be low and should not pose an unacceptable risk to human health or the environment.

To provide a conservative estimate, or upper bound, of the vapor emission rate prior to performing the pilot test, it can be assumed that, at steady-state, the contaminant vapor emission rate will equal the dissolved contaminant migration rate to the IAS system. Thus, this upper bound can be calculated from an estimate of the groundwater specific discharge q [ft/d], width of the IAS barrier W [ft], the depth below the groundwater table to the injection point H [ft], and dissolved contaminant concentration C_{gw} [lb/ft^3] as follows:

$$\text{Emissions}_{max} = q\ [\text{ft/d}] \times W\ [\text{ft/d}] \times H\ [\text{ft}] \times C_{gw}\ [\text{lb/ft}^3]$$

Based on the available Site 35 data from the RI Report, conservative estimates for these parameters are as follows: q = 0.06 ft/d (based on K = 0.001 cm/s, I = 0.02), W = 200 ft, H = 25 ft, C_{gw} = 0.00006 lb/ft^3 (≈1,000 µg/L). Inserting these values into the above emissions equation results in a maximum surficial emission rate of approximately 0.02 lb/d.

Assuming four sparging wells are installed over the 200-foot wide capture zone with a combined air flow rate of 40 cubic feet per minute (cfm) (i.e., four wells spaced 50 feet apart with 10 cfm per well), the resulting contaminant air concentration passing through the vadose zone would be 3.5×10^{-7} lb/ft^3 or 5.6 mg/m^3. For a qualitative risk assessment, this value can be compared to the threshold limit value (TLV) for an 8-hour exposure (i.e., time-weighted average (TWA)) for benzene and TCE, which are 32 mg/m^3 and 269 mg/m^3, respectively. Additional risk assessment analyses will be performed based on the air sampling results from the pilot tests.

Another potential concern associated with the IAS system is the amount of contamination that will be retained in the soils (i.e., resulting contaminant concentrations) since implementation of a soil vapor extraction system to collect volatilized contaminants in the vadose zone may not be possible. Based on an vapor contaminant concentration of 5.6 mg/m^3 and assuming an equilibrium soil-vapor partitioning coefficient of 3.3 L/kg for benzene and 2.5 L/kg for TCE (see calculations provided in Appendix C), the degree of soil contamination resulting from this contaminated air is approximately 0.018 mg/kg. for benzene and 0.014 mg/kg for TCE. The acceptable U.S. EPA risk-based concentrations (RBCs) for exposure to contaminated soil (i.e., accidental ingestion) under a residential use scenario are 22 mg/kg and 58 mg/kg for benzene and TCE, respectively. Thus, the IAS system should not create soil contamination that poses an unacceptable risk to human health or the environment.

2.3 Technology Implementation/Design Basis

The IAS alternative in the Interim FS (Baker, 1995), Remedial Action Alternative (RAA) 4, included installation of an IAS "curtain," or barrier, to contain and treat contaminated groundwater as it flows towards Brinson Creek. The conceptual design for RAA 4 included a total of 43 sparging (i.e., air injection) wells spaced approximately 25 feet apart. As shown in Figure 2-1, a total capture zone approximately 1000 feet in width was assumed based on available data. The capture zone width was based on containing groundwater contaminated above the NC DEHNR-based groundwater standards (Table 1-1). As shown in Figure 2-1, the sparging curtain is expected to be located approximately 25 feet downgradient, or east, of the highway's eastern right of way. A soil vapor extraction system was included in the FS as part of RAA 4, since it is typically required for an IAS system as a safeguard measure for controlling vapor emissions. RAA was not selected because of the high water table conditions in the capture zone area along Brinson Creek.

One of the goals of the pilot-scale test is to refine the conceptual design in the FS using test data as well as additional groundwater contaminant data obtained during the Phase II RI at Site 35. The Phase II RI is scheduled to be completed prior to the initiation of the pilot test. A summary of the available groundwater data through the 1994 RI for the fuel-related (i.e., benzene, toluene, ethylbenzene, and xylenes (BTEX)) and solvent-related (i.e., total chlorinated hydrocarbons (CHCs)) contamination in the vicinity of Brinson Creek is provided in Figure 2-2. Total concentrations of BTEX and CHCs detected during the April 1996 field investigation are shown in Figure 2-3.

Groundwater sampling results from the most recent field investigation and previous studies conducted by ESE (1986), NUS (1990), Law (1991 and 1993), and Baker (1994), indicate three primary areas of contamination that intercept the proposed sparging curtain boundary. Hypothetical contaminant plumes for these areas were developed (Figure 2-4) to estimate capture zones and to identify additional data needs. These plumes have been identified as plumes A, B, and C for purposes of this report. These plumes are considered hypothetical since it is unknown if each plume originates from a single source area or if it is actually a composite of two or more plumes originating from multiple sources. The two northern plumes (A and B) represent BTEX contamination associated with monitoring wells MW-20 and MW-16, respectively. The southern plume (plume C) consists of chlorinated solvent contamination, primarily TCE and 1,2-DCE, associated with monitoring well MW-19. A fourth potential area of solvent contamination (not shown), plume D, is located south of plume C near wells 35MW-34B, 35MW-35B, and 35MW-36B (see Figures 1-3 and 1-4). This zone of contamination does not appear to have encroached as near to Brinson Creek as plumes A, B, and C. The concentrations in plume D are three orders of magnitude less than the plume C contamination and appear to represent a separate contaminant source.

Of the three or four plumes intercepting the sparging curtain boundary, plumes B and C contain the bulk of the contaminant mass in the groundwater and pose the most risk to receptors in Brinson Creek. The significance of these two plumes with respect to the remedial design/action is discussed later in this section. Groundwater data (Figure 2-2) show that BTEX levels associated with plume A attenuate rapidly in the downgradient direction, suggesting natural attenuation mechanisms (i.e., biodegradation) are preventing appreciable contamination from reaching the creek. With respect to plume D, contaminant levels in this area only slightly exceed established cleanup levels. Therefore, with containment/treatment of the upgradient source area, natural attainment of the cleanup levels in plumes A and D may be possible through dilution and dispersion.

Conceptually, the shallow aquifer can be divided into two regions; an upper region in which the majority of the BTEX contamination resides, and a lower region that contains the bulk of the solvent-related contamination. The thickness of the shallow aquifer is approximately 30 to 35 feet, with the water table located approximately two to three feet bgs along the sparge curtain boundary. BTEX compounds were generally detected in the upper 0 to 15 feet of aquifer; whereas, the highest concentrations of chlorinated compounds were detected in the lower 20 to 35 feet of aquifer (i.e., above the semi-confining layer). BTEX concentrations in the upper aquifer are generally about two orders of magnitude higher in the upper aquifer than in the lower aquifer.

Plume B is generally a shallow BTEX plume with contamination in the center of the plume extending into the middle portion of the shallow aquifer (approximately 25 feet bgs) and contamination near the edges of the plume extending only to about 15 feet bgs. Plume B is approximately 300 feet in width. The centerline of the plume appears to be located near well TW-23. Soil conditions across Plume B appear more uniform compared to those across Plume C. Most of the saturated aquifer material across Plume B is composed of medium- and fine-grained sands. Thin silt/clay stringers were observed in some of the borings, however, the soils are predominantly sands. Therefore, there is a good chance of success for implementing IAS in Plume B.

In contrast to Plume B, Plume C is generally a deeper chlorinated solvent plume (mainly TCE and 1,2-DCE) with contamination generally absent in the upper 10 feet of aquifer and then increases dramatically with depth to the confining layer located 30-35 feet bgs. Plume C appears to be at least 450 feet in width. As shown in Figure 2-4, part of plume C overlaps with plume B. The highest concentrations of the TCE and 1,2 DCE contamination are centered near well locations TW-16 and TW-17. Soil boring logs from the wells installed along Plume C indicate a much more heterogeneous condition. Boring log TW-16 indicates either silty clay or clayey silt from 6.5 to 25 feet bgs. Silt and clay was also apparent in boring TW-17 down to 18.5 feet bgs with silty sand down to about 24.5 feet bgs. Borings TW-16 and TW-17 contained the highest concentrations of TCE and 1,2-DCE. The thicknesses of the silt/clay and clay/silt lenses appear to dramatically decrease in the northwestern direction along the sparge curtain boundary. A silt/clay lens was only detected from about 8.5 to 9.5 feet in boring TW-18. The thickness of the silt/clay lens may also attenuated in the southeastern direction. Upon implementation of IAS, air flow channels will likely be dependent on the extent and shape of the silt/clay material. Depending on these factors, as well as the permeability and heterogeneity of the sandy and shell hash materials below the silt/clay layer, injected air could travel in a uniform lateral direction beneath the layer, preferentially travel in one direction, or become trapped beneath the silt/clay layer.

Since plumes B and C essentially represent two distinct sites with different types of contamination and soils, two short-term (6-day) pilot-scale tests are proposed for Site 35, one for plume B and one for plume C. The pilot test for plume B will be conducted first since the soil lithology is more homogeneous and contains more sand and less silt than the aquifer materials located further south in the plume C area. Thus, the plume B area is more conducive to IAS technology and has the greatest chance of success. If the plume B pilot test appears successful (i.e., air can be effectively injected into the aquifer with no signs of entrapment below confining layers), then the plume C pilot test will be performed. This area contains the highest levels of solvent-related contamination and poses the greatest treatment challenge with respect to IAS. It is anticipated that the scope of work for the plume C pilot test will be very similar to the first plume B pilot test. However, modifications and adjustments may be made to the plume C study based on data obtained and lessons learned from the first test.

To accommodate the two different types and zones of contamination, two sparging wells are proposed for the plume B treatability study, as shown in Figure 2-5. The upper sparging well would be screened approximately 14 to 16 feet bgs, whereas the lower sparging well would be screened from approximately 32 to 34 feet bgs. Exact screen placements would be determined in the field based on actual conditions. As shown in Figure 2-6, only one deep sparging well is proposed for plume C because of the silt/clay and clay silt lenses present from approximately 7 to 23 feet bgs. Air injected into the plume C sparging well is expected to travel horizontally within the lower sand layer and beneath the silt/clay lenses. The air will gradually travel upward as the silt/clay lenses become thinner and eventually disappear.

As shown in Figures 2-5 and 2-6, as the injected air exits the well screen and travels upward towards the water table, it fans out radially, forming a parabolic-shaped zone of influence (under homogeneous conditions). Soil heterogeneities, however, such as silt stringers or very permeable sand lenses, can dramatically alter this flow regime by trapping air and forcing it to move laterally and/or by creating preferential flow paths. Thus, changes in lithology may preclude the sparge curtain from treating certain zones of contamination. Because of the "fanning-out" effect, the length of the radius of influence (ROI) of a sparging well is typically least at the bottom of the well and greatest near the water table. Since the sparging wells cannot be placed below the semi-confining layer, chlorinated hydrocarbons located immediately above this layer may pass beneath and/or between the sparging wells. To minimize this problem, sparging wells may need to be tightly spaced in the deep zones of contamination (i.e., plume C). In areas with mainly shallow contamination, a longer spacing may be feasible, depending on lithology.

Depending on the results of the test and the observed vertical distributions of BTEX compounds and chlorinated hydrocarbons, the full-scale design could include any of the following sparging well combinations:

- Shallow sparging wells for BTEX
- Shallow and deep sparging wells for BTEX
- Deep sparging wells for chlorinated hydrocarbons
- Shallow and deep wells for chlorinated hydrocarbons

The results of the short-term pilot tests will provide key information concerning the effectiveness and implementability of IAS technology at the Site 35 plumes. However, the short-term tests will not provide conclusive evidence as to the effectiveness of the sparge curtain to mitigate long-term contaminant migration. Furthermore, since the plume B pilot test will only be performed for a short duration, it will not provide data regarding potential enhancement of biodegradation rates in this area. For these reasons, a long-term (i.e., 12 to 18-month) barrier effectiveness test is proposed for plumes B and C, provided the short-term pilot test(s) yield(s) promising results. The long-term test would essentially represent the first phase of the interim remedial action, in which permanent, full-scale equipment and utilities would be installed by the Remedial Action Contract (RAC) contractor and operated at the site. During this period, new and existing monitoring wells located up-, down-, and cross-gradient of the sparge curtain boundary would be monitored to track contamination in both untreated and treated areas. Near the end of this time frame, one of the following decisions would be made based on sampling results:

- Continue operation of the existing system

- Expand the existing IAS system to include additional areas if necessary (e.g., plume A and/or plume D)

- Discontinue use of the sparging system in plume B and/or plume C in favor of an alternate technology (i.e., in-well aeration)

Should the short-term tests demonstrate that IAS is a potentially feasible technology for both the BTEX and solvent-related plumes, Baker proposes to proceed with the design of the full-scale interim system based on the collected data and following receipt of review comments on the Treatability Study Report.

3.0 TREATABILITY STUDY OBJECTIVES

At Site 35 IAS is proposed as part of an interim remedial action. The focus of this interim action is the contaminated surficial groundwater in the area located east of the former Site 35 Fuel Farm, between Brinson Creek and the proposed divided highway. As this represents only a portion of the contaminated shallow groundwater identified at the site, this action is referred to as an Interim Remedial Action. That is, it represents only a portion of a more comprehensive investigation and remediation at Site 35 and will not necessarily be the final solution for OU No. 10.

The objectives of the pilot-scale treatability study are as follows:

- Assess the applicability of IAS technology in addressing shallow groundwater contamination at Site 35 by evaluating the effectiveness, implementability, and cost of a full-scale treatment system.

- Obtain sufficient data to afford the development of a full-scale system remedial design.

- Assess the impact of air emissions on human health and the environment, and verify that air emissions will not impact the proposed highway project.

4.0 TESTING PROCEDURES

A Final Remedial Investigation Work Plan, Sampling and Analysis Plan (SAP), Quality Assurance Project Plan (QAPP), and site-specific Health and Safety Plan (HASP) were prepared by Baker (December, 1993) for various field activities at Site 35, including monitoring well installation and soil and groundwater sampling. These project plans will be used for the monitoring well installation and groundwater sampling activities described herein for the pilot-scale test.

4.1 Mobilization

Mobilization will include site preparation, site clearing, and mobilization of drilling crew and rig.

4.1.1 Site Preparation/Site Clearing

Since the treatability study area is located in a heavily-wooded, low-lying area, site-preparation and site-clearing activities will be required to provide access and a stable working surface.

The existing dirt access road is generally accessible for a drilling rig and 4-wheel drive vehicles. However, the treatability study areas are in a low-lying portion of the site, which are subject to occasional flooding and are generally soft. Therefore, the areas will need to be improved prior to treatability study mobilization activities. A small staging area (approximately 15'x 15') will be prepared in each area by placing a 1-foot thick compacted gravel layer over a geofabric. Limited site-clearing, which includes cutting small trees and removing shrubs, may be required to install the staging areas and treatability study monitoring wells.

4.1.2 Installation of Temporary Utilities

The compressor for the IAS system will be operated using a 20-hp gas-powered engine. Therefore, installation of temporary power will not be required.

4.1.3 Temporary Facilities

Baker's existing office and storage trailers near Site 41 will be used during the study due to its short duration. Trash will be collected in garbage bags and disposed of in the dumpster located at Site 41. Baker will have a mobile phone on site during the well installation and treatability study effort.

4.2 Drilling and Well Construction

This section describes the procedures for the construction and installation of groundwater monitoring wells (two-inch diameter PVC casings two-inch diameter, No. 10 slot, well screened), IAS wells, and the soil gas monitoring probes. All drilling activities will be performed using hollow-stem augering methods under the direct supervision of a licensed well driller in accordance with the procedures provided in the Baker SAP. Oversight will be provided by a Baker geologist.

4.2.1 PVC (2-inch) Monitoring Wells

Plan views of the proposed IAS and groundwater monitoring wells for each test are shown in Figure 4-1. As shown in Figure 4-1, six pairs of shallow/deep monitoring well clusters are proposed for the pilot test for plume B. For the plume C test, four pairs of shallow/deep monitoring well clusters are planned with an additional four deep monitoring wells. Thus, a total of 12 new monitoring wells will be installed for each test. All new monitoring wells will be installed and developed immediately prior to performance of each treatability study.

To optimize data collection for the plume B study, each pair of wells will not be located immediately adjacent to one another as is done with a typical well cluster. However, the cluster well numbering terminology will be used to maintain consistency with previous investigations. The purpose of the two-well cluster concept is to provide the means for obtaining groundwater data at the shallow groundwater surface and above the underlying semi-confining layer. These intervals are monitored by existing double-nested shallow wells. According to the results of previous investigations, the shallow groundwater surface can be expected to be encountered across the treatability study area at two to three feet bgs. Data provided in previous investigations indicates that the top of the semi-confining layer is located about 35 feet bgs.

Each well in the two-well clusters will be provided with either an "A" or "B" designation (e.g., MW-45A and MW-45B). The "A" will identify the well screened at the groundwater surface, whereas "B" will identify the well screened at the top of the underlying confining layer. Existing monitoring wells are currently numbered up to 35MW-43A/B. Therefore, wells installed for the treatability studies will begin with number 35MW-44A/B.

Each well will be constructed with two-inch diameter, schedule 40 PVC casings and No. 10 slot, 2-inch diameter PVC screens. All air sparging wells (35MW-44A/B and 35MW-51B) will be installed using two-foot long screens. The shallow sparging well will be installed to a depth of approximately 16 feet bgs. The deep air sparging well will be installed just above the clayey silt semi-confining layer at a depth of approximately 34 feet bgs.

For the plume B test, a 10-foot screened interval for the groundwater surface monitoring wells will be used from about two to 12 feet bgs. For the deep monitoring wells in plume B, a five-foot long screen will be set approximately three feet higher than the screen depth used for the deep sparging well (i.e., 31 feet). These monitoring wells are placed higher than the sparge wells for the purpose of intercepting the air flow channels rising from the injection well. Detailed well construction information and well installation procedures are provided in Section 5.0 of the SAP.

Because of the presence of the silt/clay lenses, the shallow wells for the plume C test will actually be screened within the lower sand stratum just above (i.e., 1-2 feet) the deep well casing (i.e., within a range of approximately 20 to 30 feet bgs). For all deep monitoring wells which are part of a well cluster (35MW-52B, 35MW-53B, 35MW-54B, and 35MW-55B), a five-foot long screen will be set at a depth that is either equal to, or slightly higher (i.e., 1 to 3 feet) than the screen depth used for the deep sparging well, depending on the thickness of the sand stratum. Thus, the screens for these deep monitoring wells will be placed within a depth range of 26 to 34 feet bgs. For the remaining deep monitoring wells which are not part of a cluster (35MW-56B, 35MW-57B, 35MW-58B, and 35MW-59B), 15-foot long screens will be set for an interval from 19 to 34 feet bgs. The purpose of these 15-foot screens is to capture a greater section of the aquifer to allow for more effective monitoring of the horizontal movement of air at large distances from the sparge well.

Continuous split-spoon sampling using 2-foot long, 2.5- or 3-inch I.D. spoons will be performed during installation of several of the deep wells to determine soil types and well screen placements. Selected soil samples will be collected for possible future geotechnical analysis (e.g., grain size analysis), if deemed necessary following completion of the treatability study.

4.2.2 Soil Gas Probes

For each test, a total of six soil gas probes will be installed at various locations surrounding the air sparging wells as shown in Figure 4-2. The probes will be placed approximately 1 foot above the water table (i.e., 1 to 1.5 feet bgs). The probes will be constructed of 2.5-feet long, 1/2-inch diameter schedule 40 PVC piping with retractable or disposable tips. They will be manually pushed into the soil and removed upon completion of the test.

4.3 Pilot Test Design and Operation

Once the soil gas probes and monitoring wells are installed, as described in Section 4.2, each IAS test and associated air and groundwater sampling/monitoring activities will commence as follows:

- Day 1: Pre-Test Sampling (Baseline Conditions)
- Days 2-3: Phase I IAS Test (5 scfm flow rate)
- Days 4-5: Phase II IAS Test (20 scfm flow rate)
- Day 6: Post-Test Sampling

During each phase of the pilot test, air will be simultaneously injected into both the shallow and deep sparging wells. In other words, approximately 5 scfm will be injected into each well during Phase I; whereas, approximately 20 scfm will be injected into each well during Phase II. The text will be revised to clarify this point. As discussed below, the length of Phase I and/or Phase II could be expanded based on field observations.

Changes in the following parameters will be measured to evaluate the radius of influence (ROI) of the IAS system:

- Dissolved oxygen (D.O.) in groundwater
- Oxygen concentration (by volume) in soil (vadose zone)
- Contaminant levels in vadose zone (soil gas)
- Contaminant levels in groundwater
- Helium concentrations in vadose zone
- Vadose zone pressure
- Groundwater pressure (water table elevation)

All measurements in the vadose (i.e., unsaturated) zone will be taken using the soil gas probes, and all groundwater parameters will be measured using the upper and lower aquifer monitoring wells.

Of the above parameters, oxygen concentration is the key parameter that will be used to assess the zone of influence of the sparging system, particularly D.O. concentrations in the surficial aquifer. Background dissolved oxygen levels are expected to be at concentrations less than 2 mg/L in the aquifer and possibly in the range of 10 - 15 percent in the vadose zone, depending on the amount of biological activity in the area. Once the IAS system is turned on, D.O. levels in the monitoring wells may rise to various levels up to the saturation point of about 9 mg/L, and oxygen levels in the vadose zone may increase to about 20 percent. The duration of Phase I and/or Phase II could be increased an additional 12 to 24 hours if D.O. measurements indicate that the system has not reached steady-state and more time is needed to obtain an accurate ROI estimate.

In addition to oxygen, a helium tracer will be used to help determine the IAS radius of influence. Procedures for the helium tracer test as well as the other data collection methods and frequencies are discussed for each test phase in the following sections.

All samples collected during this investigation, including QA/QC samples, will be designated with a unique number. The number will serve to identify the investigation, the site, the area within the site, the sample medium, a sampling location, depth or round (pre-test, test, post-test) of sample, and QA/QC qualifiers.

The sample designation format is as follows:

Site # - Medium - Location - Depth/Round - Time (QA/QC)

An explanation of each of these identifiers is given below.

Site # — This investigation includes Site 35.

Medium

GW	=	Groundwater
SG	=	Soil Gas
WT	=	Waste

Location — The location numbers identify the sampling location. This would include station number for soil location or monitoring well number for groundwater. Each grid station will be identified with a unique identification number.

Depth/Round — Depth indicators will be used for soil samples. The number will refer to the depth of the top of the sampled interval. For example:

00	=	top of sample at ground surface
01	=	top of sample is 1 foot below surface
07	=	top of sample is 7 feet below surface

Round indicator will be used for groundwater samples as follows:

01	=	Pre-test sampling round
02	=	Pilot test (Phase I)
03	=	Pilot test (Phase II)
04	=	Post-test sampling round

Time — Time indicators will be used to identify the time (in hours) of sample collection during each phase as follows:

00	=	Initial baseline sampling or immediately after system startup (i.e., t = 10 minutes)
02	=	t = 2 hours
24	=	t = 24 hours
48	=	t = 48 hours

QA/QC	(FB)	=	Field Blank
	(D)	=	Duplicate Sample
	(TB)	=	Trip Blank
	(ER)	=	Equipment Rinsate

Under this sample designation format the sample number 35-GW-48A-01-24D refers to:

35-GW-48A-01-24D	Site 35
35-GW-48A-01-24D	Groundwater Sample
35-GW-48A-01-24D	Monitoring well 48A
35-GW-48A-01-24D	Pre-test sampling round
35-GW-48A-01-24D	Sample collected after 24 hours
35-GW-48A-01-24D	duplicate (QA/QC) sample

This sample designation format will be followed throughout the project. Required deviations to this format in response to field conditions will be documented.

The types and quantities of QA/QC samples associated with the groundwater sampling are indicated in Tables 4-1, 4-2, and 4-3 discussed in the following sections. Additional information concerning the QA/QC samples is provided in the Site 35 QAPP. Sample bottle and holding time requirements for the groundwater samples are also provided in the QAPP.

4.3.1 Pre-Test Sampling

Prior to startup of the IAS system, a 24-hour pre-test sampling event will be conducted to obtain a baseline data set of the natural physical/chemical conditions in the aquifer and vadose. The pre-test sampling matrix outlining all test parameters, methods, and sampling frequencies is provided in Table 4-1. Specific sampling methodologies are described below.

4.3.1.1. Soil Gas Sampling and Monitoring

With the exception of the SUMMA canisters, all soil gas samples will be collected using a Dawson electric high volume air sampling pump connected to the soil gas probes. The high volume air sampler is designed to provide a variable flow setting between 3 to 20 liters/min. The air sampler will be connected to the soil gas probes using 1/4" flexible tubing (i.e., tygon, PVC, polyethylene, or polypropylene). Specific methods and equipment are given below.

Oxygen Concentrations

Oxygen concentrations in the vadose zone will be measured using a portable Sentinel Model 503-A O_2/LEL meter, or equivalent. The measurement will be taken by drawing air from the air pump discharge line into the intake tube on the O_2/LEL meter.

Organic Contaminant Concentrations

The majority of the total organic compound concentrations in soil gas will be measured using an HNu Model PI-101 or DL-101 photoionization detector (PID) with a 10.2 eV lamp. The measurement will be taken by holding the PID probe the in the discharge from the air pump.

In addition to PID readings, a limited number (Table 4-1) of vapor samples will be collected using 6-liter SUMMA canisters. The inlet to the SUMMA canisters (i.e., swagelock), which are supplied under vacuum, will be connected to the soil gas probes using 1/4" flexible tubing (i.e., tygon, PVC, polyethylene, or polypropylene) and shipped to an off-site laboratory certified by NFESC or the U.S. Army Corps of Engineers for EPA Method TO-14 analysis. A list of the constituents detected by the TO-14 analysis is provided in Appendix D. There is no holding time for the SUMMA canisters; however, it is anticipated that all canisters will be shipped to the laboratory within a few days of sampling and analyzed within a two-week time frame.

Pressure Measurements

Pressure measurements will be taken using magnehelic differential pressure gauges (e.g., Dwyer Series 2000, 0-20" H_20) hard-piped to dedicated 1/4-inch diameter soil gas probes.

4.3.1.2. <u>Groundwater Sampling</u>

Oxygen Concentrations

D.O. concentrations in the aquifer will be measured using a portable YSI Model 57 D.O. meter, or equivalent. The measurement will be taken by using the peristaltic pump to pump water into a small jar in which the D.O. sensor is placed. The D.O. measurement will be taken after the sensor reading stabilizes. The collected water will be disposed in the decontamination water container.

Organic Contaminant Concentrations

Groundwater samples will be collected for VOC analysis as indicated in Table 4-1. The peristaltic pump will be used to purge three to five well volumes from the well and to obtain a turbidity reading less than 10 NTUs prior to collecting the sample. Additional sampling collection protocols are provided in the SAP. The samples will be analyzed using EPA SW 846 Method 8240 (plus xylenes) by an off-site laboratory certified by NFESC or the U.S. Army Corps of Engineers.

Pressure Measurements

Water table levels will be automatically recorded on an hourly basis in four shallow wells throughout the pre-test, pilot test, and post-test periods using pressure transducers linked to a data logger (4-channel In Situ, Inc. Hermit Model SE2000).

4.3.2 Pilot Test Operation

As previously noted, each pilot test will consist of two, 2-day phases (Phase I and Phase II) in which air injection flow rates (per well) of approximately five standard cubic feet per minute (SCFM) and 20 SCFM will be used. The phases will be performed in series without discontinuing air injection. IAS systems typically operate within the range of three to 20 SCFM, with the majority of systems operating around 10 SCFM per well. Thus, the five and 20 SCFM flow rates were selected to provide the optimal data on which to base a full-scale system design.

4.3.2.1 Pilot Test Equipment

A process flow schematic showing the equipment and instrumentation to be used for the IAS tests is provided in Figure 4-3. The equipment shown in Figure 4-3 will be pre-assembled on a single-axle flat bed trailer (5 feet by 8 feet), which will be transported to the site by a van or pickup truck. Since a soil vapor extraction (SVE) test will not be performed in conjunction with the IAS test due to the high water table, the major equipment item to be used in the IAS will be an oil-free rotary vane air compressor. The compressor will be equipped with a pressure relief valve, check valve, and pressure gauge and will be plumbed to a section of 1-inch diameter schedule 40 steel pipe with a bleed valve to control air flow and sampling port to monitor helium concentrations. Schedule 40 0.5-inch diameter high temperature hose will be used to connect the steel pipe to the injection well head. The following parameters will be measured on the compressor discharge:

- Temperature
- Pressure
- Air flow rate

These parameters will be monitored periodically and any changes/adjustments recorded in the field log book as appropriate.

4.3.2.2 Pilot Test Sampling

The test sampling matrix outlining all test parameters, methods, and sampling frequencies is provided in Table 4-1. The sampling procedures are identical to those described in Section 4.3.1, except that helium concentrations will be measured in the soil as part of the helium tracer test discussed in the next section.

4.3.2.3 Helium Tracer Test

As air injection is initiated after the baseline sampling, helium will be blended with the injection air at a concentration of about two percent. A series of pressurized helium tanks will be manifolded together and piped into the air injection line. Helium air flow will be adjusted manually by sampling the injected air. Pressure and flow gauges will also be provided on the helium line. The helium will be used as a conservative tracer to identify where the injected air reaches the vadose zone, and to identify if the injected air is traveling to any location of concern. Helium concentrations in the vadose zone will be measured using a portable battery-operated helium detector (Mark 9821 or equivalent). The measurement will be taken by drawing air from the air pump discharge line into the intake tube on the helium detector.

Once the soil gas data has been collected, contaminant emission rates will be estimated by multiplying the air injection flow rate Q_{air} [ft^3/min] with some average of the measured shallow soil gas concentrations C_{sq} [lb/ft^3]:

$$Emissions = Q_{air}\ [ft^3/min] \times C_{sq}\ [lb/ft^3]$$

As a check on the accuracy of the estimate, an estimate of the helium emission rate will be calculated using the same procedure. The helium emission estimate will then be compared with the known helium injection rate to check the accuracy of the contaminant emission rate estimate.

4.3.3 Post-Test Sampling

Following completion of Phase II air injection period, a 24-hour post-test sampling event will be conducted to evaluate how the aquifer and vadose zone return to their natural pre-test conditions. The post-test sampling matrix outlining all test parameters, methods, and sampling frequencies is provided in Table 4-3. The sampling methodologies are identical to those described in Section 4.3.1 for the pre-test sampling round.

4.4 Equipment Decontamination Procedures

All drilling and sampling equipment will be decontaminated before use, between each sampling station, and at the completion of the sampling program in accordance with the EPA Region IV ECBSOPQAM. Specific decontamination procedures are provided in the SAP (Baker, 1993).

4.5 Residuals Management

Investigation derived wastes (IDW) will be generated during the drilling and sampling activities associated with the treatability study. The IDW to be generated will include soil cuttings, purge and development groundwater, spent decontamination fluid, and personal protective equipment (PPE) and clothing (PPC). Procedures for IDW disposal are included in the SAP (Baker, 1993).

5.0 COMMUNITY RELATIONS

Community relations activities and requirements are outlined in the Base-wide Community Relations Plan prepared by Baker for the CERCLA RI/FS activities being performed on-Base. A Technical Review Committee (TRC) has been established for the MCB Camp Lejeune CERCLA activities, which includes LANTDIV, the Activity, USEPA, NC DEHNR personnel, and local citizens. The TRC reviews CERCLA documents and participates in periodic meetings with Baker to discuss ongoing CERCLA activities.

6.0 REPORTS

Two main reports are associated with the treatability study effort include this Treatability Study Work Plan and the Treatability Study Report, which will document the treatability study results and conclusions. Submission and review of these two reports are discussed in the following sections.

6.1 Treatability Study Work Plan

This Draft Treatability Study Work Plan, which details the scope of the treatability study activities to be performed, is being submitted to LANTDIV, the Activity, USEPA Region IV, and NC DEHNR for review. Comments received from the NC DEHNR and USEPA Region IV, will be addressed and incorporated, as appropriate, into the Final Treatability Study Work Plan. Baker will distribute the appropriate number of copies of the Final Treatability Study Work Plan to LANTDIV, the Activity, USEPA Region IV, NC DEHNR, and the other members of the TRC.

6.2 Treatability Study Report

Upon completion of the on-site pilot study, a Treatability Study Report will be prepared in accordance with USEPA's "Guide for Conducting Treatability Studies under CERCLA" (USEPA, October 1992). The Treatability Study Report will provide a presentation and evaluation of the treatability study test results. The Treatability Study Report will also include engineering and design-related information needed for evaluating the short- and long-term effectiveness, implementability (including long-term operation and maintenance requirements), and cost (both capital and operation and maintenance) of implementing a full-scale IAS system on site.

Two versions of the Treatability Study Report will be prepared as follows: a Draft Treatability Study Report for review by the Navy, USEPA, and NC DEHNR; and a Final Treatability Study Report, which will incorporate review comments from the Navy and regulatory agencies. Upon completion, Baker will distribute the appropriate number of copies of the Final Treatability Study Report to LANTDIV, the Activity, USEPA Region IV, NC DEHNR, and the other members of the TRC.

7.0 SCHEDULE

A preliminary schedule depicting the treatability study process is provided in Figure 7-1. As shown in Figure 7-1, the on-site operational period for the pilot system, including installation of monitoring wells and demobilization efforts, is approximately three weeks, whereas, the entire treatability study process, which includes development and review of the Treatability Study Work Plan and Treatability Study Report, is expected to require a total of eight months to complete.

8.0 PROJECT MANAGEMENT AND STAFFING

The proposed management and staffing of this Treatability Study is graphically depicted in Figure 8-1. The primary participants in this project will include:

- Mr. Matthew D. Bartman, Activity Coordinator
- Mr. Daniel Bonk, P.E., Project Manager
- Mr. Gordon J. Ruggaber, P.E., Lead Engineer
- Mr. Mark Kimes, Site Manager/Project Engineer

Mr. Daniel L. Bonk will serve as the Project Manager. He will be responsible for the overall technical preparation of the report and will serve as the client contact representative from Baker. Lead technical assistance will be provided by Mr. Gordon J. Ruggaber. All field activities will be managed and coordinated by Mr. Mark Kimes, who will serve as the Site Manager. Mr. Kimes will be responsible for coordinating with on-site subcontractors. Senior review and technical guidance will be provided by the MCB, Camp Lejeune Activity Coordinator, Mr. Matthew D. Bartman.

Overall field and reporting QA/QC will be the responsibility of Mr. Daniel L. Bonk. Mr. Ray Wattras will provide program-level technical and administrative support.

TABLES

TABLE 1-1

ORGANIC COCs THAT EXCEED REMEDIATION LEVELS
OPERABLE UNIT NO. 10 (SITE 35)
CTO-0323
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant of Concern	RL[1,2]	Basis of RL
Benzene	1	NC WQS
Trichloroethene	2.8	NC WQS
cis-1,2-Dichloroethene	70	NC WQS
trans-1,2-Dichloroethene	70	NC WQS
Ethylbenzene	29	NC WQS
Methyl Tertiary Butyl Ether	200	NC WQS
Xylenes	530	NC WQS

Notes:

(1) RL = Remediation Level
(2) Groundwater RLs expressed as μg/L (ppb)

NC WQS = North Carolina Water Quality Standard

TABLE 4-1

PRE-TEST SAMPLING MATRIX
SITE 35
MCB CAMP LEJEUNE, NORTH CAROLINA

Matrix	Location	Analysis	Frequency	Method	Total Samples
Soil gas	All probes	Oxygen	t = 0, 8, 24 hrs	O_2/LEL meter	18
Soil gas	All probes	VOCs	t = 0, 8, 24 hrs	Vapor analyzer	18
Soil gas	SG1, SG2, SG4, SG7, SG8, SG9	VOCs	t = 0 hrs	SUMMA, TO-14	3
Soil gas	All probes	Pressure	t = 0, 8, 24 hrs	Pressure gauge	18
Groundwater	All wells	D.O.	t = 0, 8, 24 hrs	D.O. meter	18
Groundwater	46A/B, 50A/B, 53A/B, 54A/B	VOCs	t = 0, 24 hrs	Lab, SW 846 8240	8 + 3*
Groundwater	45A, 46A, 48A, 50A, 52A, 53A, 54A, 55A	Water Level	Hourly for 24 hrs	Data logger	96

Notes:

* Includes following QA/QC samples:
1 Trip blank
1 Equipment rinsate (sampling pump tubing)
1 Field duplicate

TABLE 4-2

PILOT TESTING SAMPLING MATRIX
SITE 35, MCB CAMP LEJEUNE, NORTH CAROLINA

Matrix	Location	Analysis	Frequency	Method	Total Samples
Phase I, Air Flow Rate = 5 SCFM					
Soil gas	All probes	Oxygen	t=0, 2, 4, 6, 8, 12, 24, 28, 32, 36, 48 hrs	O_2/LEL meter	66
Soil gas	All probes	VOCs	t = 0, 8, 24, 32, 48 hrs	Vapor analyzer	30
Soil gas	SG1, SG2, SG4, SG7, SG8, SG9	VOCs	t = 48 hrs	SUMMA, TO-14	3
Soil gas	All probes	Pressure	t = 0, 8, 24, 32, 48 hrs	Pressure gauge	30
Soil gas	All probes	Helium	t=0, 2, 4, 6, 8, 12, 24, 28, 32, 36, 48 hrs	Portable analyzer	60
Groundwater	All wells	D.O.	t=0, 2, 4, 6, 8, 12, 24, 28, 32, 36, 48 hrs	D.O. meter	66
Groundwater	46A/B, 50A/B, 53A/B, 54A/B	VOCs	t = 24, 48 hrs	Lab, SW 846 8240	8
Groundwater	45A, 46A, 48A, 50A, 52A, 53A, 54A, 55A	Water Level	Hourly for 48 hrs	Data logger	192
Phase II, Air Flow Rate = 20 SCFM					
Soil gas	All probes	Oxygen	t=0, 2, 4, 6, 8, 12, 24, 28, 32, 36, 48 hrs	O_2/LEL meter	66
Soil gas	All probes	VOCs	t = 0, 8, 24, 32, 48 hrs	Vapor analyzer	30
Soil gas	SG1, SG2, SG4, SG7, SG8, SG9	VOCs	t = 48 hrs	SUMMA, TO-14	3
Soil gas	All probes	Pressure	t = 0, 8, 24, 32, 48 hrs	Pressure gauge	30
Soil gas	All probes	Helium	t=0, 2, 4, 6, 8, 12, 24, 28, 32, 36, 48 hrs	Portable analyzer	60
Groundwater	All wells	D.O.	t=0, 2, 4, 6, 8, 12, 24, 28, 32, 36, 48 hrs	D.O. meter	66
Groundwater	46A/B, 50A/B, 53A/B, 54A/B	VOCs	t = 24, 48 hrs	Lab, SW 846 8240	8 + 3*
Groundwater	45A, 46A, 48A, 50A, 52A, 53A, 54A, 55A	Water Level	Hourly for 48 hrs	Data logger	192

Notes:

* Includes following QA/QC samples:
1 Trip blank, 1 Field duplicate
1 Equipment rinsate (sampling pump tubing)

TABLE 4-3

POST-TEST SAMPLING MATRIX
SITE 35
MCB CAMP LEJEUNE, NORTH CAROLINA

Matrix	Location	Analysis	Frequency	Method	Total Samples
Soil gas	All probes	Oxygen	t = 4, 8, 12, 24 hrs	O_2/LEL meter	24
Soil gas	All probes	VOCs	t = 4, 8, 12, 24 hrs	Vapor analyzer	24
Soil gas	SG1, SG2, SG4, SG7, SG8, SG9	VOCs	t = 24 hrs	SUMMA, TO-14	3
Soil gas	All probes	Pressure	t = 4, 8, 12, 24 hrs	Pressure gauge	24
Soil gas	All probes	Helium	t = 4, 8, 12, 24 hrs	Portable analyzer	4
Groundwater	All wells	D.O.	t = 4, 8, 12, 24 hrs	D.O. meter	24
Groundwater	46A/B, 50A/B, 53A/B, 54A/B	VOCs	t = 24 hrs	Lab, SW 846 8240	4 + 1*
Groundwater	45A, 46A, 48A, 50A, 52A, 53A, 54A, 55A	Water Level	Hourly for 24 hrs	Data logger	96

Notes:

* Includes following QA/QC samples:
1 Trip blank

FIGURES

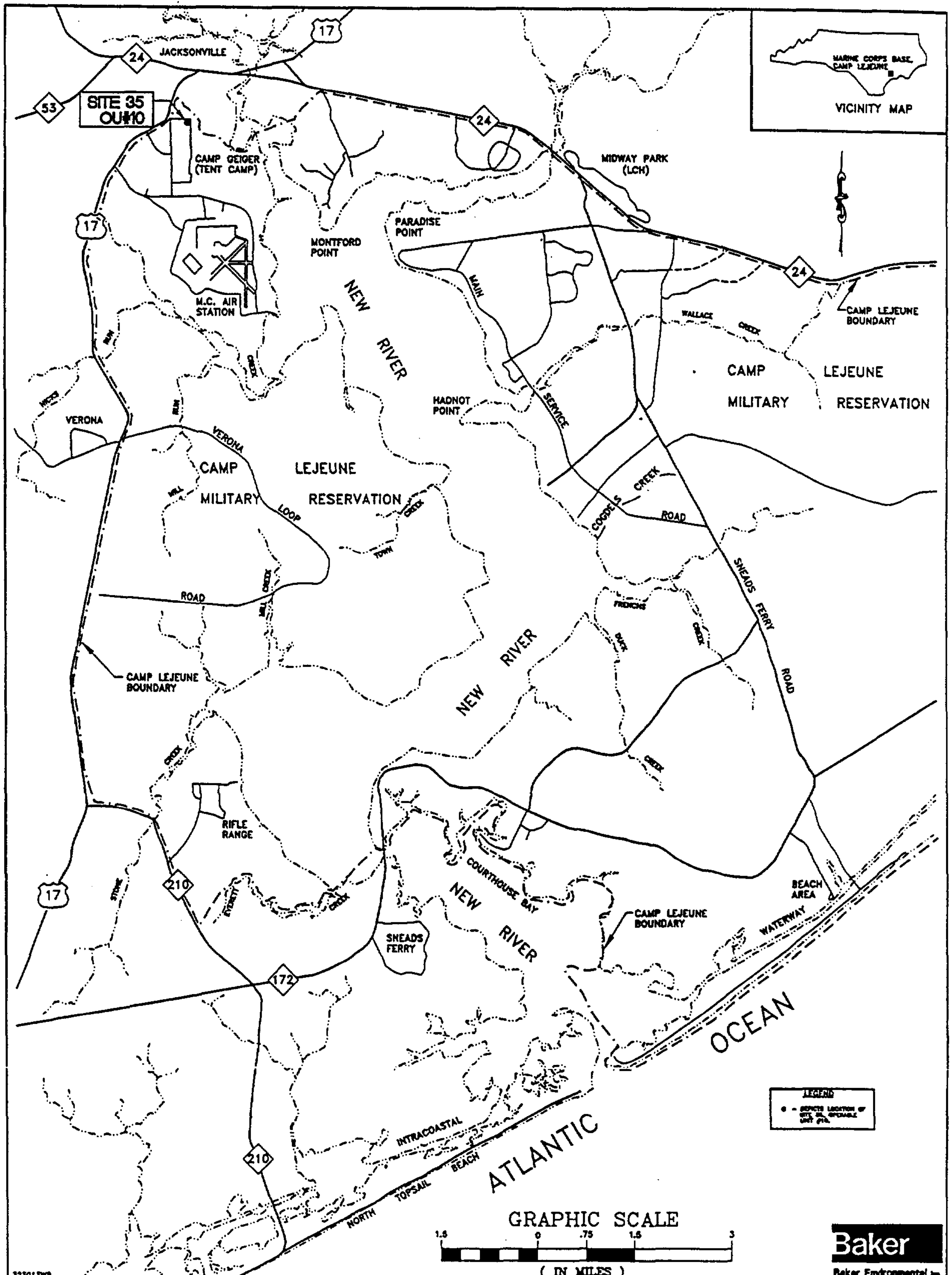
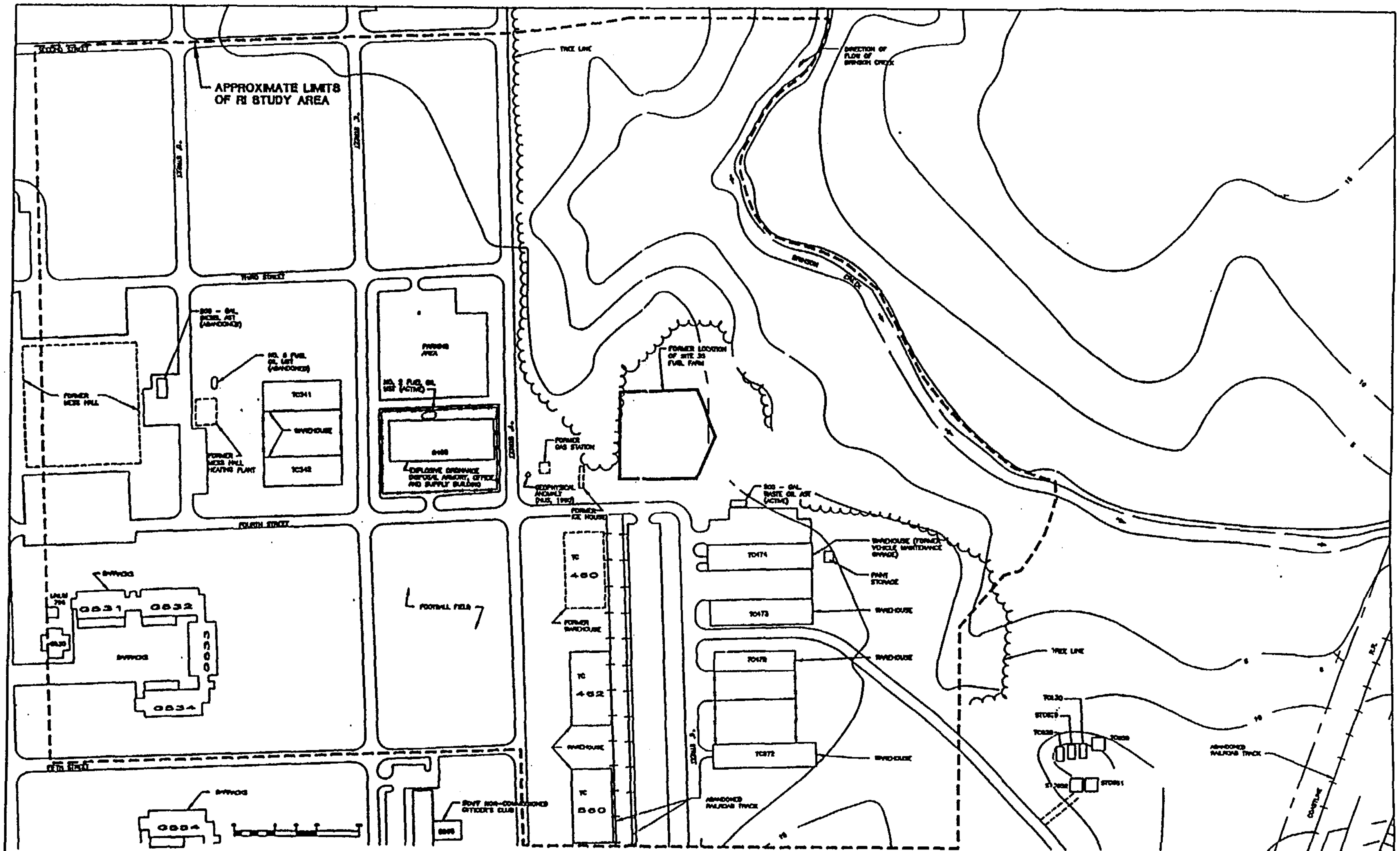


FIGURE 1-1
CAMP LEJEUNE AND SITE 35
LOCATION MAP
SITE 35, CAMP GEIGER AREA FUEL FARM
CONTRACT TASK ORDER - 0323
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



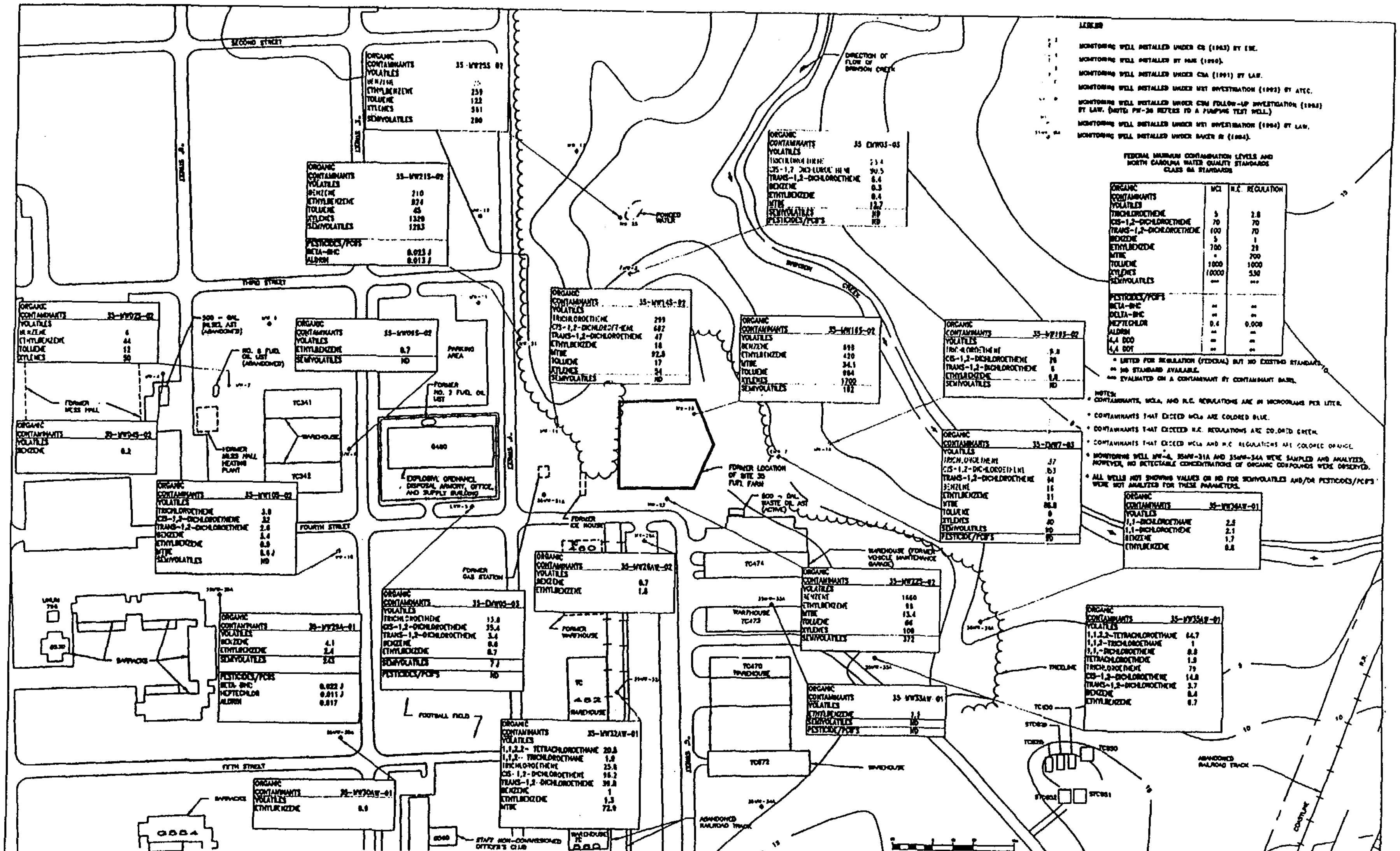
SITE 35, IAS TREATABILITY STUDY
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker

SITE PLAN
CONTRACT TASK ORDER - 0323

1-2



LEGEND

FENCE LINE

CONTOUR LINES DEPICTING SURFICIAL RELIEF

LEGEND CONTINUED IN UPPER RIGHT HAND CORNER

DATE OCT. 1994

NORTH

SITE 35, IAS TREATABILITY STUDY
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

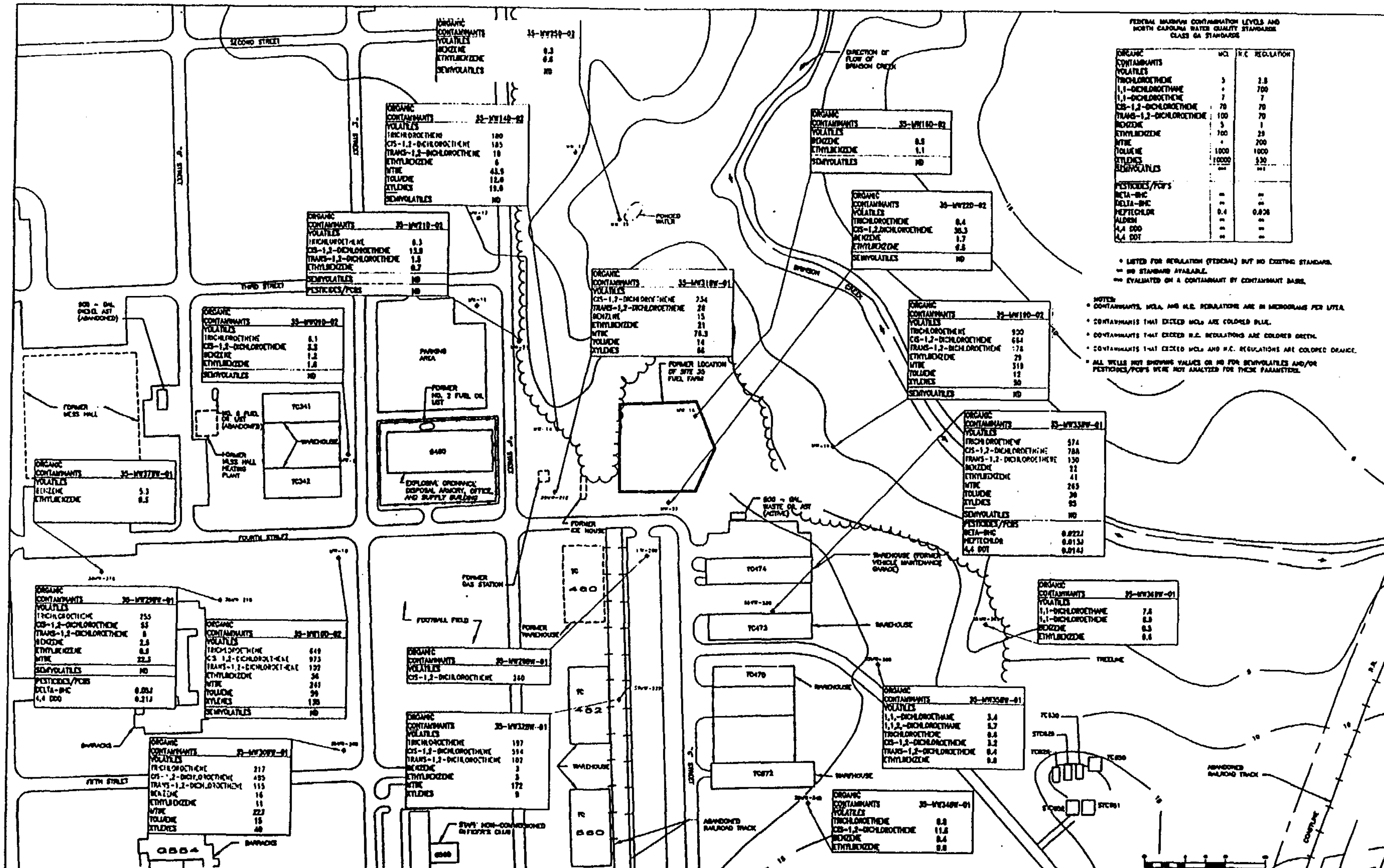
BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

DETECTED ORGANICS IN UPPER PORTION
OF SURFICIAL AQUIFER
CONTRACT TASK ORDER – 0323

DATE OCT. 1994

FIGURE No.

1 – 3



LEGEND
- = MONITORING WELL INSTALLED UNDER BAKER IS (1994).
- = MONITORING WELL INSTALLED UNDER CRA (1991) BY LAW.
- = FENCE LINE
- = CONTOUR LINES DEPICTING SURFICIAL RELIEF

DATE	OCT. 1994
SCALE	1" = 80'
DRAWN	
REVIEWED	JBC

NORTH

SITE 35, IAS TREATABILITY STUDY
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

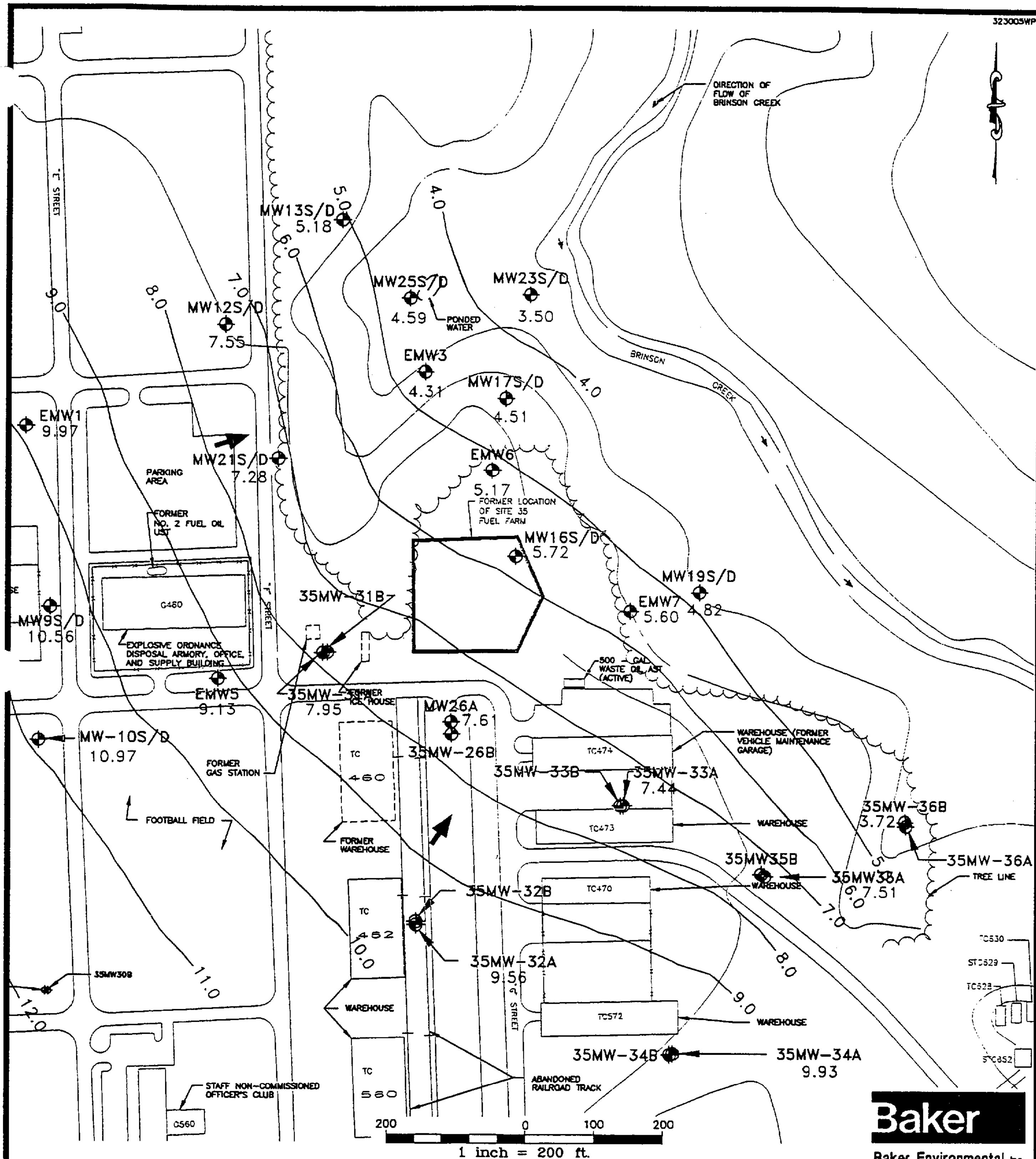
BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker

DETECTED ORGANICS IN LOWER
PORTION OF SURFICIAL AQUIFER
CONTRACT TASK ORDER – 0323

SCALE 1" = 80' DATE OCT. 1994

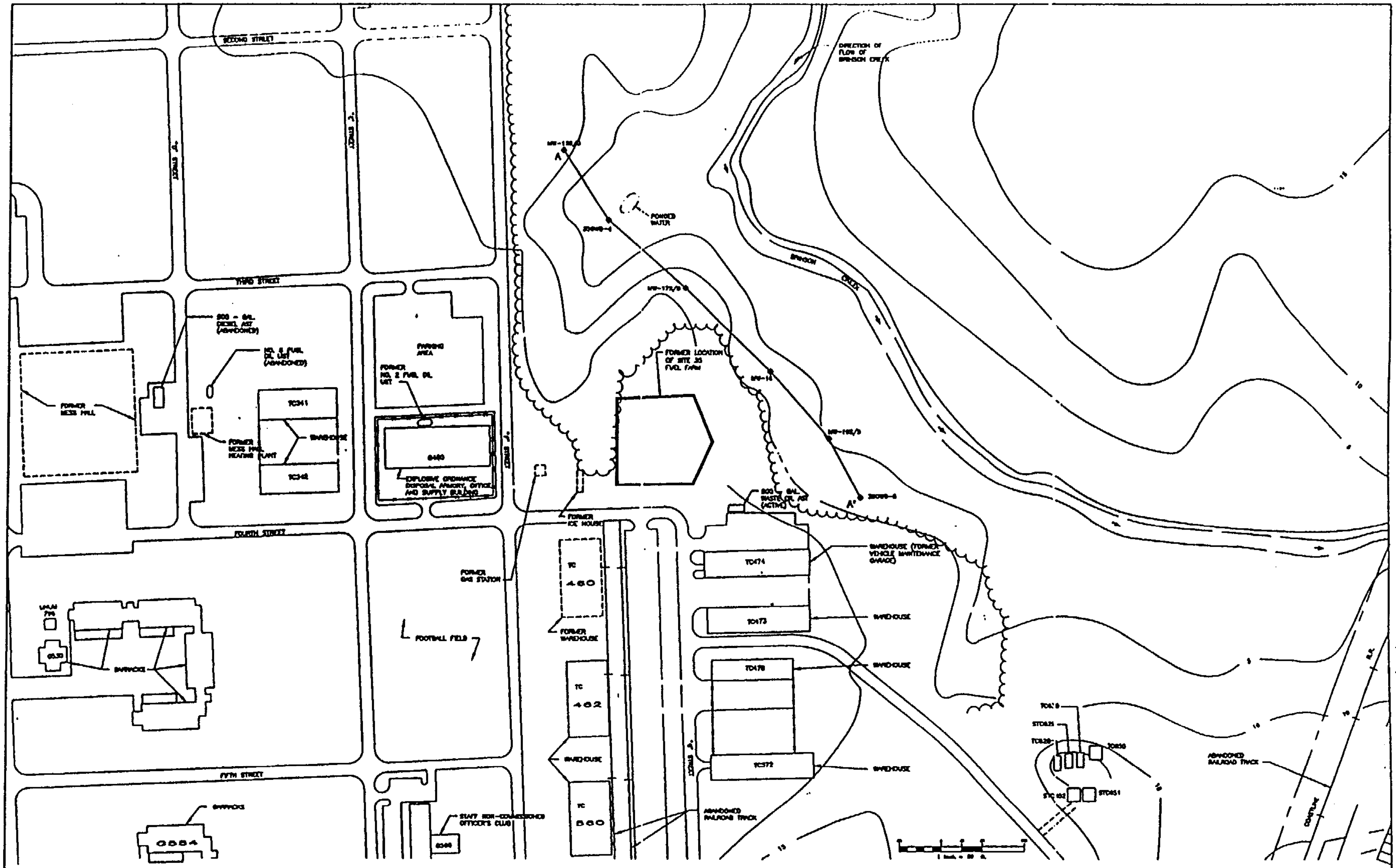
FIGURE No. 1–4



LEGEND

- FENCE LINE
- 15 CONTOUR LINES DEPICTING SURFICIAL RELIEF
- MW19S/D 4.82 MONITORING WELL LOCATION AND DESCRIPTION (MEASURED STATIC WATER LEVEL IN BLUE)
- 11.0 GROUNDWATER CONTOUR
- INDICATES DIRECTION OF GROUNDWATER FLOW

FIGURE 1-5
GROUNDWATER CONTOUR MAP
FOR SURFICIAL AQUIFER
SITE 35
CTO-323
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



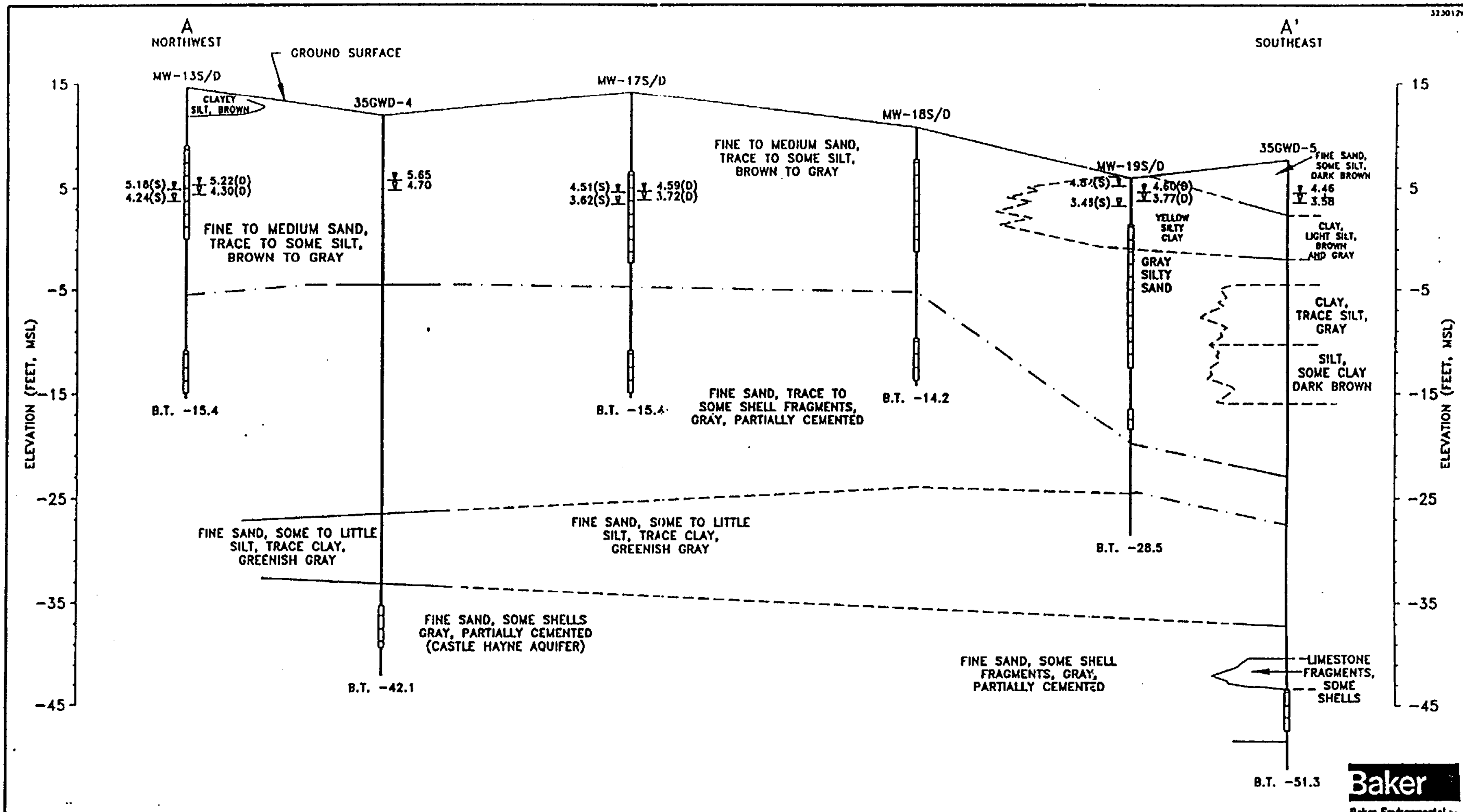
SITE 35, IAS TREATABILITY STUDY
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker

CROSS-SECTION LOCATION
SITE 35, IAS TREATABILITY STUDY
CONTRACT TASK ORDER – 0323

1–6



LEGEND

- GROUNDWATER ELEVATION (X)
- GROUNDWATER ENCOUNTERED DURING DRILLING
- B.T. X' — BORING TERMINATED, ELEVATION MSL
- BENZENE CONCENTRATIONS (ug/L) IN GROUNDWATER
- TOTAL VOC CONCENTRATIONS (ug/L) IN GROUNDWATER
- [ND] TPH CONCENTRATIONS (mg/kg) IN SOILS
- WELL SCREEN INTERVAL
- ND — NOT DETECTED AT METHOD DETECTION LIMITS
- ESTIMATED BY BAKER BORING
- PROJECTED BETWEEN KNOWN POINTS
- INFERRED FROM OTHER CONSULTANT BORINGS

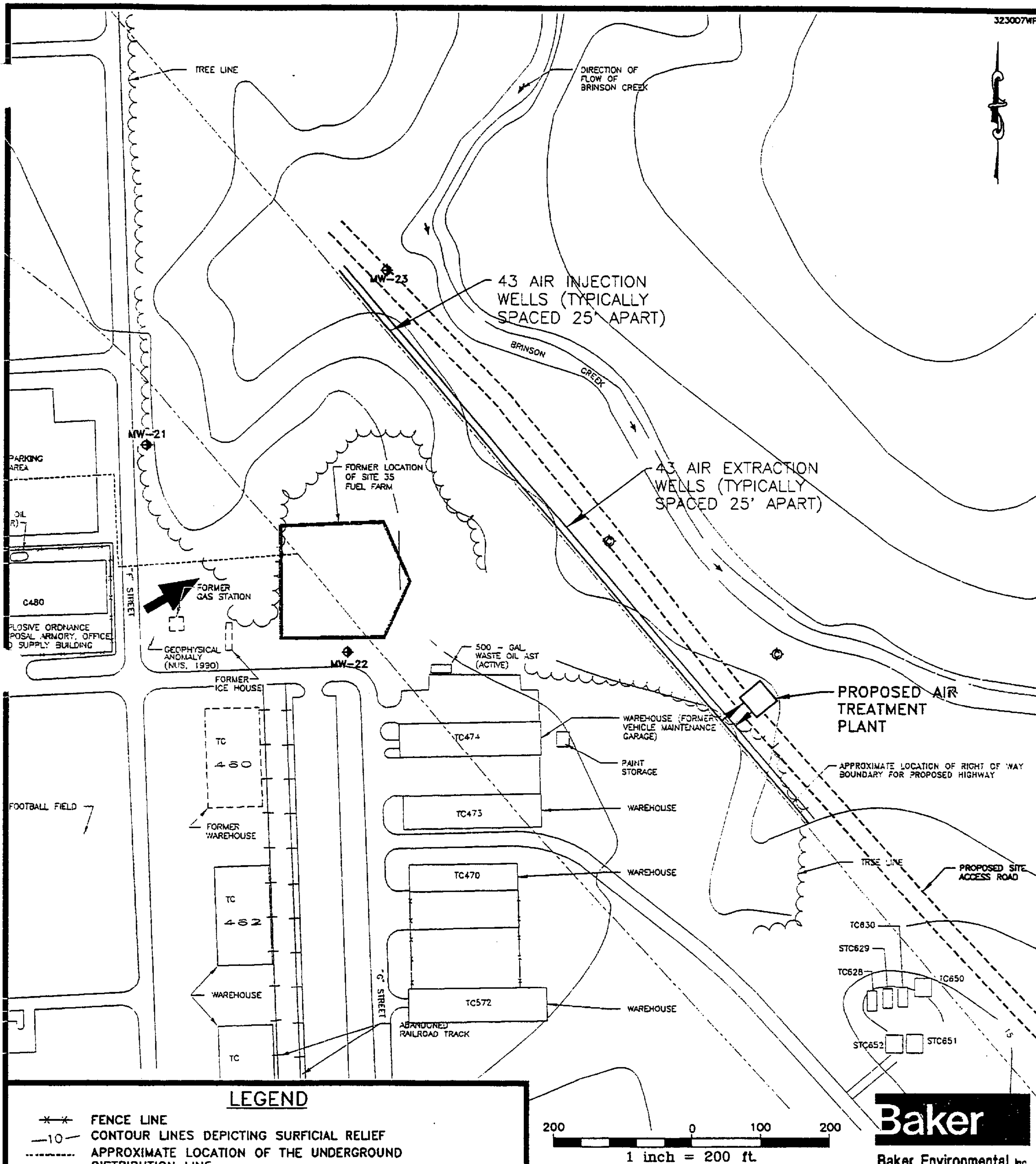
80 0 40 80 160
Horizontal Scale: 1 inch = 80 ft.

10 0 5 10 20
Vertical Scale: 1 inch = 10 ft.

THE SOIL BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS. SUBSURFACE CONDITIONS INTERPOLATED BETWEEN BORINGS ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.

FIGURE 1-7
HYDROGEOLOGIC CROSS-SECTION A-A'
SITE 35, IAS TREATABILITY STUDY
CTO-0323

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



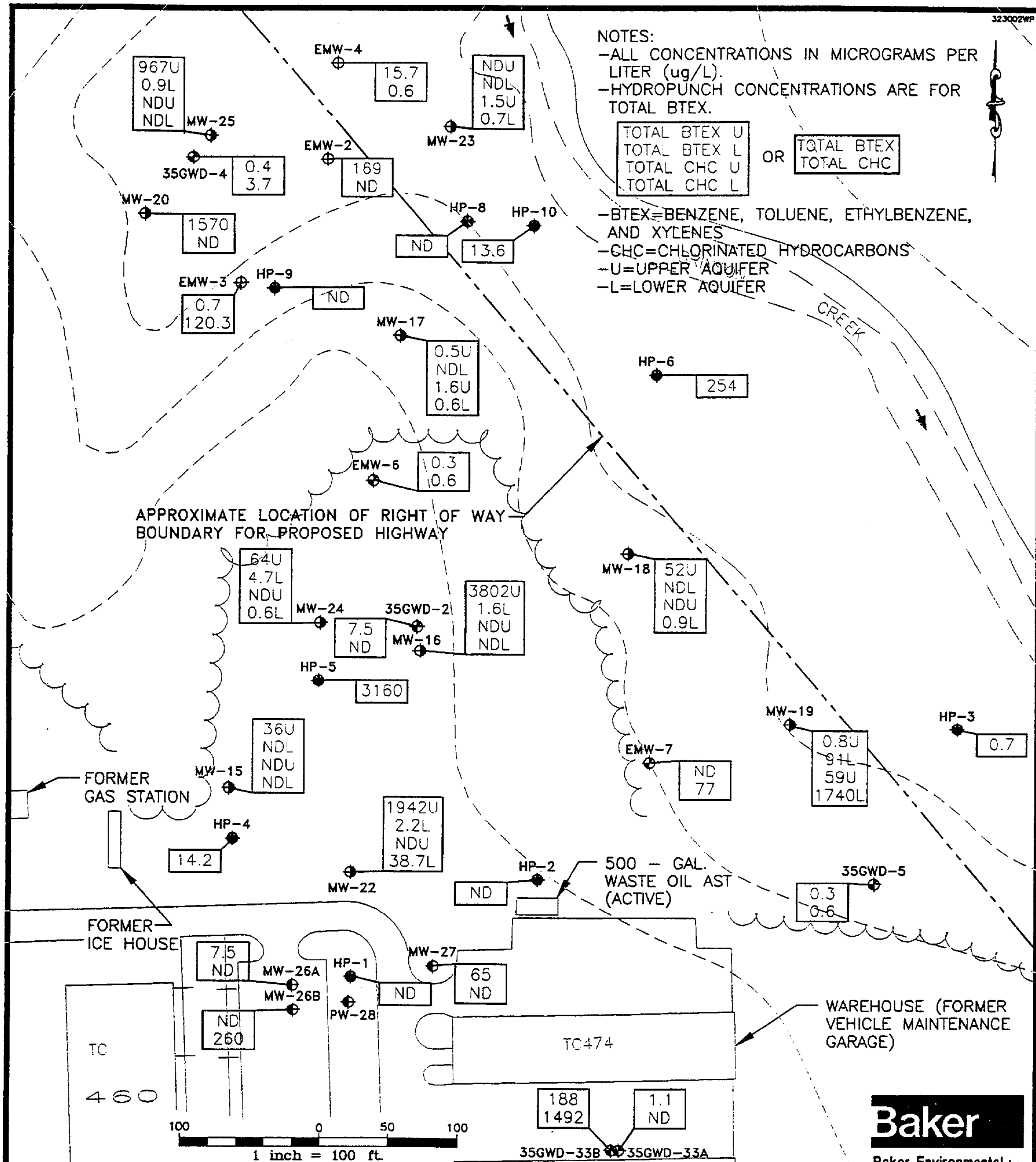
Baker

Baker Environmental, Inc.

LEGEND

- FENCE LINE
- —10— CONTOUR LINES DEPICTING SURFICIAL RELIEF
- APPROXIMATE LOCATION OF THE UNDERGROUND DISTRIBUTION LINE
- APPROXIMATE LOCATION OF RIGHT OF WAY BOUNDARY FOR PROPOSED HIGHWAY
- AIR EXTRACTION CONVEYANCE LINE
- AIR INJECTION CONVEYANCE LINE
- APPROXIMATE GROUNDWATER FLOW DIRECTION
- 100 YEAR FLOOD BOUNDARY (ref. FIRM FLOOD INSURANCE RATE MAP, ONSLOW COUNTY, NORTH CAROLINA; FEMA COMMUNITY PANEL NUMBER 3 70340 0305C.
- PROPOSED LOCATION OF SITE ACCESS ROAD
- MW-23 EXISTING WELL CLUSTER IN THE SURFICIAL AQUIFER
- 35GWD-3 EXISTING WELL IN THE DEEP AQUIFER
- PROPOSED WELL CLUSTER IN THE SURFICIAL AQUIFER

FIGURE 2-1
RAA 4: IN SITU AIR SPARGING AND OFF-GAS CARBON ADSORPTION
SITE PLAN - SITE 35
CTO-0323
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

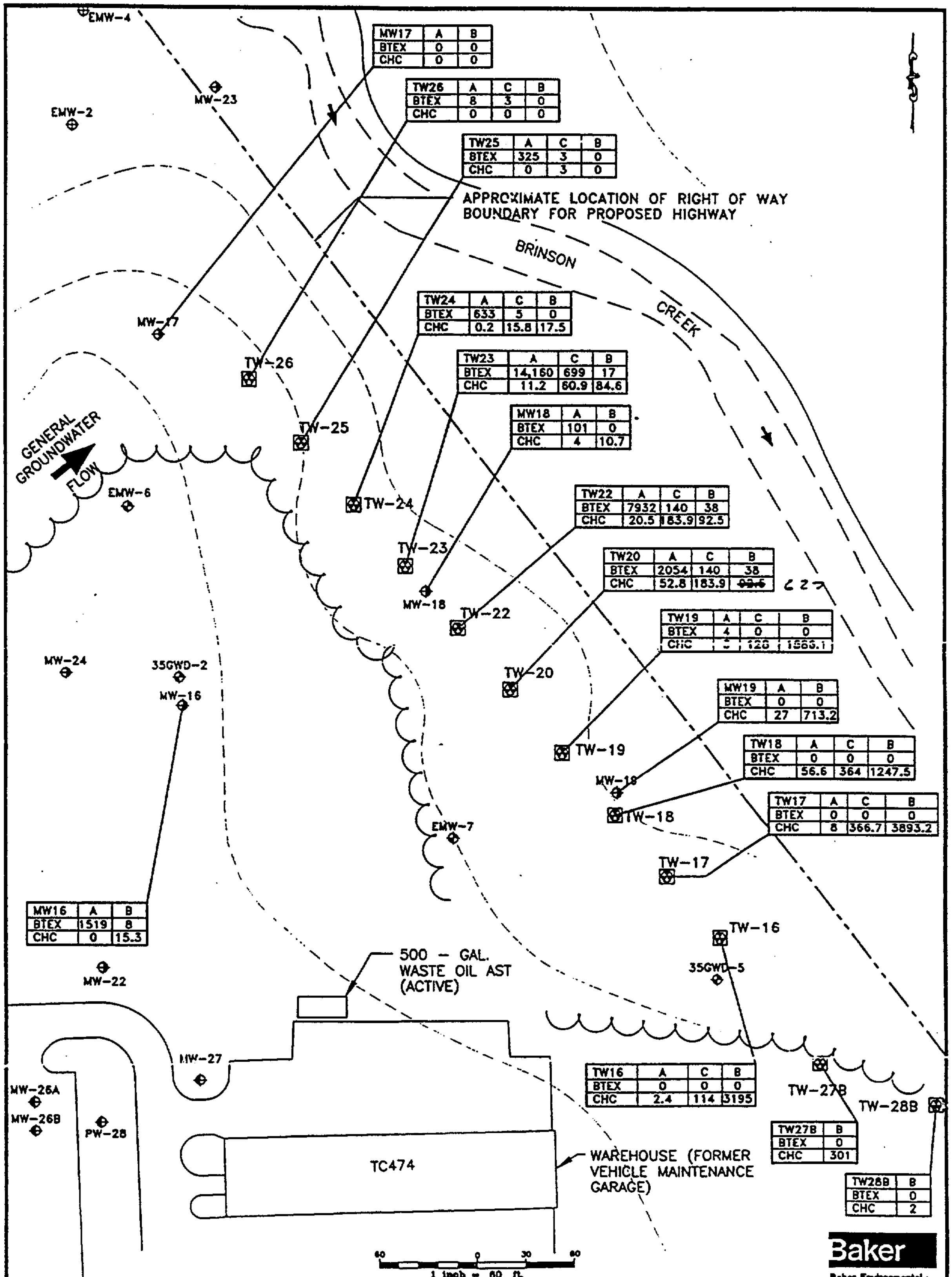


LEGEND

- EMW-7 — MONITORING WELL INSTALLED UNDER CS (1986) BY ESE.
- EMW-1 — MONITORING WELL INSTALLED BY NUS (1990).
- MW-1 — MONITORING WELL INSTALLED UNDER CSA (1991) BY LAW.
- MW-26 — MONITORING WELL INSTALLED UNDER CSM FOLLOW-UP INVESTIGATION (1993) BY LAW. (NOTE: PW-28 REFERS TO A PUMPING TEST WELL.)
- HP-18 — "HYDROPUNCH" SAMPLING POINT UNDER CSA (1991) BY LAW.
- 35GWD-4 — MONITORING WELL INSTALLED UNDER RI (1994) BY BAKER.

FIGURE 2-2
SUMMARY OF SURFICIAL AQUIFER CONTAMINATION IN TREATABILITY STUDY AREA
SITE 35
CTO-0323

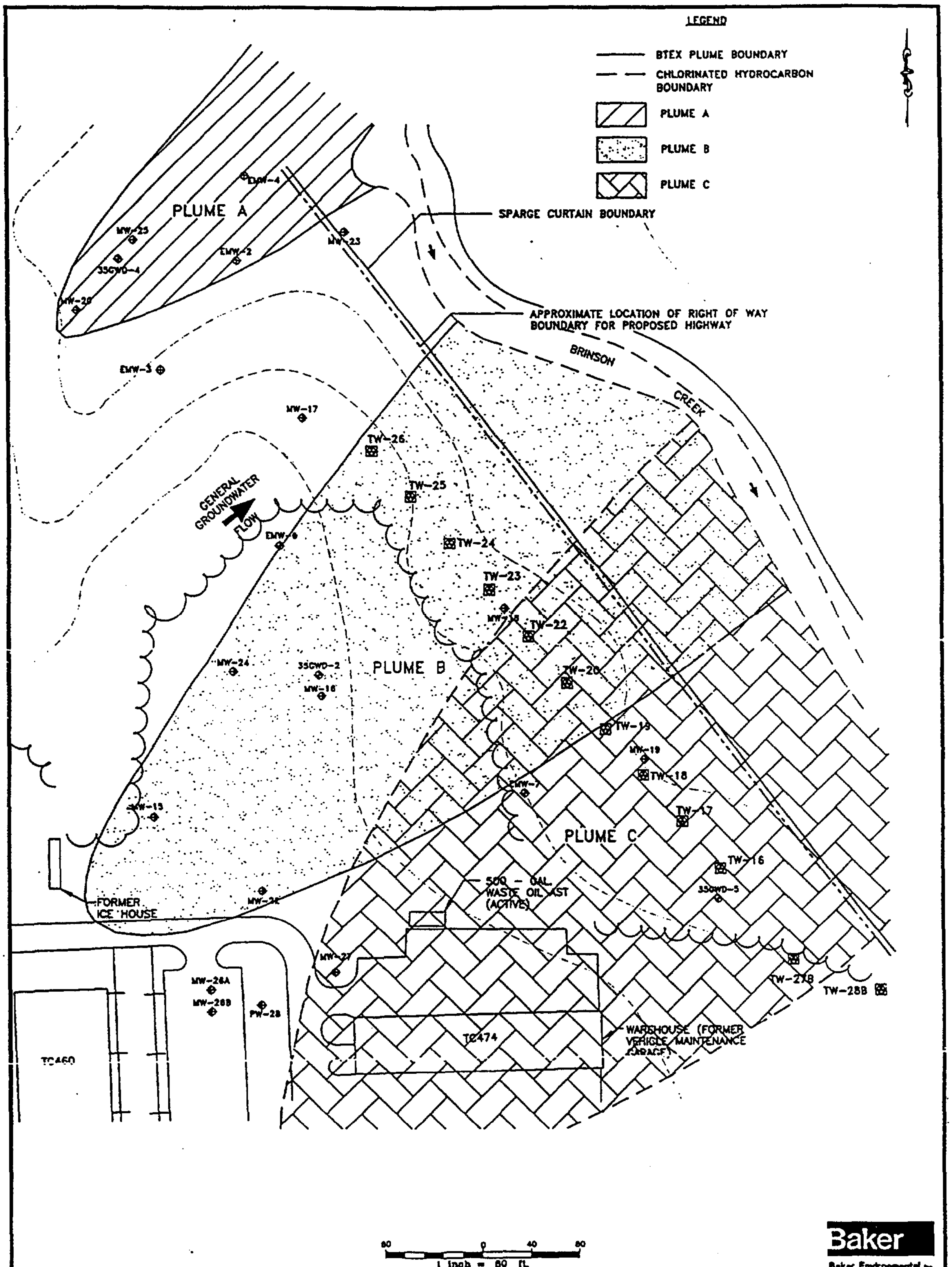
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

- EMW-7 MONITORING WELL INSTALLED UNDER CS (1986) BY ESE.
- DMW-1 MONITORING WELL INSTALLED BY NUS (1990).
- MW-1 MONITORING WELL INSTALLED UNDER CSA (1991) BY LAW.
- MW-26 MONITORING WELL INSTALLED UNDER CSA FOLLOW-UP INVESTIGATION (1993) BY LAW. (NOTE: PW-28 REFERS TO A PUMPING TEST WELL.)
- TEMPORARY WELL CLUSTER
- CHC TOTAL CHLORINATED HYDROCARBONS
- BTEX TOTAL BTEX
- A WELLS WITH 10' SCREEN LENGTH PLACED 5'-15' BGS, ACROSS THE WATER TABLE.
- C WELLS WITH 5' SCREEN LENGTH PLACED WITHIN A 18 1/2' - 27 1/2' BGS INTERVAL.
- B WELLS WITH 5' SCREEN LENGTH PLACED WITHIN A 36' - 40' BGS INTERVAL (SCREENED ON TOP OF THE CONFINING UNIT).

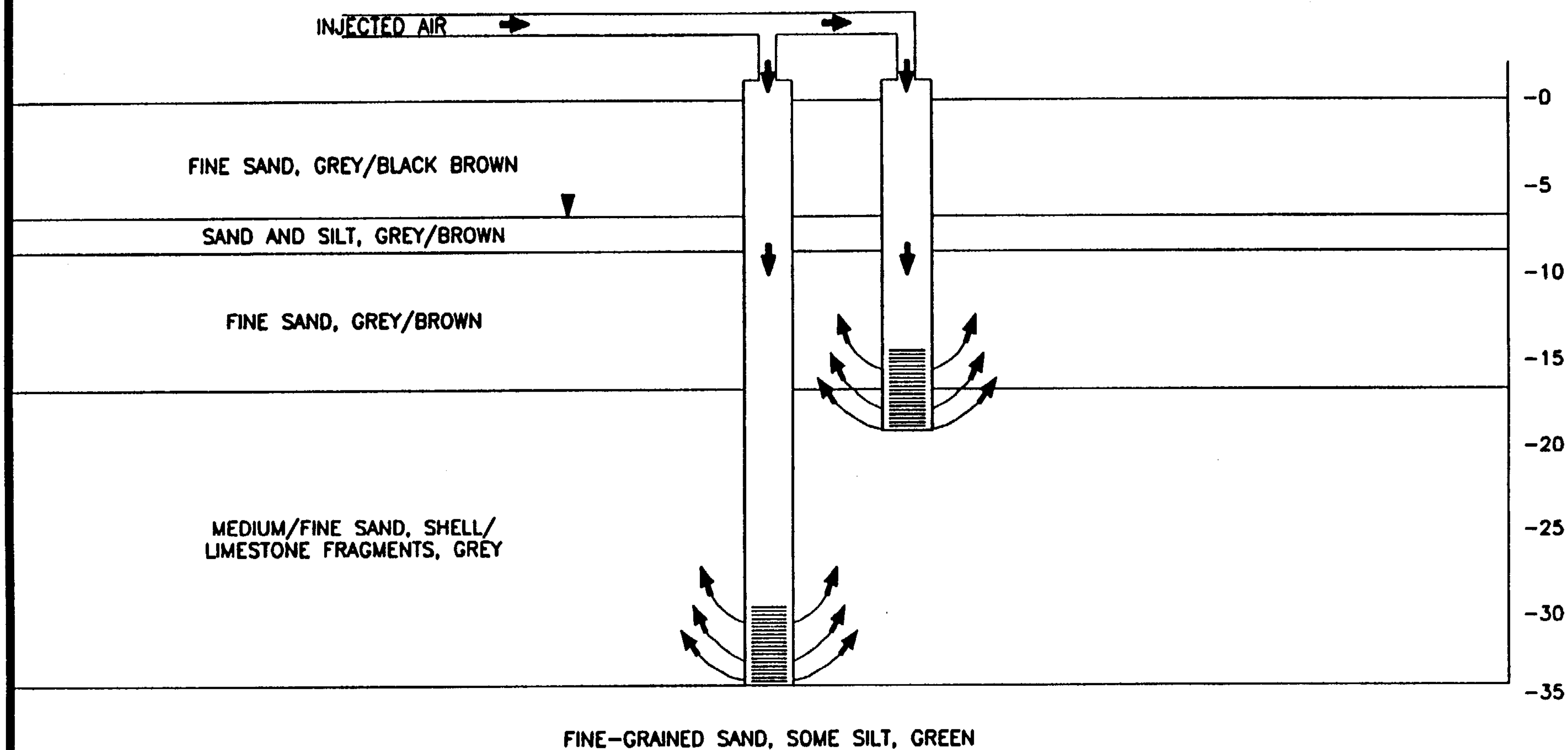
FIGURE 2-3
DETECTED BTEX AND
TOTAL CHLORINATED SOLVENTS
IN SURFICIAL AQUIFER (APRIL 1996)
SITE 35, CAMP GEIGER
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

EMW-7	MONITORING WELL INSTALLED UNDER CS (1986) BY ESE.
EMW-1	MONITORING WELL INSTALLED BY NUS (1990).
MW-1	MONITORING WELL INSTALLED UNDER CSA (1991) BY LAW.
MW-26	MONITORING WELL INSTALLED UNDER CSA FOLLOW-UP INVESTIGATION (1993) BY LAW. (NOTE: PW-26 REFERS TO A PUMPING TEST WELL.)
	TEMPORARY WELL CLUSTER
CHC	TOTAL CHLORINATED HYDROCARBONS
BTEX	TOTAL BTEX
A	WELLS WITH 10' SCREEN LENGTH PLACED 0'-10' BGS, ACROSS THE WATER TABLE.
C	WELLS WITH 8' SCREEN LENGTH PLACED WITHIN A 18 1/2' - 27 1/2' BGS INTERVAL.
D	WELLS WITH 8' SCREEN LENGTH PLACED WITHIN A 30' - 40' BGS INTERVAL (SCREENED ON TOP OF THE CONFINING UNIT).

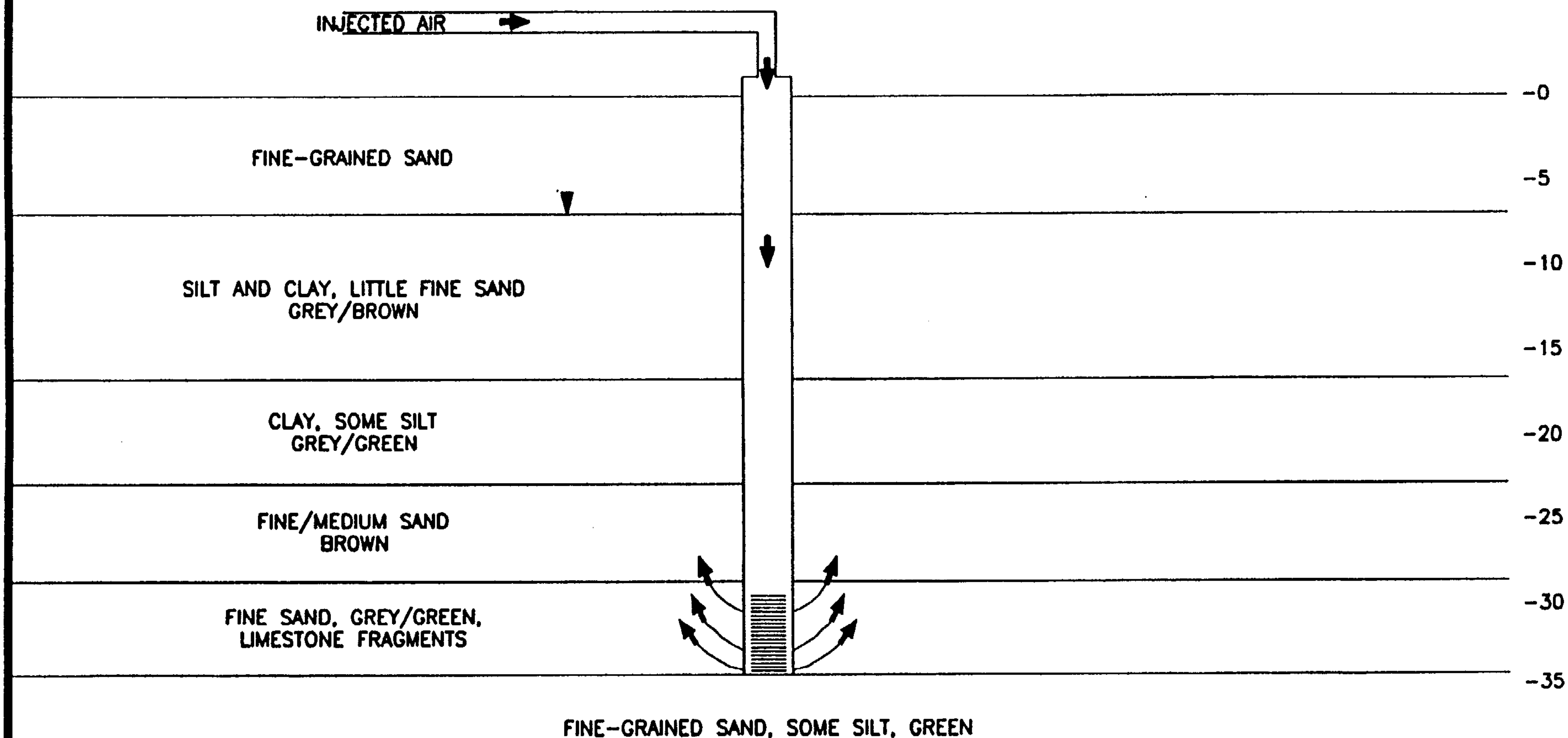
FIGURE 2-4
CONCEPTUAL CONTAMINANT PLUMES
INTERCEPTING SPARGING CURTAIN
SITE 35
CTO - 0323
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



Baker
Baker Environmental, Inc.

FIGURE 2-5
PLUME B PILOT TEST
PROPOSED SPARGING WELLS
SITE 35
CTO-0323
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

323020WP

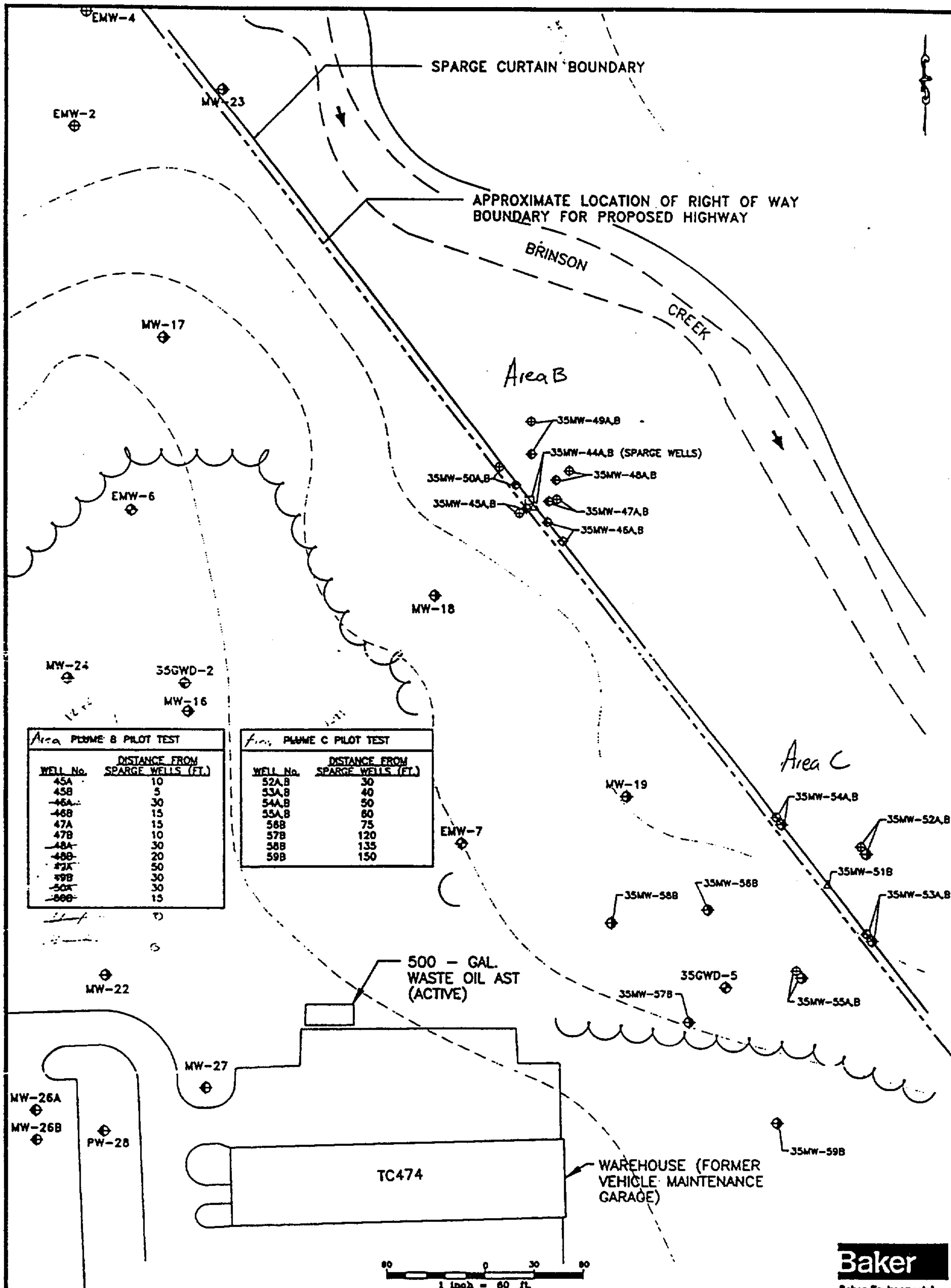


Baker

Baker Environmental, Inc.

FIGURE 2-6
PLUME C PILOT TEST
PROPOSED SPARGING WELLS
SITE 35
CTO-0323
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

323019WP



Area PLUME B PILOT TEST

WELL No.	DISTANCE FROM SPARGE WELLS (FT.)
45A	10
45B	5
~~46A~~	30
~~46B~~	15
47A	15
47B	10
~~48A~~	30
~~48B~~	20
~~49A~~	50
~~49B~~	30
~~50A~~	30
~~50B~~	15

Area PLUME C PILOT TEST

WELL No.	DISTANCE FROM SPARGE WELLS (FT.)
52A,B	30
53A,B	40
54A,B	50
55A,B	60
56B	75
57B	120
58B	135
59B	150

LEGEND

- EMW-7 — MONITORING WELL INSTALLED UNDER CS (1986) BY ESE.
- EMW-1 — MONITORING WELL INSTALLED BY NUS (1990).
- MW-1 — MONITORING WELL INSTALLED UNDER CSA (1991) BY LAW.
- MW-28 — MONITORING WELL INSTALLED UNDER CSA FOLLOW-UP INVESTIGATION (1993) BY LAW. (NOTE: PW-28 REFERS TO A PUMPING TEST WELL.) TEMPORARY WELL CLUSTER
- SHALLOW SPARGE WELL (16' DEEP)
- DEEP SPARGE WELL (24' DEEP)
- SHALLOW MONITORING WELL
- DEEP MONITORING WELL

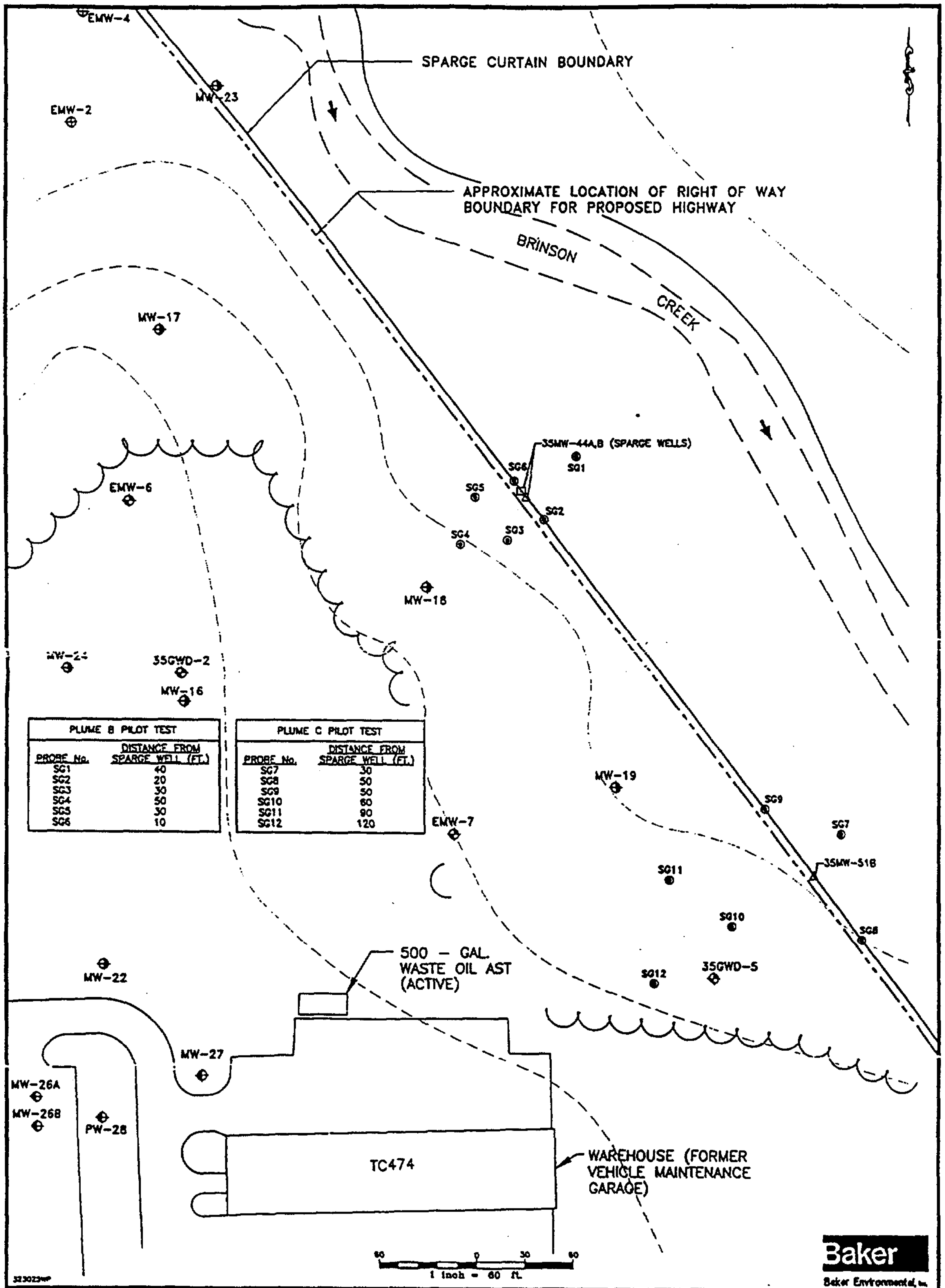
FIGURE ~~4-1~~ 1

IAS PILOT TEST ~~WELL LAYOUTS~~

SITE 35

CTO - 0323

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



PLUME B PILOT TEST	
PROBE No.	DISTANCE FROM SPARGE WELL (FT.)
SG1	40
SG2	20
SG3	30
SG4	50
SG5	30
SG6	10

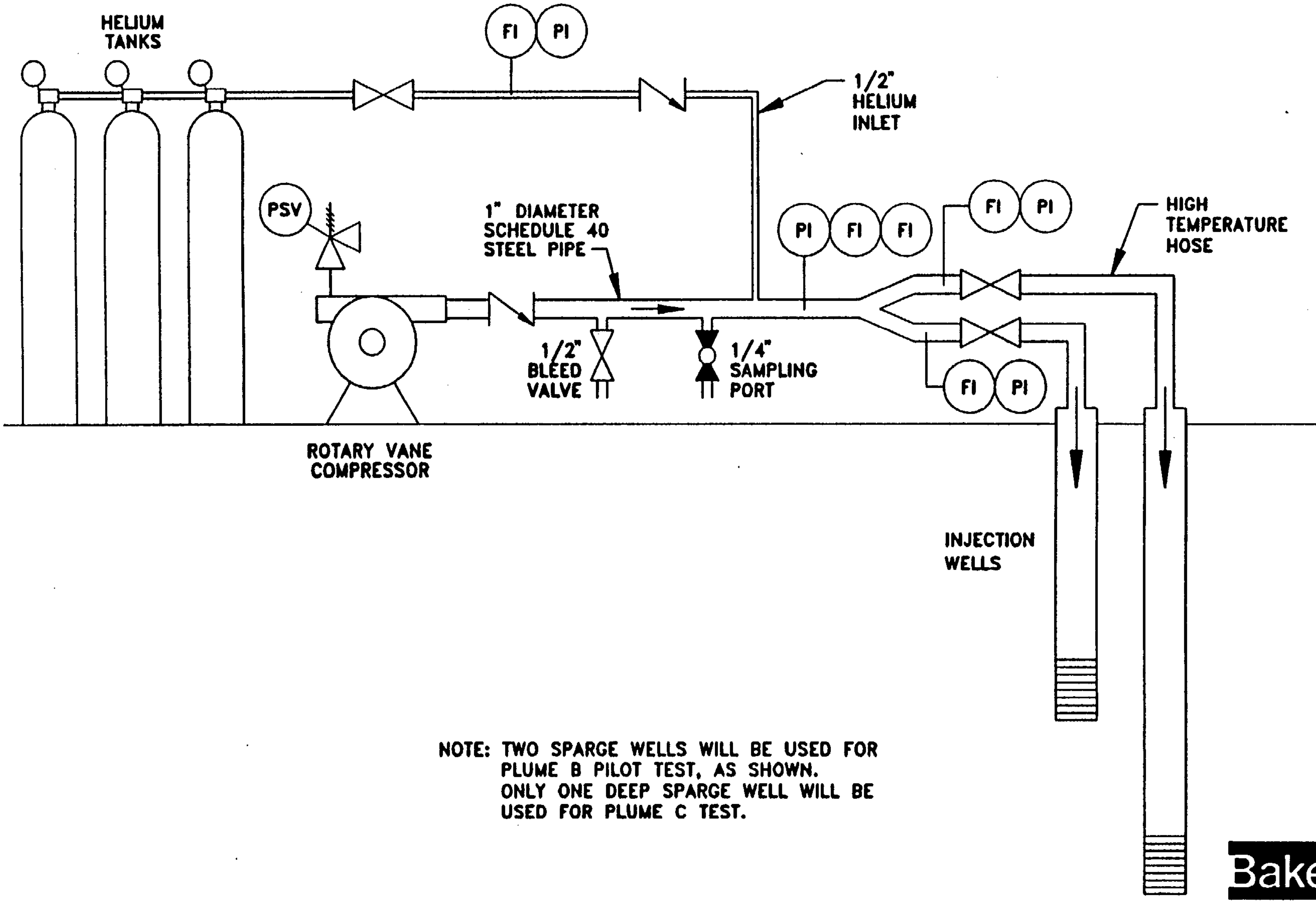
PLUME C PILOT TEST	
PROBE No.	DISTANCE FROM SPARGE WELL (FT.)
SG7	30
SG8	50
SG9	50
SG10	60
SG11	90
SG12	120

LEGEND

FIGURE 4-2

IAS PILOT TEST SOIL GAS PROBE LAYOUTS
SITE 35
CTO - 0323

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



NOTE: TWO SPARGE WELLS WILL BE USED FOR PLUME B PILOT TEST, AS SHOWN. ONLY ONE DEEP SPARGE WELL WILL BE USED FOR PLUME C TEST.

Baker
Baker Environmental, Inc.

LEGEND

- GATE VALVE
- BALL VALVE (OPEN)
- BALL VALVE (CLOSED)
- PRESSURE SAFETY VALVE (PSV)
- CHECK VALVE
- PI – PRESSURE INDICATOR
- FI – FLOW INDICATOR
- TI – TEMPERATURE INDICATOR

FIGURE 4-3
IAS PROCESS FLOW SCHEMATIC
IAS TREATABILITY STUDY
SITE 35
CTO-0323
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

323021WP

FIGURE 7-1

IAS Treatability Study Schedule
Site 35, Operable Unit No. 10
Marine Corps Base, Camp Lejeune, North Carolina

IAS Treatability Study	Start	Finish
Work Plan	**1/15/96**	**1/15/96**
Draft Treatability Study Work Plan	1/15/96	2/15/96
Navy/EPA/State Review	2/15/96	4/15/96
Final Treatability Study Work Plan	4/16/96	5/24/96
Treatability Study	**6/15/96**	**8/27/96**
Mobilization	6/17/96	7/3/96
Monitoring Well Installation (Plume B)	7/8/96	7/17/96
On-Site Pilot Study (Plume B)	7/22/96	7/30/96
Monitoring Well Installation (Plume C)	8/5/96	8/14/96
On-Site Pilot Study (Plume C)	8/19/96	8/27/96
Laboratory Analysis	7/25/96	9/27/96
Treatability Study Report	**8/28/96**	**1/30/97**
Draft Treatability Study Report	8/28/96	10/18/96
Navy/EPA/State Review	10/21/96	12/20/96
Final Treatability Study Report	12/30/96	1/30/97

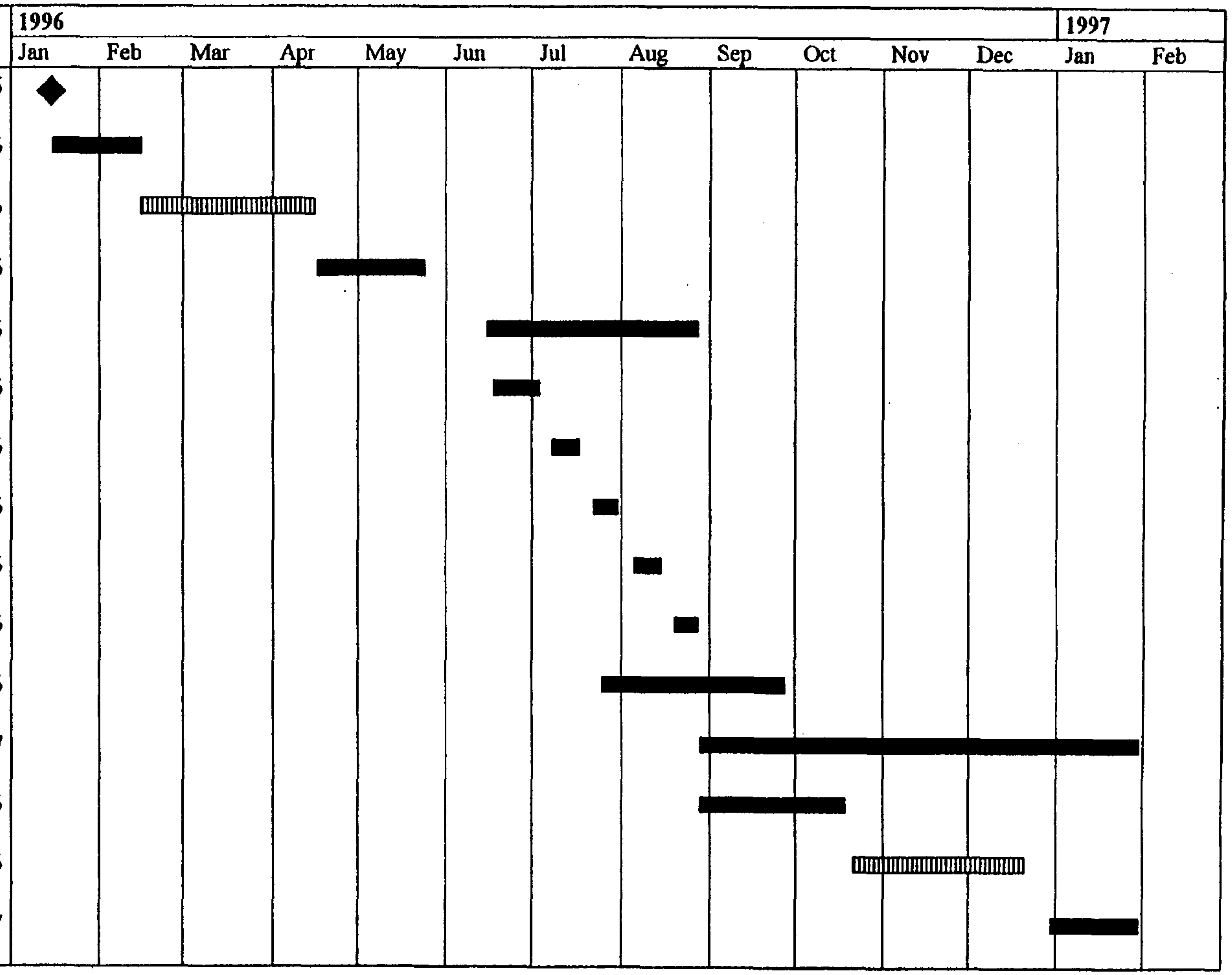
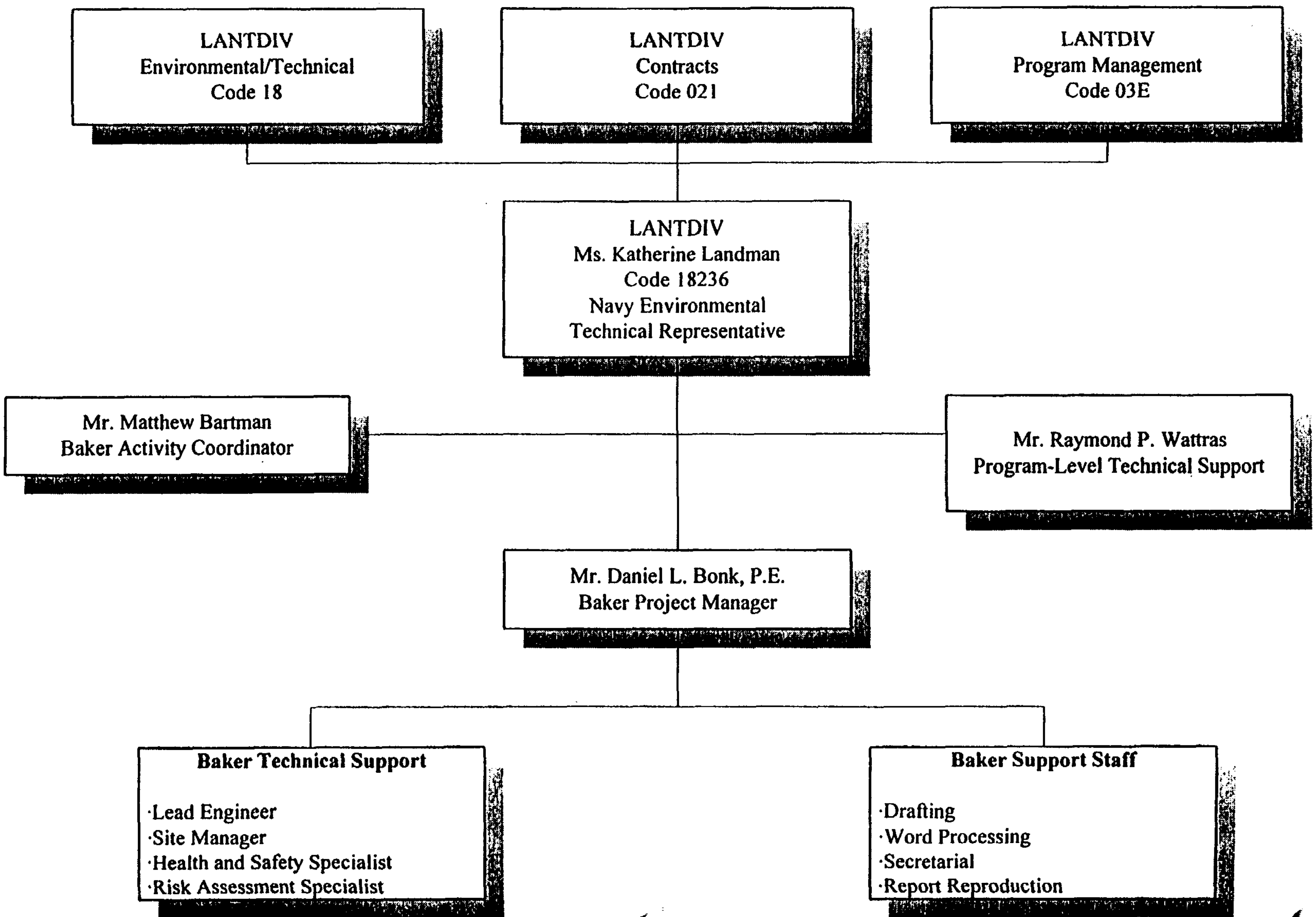


FIGURE 8-1

PROJECT ORGANIZATION



APPENDIX A
HYDROGEOLOGIC CROSS SECTIONS

MATCH LINE | CROSS SECTION TW26 - TW27

. No. ________ Drawing No. 2/2

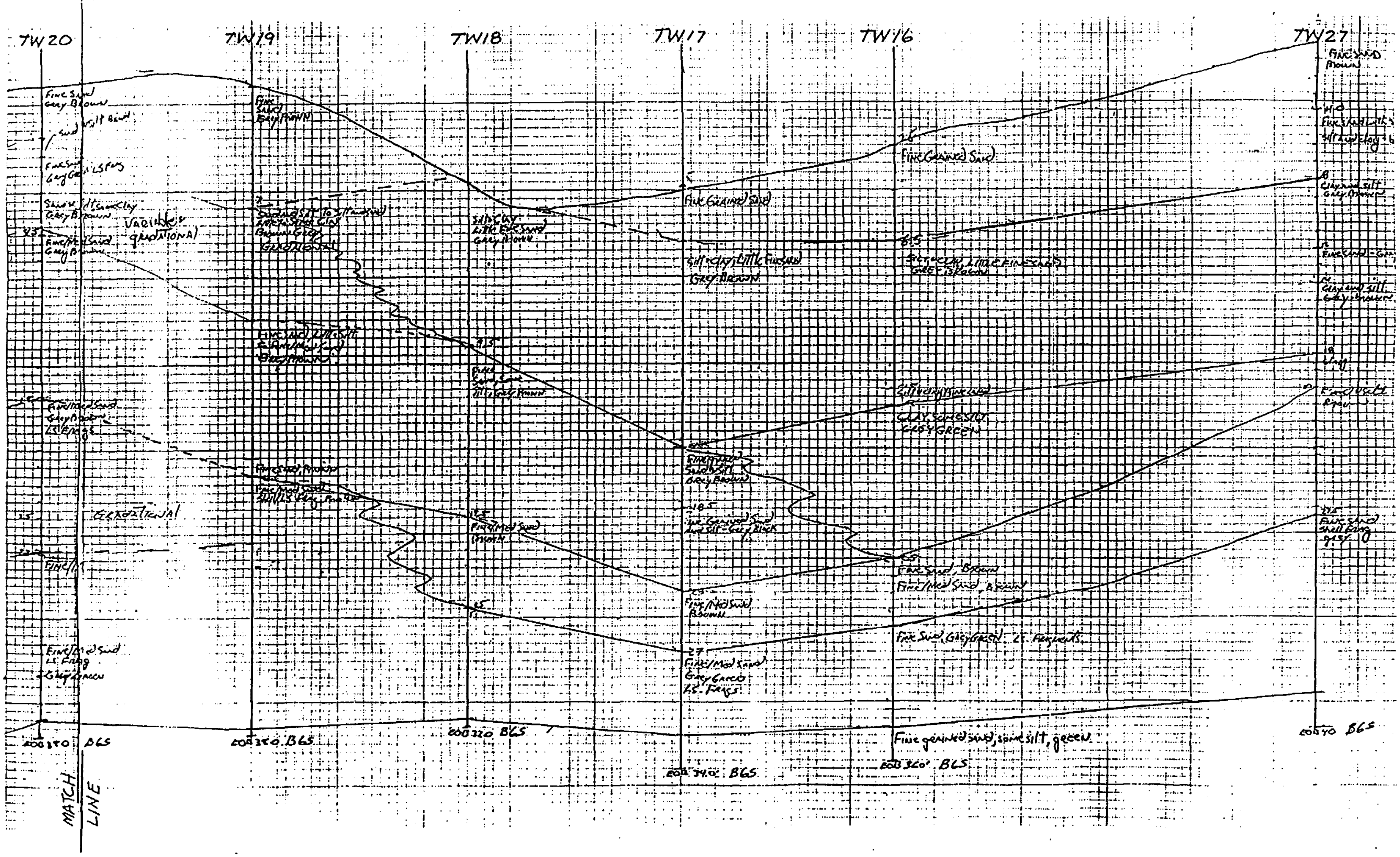
MICHAEL BAKER, JR., INC.

DESIGN PAD

Subject ________ S.O. No. ________

et No. ________ d by RPA Checked by ________ Date ________

Sheet No. ____ of ____



CROSS SECTION TW26 - TW27

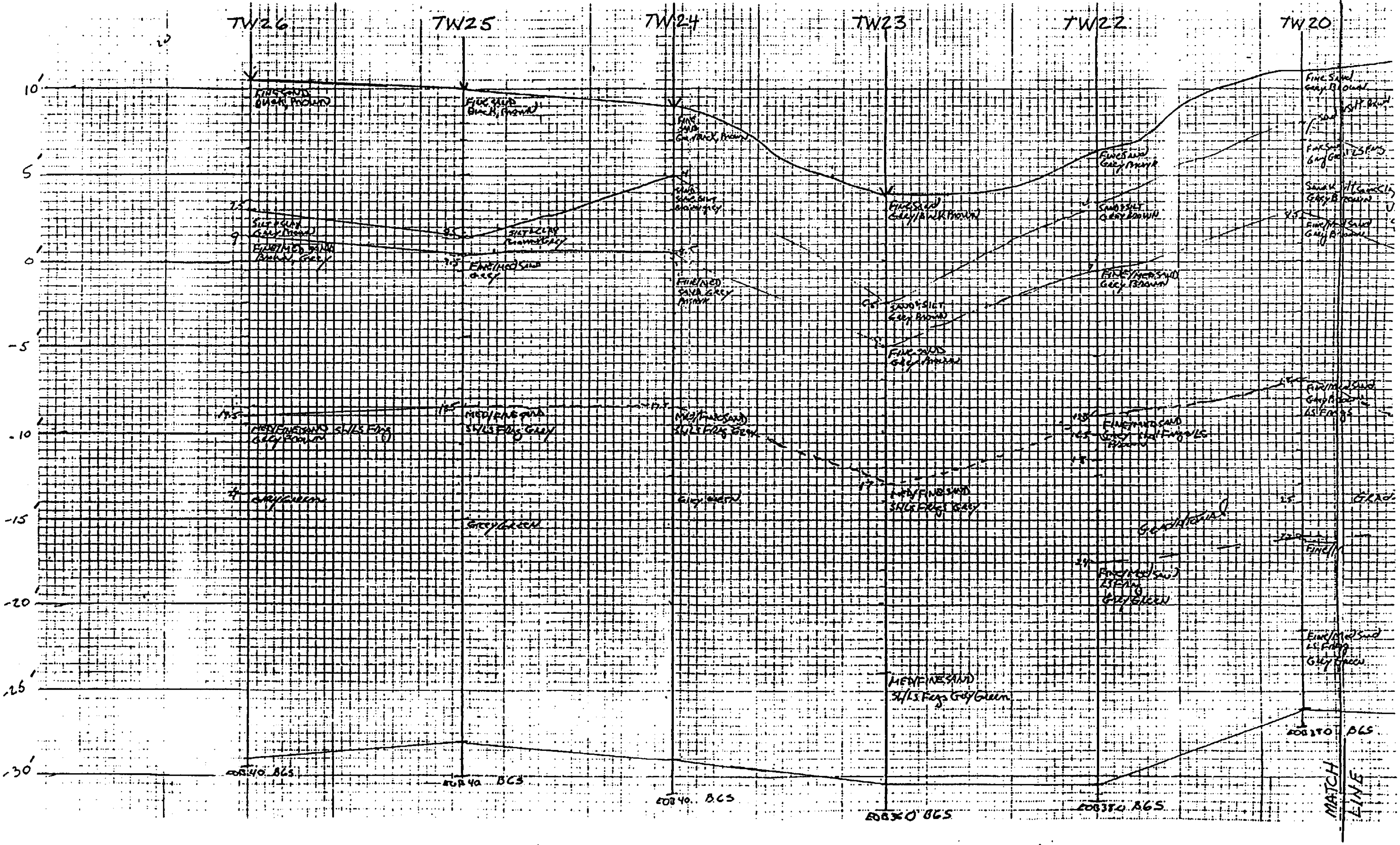
Drawing No. 1/2

MICHAEL BAKER, JR., INC.

DESIGN PAD

Computed by RPA Checked by Date

Subject S.O. No. Sheet No.



APPENDIX B
HILL AFB TECHNICAL PAPER

In Situ Air Sparging—Technology Demonstration for Remediating Groundwater Contaminated with Dissolved-Phase Constituents at Hill Air Force Base

Whitney Wheeless, Radian Corporation
Steve Hicken, Hill Air Force Base
Carrie Beitler, Jim Rowe, Mark A. Robbins, Radian Corporation
Robert E. Hinchee, Parsons Engineering Science
Paul C. Johnson, Arizona State University
Richard L. Johnson, Oregon Graduate Institute of Science & Technology
David E. McWhorter, Colorado State University

Abstract

In-situ air sparging (IAS), in conjunction with soil vapor extraction (SVE), is becoming a widely used technology for remediating groundwater contaminated with volatile organic compounds. As part of a technology demonstration conducted at Hill AFB, the authors evaluated IAS technology for remediating groundwater contaminated with dissolved-phase chlorinated organic compounds. The primary objective of the demonstration was to determine whether IAS could effectively serve as a control barrier technology and remediate the contaminant plume at Operable Unit 6, where trichloroethene is the major constituent of concern. Another objective was to establish the physical and chemical monitoring parameters and the types of sampling needed to conclusively determine the treatment effectiveness of IAS.

The investigators determined the effectiveness of IAS technology by evaluating the reduction of trichloroethene from the groundwater, as measured in hydropunch and monitor well samples of the groundwater collected before and after the twelve-week demonstration period. In addition, they used the results of a helium tracer study to determine the efficiency of the SVE system in capturing the air sparged into the aquifer. The investigators also used the results from monitor well purge tests to determine the representativeness of monitor well data for evaluating IAS systems. The zone of influence and the effect of the IAS system on the aquifer was determined on the basis of field measurements, such as water levels, subsurface pressures, and water quality parameters.

Both the monitor well and hydropunch sample results showed significant reductions of TCE concentrations during the IAS test—generally from 150 to 300 µg/L at baseline to 1 to 50 µg/L after 12 weeks of IAS operation. Significant reductions were observed at most depths for all downgradient monitor wells. These reductions are believed to be a result of a relatively uniform distribution of air flow throughout the aquifer at OU 6 during IAS treatment. The observed lateral movement of air is likely caused by the lower permeability sands within the aquifer that divert upward movement of air and force air to flow laterally. Under the flow regime at the OU 6 TD site, the aquifer as a whole was treated by the IAS system.

Introduction

In situ air sparging (IAS) is an innovative technology for remediating groundwater, where air is injected into the saturated zone for the purpose of removing organic contaminants. The vertical and horizontal air flow enables the contaminants in the groundwater to volatilize into the air stream. After the contaminated air has migrated to the unsaturated zone, it is typically collected through soil vapor extraction (SVE) for treatment or emission.

Figure 2 shows the known extent of contaminated groundwater. The contaminant plume is elongated in the direction of groundwater flow and extends from a maintenance area on Base to beneath a residential area off Base. Minimal lateral spreading is seen in the plume because of the lower-permeability materials that border the sand to silty-sand aquifer in which the contamination is migrating. Because the TCE has not appreciably spread laterally, the average peak concentration in the center of the plume is relatively consistent (generally between 200 and 300 µg/L). The location of the TD site relative to the plume and Base boundary is also shown in Figure 2.

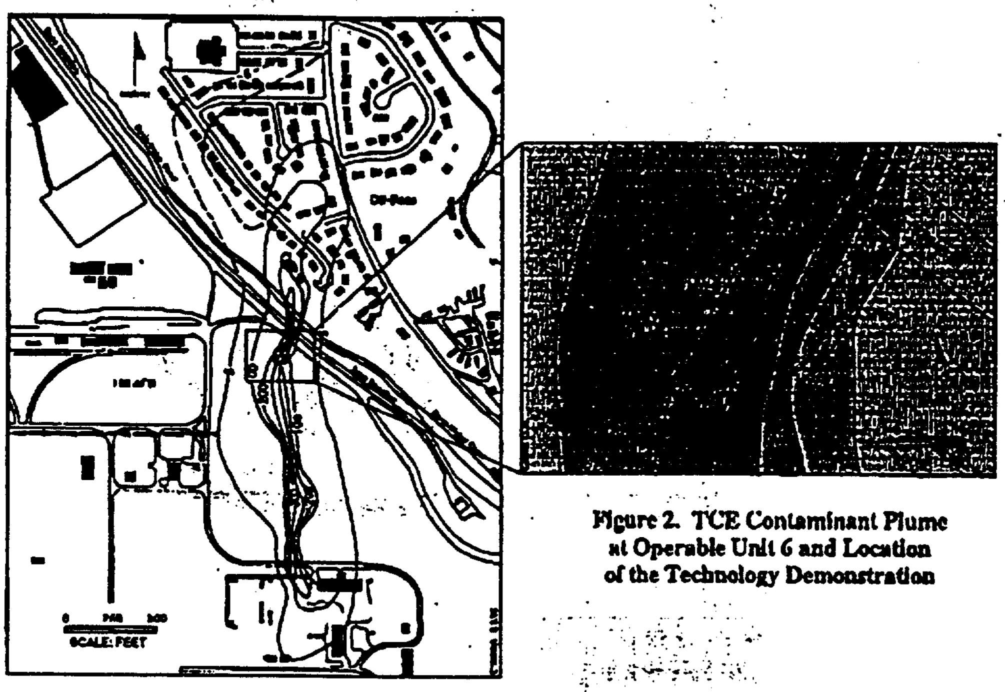


Figure 2. TCE Contaminant Plume at Operable Unit 6 and Location of the Technology Demonstration

Technical Approach

The IAS test was conducted for a 12-week period from February to May 1995 to evaluate the performance of the system in removing chlorinated dissolved-phase contaminants from the groundwater. Baseline groundwater characteristics and organic concentrations were determined.

<u>Treatment System</u>

The IAS/SVE system includes a single row of four nested sparging and SVE wells. Figure 3 shows a schematic of the treatment system installed at OU 6. The IAS process equipment was sized to provide a 90% minimum stripping efficiency using relationships developed by Pankow et al. (1993). The resulting compressor specifications were 15 scfm per well at 20

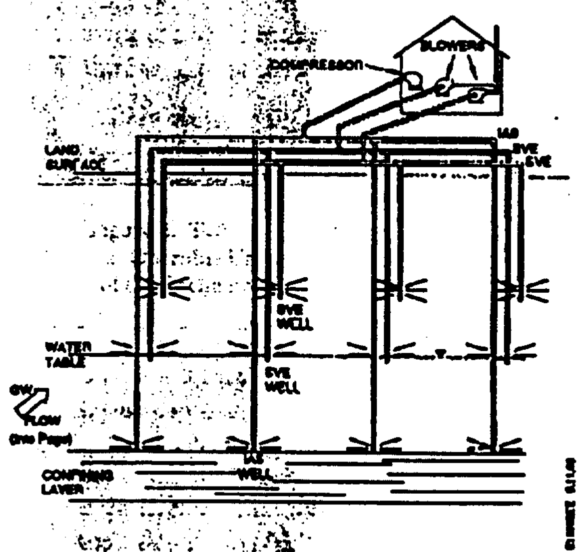


Figure 3. Schematic Diagram of the IAS System at OU 6

psig. The SVE blowers were then sized to capture the sparged air with a safety factor of three to four.

Figure 4 shows a plan of the site and the locations of the treatment and monitor wells. Each treatment well contains an IAS well at the bottom of the aquifer, a deep SVE well screened at the water table, and a shallow SVE well screened 20 ft above the water table. Ten nested monitor wells were also installed at the site at the TD site. Each cluster contains two vapor probes and three monitor wells with 5-ft screened intervals and bentonite seals between the screens. Figure 5 shows a schematic of the IAS/SVE dual wells and the nested monitor well installations.

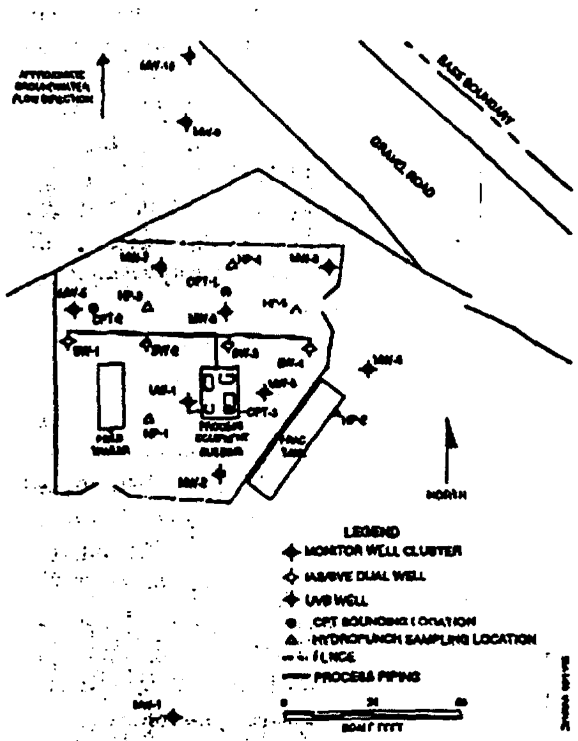


Figure 4. Treatment System Layout at the TD Site

Sampling and Analysis

To observe the impact of the treatment system on the aquifer and the unsaturated zone, numerous parameters were monitored at varying frequencies, as outlined in Table 2. Baseline samples and measurements were collected to characterize the aquifer for chlorinated organics and water quality parameters prior to the system startup. A CPT rig was used to collect hydropunch samples of groundwater at three discrete intervals at five locations within the anticipated zone of influence. The hydropunch samples were viewed as critical for quantifying the contaminant reduction from IAS because the representativeness of monitor well data is suspect. Previous studies have shown that IAS causes preferential flow to monitor wells which leads to preferential treatment at the wells (Johnson et al., 1993).

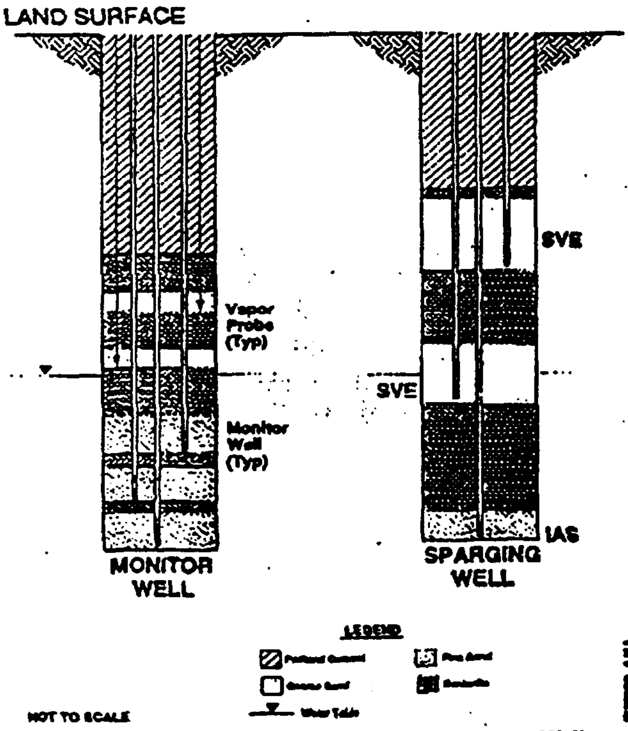


Figure 5. Schematic Diagram for the Monitor Well Clusters and the Sparging Well

After startup, weekly, monthly, and final samples were collected to monitor the treatment and the impact of the system on the subsurface. Final samples were collected from the monitor wells and at the hydropunch locations after the system had been shut off a week; these sample results were used to evaluate the effectiveness of the IAS system for removing TCE from the aquifer.

Table 2. Summary of Parameters Monitored During the IAS/SVE Test

Matrix	Parameter	Frequency	Location
Groundwater	Chlorinated volatile organic compounds	Baseline and final	Hydropunch locations
	Chlorinated volatile organic compounds	Monthly	Monitor wells
	Anions and cations		
	Alkalinity		
	Water level		
	Dissolved oxygen	Weekly or monthly	
	pH		
	Specific conductance		
	Redox potential		
	Temperature	Continuously	
Soil gas	Pressure	Continuously	Vapor probes
Air	Volatile organic compounds	Monthly	System off-gas and venting monitor well

Performance testing was also conducted to further evaluate the test results. A helium tracer recovery test was performed to determine the efficiency of the SVE system in recovering the air sparged into the aquifer. During the test, helium was added to the air sparging system, and the concentration of helium was measured in the SVE off-gas streams and also in the air flow out the venting monitor wells. The recovery of helium was calculated from the injected and recovered helium volumetric flow rates.

Additionally, a monitor well purge test was performed to evaluate the representativeness of the monitor well samples for quantifying IAS treatment. A continuous low-flow purge (0.15 gpm) was performed on three monitor wells within the treatment zone (5M, 7M, and 8M) to remove 800 gallons from each well. The TCE concentration was monitored over time to determine a stabilized concentration at each well; these concentrations were compared to the final sample results for the monitor well.

Test Results

TCE Reductions

Concentrations measured after the 12-week treatment period showed the greatest reduction from baseline levels at locations downgradient of the sparging lines. Table 3 provides the baseline and final TCE concentrations for the monitor well and hydropunch samples. These results are organized by depth since the contamination at the site varies by depth, with the shallow-medium and medium zones of the aquifer having the highest concentrations of TCE.

Although there was quite a bit of variability in baseline and final concentrations across the site, generally TCE concentration reductions in the 80% to 90% range were observed within and downgradient of the treatment zone. A portion of the test data are plotted on the contour map in Figure

Table 3. TCE Reduction by Depth for Monitor Well and Hydropunch Samples

Location	Shallow[a]				Shallow-Medium[a]				Medium[a]				Deep[a]			
	TCE Concentration (μg/L)		Percent Reduction	Absolute Reduction (μg/L)	TCE Concentration (μg/L)		Percent Reduction	Absolute Reduction (μg/L)	TCE Concentration (μg/L)		Percent Reduction	Absolute Reduction (μg/L)	TCE Concentration (μg/L)		Percent Reduction	Absolute Reduction (μg/L)
	Baseline	Final			Baseline	Final			Baseline	Final			Baseline	Final		
Monitor Well Samples[b]																
MW-1	5.99	20.9	-249	-14.9	NA	NA	NA	NA	202	170	15.8	32	46.6	18.5	60.3	28.1
MW-2	4.76	25.5	-436	-20.7	NA	NA	NA	NA	169	174	-3	-5	12	1.3	89.2	10.7
MW-3	84.7	26.6	68.6	58.1	NA	NA	NA	NA	80.9	72.8	10	8.1	0.21	0.99	-374	-0.8
MW-4	18.5	46.9	-154	-28.4	NA	NA	NA	NA	37.4	23.2	38	14.2	0.35	0.41	-19	-0.1
MW-5	35.7	68.7	-92	-33.0	NA	NA	NA	NA	222	36.8	83.4	185.2	175	71.4	59.2	103.6
MW-6	82.8	0.38	99.5	82.4	NA	NA	NA	NA	188	0.3	99.8	187.7	21.4	0.63	97.1	20.8
MW-7	120	27.2	77.3	92.8	NA	NA	NA	NA	194	32.7	83.1	161.3	186	44.3	76.2	141.7
MW-8	15.4	36	-134	-20.6	NA	NA	NA	NA	93.3	3.16	96.6	90.1	0.11	0.24	-121	-0.1
MW-9	46.7	6.38	86.3	40.3	NA	NA	NA	NA	129	38.6	70.1	90.4	60.8	15	75.3	45.8
MW-10	122	38.5	68.4	83.5	NA	NA	NA	NA	194	55.8	71.2	138.2	79.5	17.9	77.5	61.6
UW-1	2.85	NS	NC	NC	NA	NA	NA	NA	NA	NA	NA	NA	4.81	1.47	69.4	3.3
Hydropunch Samples[b]																
HP-1	3.08	NS	NC	NC	169	29.6	82.5	139.4	300	29.4	90.2	270.6	NA	NA	NA	NA
HP-2	30.9	20.4	34	10.5	110	12.5	88.6	97.5	67	66	1.49	1	NA	NA	NA	NA
HP-3	6.08	NS	NC	NC	71	14.5	79.6	56.5	130	16	87.7	114	NA	NA	NA	NA
HP-4	15.1	NS	NC	NC	60	1.58	97.4	58.4	162	4.85	97	157.2	NA	NA	NA	NA
HP-5	8.73	4.11	52.9	4.6	186	0.61	99.7	185.4	24.6	1.08	95.6	23.5	NA	NA	NA	NA

NA = Not applicable.
NC = Not calculated.
NS = Not sampled (no water at shallow depth).

[a] Refers to relative depth of sample.
[b] Upgradient of sparging line: MW-1, MW-2, MW-3, HP-1, and HP-2.
Cross-gradient of sparging line: MW-4.
Downgradient of sparging line: MW-5 through MW-10, HP-3, HP-4, and HP-5.
[c] Results are unreliable due to improper development of UW-1S and UW-1D.

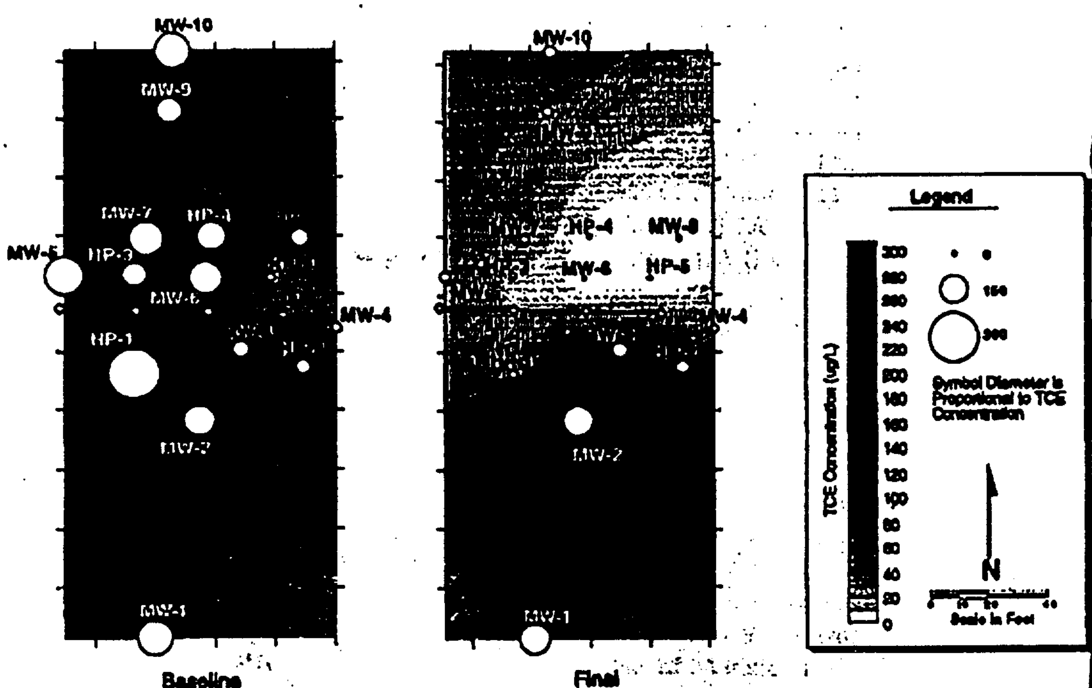


Figure 6. Contour Plot of Baseline and Final TCE Concentrations for the Medium-Depth Hydropunch and Monitor Well Samples

6 that represents baseline and final concentrations at the medium depth for both hydropunch and monitor well samples. As the figures illustrates, following the test the concentrations of TCE declined downgradient of the sparging line to concentrations ranging from 0.3 µg/L at MW-6 to 55.8 µg/L at MW-10. Statistical analysis of the baseline-to-final reductions and final concentrations confirmed that the reductions observed were statistically significant.

The higher concentration observed at MW-10 may be due to the position of the well approximately 95 ft downgradient of the sparge line. The average linear velocity at the site is low (0.5 to 1.8 ft/day), and during the course of the test, groundwater treated at the sparging line may not have had sufficient time to migrate to MW-10 by the time the final samples were collected. Evidence for this was provided in subsequent sampling at the site two months after the test period, where concentrations of TCE at MW-10M were measured at 7.8 µg/L.

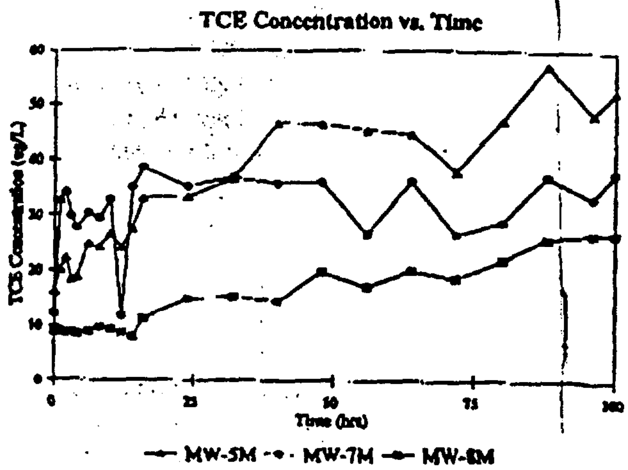
The data were evaluated to determine whether the measured reductions are real. Mass balances were performed using the liquid phase and gas phase sample results. The mass of TCE removed from the groundwater (0.29 to 3.4 lb) compared well with the mass removed from the SVE and monitor well off-gas (0.80 lb). An air-to-water ratio was calculated as ~~38~~ 12 to ~~60~~ 32 vol/vol depending on the groundwater velocity. A theoretical air-to-water ratio was calculated as 12 vol/vol. Both of these analyses indicate that the observed reductions are physically possible.

External factors (i.e., other than treatment) that could potentially affect TCE concentrations during the TD were also evaluated. These factors included normal concentration fluctuations in the aquifer and changes in groundwater gradient or flow direction. Periodic monitoring of the contaminant plume since 1993 has shown that concentrations in the center of the plume have never been measured below 150 µg/L. Groundwater level surveys taken before, during, and after the treatment show that groundwater flow direction has remained consistently to the north. Neither of these factors affected TCE concentrations or treatment at the site.

Purge Test

The results of the purge test at monitor wells 5, 7, and 8 are shown in Figure 7. The TCE concentrations at MW-7M remained essentially constant during the test around 30 μg/L, which agreed well with the final sample result of 32.7 μg/L. However, concentrations did show increases during pumping at MW-5M and MW-8M. The cause of this rise is uncertain. The observed gradual rise could be caused by mixing effects from untreated groundwater entering the wells' zones of influence or by preferential treatment at the monitor well. Mixing effects are especially relevant for monitor wells 5 and 8 since they are on the edge of the treatment zone.

Even though these results were inconclusive, the monitor well data showed good correlation with the hydropunch sample results. This correlation does not mean, however, that sampling interferences do not exist with either sampling technique, such as preferential flow or volatilization. The uncertainties in the purge test data do create questions concerning the results, but the consistent concentration reductions across the treatment zone, utilizing three different sampling techniques, appear to be indicative of treatment as a whole.



TCE Concentrations Measured During IAS Study (ug/L)

Well	Sampling Event: Baseline	Final
MW-5M	222	36.8
MW-7M	194	32.7
MW-8M	93.3	3.16

Figure 7. TCE Concentrations During the Monitor Well Purge Test and Concentrations Measured During the Baseline and Final Sampling Events

Flow Model

Because the reductions measured during the test were significant and appeared to be relatively consistent across the TD site, a conceptual physical model was necessary to account for the observed reductions. Besides the TCE concentrations, several other pieces of data collected during the test were important for evaluating the effect of IAS on the aquifer, including dissolved oxygen readings, pH measurements, the potentiometric surface and water level changes, air flow measurements from the monitor wells, and the lithology at the site.

The DO concentrations were recorded prior to and during the test, as presented graphically in Figure 8. These data show that DO concentrations increased, relative to baseline, within a week of startup. This rapid rise in DO was observed at most depths for all downgradient wells; elevated DO is indicative of oxygen transfer to the aquifer from the sparged air. Particularly noteworthy are the measurements at MW-9 and MW-10, which are located 70 and 95 ft from the sparging line, respectively, because they showed elevated DO after 4 weeks of operation (during the first sampling event). The groundwater flow at the site is approximately 0.5 to 1.8 ft/day, so it is not likely that the treated groundwater plume migrated to these locations within the first four weeks of operation

Therefore, some degree of direct air flow was observed up to 95 ft downgradient of the sparging line. The elevated DO measurements observed at deep, medium, and shallow depths at many of the wells indicate that the air flow is distributed relatively uniformly across the entire site.

Another indication of the even distribution of air at the site was the change in pH observed at numerous wells downgradient of the treatment area. A gradual rise from baseline conditions ranging from 0.15 to 1 pH units was observed in the pH measurements within 4 to 8 weeks of startup. This rise was likely caused by the stripping of CO_2 from the aquifer by the sparged air. Because the alkalinity of the groundwater is high and the CO_2 concentration in the sparged (ambient) air is low, CO_2 is stripped out of the groundwater into the air, thus raising the pH. These results indicate that stripping is occurring across much of the TD site.

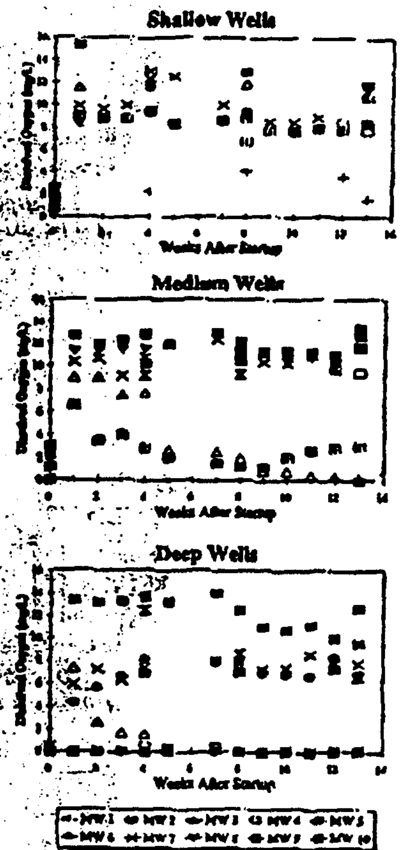


Figure 8. DO Concentrations Measured at the Monitor Wells During the Weekly and Monthly Sampling Events

This uniform treatment of the aquifer is governed by the lithology at the OU 6 TD site. Although the aquifer framework is predominantly sands, as shown in the CPT logs, there are slight changes in grain size and density and, thus, permeability throughout the saturated zone. It appears that these variations in permeability have a significant effect on the air pathways in the treatment area and, as a result, TCE removal rates. The lower permeability sands divert the upward movement of air and force the air to flow laterally. This "pancake" flow mechanism causes a laterally extensive distribution of air in the aquifer and results in treatment of the groundwater as a whole.

IAS appears to have significantly reduced dissolved-phase TCE concentrations at OU 6, however, two important questions remained: 1) Was groundwater simply diverted around the site? and 2) Was the sparged air adequately recovered by the SVE system? These points are important for understanding the impact and effectiveness of the IAS/SVE system.

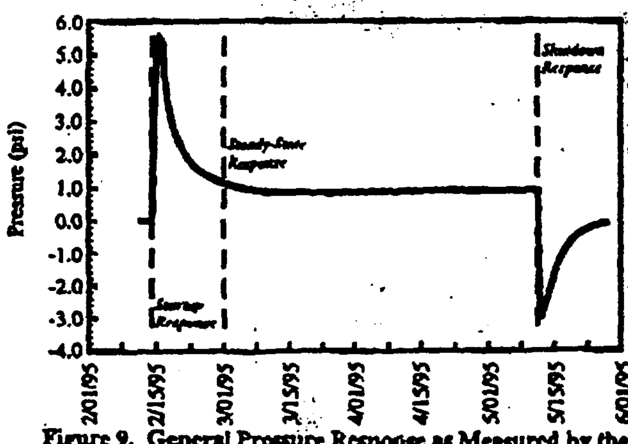


Figure 9. General Pressure Response as Measured by the Submersible Pressure Transducers During the IAS Test

When the IAS system was started at the beginning of the test, a pressure field developed in the TD area. This was seen as a significant rise in pressure measured by pressure transducers in the deep monitor wells. Figure 9 shows the general response of the submersible pressure transducers during the performance of the test.

Figure 10 presents a schematic of the conceptual air flow pathways at steady state in the OU 6 aquifer system. As the figure shows, the less permeable sands have the effect of spreading the air flow laterally through the aquifer. Unique to this site are the confining layers that restrict the air flow and create a locally extensive pressure field during treatment. The deep SVE wells and some of the shallow monitor wells penetrate the confining layers thus providing a release point for the pressure field developed because of these layers.

Conclusions

The in situ sparging system installed at Hill AFB OU 6 did appreciably remove contaminants, specifically TCE, from the groundwater. Both the monitor well and hydropunch sample results showed significant reductions of TCE concentrations during the IAS test—generally from 150 to 300 μg/L at baseline to 1 to 50 μg/L after 12 weeks of IAS operation.

Significant reductions were observed at most depths for all downgradient monitor wells. These reductions are believed to be a result of a relatively uniform distribution of air flow throughout the aquifer at OU 6 during IAS treatment. This conclusion is supported by the rapid rise in dissolved oxygen at wells up to 95 ft from the sparging line and the consistently elevated dissolved oxygen concentrations in the aquifer both laterally and vertically from the sparging wells. The lateral movement of air is likely caused by the lower permeability sands within the aquifer that divert the upward movement of air and force air to flow laterally. In contrast to a vertical channeling flow mechanism where discrete channels of air provide a relatively small air-water interface, the pancake flow of air in the OU 6 system provided air movement laterally and vertically throughout the aquifer. Since the primary removal mechanism for chlorinated organics is the stripping of contaminants caused by air movement, it appears that under the flow regime at the OU 6 TD site the aquifer as a whole was treated by the IAS system.

It was also found that subsurface lithology drastically affected the ability of the designed system to remove sparged air. The confining layers at or near the water table caused air to accumulate and a pressure field to develop in the treatment area after sparging began. These layers caused the majority of sparged air (80%) to be vented through the shallow monitor wells.

To better understand the impact and effectiveness of IAS at a site, it is recommended that submersible pressure transducer measurements, dissolved oxygen, pH, and contaminant concentrations be monitored before, during, and after the testing period.

References

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Biographical Sketches

Whitney Wheeless is a staff engineer at Radian Corporation in Austin, Texas. She serves as the technical manager of the technology demonstration at Hill Operable Unit 6. She received her B.S. degree in chemical engineering from the University of Texas at Austin. Most recently, she has worked in the site investigation and remediation field for various government clients. [8501 North Mopac Blvd.; Austin, TX 78759; 512-454-4797; fax 512-454-8807]

Steven T. Hicken is an environmental engineer at Hill Air Force Base, Utah. He serves as a project manager for Operable Units 6 and 7. He received a B.S. degree in geology from Southern Utah University and a M.S. degree from Utah State University in civil and environmental engineering. [OO-ALC/EMR; 7274 Wardleigh Rd.; Hill AFB, Utah 84056-5137; 801-777-8790; fax 801-777-4306]

Carrie Beitler is a process engineer at Radian Corporation in Austin, Texas and served as the project engineer for the TD. She received her B.S. degree in chemical engineering from Purdue University. She has experience in the design, modeling, and test of air and water pollution control technologies. [8501 North Mopac Blvd.; Austin, TX 78759; 512-454-4797; fax 512-454-8807]

Jim Rowe is a geologist at Radian Corporation in Austin, Texas and serves as the Project Geologist for the OU 6 TD. He received a B.A. degree with a major in geology from Carleton College, Northfield, MN. His project interests lie in innovative technologies for site investigation and the application of computer systems to environmental planning, assessment, and investigation. [8501 North Mopac Blvd.; Austin, TX 78759; 512-454-4797; fax 512-454-8807]

Mark A. Robbins is a senior engineer at Radian Corporation in Austin, Texas. He serves as a technical advisor for the technology demonstration. He received his B.S. degree in civil engineering from Texas Tech University. He works primarily in the site remediation area for both government and commercial clients. [8501 North Mopac Blvd.; Austin, TX 78759; 512-454-4797; fax 512-454-8807]

Dr. Robert E. Hinchee is a senior research leader at Parsons Engineering Science, Inc. He received his Ph.D. from Utah State University in civil and environmental engineering. He has been involved in the development, demonstration, and application of in situ remediation technologies at more than 200 sites located in the United States, Europe, and the South Pacific. [406 West South Jordan Parkway, Suite 300; South Jordan, Utah 84095; 801-572-5999; fax 801-572-9069]

Dr. Paul C. Johnson is an associate professor in the Department of Civil and Environmental engineering at Arizona State University in Tempe, AZ. He received his B.S. and Ph.D. degrees in chemical engineering from the University of California at Davis and Princeton University, respectively. His research and teaching interests focus on the development of cost-effective and innovative solutions to problems related to environmental protection, restoration and risk analyses. Prior to joining the faculty at ASU, he was a senior research engineer at Shell Oil Company's Westhollow Research Center. [Department of Civil Engineering; Arizona State University; Tempe, Arizona 85287-5306; 602-965-915; fax 602-965-0557]

Dr. Richard L. Johnson is an associate professor in the Department of Environmental Science and Engineering at the Oregon Graduate Institute of Science & Technology. He is also the director of the OGI Center for Groundwater Research and the OGI Large Experimental Aquifer Program. [20000 NW Walker Rd.; Beaverton, Oregon 97006-1999; 503-690-1196; fax 503-690-1273]

Dr. David B. McWhorter is a professor of chemical and bioresource engineering at Colorado State University. His specialties are multi-fluid flow in porous media, multi-component gaseous diffusion, and ground water hydrology. He is a regular consultant to industry and government on problems of ground water contamination. [Engineering Research Center; Colorado State University; Fort Collins, Colorado; 303-491-8666; fax 303-491-8224]

APPENDIX C
CONTAMINANT CONCENTRATION CALCULATIONS

S.O. No. CTO-0323

Subject: Soil-Vapor Contaminant Concentration Estimates

MCB Camp Lejeune, O.U. No. 10 Sheet No. 1 of 3

Site 35 Drawing No.

Computed by GJR Checked By RPA Date 4-26-96

Baker

Vapor Emission and Resulting Soil Contamination - Site 35 IAS Pilot Test

$\text{Emissions}_{Max} = q \times W \times H \times C_{gw}$, Emission in pounds/day

where q = groundwater flow rate (ft/d)

W = width of IAS barrier (ft)

H = depth below water table to injection point (ft)

C_{gw} = dissolved contaminant concentration (lb/ft^3)

Assume: $q = 0.06$ ft/d, based on hydraulic conductivity, K, of 0.001 cm/s and hydraulic gradient, I, of 0.02

$H = 25$ ft

$W = 200$ ft

$C_{gw} = 6.0 \times 10^{-5}\ lb/ft^3$ ($\approx 1{,}000\ \mu g/L$)

$\text{Emissions}_{max} = (0.06\ ft/d)(200\ ft)(25\ ft)(6.0 \times 10^{-5}\ lb/ft^3)$

$\text{Emissions}_{max} = 0.02\ lb/d$ of contaminant

$C_{vapor} = \text{Emissions}_{max} / Q_{IAS}$, Vapor emission contaminant concentrati

Assume: 4 IAS wells spaced 50 ft apart with flowrate = 10 ft^3/min each

Total Flow, $Q = 4\ \text{wells} \times 10\ ft^3/min/well$

$Q = 40\ ft^3/min$

$C_{vapor} = (0.02\ lb/day) / [(40\ ft^3/min)(1440\ min/d)]$

$C_{vapor} = 3.5 \times 10^{-7}\ lb/ft^3 = 5.6 \times 10^{-3}\ g/m^3$, mg/L

S.O. No. CTO-0323

Subject: Soil-Vapor Contaminant Concentration Estimates

MCB Camp Lejeune, O.U. No 10 — Sheet No. 2 of 3

Site 35 — Drawing No.

Computed by GJR — Checked By RPA — Date 4-26-96

Baker

Vapor Emission and Resulting Soil Contamination - Site 35 IAS Pilot Test

Total soil concentration, $C_{Total} = C_{sorbed} + C_{moisture}\,\theta_m + C_{vapor}\,\theta_v / \rho_s$

where C_{sorbed} = contaminants sorbed directly onto soil (mg/kg)

$C_{moisture}$ = contaminants dissolved in soil moisture (mg/L)

θ_m = soil moisture content (L-H_2O/kg-soil)

C_{vapor} = contaminants in soil vapor (mg/L)

θ_v = vapor void fraction

ρ_s = soil bulk density (kg/L)

In Equilibrium: $C_{moisture} \times H = C_{vapor}$

where H = Henry's Law Constant

$C_{moisture} \times K_d = C_{sorbed}$

where K_d = partitioning coefficient (L/kg)

$K_d = K_{oc} \times f_{oc}$, K_{oc} = adsorption coefficient for o.c.

f_{oc} = organic carbon (O.C.) content

$\therefore\ C_{sorbed} = C_{vapor}\,(K_d/H)$

$C_{moisture} = C_{vapor}\,(1/H)$

$$C_{Total} = C_{vapor}\left[K_d/H + \theta_m/H + \theta_v/\rho_s\right]$$

S.O. No. CTO-0323

Subject: Soil-Vapor Contaminant Concentration Estimates

MCB Camp Lejeune, O.U. No. 10 Sheet No. 3 of 3

Site 35 Drawing No.

Computed by GJR Checked By RPA Date 4-26-96

Baker

Vapor Emission and Resulting Soil Contamination - Site 35 IAS Pilot Test

Assume: $\theta_m \approx 0.1$ L-H_2O/kg soil

$\theta_v \approx 0.2$ L-air/L-soil

$\rho_s \approx 1.7$ kg/L

$f_{oc} \approx 0.01$ g O.C./g-soil

For Benzene, $H = 0.22$, $K_{oc} = 60$ L/kg

For TCE, $H = 0.44$, $K_{oc} = 94$ L/kg

$$C_{Total\text{-}Benzene} = C_{vapor}\left[\frac{(60\ L/kg)(0.01)}{0.22} + \frac{0.1\ L/kg}{0.22} + \frac{0.2}{1.7\ kg/L}\right]$$

$$C_{Total\text{-}Benzene} = C_{vapor}\left[2.73\ L/kg + 0.45\ L/kg + 0.12\ L/kg\right]$$

$$C_{Total\text{-}Benzene} = C_{vapor}\left[3.3\ L/kg\right]$$

$$C_{vapor} = 5.6 \times 10^{-3}\ mg/L$$

$$C_{Total\text{-}Benzene} = (5.6 \times 10^{-3}\ mg/L)(3.3\ L/kg)$$

$$C_{Total\text{-}Benzene} = 0.018\ mg/kg$$

$$C_{Total\text{-}TCE} = C_{vapor}\left[\frac{(94\ L/kg)(.01)}{0.44} + \frac{0.1\ L/kg}{0.44} + \frac{0.2}{1.7\ kg/L}\right]$$

$$C_{Total\text{-}TCE} = C_{vapor}\left[2.14\ L/kg + 0.23\ L/kg + 0.12\ L/kg\right]$$

$$C_{Total\text{-}TCE} = C_{vapor}\left[2.5\ L/kg\right]$$

$$C_{Total\text{-}TCE} = (5.6 \times 10^{-3}\ mg/L)(2.5\ L/kg)$$

$$C_{Total\text{-}TCE} = 0.014\ mg/kg$$

APPENDIX D
CONSTITUENTS DETECTED BY EPA METHOD TO-14

TABLE 1. VOLATILE ORGANIC COMPOUND DATA SHEET

COMPOUND (SYNONYM)	FORMULA	MOLECULAR WEIGHT	BOILING POINT (°C)	MELTING POINT (°C)	CAS NUMBER
Freon 12 (Dichlorodifluoromethane)	Cl_2CF_2	120.91	-29.8	-158.0	
Methyl chloride (Chloromethane)	CH_3Cl	50.49	-24.2	-97.1	74-87-3
Freon 114 (1,2-Dichloro-1,1,2,2-tetrafluoroethane)	$ClCF_2CClF_2$	170.93	4.1	-94.0	
Vinyl chloride (Chloroethylene)	$CH_2{=}CHCl$	62.50	-13.4	-1538.0	75-01-4
Methyl bromide (Bromomethane)	CH_3Br	94.94	3.6	-93.6	74-83-9
Ethyl chloride (Chloroethane)	CH_3CH_2Cl	64.52	12.3	-136.4	75-00-3
Freon 11 (Trichlorofluoromethane)	CCl_3F	137.38	23.7	-111.0	
Vinylidene chloride (1,1-Dichloroethene)	$C_2H_2Cl_2$	96.95	31.7	-122.5	75-35-4
Dichloromethane (Methylene chloride)	CH_2Cl_2	84.94	39.8	-95.1	75-09-2
Freon 113 (1,1,2-Trichloro-1,2,2-trifluoroethane)	CF_2ClCCl_2F	187.38	47.7	-36.4	
1,1-Dichloroethane (Ethylidene chloride)	CH_3CHCl_2	98.96	57.3	-97.0	74-34-3
cis-1,2-Dichloroethylene	$CHCl{=}CHCl$	96.94	60.3	-80.5	
Chloroform (Trichloromethane)	$CHCl_3$	119.38	61.7	-63.5	67-66-3
1,2-Dichloroethane (Ethylene dichloride)	$ClCH_2CH_2Cl$	98.96	83.5	-35.3	107-06-2
Methyl chloroform (1,1,1-Trichloroethane)	CH_3CCl_3	133.41	74.1	-30.4	71-55-6
Benzene (Cyclohexatriene)	C_6H_6	78.12	80.1	5.5	71-43-2
Carbon tetrachloride (Tetrachloromethane)	CCl_4	153.82	76.5	-23.0	56-23-5
1,2-Dichloropropane (Propylene dichloride)	$CH_3CHClCH_2Cl$	112.99	96.4	-100.4	78-87-5
Trichloroethylene (Trichloroethene)	$ClCH{=}CCl_2$	131.29	87	-73.0	79-01-6
cis-1,3-Dichloropropene (cis-1,3-dichloropropylene)	$CH_3CCl{=}CHCl$	110.97	76		

T014-60

APPENDIX D
TEST BORING AND WELL CONSTRUCTION RECORDS

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 SCREENING
S.O. NO.: 62470-232-03600 BORING NO.: TW1-A
COORDINATES: EAST: - NORTH: -
ELEVATION: SURFACE: 19.1 TOP OF STEEL CASING: 18.83

RIG: MOBILE 55 - TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3¼ ID		4/9/96	0-15 FT	50's cloudy	6.0	12:30 -1:00
LENGTH			5 FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" DIA	0	5
Well Screen	1"	PVC Slotted (0.01 SLOT)	5	15

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL CASING FROM 0 TO 5 FT	
2								
3						SEE BORING LOG TW1-B FOR SOIL INFORMATION	WELL SCREEN FROM 10 TO 15 FT	
4								
5	A-N							14.1
6							WELL SCREEN FROM 10 TO 15 FT	
7								
8								
9								
10								

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW1-A

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 SCREENING
S.O. NO.: 62470-232-03600 BORING NO.: TW1-A

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger T = Shelby Tube W = Wash R = Air Rotary C = Core D = Denison P = Piston N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
11–15	A-N					Continued from Sheet 1 SEE BORING LOG TW1-B FOR SOIL INFORMATION	WELL SOLID FROM 0 TO 15 FT WELL SCREEN FROM 10 TO 15 FT BOTTOM PLUG	4.1
15–30						(E) END OF BORING @ 15.0 FT		
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW1-A SHEET 2 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW1-B
COORDINATES: EAST: – NORTH: –
ELEVATION: SURFACE: 19.1 TOP OF STEEL CASING: 18.83

RIG: MOBILE 55 - TRUCK MOUNT					DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
	SPLIT SPOON	CASING	AUGERS	CORE BARREL					
SIZE (DIAM.)	1.93 in		3¼ ID		4/9/96	0 - 47	50's CLOUDY		8:30-12:30
LENGTH	2 ft		5 FT						
TYPE	SS		HS						
HAMMER WT.	140 lbs.								
FALL	30 in								
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" DIA	0	42
Well Screen	1"	PVC Slotted (0.01 SLOT)	42	47

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab.~~ ~~Moist %~~	Visual Description	Well Installation Detail	Elevation
1–2.0	S-1	1.0	8 8 8 9		<1	SURFACE SAMPLE TW1A-00 COLLECTED FROM 0.0 TO 0.5' SAND, FINE GRAIN, LITTLE SILT, BROWN GREY, DAMP TO MOIST	WELL CASING FROM 0.0 FT TO 42.0 FT	17.1
3–4.0	S-2	1.0	4 4 4 4		<1		WELL SOCK FROM 0.0 FT TO 47.0 FT	15.1
5–6.0	S-3	1.2	2 2 2 1		20	SAMPLE TW1A-03 COLLECTED FROM 4.0 TO 6.0' SAND, FINE GRAIN, GREY, MOIST TO WET, LOOSE, TRACE SILT Hnu reading elevated @ 5.0 to 5.5 ft with BLACK/DARK BROWN SAND WATER @ 6.0		
7–10.0	A-N					10.0 SAND, FINE GRAIN, LOOSE, WET Match to Sheet 2		9.1

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP / WALLY / DAVE BORING NO.: TW1-B SHEET 1 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: EGI - CTO 232 SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW1-B

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS
SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	HNU ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
11–12.0	S-4	2.0	4 8 7 12		<1	Continued from Sheet 1 SAND, FINE GRAIN, GREY, BROWN WET, LOOSE		
12.0–15.0	A-N							
15.0–17.0	S-5	2.0	6 7 11 11		<1	SAND, FINE AND MEDIUM GRAIN, GREY, BROWN, LITTLE FINE GRAVEL, TRACE TO LITTLE SILT, MED. DENSE, WET FINE GRAIN SAND AT 16.8 TO 17.0 W/ LITTLE SILT		4.1
17.0–20.0	A-N							
20.0–22.0	S-6	1.8	1/1.0 4 4		<1	SAND, FINE AND MEDIUM GRAIN, LITTLE SILT GREY, BROWN; LOOSE TO MED. DENSE, WET		-0.9
22.0–25.0	A-N							
25.0–27.0	S-7	1.8	7 10 20 20		<1	SAND, FINEGRAIN, LITTLE MEDIUM GRAIN, LITTLE SILT, GREY, BROWN, MED. DENSE TO DENSE; WET		-5.9
27–30								

Match to Sheet 3

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW1-B SHEET 2 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc.

PROJECT: SGI - CTO 232 SCREENING
S.O. NO.: 62470-232-0000-036000 BORING NO.: TW1-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger T = Shelby Tube W = Wash R = Air Rotary C = Core D = Denison P = Piston N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
31–32.0	S-8	2.0	8 10 20 20		<1	Continued from Sheet 2 SAND, FINE GRAIN, GREY DENSE, WET 31.5'	HOLE CAVED TO 30.0'	-12.0
32.0–35.0	A-N					SAND AND SILT, LITTLE FINE GRAVEL, GREY, MOIST, STIFF, LITTLE CLAY, LITTLE SHELL FRAGMENTS, PARTIALLY CEMENTED/CONSOLIDATED, LIMESTONE FRAGMENTS		
35.0–37.0	S-9	1.0	18 20 13 10		<1	SAND, LITTLE SILT, LITTLE FINE GRAVEL SHELL FRAGMENTS, WET, MED DENSE TO DENSE, FINE AND MEDIUM GRAIN, CONSOLIDATED/SHELL FRAGMENTS. @36.5 CEMENTED		
37.0–40.0	A-N					SAND, GREY, SHELL FRAGMENTS 40.5	WELL SOCK FROM 47.0 TO 0.0	-21.4
40.0–42.0	S-10	1.8	11 15 17 19		<1	SAND, FINE GRAIN, LITTLE SILT AND CLAY GREY, GREEN, MED DENSE, WET,		-22.9
42.0–45.0	A-N						WELL SCREEN FROM 42.0 TO 47.0	
45.0–47.0	S-11	2.0	4 5 8 13		<1	SAND, FINE GRAIN, SOME SILT, LITTLE CLAY, GREEN, GREY, MEDIUM STIFF TO STIFF, WET 47.0	BOTTOM PLUG @ 47.0	-27.9
47–49						END OF BORING @ 47.0 HAD TO USE WATER TO CLEAN OUT AUGER BEFORE TAKING SAMPLE ESTIMATE 150 GALLONS USED HOLE CAVED TO 30'		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW1-B SHEET 3 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 SCREENING
S.O. NO.: 62470-232-0000-03600
BORING NO.: TW2-A
COORDINATES: EAST: 2464646.7270
NORTH: 362393.3209
ELEVATION: SURFACE: 17.6
TOP OF STEEL CASING: -

RIG: MOBILE 55 TRUCK MOUNT					DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
	SPLIT SPOON	CASING	AUGERS	CORE BARREL					
SIZE (DIAM.)					4-9-96	0-15	50's CLOUDY	6.0	0 HRS
LENGTH									
TYPE									
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon   A = Auger
T = Shelby Tube   W = Wash
R = Air Rotary   C = Core
D = Denison   P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1	PVC Threaded	0	5
Well Screen	1	PVC Slotted	5	15

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL CASING FROM 0.0 TO 5.0 FT.	
2						SEE BORING LOG TW2-B FOR SOIL INFORMATION	WELL SOCK FROM 0.0 to 15.0 FT	
3								
4								
5	A-N							12.6
6							WELL SCREEN FROM 5.0 to 15.0 FT.	
7								
8								
9								
10						Match to Sheet 2		

DRILLING CO.: PARRATT WOLFF
DRILLER: CHIP
BAKER REP.: BRIAN E. DAVIS
BORING NO.: TW2-A
SHEET 1 OF 2

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW2-A

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
11						Continued from Sheet 1	WELL SOCK FROM 0.0 TO 15.0 FT.	
12	A-N						WELL SCREEN FROM 5.0 to 6.0 FT	
13								
14						END OF BORING @ 14.0		
15						NOTE: HOLE WASHED TO 15.0 FT.	BOTTOM PLUG @ 15.0 FT	2.6
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW2-A SHEET 2 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 SCREENING
S.O. NO.: 62470-232-03600 BORING NO.: TW2-B
COORDINATES: EAST: 2464646.7270 NORTH: 362393.3209
ELEVATION: SURFACE: 17.6 TOP OF STEEL CASING: —

RIG: MOBILE 55 - TRUCK MOUNT					DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
	SPLIT SPOON	CASING	AUGERS	CORE BARREL					
SIZE (DIAM.)	1 3/8 IN		3 1/4 ID		4/9/96	0-47	50's CLOUDY	6.0	0 HRS
LENGTH	2 FT		5 FT						
TYPE	SS		HS						
HAMMER WT.	140 lb.								
FALL	30 IN								
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" DIA	0.0	42.0
Well Screen	1"	PVC Slotted 0.01 SLOT	42.0	47.0

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
0–2.0	S-1	1.2	4 10 10 12		<1	SAMPLE TW2-00 COLLECTED FROM 0.0 TO 0.5' 13:13 SAND, FINE GRAIN, BLACK, BROWN, DAMP ROOTS	WELL CASING FROM 0.0 FT TO 45.0 FT.	
2.0–4.0	S-2	1.5	7 7 6 6		<1	3.0 SAND, FINE GRAIN, BROWN, GREY, DAMP LOOSE, LITTLE SILT	WELL SOCK FROM 0.0 FT TO 47.0 FT	14.60
4.0–6.0	S-3	2.0	2 2 2 3		20	BLACK SAND LAYER @ 4.5 to 5.0' - 20 ppm ON HNU WATER @ 6.0' SAMPLE TW-02-03 COLLECTED FROM 4.0 TO 6.0 13:45		
6.0–10.0	A-N							

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW2-B SHEET 1 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: 3GI - LTD 232 SCREENING
S.O. NO.: 62470-232-03600 BORING NO.: TW2-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; A = Auger; T = Shelby Tube; W = Wash; R = Air Rotary; C = Core; D = Denison; P = Piston; N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5'); RQD = Rock Quality Designation (%); Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
11–12.0	S-4	0.8	4 4 6 6		<1	Continued from Sheet 1 SAND, FINE GRAIN, GREY, LOOSE, WET	WELL CASING FROM 0.0 TO 45.0 FT WELL SOLID FROM 2.0 FT TO 47.0 FT	
12.0–15.0	A-N					15.0		2.60
15.0–17.0	S-5	1.0	4 7 6 5		<1	SAND, MEDIUM GRAIN, LITTLE SILT BROWN, LOOSE, WET LITTLE COARSE GRAIN SAND/FINE GRAIN GRAVEL		
17.0–20.0	A-N					20.0		-2.40
20.0–22.0	S-6	1.8	1 1 1 1		<1	SAND, FINE GRAIN, TRACE SILT GRAY, LOOSE, WET		
22.0–25.0	A-N							
25.0–27.0	S-7	1.5	11 13 18 14		<1	26.5 SAND, FINE AND MEDIUM GRAIN, SOME FINE GRAVEL, GREY, MED DENSE WET		-8.90
27.0–30.0	A-N					30.0 SAND AND SILT Match to Sheet 3		-12.4

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW2-B SHEET 2 OF 3

Baker

Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI · CTO 232 SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW2-B

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	HNU ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
31 – 32.0	S-8	2.0	17 18 19 32		<1	Continued from Sheet 2 SAND AND SILT, LITTLE FINE GRAVEL WET, DENSE, LITTLE CLAY, SHELL FRAGMENTS & LIMESTONE FRAGMENTS, CONSOLIDATED SHELL FRAGMENTS FROM 30-30.5	WELL CASING FROM 0.0 TO 42.0 FT. WELL SOCK FROM 0.0 TO 47.0 FT	
32 – 35.0	A-N							
35 – 37.0	S-9	0	20 20 19 10		—	NO SAMPLE SAMPLE SLIPPED OUT OF SPLIT SPOON		
37 – 40.0								
40 – 42.0	S-10	2.0	16 18 22 25		<1	SAND AND SILT, FINE AND MEDIUM GRAIN, SOME SHELL FRAGMENTS AND LIMESTONE FRAGMENTS UNCONSOLIDATED, WET, DENSE		-24.40
42 – 45.0						45.0	WELL SCREEN FROM 42.0 TO 47.0 FT	-27.40
45 – 47.0	S-11	2.0	4 7 9 10		<1	SAND, FINE GRAIN, LITTLE SILT, GREEN, GREY, MEDIUM DENSE, WET 47.0		-29.40
47 – 50						END OF BORING @ 47.0 FT. HAD TO USE WATER TO CLEAN OUT AUGER BEFORE TAKING SAMPLE ESTIMATE 50 GALLONS USED HOLE CAVED TO 30'		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW2-B SHEET 3 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW3-A

COORDINATES: EAST: – NORTH: –

ELEVATION: SURFACE: 17.8 TOP OF STEEL CASING: 17.59

RIG: MOBILE 55 TRUCK MOUNT					DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
	SPLIT SPOON	CASING	AUGERS	CORE BARREL					
SIZE (DIAM.)			3¼ ID		4/10/96	0-15	50's SUNNY	6 FT	0 hrs.
LENGTH			5FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" DIA	0	5
Well Screen	1"	PVC Slotted 0.01 SLOT	10	15

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL SOCK FROM 0.0 TO 15.0 FT	
2								
3							WELL CASING FROM 0.0 TO 10.0 FT	
4						SEE BORING LOG TW3-B FOR SOIL INFORMATION		
5	A-N							12.8
6								
7							WELL CASING FROM 5.0 TO 15.0 FT	
8								
9								
10						Match to Sheet 2		

DRILLING CO.: PARRATT - WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW3-A SHEET 1 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker

Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 62470 - 232 - 0000 - 03600 BORING NO.: TW3-A

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; A = Auger; T = Shelby Tube; W = Wash; R = Air Rotary; C = Core; D = Denison; P = Piston; N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5'); RQD = Rock Quality Designation (%); Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
						Continued from Sheet 1	WELL SOCK FROM 0.0 TO 15.0 FT	
11								
12							WELL SCREEN FROM 10.0 TO 15.0 FT	
13						SEE BORING TW3-B		
14						FOR SOIL INFORMATION		
15							BOTTOM PLUG	2.8
						END OF BORING @ 15.0 FT.		
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT - WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW3- A SHEET 2 OF 2

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600
BORING NO.: TW3-B
COORDINATES: EAST: -
NORTH: -
ELEVATION: SURFACE: 17.8
TOP OF STEEL CASING: 17.59

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1 4/3 in		3 1/4 ID		4/9/96	0-47'	50° WINDY	6 FT	0 HRS
LENGTH	2 FT		5 FT						
TYPE	SS		HS						
HAMMER WT.	140 lbs.								
FALL	30 in.								
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon
T = Shelby Tube
R = Air Rotary
D = Denison
A = Auger
W = Wash
C = Core
P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" DIA	0	42
Well Screen	1"	PVC Slotted 0.01 SLOT	42	47

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
0-2.0	S-1	2.0	5 5 6 7		<1	SAND, FINE GRAIN, BROWN, BLACK, DAMP LOOSE, ROOTS SAMPLE TW-03-00 COLLECTED FROM 0.0 TO 0.5 FT @ 16:54	WELL SOCK FROM 0.0 FT TO 47.0 FT	
2.0-4.0	S-2	1.8	10 4 3 3		<1	2.0 SAND, FINE GRAIN, GREY, BROWN, DAMP MED. DENSE, LITTLE SILT 4.0	WELL CASING FROM 0.0 FT TO 42.0 FT	15.3 / 13.8
4.0-6.0	S-3	2.10	4 4 4 5		<1	SAND, FINE GRAIN, BROWN, GREY, WET SAMPLE TW-03-03 COLLECTED FROM 4.0 to 6.0 @ 17:15		
6.0-10	A-N					10.0 SILT AND CLAY		7.8

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF
BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP
BORING NO.: TW3-B
SHEET 1 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW3-B

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS
SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
11-12.0	S-4	2.0	2 2 2 3		1	Continued from Sheet 1 SILT AND CLAY, LITTLE FINE SAND, GREY, SOFT, WET, TREE ROOT	WELL SOCK FROM 0.0 FT TO 47.0FT WELL CASING FROM 0.0FT TO 42.0FT	
12.0-15.0	A-N					15.0		2.8
15.0-17.0	S-5	2.0	3 5 6 7		<1	SAND, FINE GRAIN, LITTLE SILT GREY, WET, MEDIUM DENSE		
17.0-20.0	A-N							
20.0-22.0	S-6	2.0	3 3 3 3		<1	SAND, FINE GRAIN, LITTLE TO TRACE SILT, GREY, WET, LOOSE TO MED. DENSE		
22.0-25.0	A-N					25.0		-7.2
25.0-27.0	S-7	1.0	1 WOH			SILT AND CLAY, SOME FINE GRAIN SAND GREY, WET, SOFT		
27.0-30						30.0 SAND Match to Sheet 3		-12.

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E DAVIS
DRILLER: CHIP BORING NO.: TW3-B SHEET 2 OF 3

Baker

Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW3-B

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
30.0–32.0	S-8	2.0	7 9 11 13		<1	Continued from Sheet 2 SAND, COARSE AND MEDIUM GRAIN, LITTLE FINE GRAIN, LITTLE SILT, GREY, WET MED DENSE TO DENSE, TRACE CLAY LIMESTONE FRAGMENTS, SHELL FRAGMENTS UNCONSOLIDATED	WELL SOCK FROM 0.0 FT TO 47.0 FT WELL CASING FROM 0.0 FT TO 42.0 FT	
32.0–35.0	A-N							
35.0–37.0	S-9	2.0	10 18 28 13		<1	SAND, SOME SILT, TRACE CLAY GREY, GREEN, LIMESTONE FRAGMENTS WET, MED DENSE TO DENSE		
37.0–40.0	A-N							
40.0–42.0	S-10	2.0	8 13 18 24		<1	SAND, LITTLE SILT, TRACE CLAY GREY. LIMESTONE FRAGMENTS UNCONSOLIDATED, WET, MED DENSE		
42.0–45.0	A-N					45.0	WELL SCREEN FROM 42.0 FT TO 47.0 FT	-27.2
45.0–47.0	S-11	2.0	5 6 7 9		<1	SAND, FINE GRAIN, LITTLE SILT, GREEN GREY, MEDIUM DENSE, WET 47.0		-29.2
47.0–50						END OF BORING @ 47.0 ft HAD TO USE WATER TO CLEAN OUT AUGER BEFORE TAKING SAMPLE ESTIMATE 30 GALLONS USED HOLE CAVED TO		

DRILLING CO.: PARRATT-WOLFF
DRILLER: CHIP
BAKER REP.: BRIAN E. DAVIS
BORING NO.: TW3-B
SHEET 3 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW4-A
COORDINATES: EAST: 2465299.0839 NORTH: 322362.1345
ELEVATION: SURFACE: 15.80 TOP OF STEEL CASING: —

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3¼" ID		4/10/96	0-45	50's SUNNY	8 FT	0 HRS
LENGTH			5 FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" DIA	0	5
Well Screen	1"	PVC Slotted 0.01" SLOT	5	15

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL SOCK FROM 0.0 TO 15.0 FT	
2								
3							WELL CASING FROM 0.0 TO 5.0 FT	
4								
5	A-N					SEE BORING LOG TW4-A FOR SOIL INFORMATION		10.80
6							WELL SCREEN FROM 5.0 TO 15.0 FT	
7								
8								
9								
10						Match to Sheet 2		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW4-A SHEET 1 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker

Baker Environmental, Inc

PROJECT: SGI -CTO 232- SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW4-A

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
11						Continued from Sheet 1 SEE BORING LOG TW4-B FOR SOIL INFORMATION	WELL SOCK FROM 0.0 TO 15.0 FT	
12	A-N						WELL SCREEN FROM 5.0 TO 15.0 FT	
13								
14								
15							BOTTOM PLUG	0.80
16						END OF BORING @ 15.0 FT		
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF
DRILLER: CHIP
BAKER REP.: BRIAN E. DAVIS
BORING NO.: TW4-A
SHEET 2 OF 2

Baker
Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW4-B
COORDINATES: EAST: 2465299.0839 NORTH: 322362.345
ELEVATION: SURFACE: 15.80 TOP OF STEEL CASING: —

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43 ID		3 1/4 ID		4/10/96	0-42	60's SUNNY	6.0	0 Hrs
LENGTH	2 FT		5 FT						
TYPE	SS		HS						
HAMMER WT.	140 lbs								
FALL	30 IN								
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" DIA	0	37
Well Screen	1"	PVC Slotted 0.01 SLOT	37	42

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist~~ % (ppm)	Visual Description	Well Installation Detail	Elevation
0–2.0	S-1	1.5	6 8 12 8		<1	SAND, LITTLE SILT, BROWN, ROOTS, SAMPLE TW4-00 COLLECTED FROM 0.0 TO 0.5 FT. @ 9:10	WELL SOCK FROM 0.0 TO 42.0 FT; WELL CASING FROM 0.0 TO 37.0 FT	
2.0–4.0	S-2	1.2	2 2 3 4		<1	3.0 — SILT AND CLAY, GREY, BROWN, BLACK DAMP, MED. STIFF, MOTTLED		12.8
4.0–6.0	S-3	2.0	4 4 4 4		<1	SAMPLE TW4-03 COLLECTED FROM 4' to 6' @ 9:35		
6.0–10.0	A-N							

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW4-B SHEET 1 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW4-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; T = Shelby Tube; R = Air Rotary; D = Denison; A = Auger; W = Wash; C = Core; P = Piston; N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5'); RQD = Rock Quality Designation (%); Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	HNU ~~Lab. Moist %~~ (PPM)	Visual Description	Well Installation Detail	Elevation
11–12.0	S-4	2.0	2 2 2 2		<1	Continued from Sheet 1 SILT AND CLAY, FEW THIN FINE GRAIN SAND BEDS/STRINGERS, BROWN, TREE ROOT @ 11.5ft, SOFT, WET	WELL SOCK FROM 0.0 TO 12.0 FT WELL CASING FROM 0.0 TO 32.0 FT.	
12.0–15.0	A-N							
15.0–17.0	S-5	1.5	WOR 3 5 3		<1	SILT AND CLAY, SOME FINE GRAIN SAND, BROWN, BLACK, GREY WET, SOFT, TREEROOT FROM 16.5 TO 17.0		
17.0–20.0	A-N							
20.0–22.0	S-6	2.0	WOR		<1	SAND, FINE GRAIN, LITTLE SILT GREY, WET, LOOSE		
22.0–25.0	A-N					27.0		-11.20
25.0–27.0	S-7	2.0	7 9 14 16		<1	SAND, FINE GRAIN, SOME SILT, TRACE CLAY GREY, MED. DENSE, WET, LIMESTONE FRAGMENTS, SHELL FRAGMENTS, UNCONSOLIDATED		
27.0–30.0	A-N					Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF
DRILLER: CHIP
BAKER REP.: BRIAN E. DAVIS
BORING NO.: TW4-B
SHEET 2 OF 3

Baker

Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW4-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; A = Auger	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
T = Shelby Tube; W = Wash	RQD = Rock Quality Designation (%)
R = Air Rotary; C = Core	Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
D = Denison; P = Piston	Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis
N = No Sample	

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	~~Lab. Moist %~~ Anu (ppm)	Visual Description	Well Installation Detail	Elevation
						Continued from Sheet 2		
31 – 32.0	S-8		10 22 16 12		<1	SAND, SOME SILT, TRACE CLAY, GREY LIMESTONE FRAGMENTS, WET MED DENSE TO DENSE	WELL SOCK FROM 0.0 TO 42.0 FT	
32								
33							WELL CASING FROM 0.0 TO 37.0 FT	
34								
35.0 – 37.0	S-9		10 14 16 13		<1	SAND, FINE GRAIN, SOME SILT, TRACE CLAY, LIMESTONE FRAGMENT, WET MED. DENSE		
37							WELL SCREEN FROM 37.0 TO 42.0 FT	-21.20
38								
39								
40.0	S-10		10 9 9 10		<1	SAND, FINE AND MEDIUM GRAIN, LIMESTONE FRAGMENTS, LITTLE SILT GREY, WET, MED. DENSE 41.0		
41						SAND, FINE GRAIN, LITTLE SILT, GREEN, GREY, MEDIUM DENSE WET		-25.20
42.0						END OF BORING @ 42.0'	BOTTOM PLUG	-26.20
43						HOLE CAVED TO 16.0 FT		
44						HAD TO ADD 50 gallons of WATER TO CLEAN OUT AUGERS TAKEN SAMPLE		
45								
46								
47								
48								
49								

DRILLING CO.: PARRATT - WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW4-B SHEET 3 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW5-A

COORDINATES: EAST: 2465609.5576 NORTH: 362391.5868

ELEVATION: SURFACE: 16.20 TOP OF STEEL CASING: —

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)					4/10/96	0-15	50's SUNNY	5.2	0 Hrs
LENGTH									
TYPE									
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded	0	5
Well Screen	1"	PVC Slotted	5	15

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL SOCK FROM 0.0 TO 15.0 FT	
2								
3							WELL CASING FROM 0.0 TO 5.0 FT	
4								
5	A-N					SEE BORING LOG TW5-B FOR SOIL INFORMATION	WELL SCREEN FROM 5.0 TO 15.0 FT	11.20
6								
7								
8								
9								
10						Match to Sheet 2		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW5-A SHEET 1 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker

Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TWS-A

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; A = Auger; T = Shelby Tube; W = Wash; R = Air Rotary; C = Core; D = Denison; P = Piston; N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5'); RQD = Rock Quality Designation (%); Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
11						Continued from Sheet 1	WELL SOCK FROM 0.0 TO 15.0 FT	
12	A-N					FOR SOIL INFORMATION SEE BORING LOG TWS-B	WELL SCREEN FROM 0.5 TO 15.0 FT	
13								
14								
15						END OF BORING @ 15.0 FT.	BOTTOM PLUG	1.20
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TWS-A SHEET 2 OF 2

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-0 BORING NO.: TW5-B

COORDINATES: EAST: 2465609.5576 NORTH: 362391.5868

ELEVATION: SURFACE: 16.20 TOP OF STEEL CASING: —

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43 IN.		3¼ ID		4/10/96	0-47	50's SUNNY	6.0	0 hrs.
LENGTH	2 FT		5 FT						
TYPE	SS		HS						
HAMMER WT.	140 lbs								
FALL	30 IN								
STICK UP									

REMARKS:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" dia.	0	37
Well Screen	1"	PVC Slotted 0.01" SLOT	37	42

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
1–2 (2.0)	S-1	2.0	7 10 8 8		<1	SAND, FINE GRAIN, LITTLE SILT GREY, BROWN, MEDIUM DENSE, DAMP SAMPLE 35-TB5-00 COLLECTED FROM 0.0 TO 0.5 FT. @ 12:57	WELL SOCK FROM 0.0 TO 42.0 FT WELL CASING FROM 0.0 TO 37.0 FT	
3–4 (4.0)	S-2	2.0	4 4 5 6		<1			
5–6 (6.0)	S-3	1.3	4 6 4 6		<1	SAND, FINE GRAIN, LITTLE SILT GREY, BROWN, MEDIUM DENSE, WET SAMPLE 35-TB5-03 COLLECTED @ 13:14 FROM 4.0 TO 6.0 FT		
7–10 (10.0)	A-N							

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW-5-B SHEET 1 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW5-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; T = Shelby Tube; R = Air Rotary; D = Denison; A = Auger; W = Wash; C = Core; P = Piston; N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5'); RQD = Rock Quality Designation (%); Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
11–12.0	S-4	2.0	2 4 4 5		<1	Continued from Sheet 1 SAND, FINE GRAIN, LITTLE SILT, GREY WET, LOOSE TO MEDIUM DENSE	WELL SOCK FROM 0.0 FT TO 42.0 FT WELL CASING FROM 0.0 TO 37.0 FT	
12.0–15.0	A-N							
15.0–17.0	S-5	2.0	WOR 1 4 4		<1	15.0 SAND, MEDIUM AND FINE GRAIN, GREY, BROWN, WET, LOOSE TO MEDIUM DENSE		1.20
17.0–20.0	A-N							
20.0–22.0	S-6	2.0	4 4 5 4		<1	SAND, MEDIUM AN FINE GRAIN, BROWN, WET,		
22.0–25.0	A-N							
25.0–27.0	S-7	2.0	12 24 20 15		<1	26.0 SAND, FINE AND MEDIUM GRAIN, LITTLE SILT, TRACE CLAY, GREY, LIMESTONE FRAGMENT, SHELL FRAGMENTS, PARTIALLY CEMENTED		-9.80
27.0–30.0	A-N					Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E DAVIS
DRILLER: CHIP BORING NO.: TW5-B SHEET 2 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW5-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger, T = Shelby Tube, W = Wash, R = Air Rotary, C = Core, D = Denison, P = Piston, N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	HNU ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
31–32.0	S-8	2.0	7 17 18 20	-	<1	Continued from Sheet 2. SAND, COARSE GRAIN, SOME MEDIUM AND FINE GRAIN SAND, SOME FINE AND MEDIUM GRAVEL, LITTLE SILT TRACE CLAY, GREY, SHELL FRAGMENTS LIMESTONE FRAGMENTS, GREY, WET, MEDIUM DENSE	WELL SOCK FROM 0.0 TO 42.0 WELL CASING FROM 0.0 to 37.0 FT WELL SCREEN FROM 37.0 to 42.0 FT.	
32.0–35.0	A-N							
35.0–37.0	S-9	2.0	21 21 24 18		<1	SAND, COARSE GRAIN, SOME MEDIUM AND FINE GRAIN, LITTLE SILT, TRACE CLAY, GREY SHELL FRAGMENTS, LIMESTONE FRAGMENTS, WET, MEDIUM DENSE, UNCONSOLIDATED		-20.80
37.0–40.0	A-N							
40.0–42.0	S-10	2.0	15 19 23 24		<1	SAND, COARSE GRAIN, GREY, GREEN, SHELL FRAGMENTS, LIMESTONE FRAGMENTS 41.5 SAND, FINE GRAIN, GREEN, GREY, MEDIUM DENSE, WET	BOTTOM PLUG	-25.30 -25.80
42.0						END OF BORING @ 42.0 FT HAD TO ADD 50 gallons of water to clean out augers then sample		

DRILLING CO.: PARRATT WOLFF
DRILLER: CHIP

BAKER REP.: BRIAN E. DAVIS
BORING NO.: TW5-B
SHEET 3 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW6-A
COORDINATES: EAST: — NORTH: —
ELEVATION: SURFACE: — TOP OF STEEL CASING: —

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3¼ ID		4/11/96	0 - 15	60's SUNNY	6 FT	0 HRS
LENGTH			5 FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" dia	0.0	5.0
Well Screen	1"	PVC Slotted 0.01 SLOT	5.0	15.0

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL CASING FROM 0.0 FT TO 5.0 FT	
2								
3							WELL SOCK FROM 0.0 FT TO 15.0 FT	
4								
5	A-N					SEE BORING LOG TW6-B FOR SOIL INFORMATION	WELL SCREEN FROM 5.0 FT TO 15.0 FT	
6								
7								
8								
9								
10								

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW6-A SHEET 1 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 6-A

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger, T = Shelby Tube, W = Wash, R = Air Rotary, C = Core, D = Denison, P = Piston, N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5'); RQD = Rock Quality Designation (%); Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
11–15	A-N					Continued from Sheet 1 SEE BORING LOG TW6-B FOR SOIL INFORMATION	WELL SOCK From 0.0 TO 15.0 FT BOTTOM PLUG	
15–30						END OF BORING @ 15.0 FT		

Match to Sheet 3

DRILLING CO.: PARRATT WOLFF
DRILLER: CHIP
BAKER REP.: BRIAN E. DAVIS
BORING NO.: TW6-A

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW6-B
COORDINATES: EAST: – NORTH: –
ELEVATION: SURFACE: – TOP OF STEEL CASING: –

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43 IN		3 1/4 ID		4/1/96	0 - 47	60's SUNNY	6.0	0 Hrs
LENGTH	2 FT		5 FT						
TYPE	SS		HS						
HAMMER WT.	140 lbs.								
FALL	30 IN								
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded (1" dia.)	0	42
Well Screen	1"	PVC Slotted 0.01" SLOT	42	47

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab.~~ Moist ~~%~~ (ppm)	Visual Description	Well Installation Detail	Elevation
0–2.0	S-1	2.0	7 8 6 6		<1	SAND, FINE GRAIN, BROWN, GREY, LITTLE SILT DAMP, MEDIUM DENSE, FEW ROOTS SAMPLE 35-TW06-00 COLLECTED FROM 0.0 TO 0.5 FT @ 7:34	WELL CASING FROM 0.0 FT TO 42.0 FT	
2.0–4.0	S-2	2.0	4 5 5 5		<1	SAND, FINE GRAIN, BROWN, GREY, MOTTLED	WELL SOCK FROM 10.0 FT TO 47.0 FT	
4.0–6.0	S-3	2.0	6 4 5 3		<1	SAND, FINE AND MEDIUM GRAIN, BROWN, GREY, LITTLE SILT AND CLAY, WET SAMPLE 35-TW06-02 COLLECTED FROM 4.0 to 6.0 FT @ 7:55		
6.0–10.0	A-N							

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW6-B SHEET 1 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW6-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger T = Shelby Tube W = Wash R = Air Rotary C = Core D = Denison P = Piston N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
11–12 (12.0)	S-4	2.0	6 6 8 20		<1	Continued from Sheet 1 SAND, FINE, MEDIUM, COARSE GRAIN, LITTLE SILT, GREY, BROWN, WET MEDIUM DENSE	WELL CASING FROM 0.0 FT TO 42.0 FT	
12–15 (15.0)	A-N						WELL SOCK FROM 10.0 FT TO 47.0 FT	
15–17 (17.0)	S-5	0	WOR 3		—	NO SAMPLE SAMPLE SLIPPED OUT OF SAMPLER		
17–20 (20.0)	A-N					20.0		
20–22 (22.0)	S-6	2.0	8 10 12 12		<1	SAND, FINE GRAIN, LITTLE SILT, GREY, FEW SHELL FRAGMENTS, MEDIUM DENSE, WET		
22–25 (25.0)	A-N							
25–27 (27.0)	S-7	2.0	8 10 10 11		<1	SAND, FINE AND MEDIUM GRAIN, LITTLE SILT, TRACE CLAY, SHELL FRAGMENTS, GREY, MEDIUM DENSE, WET		
27–30 (30.0)								

Match to Sheet 3

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW6-B SHEET 2 OF 3

Baker

Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI -CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW6-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; T = Shelby Tube; R = Air Rotary; D = Denison; A = Auger; W = Wash; C = Core; P = Piston; N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5'); RQD = Rock Quality Designation (%); Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	HNU ~~Lab.~~ ~~Moist~~ ~~%~~ (ppm)	Visual Description	Well Installation Detail	Elevation
31, 32 (32.0)	S-8	2.0	16 20 15 16		<1	Continued from Sheet 3 SAND, COARSE GRAIN, SOME FINE AND MEDIUM GRAIN, LITTLE SILT TRACE CLAY, LITTLE GRAVEL, SHELL FRAGMENTS, LIMESTONE FRAGMENTS, PARTIALLY CEMENTED @ 31.5 to 32.0 FT. WET MEDIUM DENSE TO DENSE	WELL SOCK FROM 10.0FT TO 47.0FT WELL CASING FROM 10.0 FT TO 42.0FT	
33, 34, 35 (35.0)	A-N							
36 (37.0)	S-9	2.0	12 12 10 9		<1	SAND, FINE AND MEDIUM GRAIN, LITTLE COARSE GRAIN, LITTLE SILT, TRACE CLAY SHELL FRAGMENTS, LIMESTONE FRAGMENTS PARTIALLY CEMENTED @ 35.0 TO 35.5 FT AND 36.8 TO 37.0 FT		
38, 39, 40 (40.0)	A-N							
41, 42 (42.0)	S-10	2.0	10 16 11 10		<1	SAND, COARSE AND MEDIUM GRAIN, LITTLE FINE GRAIN, LITTLE SILT, GREENISH GREY. SHELL FRAGMENTS, LIMESTONE FRAGMENTS, UNCONSOLIDATED, FEW PARTIALLY CEMENTED FRAGMENTS	WELL SCREEN FROM 42.0FT TO 47.0FT	
43, 44, 45 (45.0)	A-N					45.5		
46, 47 (47.0)	S-11		7 7 9 17		<1	SAND, FINE GRAIN, SOME SILT, LITTLE CLAY GREEN, GREY, MEDIUM DENSE, WET	BOTTOM PLUG	
48, 49						END OF BORING @ 47.0 FT HAD TO ADD 150 gallons of WATER TO CLEAN OUT AUGERS FOR SAMPLE		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW6-B SHEET 3 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW7-A
COORDINATES: EAST: 2464039.7530 NORTH: 361874.6056
ELEVATION: SURFACE: 19.2 TOP OF STEEL CASING: -

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)					4/11/96	0-15	70's SUNNY	6'	0 HRS
LENGTH									
TYPE									
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded	0	5
Well Screen	1"	PVC Slotted	5	15

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL SOCK FROM 0.0 FT TO 15.0 FT	
2								
3							WELL CASING FROM 0.0 TO 5.0 FT	
4						SEE BORING LOG TW7-B FOR SOIL INFORMATION		
5	A-N							14.20
6								
7							WELL SCREEN FROM 5.0 TO 15.0 FT	
8								
9								
10								

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E DAVIS
DRILLER: CHIP BORING NO.: TW7-A SHEET 1 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-235-0000-03600 BORING NO.: TW7-A

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger T = Shelby Tube, W = Wash R = Air Rotary, C = Core D = Denison, P = Piston N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
11						Continued from Sheet 1	WELL SOCK FROM 0.0 TO 15.0 FT	
12	A-N					SEE BORING LOG TW7-B FOR SOIL INFORMATION	WELL SCREEN FROM 5.0 TO 15.0 FT	
13								
14								
15 (15.0)						END OF BORING @ 15.0 FT	BOTTOM PLUG	4.20
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E DAVIS
DRILLER: CHIP BORING NO.: TW7-A SHEET 2 OF 2

Baker
Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI-CTO 232 -SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 7-B
COORDINATES: EAST: 2464039.7530 NORTH: 361874.6056
ELEVATION: SURFACE: 19.2 TOP OF STEEL CASING: -

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43 IN		3¼ ID		4/11/96	0 - 47	60's SUNNY	6 ft	0 hrs.
LENGTH	2 FT		5 FT						
TYPE	SS		HS						
HAMMER WT.	140 lbs.								
FALL	30 IN								
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" DIA.	0	42
Well Screen	1"	PVC Slotted 0.01" SLOT	42	45

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
0–2.0	S-1	2.0	10 15 15 5		<1	SAMPLE 35-TW7-00 COLLECTED FROM 0.0 TO 0.5 FT @ 10:59 SAND, FINE GRAIN, GREY, BROWN DAMP, MEDIUM DENSE	WELL SOCK FROM 0.0 FT TO 47.0 FT	
2.0–4.0	S-2	2.0	15 10 9 8			4.0	WELL CASING FROM 0.0 FT TO 42.0 FT	15.20
4.0–6.0	S-3	2.0	7 8 8 5		<1	SAMPLE 35-TW7-03 COLLECTED FROM 4.0 TO 6.0 FT @ 11:15 SAND, MEDIUM AND FINE GRAIN, LITTLE COARSE GRAIN, SOME SILT, TRACE CLAY, GREY, TRACE FINE GRAVEL, MOIST TO WET		
6.0–10.0	A-N							

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW 7-B SHEET 1 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW7-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger, T = Shelby Tube, W = Wash, R = Air Rotary, C = Core, D = Denison, P = Piston, N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab.~~ Moist ~~%~~ (ppm)	Visual Description	Well Installation Detail	Elevation
10.0–12.0	S-4	2.0	4, 6, 10, 12		<1	Continued from Sheet 1 SAND, MEDIUM AND FINE GRAIN, GREY, LITTLE SILT, TRACE CLAY, BROWN, MEDIUM DENSE, WET BROWN @ 11.5 FT	WELL SOCK FROM 0.0 TO 47.0 FT WELL CASING FROM 0.0 TO 42.0 FT	
12.0–15.0	A-N							
15.0–17.0	S-5	2.0	WOR, 2, 2		<1	15.0 SAND, FINE GRAIN, LOOSE, WET GREY, GREEN, 16.5		4.20 2.70
17.0–20.0	A-N					SAND, MEDIUM AND FINE GRAIN, LITTLE COARSE SAND, LITTLE SILT, TRACE CLAY, SHELL FRAGMENTS, LIMESTONE FRAGMENTS, UNCONSOLIDATED GREY, WET, MED. DENSE		
20.0–22.0	S-6	2.0	5, 7, 9, 11		<1	SAND, FINE AND MEDIUM GRAIN, LITTLE COARSE SAND, LITTLE SILT, TRACE CLAY; FEW SHELL FRAGMENTS GREY, WET, MEDIUM DENSE		
22.0–25.0	A-N							
25.0–27.0	S-7	2.0	3, 13, 17, 18		<1	SAND, FINE AND MEDIUM GRAIN LITTLE COARSE SAND, LITTLE FINE GRAVEL, LITTLE SILT, TRACE CLAY, SHELL FRAGMENTS, LIMESTONE FRAGMENTS, GREY, WET, MED. DENSE TO DENSE		
27.0–30.0	A-N					Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW7-B SHEET 2 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW7-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger, T = Shelby Tube, W = Wash, R = Air Rotary, C = Core, D = Denison, P = Piston, N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5'); RQD = Rock Quality Designation (%); Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
31–32.0	S-8	2.0	11 17 23 15		<1	Continued from Sheet 2. SAND AND GRAVEL, GREY, GREEN, DENSE WET, SHELL FRAGMENTS, LIMESTONE FRAGMENTS	WELL SOCK FROM 0.0 TO 47.0 FT	
32.0–35.0	A-N						WELL CASING FROM 0.0 TO 42.0 FT	
35.0–37.0	S-9	2.0	8 9 13 13		<1	SAND, MEDIUM AND FINE GRAIN, LITTLE GRAVEL, LITTLE SILT, TRACE CLAY, LITTLE LIMESTONE FRAGMENTS GREY, WET, DENSE		
37.0–40								
40–42.0	S-10	2.0	7 9 17 18		<1	SAND, MEDIUM AND FINE GRAIN, LITTLE SILT, TRACE CLAY, LITTLE LIMESTONE FRAGMENTS, GREY, GREEN, WET MEDIUM DENSE TO DENSE		
42.0–45.0							WELL SCREEN FROM 42.0 TO 45.0 FT	-22.80
45.0–47.0	S-11	2.0			<1	46.5 SAND, FINE GRAIN, GREY, GREEN, MEDIUM DENSE, LITTLE SILT, TRACE CLAY, WET	BOTTOM PLUG; HOLE CAVED TO 45.0'	-25.80; -27.30; -27.80
47–50						END OF BORING AT 47.0. HAD TO ADD 50 GALLONS OF WATER TO CLEAN OUT AUGERS FOR SOIL SAMPLE		

DRILLING CO.: PARRATT WOLFF
DRILLER: CHIP
BAKER REP.: BRIAN E DAVIS
BORING NO.: TW7-B
SHEET 3 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW8-A

COORDINATES: EAST: 2464682.0303 NORTH: 361896.4459

ELEVATION: SURFACE: 15.40 TOP OF STEEL CASING: –

RIG: MOBILE 55' TRUCK MOUNT									
	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3¼ ID		4/11/96	0-15	70's SUNNY	6	0hrs.
LENGTH			5 FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE

- S = Split Spoon A = Auger
- T = Shelby Tube W = Wash
- R = Air Rotary C = Core
- D = Denison P = Piston
- N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" DIA.	0	5
Well Screen	1"	PVC Slotted .01" SLOT	5	15

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL SOCK FROM 0.0 TO 15.0 FT	
2								
3							WELL CASING FROM 0.0 TO 5.0 FT.	
4								
5	A-N					SEE BORING LOG TW8-B FOR SOIL INFORMATION	WELL SCREEN FROM 5.0 FT TO 15.0 FT	10.40
6								
7								
8								
9								
10								

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW8-A SHEET 1 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker

Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW8-A

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger T = Shelby Tube W = Wash R = Air Rotary C = Core D = Denison P = Piston N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
11						Continued from Sheet 1	WELL SOCK FROM 5.0 FT TO 15.0 FT	
12	A-N					SEE BORING LOG TW8-B FOR SOIL INFORMATION	WELL SCREEN FROM 5.0 to 15.0 FT	
13								
14								
15	15.0						BOTTOM PLUG @ 15.0 FT	0.40
						END OF BORING @ 15.0 FT.		
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW8-A SHEET 2 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 8 B
COORDINATES: EAST: 2464682.0303 NORTH: 361896.4459
ELEVATION: SURFACE: 15.40 TOP OF STEEL CASING: —

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43 ID		3¼ ID		4/11/96	0 – 42	70's SUNNY	6	0 hrs.
LENGTH	2 FT		5'						
TYPE	SS		HS						
HAMMER WT.	140 lbs								
FALL	30 IN								
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" dia.	0	35
Well Screen	1"	PVC Slotted 0.01" SCOTT	35	40

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
0–2.0	S-1	2.0	2 3 3 3		<1	SAND AND SILT, GREY, BLACK, BROWN DAMP TO MOIST, TRACE CLAY, SOFT TO STIFF BLACK FROM 0.0 TO 1.5 FT SAMPLE 35-TW08-00 COLLECTED FROM 0.0 TO 0.5 FT @	WELL SOCK FROM 0.0 TO 40.0 FT	
2.0–4.0	S-2	2.0	3 3 4 8		<1		WELL CASING FROM 0.0 TO 35.0 FT	
4.0–6.0	S-3	2.0	3 3 4 7		<1	5.5 SAND, FINE GRAIN, LITTLE SILT, GREY, BLACK, WET SAMPLE 35-TW08-03 COLLECTED FROM 4.0 TO 6.0 FT		9.90
6.0–10.0	A-N					10.0 Match to Sheet 2		5.40

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW8 - B SHEET 1 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000
BORING NO.: TW 8-B

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS
SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	HNU ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
11 – 12.0	S-4	2.0	1 1 1 2		<1	Continued from Sheet 1 SILT AND CLAY, LITTLE FINE SAND, SOFT, WET, GREEN/GREY 11.5 SAND, FINE GRAIN, SOME SILT TRACE CLAY, WET, MEDIUM DENSE GREY, BLACK, GREEN, BROWN	WELL SOCK FROM 0.0 TO 40.0 FT. WELL CASING FROM 0.0 TO 35.0 FT	3.90
12.0 – 15.0	A-N							
15.0 – 17.0	S-5	1.5	4 5 5 5		<1	SAND, FINE GRAIN, SOME SILT TRACE CLAY, WET, GREY, GREEN, MED. DENSE		
17.0 – 20.0	A-N					21.5		-6.10
20.0 – 22.0	S-6	2.0	5 12 12 12		<1	SAND, FINE AND MEDIUM GRAIN, LITTLE COARSE SAND, LITTLE SILT, TRACE CLAY, SHELL FRAGMENTS, LIMESTONE FRAGMENTS, WET DENSE, GREY CLAM @ 21.5 FT		
22.0 – 25.0								
25.0 – 27.0	S-7	2.0	10 12 14 14		<1	SAND, COARSE AND MEDIUM GRAIN, SOME FINE GRAIN, LITTLE SILT, TRACE CLAY, SHELL FRAGMENTS LIMESTONE FRAGMENTS, WET DENSE, GREY		
27.0 – 30.0								

Match to Sheet 3

DRILLING CO.: PARRATT WOLFF
DRILLER: CHIP
BAKER REP.: BRIAN E. DAVIS
BORING NO.: TW8-B

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI-CTO 232-SCREENING
S.O. NO.: 62470-232-0000-07600 BORING NO.: TW8-B

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS
SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	HNU ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
31–32.0	S-8	2.0	12 20 21 25		<1	Continued from Sheet SAND, COARSE AND MEDIUM GRAIN, SOME FINE GRAVEL, GREY, LITTLE SILT, TRACE CLAY. SHELL FRAGMENTS LIMESTONE FRAGMENTS, DENSE TO VERY DENSE, WET	WELL SOCK FROM 0.0 TO 40.0 FT WELL CASING FROM 0.0 TO 35.0 FT	
32.0–35.0	A-N							
35.0–37.0	S-9	2.0	6 8 9 13		<1	35.0 SAND, MEDIUM AND FINE GRAIN, LITTLE COARSE GRAIN, LITTLE SILT, TRACE CLAY, GREY, GREEN, WET	WELL SCREEN FROM 35.0 TO 40.0 FT	-19.6
37.0–40.0	A-N							
40.0–42.0	S-10		7 7 8 8		<1	40.0 SAND, FINE GRAIN, SOME SILT, LITTLE CLAY, GREEN, GREY, MEDIUM DENSE WET	BOTTOM PLUG @ 40.0 HOLE CAVE FROM 40.0 TO 42.0 FT	-24.6
42.0						END OF BORING @ 42.0 FT HAD TO ADD 50 GALLONS OF WATER TO CLEAN OUT AUGERS FOR SOIL SAMPLES		-26.6

Depth scale: 31, 32, 33, 34, 35, 36, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW8-B SHEET 3 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW9-A

COORDINATES: EAST: — NORTH: —

ELEVATION: SURFACE: 15.3 TOP OF STEEL CASING: 15.01

RIG: MOBILE 55 TRUCK MOUNT									
	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3¼ ID		4/12/96	0 - 15	70's SUNNY	6	0 HRS.
LENGTH			5 FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" dia	0	5
Well Screen	1"	PVC Slotted 0.01" SLOT	5	15

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL SOCK FROM 0.0 FT TO 15.0 FT	
2						HAND DUG FROM 0.0 TO 4.0 FT UTILITY CONCERN		
3							WELL CASING FROM 0.0 FT TO 15.0 FT	
4						SEE BORING LOG TW9-B		
5	A-N					FOR SOIL INFORMATION	WELL SCREEN FROM 5.0 FT TO 15.0 FT	10.3
6								
7								
8								
9								
10						Match to Sheet 2		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

CHIP

BORING NO.: TW9-A SHEET 1 OF

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW9-A

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger, T = Shelby Tube, W = Wash, R = Air Rotary, C = Core, D = Denison, P = Piston, N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5'); RQD = Rock Quality Designation (%); Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
11						Continued from Sheet 1	WELLSOCK FROM 0.0 TO 15.0 FT	
12	A-N					SEE BORING LOG TW9-B FOR SOIL INFORMATION	WELL SCREEN FROM 5.0 TO 15.0 FT	
13								
14								
15						END OF BORING @ 15.0 FT	BOTTOM PLUG	0.3
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW9-A SHEET 2 OF 2

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI • CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW9-B
COORDINATES: EAST: — NORTH: —
ELEVATION: SURFACE: 15.3 TOP OF STEEL CASING: 15.01

RIG: MOBILE 55 TRUCK MOUNT									
	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43 IN		3¼ ID		4/12/96	0-47	70's SUNNY	6	0 hrs
LENGTH	2 FT		5 FT						
TYPE	SS		HS						
HAMMER WT.	140 lbs								
FALL	30 IN								
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1	PVC Threaded 1" dia	0	37
Well Screen	1	PVC Slotted 0.01 SLOT	37	42

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	HNu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
0.0–4.0	HAND DUG				<1	SAND, FINE GRAIN, BLACK, BROWN, DAMP. SAMPLE SS-TW9-00 COLLECTED FROM 0.0 TO 0.5 FT. HAND DUG FROM 0.0 TO 4.0 FT BECAUSE OF UTILITY CONCERNS. BEGAN AUGERING/SAMPLING @ 4.0 FT	WELL SOCK FROM 0.0 TO 42.0 FT. WELL CASING FROM 0.0 TO 37.0 FT	11.3
4.0–6.0	S-1	2.0	1 2 2 4		<1	SILT and CLAY, GREY, BROWN, MOTTLED, SOFT TO STIFF, MOIST TO WET		
6.0–10.0	A-N					10.0		5.3

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E DAVIS
CHIP TW9-B SHEET 1 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc.

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW9-B

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
11–12.0	S-2	2.0	8 12 16 16		<1	Continued from Sheet 1 SAND, FINE GRAIN, SOME SILT, GREY MEDIUM DENSE, WET	WELL SOCK FROM 0.0 TO 42.0 FT.	
12.0–15.0	A-N						WELL CASING FROM 0.0 TO 37.0 FT	
15.0–17.0	S-3	1.5	5 5 6 6		<1	SAND, FINE GRAIN, LITTLE MEDIUM GRAIN, LITTLE SILT, TRACE CLAY, MEDIUM DENSE TO LOOSE, WET		
17.0–20.0	A-N					20.0		-4.7
20.0–22.0	S-4	2.0	1 1 1 2		<1	SAND, FINE GRAIN, SOME SILT GREEN, GREY, SOFT 21.0 SAND, FINE AND MEDIUM GRAIN, LITTLE SILT, TRACE CLAY, MEDIUM DENSE, WET, GREY, GREEN		-5.7
22.0–25.0	A-N					25.0		-9.7
25.0–27.0	S-5	2.0	7 8 11 11		<1	SAND, FINE AND MEDIUM GRAIN, SOME SILT, LITTLE CLAY, MEDIUM DENSE, WET, GREY, SHELL FRAGMENTS DECOMPOSED LIMESTONE FRAGMENTS		
27.0–30.0	A-N					Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW9-B SHEET 2 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - GTO 232 - SCREENING
S.O. NO.: 62470-235-0000-03600 BORING NO.: TW9-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger T = Shelby Tube W = Wash R = Air Rotary C = Core D = Denison P = Piston N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
31–32.0	S-6	1.5	12, 16, 12, 10		<1	Continued from Sheet 2 SAND, FINE AND MEDIUM GRAIN, LITTLE COARSE GRAIN, LIMESTONE FRAGMENTS FEW SHELL FRAGMENTS, DENSE, GREY WET	WELL SOCK FROM 0.0 FT TO 42.0 FT	
32.0–35.0	A-N						WELL CASING FROM 0.0 FT TO 37.0 FT	
35.0–37.0	S-7	1.5	12, 16, 12, 10		<1	SAND, FINE AND MEDIUM GRAIN, LITTLE SILT, TRACE CLAY, LIMESTONE FRAGMENTS, SHELL FRAGMENTS, MED DENSE TO DENSE		
37.0–40.0	A-N					SAND, SHELL AND LIMESTONE FRAGMENTS 41.5	WELL SCREEN FROM 37.0 FT TO 42.0 FT	-21.7
40.0–42.0	S-8	2.0	4, 5, 6, 9		<1	SAND, MEDIUM GRAIN, SOME SILT, LITTLE CLAY, GREEN, GREY, MEDIUM DENSE, WET	Bottom Plug	-26.2 -26.7
42–49						END OF BORING @ 42.0 FT HAD TO ADD 50 GALLONS OF WATER TO CLEAN OUT AUGERS FOR SOIL SAMPLES		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW9-B SHEET 3 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO232 - SCREENING

S.O. NO.: 62470 - 232 - 0000 - 03600 BORING NO.: TW 10 - A

COORDINATES: EAST: — NORTH: —

ELEVATION: SURFACE: 16.7 TOP OF STEEL CASING: 16.43

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3 1/4 ID		4/12/96	0 - 15	70's SUNNY	6	0 HRS
LENGTH			5 FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE

S = Split Spoon, T = Shelby Tube, R = Air Rotary, D = Denison, A = Auger, W = Wash, C = Core, P = Piston, N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" dia.	0	6
Well Screen	1"	PVC Slotted 0.01" SLOT	5	15

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL SOCK FROM 0.0 TO 15.0 FT	
2								
3							WELL CASING 0.0 TO 5.0 FT	
4						SEE BORING LOG TW10-A FOR SOIL INFORMATION		
5	A-N						WELL SCREEN FROM 5.0 TO 15.0 FT	11.7
6								
7								
8								
9								
10						Match to Sheet 2		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW 10 - A SHEET 1 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 10-A

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger T = Shelby Tube, W = Wash R = Air Rotary, C = Core D = Denison, P = Piston N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
11						Continued from Sheet 1	WELL SOCK FROM 0.0 FT TO 15.0 FT	
12	A-N					SEE BORING LOG TW10-B FOR SOIL INFORMATION		
13							WELL SCREEN FROM 5.0 TO 16.0 FT	
14								
15	15.0							1.7
16						END OF BORING @ 15.0 FT HOLE WASHED TO 16.0 FT	BOTTOM PLUG	0
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW10-A SHEET 2 OF 2

Baker
Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW10-B
COORDINATES: EAST: — NORTH: —
ELEVATION: SURFACE: 16.7 TOP OF STEEL CASING: 16.43

RIG: MOBILE 55 TRUCK MOUNT	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43 IN		3 1/4 ID		4-12-96	0-47	70's SUNNY	7.5	0 hrs
LENGTH	2 FT		5 FT						
TYPE	SS		HS						
HAMMER WT.	140 lbs.								
FALL	30 IN.								
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" dia	0	42
Well Screen	1"	PVC Slotted 0.01 slot	42	47

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
0–2.0	S-1	2.0	3 3 4 4		<1	SAMPLE 35-TW10-00 COLLECTED FROM 0.0 TO 0.5 FT @ 12:24 SAND, FINE GRAIN, GREY, BROWN, DAMP	WELL SOCK FROM 0.0 TO 47.0 FT	
2.0–4.0	S-2	2.0	4 5 6 5		<1			
4.0–6.0	S-3	2.0	5 6 5 6		<1	SAND, FINE GRAIN, LITTLE SILT, WHITE, GREY, BROWN, LOOSE, MOIST TO WET sample 35-TW10-03 COLLECTED From 4.0 to 6.0' @ 12:36	WELL CASING FROM 0.0 TO 42.0 FT	
6.0–10.0	A-N							

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E DAVIS
CHIP
BORING NO.: TW 10-B SHEET 1 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 10-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon T = Shelby Tube R = Air Rotary D = Denison A = Auger W = Wash C = Core P = Piston N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	HNU ~~Lab. Moist %~~ (PPM)	Visual Description	Well Installation Detail	Elevation
10.0–12.0	S-4	1.5	4 4 5 6		<1	Continued from Sheet 1 SAND, FINE GRAIN, BROWN GREY, WET, MEDIUM DENSE	WELL SOCK FROM 0.0 TO 47.0 FT WELL CASING FROM 0.0 TO 42.0 FT	
12.0–15.0	A-N							
15.0–17.0	S-5	2.0	6 7 10 6		<1	SAND, FINE and MEDIUM GRAIN BROWN, GREY, WET, MEDIUM DENSE		
17.0–20.0	A-N							
20.0–22.0	S-6	2.0	5 8 7 9		<1	SAND, MEDIUM AND FINE GRAIN, BROWN, GREY, MEDIUM DENSE, WET		
22.0–25.0	A-N							
25.0–27.0	S-7	2.0	17 25 50/1		<1	SAND, BROWN, GREY		-9.8
27.0–30.0	A-N					SAND, MEDIUM AND FINE GRAIN, GREY, LITTLE SILT, SHELL FRAGMENTS LIMESTONE FRAGMENTS, TRACE WAY LOOSE TO MEDIUM DENSE, WET		

Match to Sheet 3

DRILLING CO.: PARRATT WOLFF
DRILLER: CHIP
BAKER REP.: BRIAN E. DAVIS
BORING NO.: TW10-B

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW10-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; A = Auger; T = Shelby Tube; W = Wash; R = Air Rotary; C = Core; D = Denison; P = Piston; N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5'); RQD = Rock Quality Designation (%); Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab.~~ Moist ~~%~~ (ppm)	Visual Description	Well Installation Detail	Elevation
31–32.0	S-8	2.0	22 23 25 25		<1	Continued from Sheet 2 SAND AND GRAVEL, GRAY, GREEN, LIMESTONE FRAGMENTS, SHELL FRAGMENTS, VERY DENSE, WET	WELL SOCK FROM 0.0 TO 47.0 WELL CASING FROM 0.0 TO 42.0 FT	
32.0–35.0	A-N							
35.0–37.0	S-9	1.5	30 22 18 70		<1	SAND, MEDIUM AND FINE GRAIN, LITTLE COARSE GRAIN, LITTLE SILT, TRACE CLAY, LIMESTONE FRAGMENTS GREY, GREEN, SHELL FRAGMENTS VERY DENSE TO DENSE, WET	WELL SCREEN FROM 42.0 FT TO 47.0 FT	
37.0–40.0	A-N							
40.0–42.0	S-10	2.0	11 17 16 15		<1	SAND AND GRAVEL, LITTLE SILT, TRACE CLAY, LIMESTONE FRAGMENTS, SHELL FRAGMENTS.		-25.3
42.0–45.0	A-N					45.0		
45.0–47.0	S-11	2.0	5 7 7 8		<1	SAND, FINE GRAIN, SOME SILT, TRACE CLAY, GREEN, WET, MEDIUM DENSE	BOTTOM PLUG	-28.3 -30.3
47–50						END OF BORING @ 47.0 FT HAD TO ADD 50 GALLONS OF WATER TO CLEAN OUT AUGERS FOR SOIL SAMPLES		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW10-B SHEET 3 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW11-A
COORDINATES: EAST: - NORTH: -
ELEVATION: SURFACE: 11.5 TOP OF STEEL CASING: -

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3¼ ID		4/12/96	0 – 15	70's SUNNY	6.5	0 hrs.
LENGTH			5 FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" DIA.	0	5
Well Screen	1"	PVC Slotted 0.01" SLOT	5	15

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL SOIL FROM 0.0 FT TO 15.0 FT	
2								
3							WELL CASING FROM 0.0 TO 5.0 FT	
4						SEE BORING LOG TW11-B FOR SOIL INFORMATION		
5	A-N							6.5
6							WELL SCREEN FROM 5.0 TO 15.0 FT	
7								
8								
9								
10								

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW11-A SHEET 1 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker

Baker Environmental, Inc

PROJECT: SG-I-CTO 232

S.O. NO.: 62470-232-0000-03600   BORING NO.: TW11-A

SAMPLE TYPE

S = Split Spoon   A = Auger
T = Shelby Tube   W = Wash
R = Air Rotary   C = Core
D = Denison   P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
						Continued from Sheet 1		
11–15	A-N					SEE BORING LOG TW11-B FOR SOIL INFORMATION	WELL SOCK FROM 0.0 TO 15.0 FT WELL SCREEN FROM 5.0 TO 15.0 FT BOTTOM PLUG	-3.5
15						END OF BORING @ 15 FT		
16–30								
						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF   BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP   BORING NO.: TW-11A   SHEET 2 OF 2

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 11-B

COORDINATES: EAST: - NORTH: -

ELEVATION: SURFACE: 11.5 TOP OF STEEL CASING: -

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43 IN		3¼ ID		4/12/96	0 - 42	70's SUNNY	6.5	0 hrs.
LENGTH	2 FT		5 FT						
TYPE	SS		HS						
HAMMER WT.	140 lbs								
FALL	30 IN								
STICK UP									

REMARKS:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded	0	37
Well Screen	1"	PVC Slotted	37	42

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	HNU ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
0–2.0	S-1	1.5	15 12 12 10		<1	SAND AND SILT, TRACE CLAY FINE GRAIN, BLACK BROWN GREY, DAMP TO MOIST, MEDIUM DENSE SAMPLE 35-TW11-00 COLLECTED FROM 0.0 TO 0.5 FT. @ 15:20		
2.0–4.0	S-2	1.5	6 4 4 4		<1			
4.0–6.0	S-3	1.5	6 12 12 12		<1	SAND, FINE GRAIN, LITTLE SILT SAMPLE 35-TW11-03 collected from 4.0 TO 6.0 FT @ 15:40		
6.0–10.0	A-N							

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E DAVIS

DRILLER: [illegible] BORING NO.: TW 11-B SHEET 1 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW11-B

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
11–12.0	S-4	2.0	2 3 3 5		<1	Continued from Sheet 1 SAND, FINE AND MEDIUM GRAIN, LITTLE SILT, TRACE CLAY, BROWN GREY, WET, MEDIUM DENSE	WELL SOCK FROM 0.0 TO 42.0 FT WELL CASING FROM 0.0 TO 37.0 FT.	
12.0–15.0	A-N							
15.0–17.0	S-5	2.0	10 11 12 13		<1	SAND, FINE AND MEDIUM GRAIN, LITTLE SILT, BROWN, GREY WET, MEDIUM DENSE		
17.0–20.0	A-N					20.5		-9.0
20.0–22.2	S-6	1.0	1 1 1 1		<1	SAND, LITTLE SILT, GREEN, SOFT WET 21.0 SAND, FINE GRAIN, BROWN, SOFT, WET		-9.5
22.2–25.0	A-N							
25.0–27.0	S-7	2.0	20 40 40 15			SAND, COARSE AND MEDIUM GRAIN, LITTLE SILT, TRACE CLAY, GREY SHELL FRAGMENTS, LIMESTONE FRAGMENTS, WET		
27.0–30.0	A-N							

Match to Sheet 3

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW11-B

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental

PROJECT: SGI - CTO232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW11 - B

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
31.0–32.0	S-8	2.0	10 12 20 24		<1	Continued from Sheet 2 SAND, MEDIUM AND FINE GRAIN, LITTLE COARSE GRAVEL, LITTLE SILT, TRACE CLAY, SHELL FRAGMENT, LIMESTONE FRAGMENTS, GREY, DENSE, WET	WELL SOCK FROM 0.0 FT TO 42.0 FT	
32.0–35.0	A-N						WELL CASING FROM 0.0 FT TO 42.0 FT	
35.0–37.0	S-9	1.0	10 24 25 19		<1	SAND, MEDIUM AND FINE GRAIN, LITTLE COARSE GRAIN, LITTLE SILT, TRACE CLAY, SHELL FRAGMENTS, LIMESTONE FRAGMENTS, GREY, DENSE, WET		-14.0
37.0–40.0	A-N						WELL SCREEN FROM 37.0 to 42.0 FT	
40.0–42.0	S-10	2.0	10 14 11 12		<1	SAND, MEDIUM AND FINE GRAIN, SHELL FRAGMENTS LIMESTONE 41.5 SAND, FINE GRAIN, SOME SILT, LITTLE CLAY, GREEN, MEDIUM DENSE, WET	BOTTOM PLUG	-30.0 -30.5
						END OF BORING AT 42.0 FT		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW-11-B SHEET 3 OF 3

Baker

Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Supplemental Groundwater Investigation at Site 35 - MCBCLEJ

CTO NO.: 62470-232 BORING NO.: 35-TW12B

COORDINATES: EAST: - NORTH: -

ELEVATION: SURFACE: 15.2 TOP OF PVC CASING: 15.12

RIG: Mobile B-53	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT.)	WEATHER	WATER DEPTH (FT.)	TIME
SIZE (DIAM.)	1 3/8" ID	-	3 1/4" ID	-	4/26	0.0 - 42.0	M. Sunny, 60s	-	-
LENGTH	2'	-	5'	-					
TYPE	Stainless	-	HSA	-					
HAMMER WT.	140 lbs	-	-	-					
FALL	30"	-	-	-					
STICK UP	-	-	-	-					

REMARKS: Well shrouded with well sock material; boring allowed to collapse around well

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

Well Information	Diam.	Type	Top Depth (ft.)	Bottom Depth (ft.)
	1" OD	Sch 40 PVC Riser		33.0
	1" OD	Sch 40 PVC Screen	33.0	38.0

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab Class. or Pen. Rate	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
1–2.0	S-1	1.7 85%	4 6 7 8	-	0.1/0.1	FINE SAND, little silt, trace clay; lt. brown; m. dense; damp		
3–4.0	S-2	1.8 90%	8 7 7 6	-	0.1/0.1			
5–6.0	S-3	2.0 100%	6 6 5 5	-	0.1/0.1	wet @ 6.0'	∇	
7–10.0	A-N	-	-	-	-	10.0		5.2

Match to Sheet 2

DRILLING CO.: Parratt-Wolff BAKER REP.: Mark DeJohn

DRILLER: Chip Lafever BORING NO.: 35-TW12B SHEET 1 OF 3

Baker

Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Supplemental Groundwater Investigation at Site 35 - MCBCLEJ

CTO NO.: 62470-232 BORING NO.: 35-TW12B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger, T = Shelby Tube, W = Wash, R = Air Rotary, C = Core, D = Denison, P = Piston, N = No Sample	SPT = Standard Penetration Test (ASTM D-1586)(Blows/0.5'); RQD = Rock Quality Designation (%); Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab Class. or Pen. Rate	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
						Continued from Sheet 1		
11–12.0	S-4	1.6 80%	8 7 7 6	-	0.1/0.1	FINE TO MED SAND, some silt, trace coarse sand & clay; brown w/ orange laminae; m. dense; wet		
12.0–15.0	A-N	-	-	-	-	15.0		0.2
15.0–17.0	S-5	1.5 75%	1 1 1 1	-	0.1/0.1	FINE TO MED SAND, some shell frag. & silt, trace clay; dk green; v. loose; wet		
17.0–20.0	A-N	-	-	-	-			
20.0–22.0	S-6	0.7 35%	10 8 8 9	-	0.1/0.1			
22.0–25.0	A-N	-	-	-	-	25.0		-9.8
25.0–27.0	S-7	2.0 100%	7 8 8 9	-	0.1/0.1	SILT, some shell frag., trace fine sand & clay; gray; dense; wet		
27.0–30.0	A-N	-	-	-	-	Match to Sheet 3 30.0		-14

DRILLING CO.: Parratt-Wolff BAKER REP.: Mark DeJohn

DRILLER: Chip Lafever BORING NO.: 35-TW12B SHEET 2 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Supplemental Groundwater Investigation at Site 35 - MCBCLEJ

CTO NO.: 62470-232 BORING NO.: 35-TW12B

SAMPLE TYPE		DEFINITIONS
S = Split Spoon	A = Auger	SPT = Standard Penetration Test (ASTM D-1586)(Blows/0.5')
T = Shelby Tube	W = Wash	RQD = Rock Quality Designation (%)
R = Air Rotary	C = Core	Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
D = Denison	P = Piston	Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis
N = No Sample		

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab Class. or Pen. Rate	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
31–32.0	S-8	1.0 50%	20 20 18 15	-	0.1/0.1	Continued from Sheet 2		
32.0–35.0	A-N	-	-	-	-	35.0		-17.8; -19.8
35.0–37.0	S-9	1.5 75%	20 19 18 15	-	0.6/0.4	SHELL FRAGMENTS, little silt; gray; dense; wet		
37.0–40.0	A-N	-	-	-	-	40.0		-22.8; -24.8
40.0–42.0	S-10	1.7 85%	4 5 5 5	-	0.2/0.2	FINE SAND & SILT, little clay; olive green; stiff; moist 42.0	42.0	-26.8
42–50						BOH @ 42.0 ft		

DRILLING CO.: Parratt-Wolff BAKER REP.: Mark DeJohn

DRILLER: Chip Lafever BORING NO.: 35-TW12B SHEET 3 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Supplemental Groundwater Investigation at Site 35 - MCBCLEJ

CTO NO.: 62470-232 BORING NO.: 35-TW13B

COORDINATES: EAST: 2465098.1832 NORTH: 361208.5229

ELEVATION: SURFACE: 11.7 TOP OF PVC CASING: 11.70

RIG: Mobile B-53	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT.)	WEATHER	WATER DEPTH (FT.)	TIME
SIZE (DIAM.)	1 3/8" ID	-	3 1/4" ID	-	4/26	0.0 - 42.0	M.Sunny, 60s	-	-
LENGTH	2'	-	5'	-					
TYPE	Stainless	-	HSA	-					
HAMMER WT.	140 lbs	-	-	-					
FALL	30"	-	-	-					
STICK UP	-	-	-	-					

REMARKS: Well shrouded with wellsock material; boring allowed to collapse around well

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

Well Information	Diam.	Type	Top Depth (ft.)	Bottom Depth (ft.)
	1" OD	Sch 40, PVC Riser	-	33.0
	1" OD	Sch 40, PVC Screen	33.0	38.0

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab Class. or Pen. Rate	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
0.0–2.0	S-1	0.0	3 5 9 9	-	-			
2.0–4.0	S-2	0.8 40%	9 3 3 3	-	0.4/0.4	SILT & FINE SAND, trace clay (Fill); dk. brown; loose; moist 4.0		
4.0–6.0	S-3	1.8 90%		3 2 2 1	0.4/0.4	FINE SAND, some silt, little clay (alluvium); dk. brown; loose; wet	∇ (4.0)	7.7
6.0–10.0	A-N	-	-	-	-	10.0		1.7

Match to Sheet 2

DRILLING CO.: Parratt-Wolff BAKER REP.: Mark DeJohn

DRILLER: Chip Lafever BORING NO.: 35-TW13B SHEET 1 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Supplemental Groundwater Investigation at Site 35 - MCBCLEJ

CTO NO.: 62470-232 BORING NO.: 35-TW13B

SAMPLE TYPE		DEFINITIONS
S = Split Spoon	A = Auger	SPT = Standard Penetration Test (ASTM D-1586)(Blows/0.5')
T = Shelby Tube	W = Wash	RQD = Rock Quality Designation (%)
R = Air Rotary	C = Core	Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
D = Denison	P = Piston	Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis
N = No Sample		

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab Class. or Pen. Rate	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
11 – 12 (12.0)	S-4	1.8 90%	5 2 3 2	-	0.4/0.4	Continued from Sheet 1 MED-COARSE SAND, trace silt; brown/tan; loose; wet 11.5		-0.2
12 – 15 (15.0)	A-N	-	-	-	-	FINE SAND, some silt, little clay; olive green; loose; wet 15.0		-3.3
15 – 17 (17.0)	S-5	2.0 100%	15 10 16 26	-	0.4/0.4	FINE SAND, some silt, little clay; gray; m. dense; wet 16.1		-4.4
17 – 20 (20.0)	A-N	-	-	-	-	SHELL FRAGMENTS, trace silt; gray; m. dense; wet 20.0		-8.3
20 – 22 (22.0)	S-6	1.4 70%	14 9 13 18	-	0.4/0.4	SILT, some clay, little shell frag, trace fine sand; gray; v. stiff; moist		
22 – 25 (25.0)	A-N	-	-	-	-	25.0		-13.3
25 – 27 (27.0)	S-7	1.8 90%	12 13 12 12	-	0.4/0.4	SHELL FRAGMENTS, little silt; gray; m. dense to v. dense; wet		
27 – 30 (30.0)	A-N	-	-	-	-	Match to Sheet 3		

DRILLING CO.: Parratt-Wolff BAKER REP.: Mark DeJohn

DRILLER: Chip Lafever BORING NO.: 35-TW13B SHEET 2 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Supplemental Groundwater Investigation at Site 35 - MCBCLEJ
CTO NO.: 62470-232 BORING NO.: 35-TW13B

SAMPLE TYPE		DEFINITIONS
S = Split Spoon	A = Auger	SPT = Standard Penetration Test (ASTM D-1586)(Blows/0.5')
T = Shelby Tube	W = Wash	RQD = Rock Quality Designation (%)
R = Air Rotary	C = Core	Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
D = Denison	P = Piston	Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis
N = No Sample		

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab Class. or Pen. Rate	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
31–32.0	S-8	1.8 90%	18 25 24 30	-	0.4/0.4	continued from Sheet 2		
32.0–35.0	A-N	-	-	-	-		33.0	-21.3
35.0–37.0	S-9	0.9 45%	28 30 32 16	-	0.4/0.4			
37.0–40.0	A-N	-	-	-	-		38.0	-26.3
40.0–42.0	S-10	1.2 60%	20 14 14 22	-	0.4/0.4	40.0 FINE SAND, some silt, little clay; greenish gray; damp to moist; v. stiff 42.0		-28.3
42						BOH @ 42.0 ft	42.0	-30.3
43–50								

DRILLING CO.: Parratt-Wolff BAKER REP.: Mark DeJohn
DRILLER: Chip Lafever BORING NO.: 35-TW13B SHEET 3 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - GROUNDWATER SCREENING - CTO 232
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 14-B
COORDINATES: EAST: 2465460.9183 NORTH: 361565.1272
ELEVATION: SURFACE: 16.10 TOP OF STEEL CASING: -

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43 IN.		3¼ ID		4-29-96	0 - 42.0	70's cloudy	6	0 Hrs -
LENGTH	2 FT		2 FT						
TYPE	SS		HS						
HAMMER WT.	140 lbs.								
FALL	30 IN								
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded	0	35
Well Screen	1"	PVC Slotted	35	40

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
0 – 2.0	S-1		10, 9, 5, 6			SAND, FINE GRAIN, GREY, BROWN, LITTLE SILT, TRACE CLAY, MOIST	WELL SOCK FROM 0.0 TO 40.0 FT	
2.0 – 4.0	S-2		4, 6, 5, 4				WELL CASING FROM 0.0 TO 40.0 FT	
4.0 – 6.0	S-3		4, 4, 2, 2			5.0 SAND AND SILT, SOME CLAY, BROWN, GREY, WET, SOFT.		11.10 (5)
6.0 – 10.0	AN					10.0		6.10 (10)

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E DAVIS
DRILLER: CHIP BORING NO.: TW-14B SHEET 1 OF

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI-GROUNDWATER SCREENING
S.O. NO.: 62470-232-0000-07600 BORING NO.: TW14-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; A = Auger T = Shelby Tube; W = Wash R = Air Rotary; C = Core D = Denison; P = Piston N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	~~Lab. Moist %~~ HNU (ppm)	Visual Description	Well Installation Detail	Elevation
11–12.0	S-4	1.5	7 7 6 7		<1	Continued from Sheet 1 SAND, FINE GRAIN, LITTLE SILT, GREY WET, MEDIUM DENSE	WELL SOCK FROM 0.0 TO 40.0 FT WELL CASING FROM 35.0 TO 40.0 FT	
12.0–15.0	A-N					15.0		
15.0–17.0	S-5	1.0	WOT WOT 1 2		<1	SAND, FINE AND MEDIUM GRAIN, BROWN, WET, LOOSE, LITTLE SILT		1.10
17.0–20.0	A-N							
20.0–22.0	S-6	0.5	WOT WOT WOT WOT		21	SAND, FINE GRAIN, BROWN, WET, LOOSE, LITTLE SILT		
22.0–25.0	A-N					25.0		
25.0–27.0	S-7	0.5	16 10 16 14		<1	SAND, FINE AND MEDIUM GRAIN, SOME SILT, MEDIUM DENSE, GREY, GREEN WET, LIMESTONE AND SHELL FRAGMENTS PARTIALLY CEMENTED		-8.90
27.0–30	A-N					Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW14-B SHEET 2 OF 3

Baker
Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - GROUNDWATER SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 14-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger T = Shelby Tube, W = Wash R = Air Rotary, C = Core D = Denison, P = Piston N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
31–32 (32.0)	S-6	2.0	20 14 12 10		<1	Continued from Sheet 2 SAND, FINE AND MEDIUM GRAIN, GREY, LIMESTONE AND SHELL FRAGMENTS, WET, PARTIALLY CEMENTED, DENSE	WELL CASING 0.0 TO 35.0 FT WELL SOCK FROM 0.0 TO 40.0 FT	
33–35 (35.0)	A-N							
35–37 (37.0)	S-7	2.0	30 36 24 20		<1	SAND, FINE AND MEDIUM GRAIN, GREY, GREEN, LIMESTONE AND SHELL FRAGMENTS, WET, PARTIALLY CEMENTED, DENSE TO VERY DENSE	WELL CASING FROM 35.0 TO 40.0 FT	-18.90
38–40 (40.0)	A-N					40.0		
40–42 (42.0)	S-8	2.0	6 7 6 6		<1	SAND, FINE GRAIN, GREEN, SOME SILT, LITTLE CLAY, WET, MED. STIFF	BOTTOM PLUG HOLE CAVED FROM 40.0 TO 42.0 FT	-23.90
42						END OF BORING @ 42.0 FT		-24.90
43–50								

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E DAVIS
DRILLER: CHIP BORING NO.: TW 14-B SHEET 3 OF 3

TW 27

Baker
Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - SCREENING - CTO 232
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW15-B
COORDINATES: EAST: 2466064.6254 NORTH: 361251.1824
ELEVATION: SURFACE: 15.20 TOP OF STEEL CASING: -

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43 in.		3¼ ID		4/30/96	0-	60's cloudy	6	0 Hrs.
LENGTH	2 FT		5 FT						
TYPE	SS		HS						
HAMMER WT.	140 lbs.								
FALL	30 in.								
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded	0	35
Well Screen	1"	PVC Slotted	35	40

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Per. Rate	HNU ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
1, 2 (2.0)	S-1	0.5	5 6 7 8		<1	Sand, fine grain, brown, gray, loose, damp to moist, little silt		
3, 4 (4.0)	S-2	1.5	6 10 5 8		<1	4.0		11.20
5, 6 (6.0)	S-3	2.0	5 5 5 4		<1	Sand, fine grain, little silt, trace clay, wet, soft to medium stiff		
7, 8, 9, 10 (10.0)	A-N							

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: WALLY BORING NO.: TW15-B SHEET 1 OF-

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - SCREENING - CTO 232
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW15-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger T = Shelby Tube, W = Wash R = Air Rotary, C = Core D = Denison, P = Piston N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
11–12.0	S-4	2.0	6 10 12 13		<1	Continued from Sheet 1 SAND, FINE GRAIN, SOME SILT, WET, SOFT, BROWN, GREY, RED	WELL SOCK FROM 0.0 TO 40.0 FT WELL CASING FROM 0.0 TO 35.0 FT	
12.0–15.0	A-N							
15.0–17.0	S-5	2.0	WOR WOR WOR 2		<1	SAND, FINE GRAIN, LITTLE SILT, WET, GREY SOFT 15.5 SAND, FINE GRAIN, SOME SILT, WET, BROWN, VERY SOFT TO SOFT LITTLE CLAY		-0.30
17.0–20.0	A-N							
20.0–22.0	S-6	2.0	WOR 3 2 3		<1	SAND, FINE GRAIN, SOME SILT, WET, LITTLE CLAY, VERY SOFT TO SOFT BROWN, GREY, VERY THIN VANES		
22.0–25.0	A-N					25.0		
25.0–27.0	S-7		15 19 21 19		<1	SAND, FINE GRAIN, SOME SILT GREY, GREEN 25.5 SAND, FINE GRAIN, SOME SILT, GREY, DENSE, TRACE CLAY, SHELL FRAGMENTS WET		-9.80 -10.30
27.0–30.0	A-N					Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: WALLY BORING NO.: TW15-B SHEET 2 OF 3

Baker
Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - SCREENING - CTO 232
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW15-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger T = Shelby Tube W = Wash R = Air Rotary C = Core D = Denison P = Piston N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
31–32.0	S-8	1.5	20 15 15 18		<1	Continued from Sheet 2. SAND, FINE AND MEDIUM GRAIN, GREY, GREEN, LIMESTONE AND SHELL FRAGMENTS, WET, DENSE, LITTLE SILT	WELL CASING FROM 0.0 TO 35.0 FT. WELL SOCK FROM 0.0 TO 40.0 FT	
32.0–35.0	A-N							
35.0–37.0	S-9	2.0	17 18 18 15		<1	SAND, FINE AND MEDIUM GRAIN, GREY, GREEN, LIMESTONE AND SHELL FRAGMENTS WET, DENSE, LITTLE SILT,	WELL SCREEN FROM 35.0 TO 40.0 FT	-19.80
37.0–40.0	A-N					40.0		
40.0–42.0	S-10	2.0	5 7 9 9		<1	SAND FINE GRAIN, GREEN, SOME SILT, LITTLE CLAY, WET, MEDIUM STIFF	BOTTOM PLUG. HOLE CAVED TO 40.0	-24.80
42						END OF BORING @ 42.0 FT		-26.80
43–50								

DRILLING CO.: PARRATT - WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: WALLY BORING NO.: TW15-B SHEET 3 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc.

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470 - 232 - 0000 - 03600
BORING NO.: TW 16 A
COORDINATES: EAST: 2465825.2426
NORTH: 363304.7185
ELEVATION: SURFACE: 6.90
TOP OF STEEL CASING: -

RIG: CME 850 TRACK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3 1/4 ID		4/16/96	0 - 15	70's SUNNY	6	0 Hrs
LENGTH			5 FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" dia.	0	5
Well Screen	1"	PVC Slotted 0.01" SLOT	5	15

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL SOCK FROM 0.0 TO 15.0 FT	
2								
3								
4							WELL CASING FROM 0.0 TO 5.0 FT	
5	A-N					SEE BORING LOG TW 16-B FOR SOIL INFORMATION		1.9
6							WELL SCREEN FROM 5.0 TO 15.0 FT	
7								
8								
9								
10						Match to Sheet 2		

DRILLING CO.: PARRATT WOLFF
BAKER REP.: BRIAN E. DAVIS
DRILLER: WALLY
BORING NO.: TW 16-A
SHEET 1 OF 2

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI-CTO 232-SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW16-A

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger T = Shelby Tube, W = Wash R = Air Rotary, C = Core D = Denison, P = Piston N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
						Continued from Sheet 1	WELL SOCK 0.0 TO 15.0 FT	
11							WELL SCREEN FROM 5.0 TO 15.0 FT	
12	A-N					SEE BORING LOG TW16-B FOR SOIL INFORMATION		
13								
14							BOTTOM PLUG	-8.10
15						END OF BORING @ 15.0 FT		
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: WALLY BORING NO.: TW-16A

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW16-B
COORDINATES: EAST: 2465825.2426 NORTH: 363304.7185
ELEVATION: SURFACE: 6.90 TOP OF STEEL CASING: -

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43"		3¼ IN		4/16/96	0-18	70's SUNNY	4 FT	0 HRS
LENGTH	2 FT		5 FT		4/17/96	18-36	60's SUNNY	5 FT	0 HRS
TYPE	SS		HS						
HAMMER WT.	140 lbs								
FALL	30 in.								
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded	0	30
Well Screen	1"	PVC Slotted	30	35

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Per. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
0-2.0	S-1	2.0	2, 2, 3, 2		<1	SAND, FINE GRAIN, LITTLE SILT, MOIST, LITTLE SILT, BR[illegible], GREY, MEDIUM DENSE	WELL SOCK FROM 0.0 TO 35.0 FT	
2.0-4.0	S-2	2.0	5, 5, 5, 6		<1	SAND, FINE GRAIN, LITTLE SILT GREY, MEDIUM DENSE	WELL CASING FROM 0.0 TO 30.0 FT	
4.0-6.0	S-3	2.0	6, 11, 6, 7		<1			
6.0-8.0	S-4	2.0	5, 5, 6, 5		<1	SAND, FINE GRAIN, GREY, LITTLE SILT MEDIUM DENSE 6.5 / SILT AND CLAY, LITTLE FINE GRAIN SAND, GREY BROWN, STIFF, WET		0.4
8.0-10.0	S-5	2.0	3, 3, 3, 3		<1	CLAY, SOME SILT, TRACE FINE GRAIN SAND GREY, BROWN, WET		

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E DAVIS
DRILLER: CHIP BORING NO.: TW16-B SHEET 1 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW16-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger, T = Shelby Tube, W = Wash, R = Air Rotary, C = Core, D = Denison, P = Piston, N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
11–12.0	S-6	1.5	2 3 2 3		<1	Continued from Sheet 1 SILT AND CLAY, LITTLE FINE GRAIN SAND, GREY, BROWN, WET, STIFF		
12–14.0	S-7	1.5	2 3 2 4		<1	SILT AND CLAY, LITTLE FINE GRAIN SAND, GREY BROWN, WET, STIFF Very thin to thin FINE GRAIN SAND		
14–16.0	S-8	1.5	2 3 3 4		<1	15.0 SILT AND CLAY, SOME FINE GRAIN SAND, GREY, WET, STIFF 16.0		-8.10 -9.10
16–18.0	S-9	1.5	2 2 3 3		<1	CLAY, SOME SILT, LITTLE TO TRACE FINE GRAIN SAND, GREY GREEN, MOIST TO WET		
18–20.0	S-10	2.0	1 2 3 3		<1	CLAY, SOME SILT, TRACE FINE SAND, MOIST TO WET, GREY, GREEN, BLACK, MEDIUM STIFF Thin Fine Grain Sand @ 18.0 to 18.2 FT		
20–22.0	S-11	2.0	1 2 2 3		<1	CLAY, SOME SILT, TRACE FINE SAND, MOIST TO WET Thin Fine Grain Sand @ 21.0'		
22–24.0	S-12	2.0	5 6 5 6	\	<1	CLAY, SOME SILT, TRACE FINE SAND, MOIST TO WET, GREY, GREEN, BLACK, MEDIUM STIFF Thin Fine Grain Sand from 23.5 to 23.7'		
24–26.0	S-13	2.0	4 6 6 9		<1	CLAY AND SILT, 25.0 SAND, FINE GRAIN, BROWN, LITTLE SILT, MEDIUM DENSE, WET 26.0		-18.10 -19.10
26–28.0	S-14	2.0	3 5 6 7		<1	SAND, FINE AND MEDIUM GRAIN, BROWN, TRACE SILT, WET 27.5 SAND, FINE GRAIN		-20.60
28–30.0	S-15	1.5	15 20 22 23		<1	29.0 SAND, FINE GRAIN, LITTLE SILT, WET, GREY, [illegible] DENSE [illegible] Match to Sheet 3		-22.10

DRILLING CO.: PARRATT WOLFF
DRILLER: [illegible]
BAKER REP.: BRIAN E DAVIS
BORING NO.: TW16-B
SHEET 2 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI-CTO 232-SCREENING
S.O. NO.: 62470-232-0000-02400 BORING NO.: TW16-B

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS
SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
31–32.0	S-16	1.5	7 12 15 20		<1	Continued from Sheet 2 SAND, FINE AND MEDIUM GRAIN, LITTLE SILT; SHELL FRAGMENTS, LIMESTONE FRAGMENTS. GREY, GREEN, DENSE, FEW PEAT ... CEMENTED LIMESTONE FRAGMENTS, WET	WELL SOCK FROM 0.0 TO 35.0 FT WELL SCREEN FROM 30.0 TO 35.0 FT	-23.10
32–34.0	S-17	1.5	23 40 50/5		<1	SAND, FINE AND MEDIUM GRAIN, LITTLE SILT; SHELL AND LIMESTONE FRAGMENT. GREY, GREEN, WET, VERY DENSE 34.0		
34–36.0	S-18	2.0	6 7 6 6		<1	SAND, FINE GRAIN, SOME SILT, LITTLE CLAY, GREEN, WET, MEDIUM DENSE	BOTTOM PLUG AT 35.0 FT HOLE CAVED TO 35.0	-28.10 -29.10
36–50						END OF BORING @ 36.0 FT		

DRILLING CO.: PARRATT WOLFF
DRILLER: CURT
BAKER REP.: BRIAN E. CAR...
BORING NO.: TW16-B
SHEET 3 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 62470 - 232-0000-03600 BORING NO.: TW16 - C

COORDINATES: EAST: 2465825.2426 NORTH: 363304.7185

ELEVATION: SURFACE: 6.90 TOP OF STEEL CASING: -

RIG: MOBILE 55 TRUCK MOUNT	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3 1/4 ID		4/17/96	0-25	60's SUNNY	6	0 Hr
LENGTH			5FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE

S = Split Spoon, A = Auger
T = Shelby Tube, W = Wash
R = Air Rotary, C = Core
D = Denison, P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded	0	20
Well Screen	1"	PVC Slotted	20	25

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Per. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL SOCK FROM 0.0 to 25.0 FT	
2								
3								
4							WELL CASING 0.0 TO 20.0 FT	
5	A-N					SEE BORING LOG TW16-B FOR SOIL INFORMATION		
6								
7								
8								
9								
10								

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW16-C SHEET 1 OF 2

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI-CTO 232-SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW16-C

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger T = Shelby Tube, W = Wash R = Air Rotary, C = Core D = Denison, P = Piston N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
						Continued from Sheet 1	WELL SOCK FROM 0.0 TO 20.0 FT	
11								
12								
13							WELL CASING 0.0 TO 20.0 FT	
14								
15								
16								
17	A-N					SEE BORING LOG TW16-B FOR SOIL INFORMATION		
18								
19								
20							WELL SCREEN FROM 20.0 TO 25.0 FT	-13.10
21								
22								
23								
24								
25						END OF BORING @ 25.0 FT	BOTTOM PLUG	-18.10
26								
27								
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW16-C

TEST BORING AND WELL CONSTRUCTION RECORD

Baker

Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600

BORING NO.: TW17-A

COORDINATES: EAST: 2465786.5749

NORTH: 363349.6850

ELEVATION: SURFACE: 4.70

TOP OF STEEL CASING: –

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3¼ I		4/16/96	0-15	70's sunny	6	0 Hrs
LENGTH			5 FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded	0	5
Well Screen	1"	PVC Slotted	5	15

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Per. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							Well sock from 0.0 to 15.0 ft	
2							Well casing from 0.0 to 5.0 ft	
3								
4						SEE BORING LOG TW17-B FOR SOIL INFORMATION		
5	A-N							-0.30
6								
7								
8								
9								
10						Match to Sheet 2		

DRILLING CO.: PARRATT WOLFF

BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP

BORING NO.: TW17-A

SHEET 1 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker

Baker Environmental, Inc

PROJECT: SC-I-CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW17-A

SAMPLE TYPE

S = Split Spoon
T = Shelby Tube
R = Air Rotary
D = Denison
A = Auger
W = Wash
C = Core
P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
11						Continued from Sheet 1	WELL SCREEN FROM 5.0 TO 15.0 FT	
12	A-N					SEE BORING LOG TW17-B FOR SOIL INFORMATION	WELL SOCK FROM 0.0 TO 15.0 FT	
13								
14								
15	15.0					END OF BORING @ 15.0 FT	BOTTOM PLUG	-10.30
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW17-A SHEET 2 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600
BORING NO.: TW17-B
COORDINATES: EAST: 2465786.5749
NORTH: 363349.6850
ELEVATION: SURFACE: 4.70
TOP OF STEEL CASING: –

RIG: CME 850 TRACK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43"		3 1/4 ID		4/16/96	0-34.0	70's SUNNY	6	0 HR
LENGTH	2FT		5FT						
TYPE	SS		HS						
HAMMER WT.	140 lbs								
FALL	30 in.								
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon, A = Auger
T = Shelby Tube, W = Wash
R = Air Rotary, C = Core
D = Denison, P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" dia	0	27
Well Screen	1"	PVC Slotted 0.01" slot	27	32

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Per. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
0-2.0	S-1		1 1 1 2		<1	SAND, FINE GRAIN, LITTLE SILT, GREY, BROWN, DAMP TO MOIST, LOOSE		
2.0-4.0	S-2		2 2 2 3		<1	3.0 SILT AND CLAY, LITTLE FINE GRAIN SAND, BROWN, GREY, MOTTLED, MOIST TO WET STIFF		1.70
4.0-6.0	S-3		2 2 2 1		<1			
6.0-8.0	S-4		5 5 5 6		<1	SAND AND SILT STRINGER FROM 8.0 TO 8.1 FT		
8.0-10.0	S-5		3 3 3 5		<1	SILT AND CLAY, LITTLE TO TRACE FINE GRAIN SAND, BROWN, GREY, MOTTLED WET STIFF		

Match to Sheet 2

DRILLING CO.: [illegible]
DRILLER: [illegible]
BAKER REP.: BRIAN E. DAVIS
BORING NO.: TW17-B
SHEET 1 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: [illegible]

S.O. NO.: [illegible] BORING NO.: TW 17-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger T = Shelby Tube, W = Wash R = Air Rotary, C = Core D = Denison, P = Piston N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
10.5–12.0	S-6	2.0	3 2 2 3		<1	Continued from Sheet 1 — 10.5 SILT AND CLAY, SOME FINE GRAIN SAND, GREY, BROWN, WET, STIFF	WELL SOCK FROM 0.0 TO 32.0 Ft	-5.80
12.0–14.0	S-7	2.0	3 3 4 3		<1	SILT AND CLAY, SOME FINE GRAIN SAND, GREY, WET STIFF	WELL CASING FROM 0.0 TO 27.0 FT	
14.0–16.0	S-8	2.0	4 4 4 4		<1	15.0 SAND AND SILT, FINE GRAIN, BLACK, GREY, BROWN, WET, SOFT TO MEDIUM STIFF SOME CLAY		-10.30
16.0–18.0	S-9	2.0	4 5 4 5		<1	TREE ROOT FROM 16.5 TO 16.75' 17.5 SAND AND SILT, LITTLE CLAY, GREY WET, MEDIUM STIFF 18.5		-12.80 -13.80
18.0–20.0	S-10	2.0	4 2 4 4		<1	SAND, FINE GRAIN, SOME SILT, GREY, BLACK WET, SOFT TO MEDIUM STIFF		
20.0–22.0	S-11	1.5	4 7 4 5		<1			
22.0–24.0	S-12	2.0	4 4 4 2		<1	SAND, FINE GRAIN, SOME SILT, GREY, BLACK WET; 23.5 SAND, FINE AND MEDIUM GRAIN, LITTLE SILT BROWN, WET, LOOSE TO MEDIUM DENSE		-18.80
24.0–26.0	S-13	1.0	4 7 2 2		<1			
26.0–28.0	S-14	2.0	12 13 20 31		<1	27.0 SAND, FINE AND MEDIUM GRAIN, LITTLE SILT SHELL AND LIMESTONE FRAGMENTS, MEDIUM DENSE, WET, GREY, GREEN TO VERY DENSE	WELL SCREEN FROM 27.0 TO 32.0 FT	-22.30
28.0–30.0	S-15	2.0	12 26 30 34		<1	SAND, FINE AND MEDIUM GRAIN, SOME COARSE GRAIN, GREY, GREEN, SHELL AND LIMESTONE FRAGMENTS, DENSE TO VERY DENSE Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF

DRILLER: CHIP

BAKER REP.: BRIAN E. DAVIS

BORING NO.: TW 17-B

SHEET 2 OF 2

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI -CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW17-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger T = Shelby Tube W = Wash R = Air Rotary C = Core D = Denison P = Piston N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)		Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	H_{NU} ~~Lab.~~ Moist ~~%~~ (ppm)	Visual Description	Well Installation Detail	Elevation
							Continued from Sheet 2	WELL SOLID - From 0.0 to 32.0 FT	
31		S-16	2.0	13 16 14 17		<1	SAND, FINE AND MEDIUM GRAIN, GREY, LIMESTONE AND SHELL FRAGMENTS, DENSE	WELL SCREEN From 27 to 32.0 FT	
32	32.0						32.0	BOTTOM PLUG	-27.3
				16 18			SAND AND SILT, SOME CLAY, MEDIUM DENSE, WET, GREEN	HOLE CAVED TO 32.0	
33		S-17	1.0	20 20		<1			
34	34.0						END OF BORING @ 34.0 FT		-29.3
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW17-B SHEET 3 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI-CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW17-C
COORDINATES: EAST: 2465786.5749 NORTH: 363349.6850
ELEVATION: SURFACE: 4.70 TOP OF STEEL CASING: -

RIG: CME 850 TRACK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3¼ ID		4-16-96	0-23.5	60's SUNNY	6	0 Hrs.
LENGTH			5 FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded	0	18.5
Well Screen	1"	PVC Slotted	18.5	23.5

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1								
2								
3								
4								
5	A-N					SEE BORING LOG TW17-C FOR SOIL INFORMATION		
6								
7								
8								
9								
10						Match to Sheet 2		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW17-C SHEET 1 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI-CTO 232-SCREENING
S.O. NO.: 62470-0000-03600 BORING NO.: TW17-C

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS
SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
						Continued from Sheet 1	WELL SOIL FROM 0.0 TO 23.5 FT	
11								
12								
13							WELL CASING FROM 0.0 TO 18.5 FT	
14								
15								
16								
17	A-N					SEE BORING LOG TW17-B FOR SOIL INFORMATION		
18								-13.80
19							WELL SCREEN FROM 18.5 TO 23.5	
20								
21								
22								
23	23.5						BOTTOM PLUG	-18.80
24						END OF BORING @ 23.5 FT		
25								
26								
27								
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW17-C SHEET 2 OF 2

Baker
Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO232 - SCREENING
S.O. NO.: 62470-232-0000-03200 BORING NO.: TW18-A
COORDINATES: EAST: 2465761.5149 NORTH: 363409.7343
ELEVATION: SURFACE: 4.60 TOP OF STEEL CASING: -

RIG: LME 550 TRACK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3¼ ID		4/16/96	0-15.0	70's SUNNY	6	0 Hr.
LENGTH			5 FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" dia.	0	5
Well Screen	1"	PVC Slotted 0.01" slot	5	15

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Per. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL SOCK FROM 0.0 TO 15.0 FT	
2								
3							WELL CASING FROM 0.0 TO 5.0 FT	
4						SEE BORING LOG TW18-B FOR SOIL INFORMATION		
5	A-N						WELL SCREEN FROM 5.0 TO 15.0 FT	-0.40
6								
7								
8								
9								
10						Match to Sheet 2		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: [illegible] BORING NO.: TW18-A SHEET 1 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 18 - A

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS
SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
11						Continued from Sheet 1	WELL SOCK From 0.0 TO 15.0 FT	
12	A-N							
13								
14								
15 (15.0)							BOTTOM PLUG	-10.40
16						END OF BORING @ 15.0 FT		
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E DAVIS
DRILLER: WALLY BORING NO.: TW 18-A SHEET 2 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc.

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 18-B
COORDINATES: EAST: 2465761.5149 NORTH: 363409.7343
ELEVATION: SURFACE: 4.60 TOP OF STEEL CASING: —

RIG: CME 850 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43 in		3¼ ID		4/16/96	0 - 32.0	70's SUNNY	6	0 hr
LENGTH	2 FT		5 FT						
TYPE	SS		HS						
HAMMER WT.	140 lb.								
FALL	30 IN								
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" dia	0	27.0
Well Screen	1"	PVC Slotted 0.01" slot	27.0	32.0

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Per. Rate	~~Hau Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
0-2.0	S-1	1.5	2, 1, 3, 2		<1	SILT AN CLAY, LITTLE FINE GRAIN SAND, DAMP to MOIST, BROWN; GREY SOFT TO MEDIUM STIFF	WELL SOCK FROM 0.0 TO 32.0 FT; WELL CASING FROM 0.0 TO 27.0 FT	
2.0-4.0	S-2	1.5	2, 2, 3, 2		<1	SILT AND CLAY, LITTLE TO TRACE FINE GRAIN SAND, MOIST TO WET MEDIUM STIFF — 4.5		0.10
4.0-6.0	S-3	2.0	5, 5, 5, 6		<1	SAND AND SILT, FINE GRAIN, SOME CLAY, GREY, BROWN, MOTTLED, WET		
6.0-8.0	S-4	2.0	1, 2, 4, 5		<1	SAND AND SILT, FINE GRAIN, SOME CLAY, GREY BROWN, MOTTLED, [illegible], SOFT TO SOFT		
8.0-10.0	S-5	2.0			<1	8.5 — SILT AND CLAY, SOME FINE GRAIN SAND, GREY [illegible] MOTTLED, WET, SOFT - MEDIUM [illegible] — 9.5; SAND, FINE GRAIN, SOME SILT, GREY. WET [illegible]		-3.90; -4.90

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. [illegible]
DRILLER: [illegible] BORING NO.: TW 18-B SHEET 1 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW18-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger, T = Shelby Tube, W = Wash, R = Air Rotary, C = Core, D = Denison, P = Piston, N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist~~ % (ppm)	Visual Description	Well Installation Detail	Elevation
11–12.0	S-6	2.0	5 6 6 7		<1	Continued from Sheet 1 SAND, FINE GRAIN, GREY 11.0 SAND, FINE GRAIN, SOME SILT, BROWN, LOOSE TO MEDIUM DENSE, WET	WELL SOCK FROM 0.0 TO 32.0 FT	-6.40
12–14.0	S-7	2.0	8 8 7 7		<1	SAND, FINE GRAIN, SOME TO LITTLE SILT, BROWN, GREY,	WELL CASING FROM 0.0 TO 27.0 FT	
14–16.0	S-8	0.3	6 6 6 8		<1	SAND, FINE GRAIN, SOME SILT, WET SOFT TO MEDIUM DENSE, BROWN	WELL SCREEN FROM 27.0 TO 32.0 FT	
16–18.0	S-9	1.5	4 3 1 2		<1	SAND, FINE GRAIN, SOME SILT, WET SOFT TO MEDIUM DENSE BROWN		
18–20.0	S-10	1.5	2 2 2 2		<1	SAND, FINE GRAIN, SOME SILT, WET SOFT, BROWN 19.5		-14.90
20–22.0	S-11	1.5	7 8 1 2		<1	SAND, FINE AND MEDIUM GRAIN, LITTLE SILT, BROWN, WET, LOOSE SAND, FINE AND MEDIUM GRAIN, Little to trace SILT, BROWN, WET, LOOSE		
22–24.0	S-12	2.0	1 3 1 1		<1	SAND, FINE AND MEDIUM GRAIN, trace silt BROWN, wet, LOOSE		
24–26.0	S-13	2.0	49 13 17		<1	25.0 SAND, FINE AND MEDIUM GRAIN, LITTLE SILT, SHELL AND LIMESTONE FRAGMENTS, GREY, PARTIALLY CEMENTED [illegible] DENSE 26.0		-20.40 -21.40
26–28.0	S-14	2.0	10 16 17 32		<1	SAND, LITTLE SILT, BROWN, WET 27.0 SAND, FINE AND MEDIUM GRAIN, LITTLE COARSE GRAIN, LITTLE SILT, SHELL AND LIMESTONE FRAGMENTS, GREY, PARTIALLY CEMENTED [illegible] 28.0		-22.40 -23.40
28–30.0	S-15	2.0	10 18 22 40		<1	[illegible] DENSE SAND, SHELL FRAG, BROWN, WET 29.0 SAND, FINE AND MEDIUM GRAIN, LITTLE SILT SHELL FRAGMENTS, GREY, DENSE WET [illegible] Match to Sheet 3		-24.40

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW18-B SHEET 2 OF 3

![Baker Environmental, Inc. logo]

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW18-B

SAMPLE TYPE

S = Split Spoon
T = Shelby Tube
R = Air Rotary
D = Denison
A = Auger
W = Wash
C = Core
P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	HNU ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
31	S-16	2.0	7 / 12 / 12 / [illegible]		<1	Continued from Sheet 2 SAND, MEDIUM AND FINE GRAIN, LITTLE COARSE GRAIN, LITTLE SILT, GREY, LIMESTONE AND SHELL FRAGMENTS, WET 31.5 SAND AND SILT, FINE GRAIN, LITTLE CLAY, GREEN, MED. DENSE	WELL CASING FROM 0.0 TO 22.0 FT. WELL SCREEN FROM 22.0 TO 32.0 FT	-26.90
32 (32.0)						END OF BORING @ 32.0 FT	BOTTOM PLUG	-27.40
33								
34								
35								
36								
37								
38								
39								
40								
41								
42								
43								
44								
45								
46								
47								
48								
49								
50								

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW18-B SHEET 3 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW18-C
COORDINATES: EAST: 2465761.5149 NORTH: 363409.7343
ELEVATION: SURFACE: 4.60 TOP OF STEEL CASING: -

RIG: CME 850 TRACK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3 1/4 ID		4/16/96	0 - 23.5	70's SUNNY	6	0 HRS
LENGTH			5 FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" dia	0	18.5
Well Screen	1"	PVC Slotted 0.01" SLOT	18.5	23.5

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL SOCK FROM 0.0 TO FT	
2								
3								
4							WELL CASING FROM 0.0 TO FT	
5	A-N					SEE BORING LOG TW18-B FOR SOIL INFORMATION		
6								
7								
8								
9								
10								

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E DAVIS
DRILLER: WALLY BORING NO.: TW18-C SHEET 1 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW18-C

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; A = Auger; T = Shelby Tube; W = Wash; R = Air Rotary; C = Core; D = Denison; P = Piston; N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5'); RQD = Rock Quality Designation (%); Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
11						Continued from Sheet 1	WELL SOCK FROM 0.0 TO 23.5 FT	
12								
13								
14							WELL CASING FROM 0.0 TO 18.5 FT	
15	A-N					SEE BORING LOG TW18-B FOR SOIL INFORMATION		
16								
17								
18							WELL SCREEN FROM 18.5 TO 23.5 FT	-13.90
19								
20								
21								
22								
23								-18.90
24						END OF BORING AT 23.5 FT		
25								
26								
27								
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E DAVIS
DRILLER: WALLY BORING NO.: TW 18-C SHEET 2 OF 2

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI-CTO232-SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW19-A

COORDINATES: EAST: 2465719.1571 NORTH: 363445.7345

ELEVATION: SURFACE: 10.90 TOP OF STEEL CASING: -

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3¼ ID		4/15/96	0-15	60's Cloudy	6	0 hr.
LENGTH			5 FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE

S = Split Spoon A = Auger

T = Shelby Tube W = Wash

R = Air Rotary C = Core

D = Denison P = Piston

N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1.0" dia	0	5
Well Screen	1"	PVC Slotted 0.01" slot	5	15

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Per. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL SOIL From 0.0 To 15.0 FT	
2								
3							WELL CASING From 0.0 To 5.0 FT	
4								
5	A-N					SEE BORING LOG TW19-B FOR SOIL INFORMATION	WELL SCREEN From 5.0 To 15.0 FT	5.90
6								
7								
8								
9								
10						Match to Sheet 2		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E DAVIS

DRILLER: CHIP BORING NO.: TW19-A SHEET 1 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI-CTO 232-SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW19-A

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; A = Auger; T = Shelby Tube; W = Wash; R = Air Rotary; C = Core; D = Denison; P = Piston; N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5'); RQD = Rock Quality Designation (%); Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
						Continued from Sheet 1	WELL SCREEN FROM 5.0 TO 15.0 FT	
11								
12	A-N					SEE BORING LOG TW19-B FOR SOIL INFORMATION	WELL SOCK FROM 0.0 TO 15.0 FT	
13								
14								
15						END OF BORING @ 15.0 FT	BOTTOM PLUG	-4.10
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW19-A SHEET 2 OF 2

Baker
Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 32 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW19-B
COORDINATES: EAST: 2465719.1571 NORTH: 363445.7345
ELEVATION: SURFACE: 10.90 TOP OF STEEL CASING: -

RIG: CME 850 - TRACK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43 ID		3 1/4 ID		4/15/96	0 - 38	60's Cloudy	6	0 hrs.
LENGTH	2.0 FT		5 FT						
TYPE	SS		HS						
HAMMER WT.	140 lbs.								
FALL	30 IN								
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing		PVC Threaded	0	33
Well Screen		PVC Slotted	33	38

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Perc. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
0 - 2.0	S-1	2.0	1 1 1 1		<1	Sand, fine grain, Brown, Grey, Damp to moist, little to trace silt, loose	Well sock from 0.0 to 38.0 Ft	
2.0 - 4.0	S-2	2.0	2 2 2 2		<1	Sand, fine grain, brown, grey damp to moist, loose,	Well casing from 0.0 to 33.0 Ft	
4.0 - 6.0	S-3	1.5	1 2 2 2		<1	Sand, fine grain, wet		
6.0 - 8.0	S-4	1.5	2 3 3		<1	7.0 Sand and silt, fine grain, little clay, brown, soft		3.90
8.0 - 10.0	S-5	2.0	1 1 3 4		<1	Sand and silt, fine grain, some clay, brown, red, grey mottled, wet		

Match to Sheet 2

DRILLING CO.: Parratt Wolff BAKER REP.: Brian E Davis
DRILLER: Chip BORING NO.: TW19-B SHEET 1 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW19-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; A = Auger; T = Shelby Tube; W = Wash; R = Air Rotary; C = Core; D = Denison; P = Piston; N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5'); RQD = Rock Quality Designation (%); Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
11–12.0	S-6	2.0	WOT 1 1 1		<1	Continued from Sheet 1 SILT AND SAND, SOME CLAY 11.0 SILT AND SAND, BROWN, GREY, FINE GRAIN; SOFT	WELL SCREEN From 0.0 TO 38.0 Ft	-0.10
12–14.0	S-7	2.0	WOT WOT 1 3		<1	12.5 SAND AND SILT, SOME CLAY, BROWN, SOFT, WET 13.5 SAND, FINE GRAIN SOME SILT, TRACE CLAY BROWN, SOFT TO MEDIUM DENSE, WET 14.0	WELL CASING From 0.0 TO 33.0 Ft	-1.60 -2.10 -3.10
14–16.0	S-8	2.0	3 4 5 6		<1	SAND, FINE GRAIN, LITTLE SILT, LITTLE COARSE GRAIN, GREY; MEDIUM DENSE, WET		
16–18.0	S-9	2.0	2 6 15 12		<1	SAND, FINE GRAIN, BROWN, LITTLE SILT GREY, BROWN, WET, SOFT TO DENSE		
18–20.0	S-10	2.0	WOT WOT WOT 1		<1	SAND, FINE AND MEDIUM GRAIN, BROWN GREY, WET, SOFT, HIGHLY COMPACTED SAND @ 19.0 TO 19.5 FT		
20–22.0	S-11	2.0	4 4 WOT WOT		<1	21.5		-10.60
22–24.0	S-12	2.0	7 11 12 14		<1	SAND, FINE GRAIN, RED, BROWN, SOME HIGHLY COMPACTED FRIABLE SAND, LITTLE MEDIUM GRAIN, WET SOFT 22.5 SAND, FINE AND MEDIUM GRAIN, SHELL FRAGMENTS AND LIMESTONE FRAGMENTS GREY, LITTLE SILT, WET, MEDIUM DENSE TO DENSE 24.5		-11.60 -13.60
24–26.0	S-13	2.0	7 2 10 12		<1	SAND, FINE AND MEDIUM GRAIN BROWN, RED LITTLE SILT, SOFT, WET SAND, FINE AND MEDIUM GRAIN, BROWN RED LITTLE SILT, SOFT WET 26.5		-15.60
26–28.0	S-14	2.0	10 1 WOT WOT		<1	SAND, FINE AND MEDIUM GRAIN, GREY SHELL AND LIMESTONE FRAGMENTS, LOOSE, LITTLE SILT, WET		
28–30	S-15	2.0	10 20 32 31		<1	SAND, FINE AND MEDIUM GRAIN, GREY SHELL AND LIMESTONE FRAGMENTS WET PARTIALLY CEMENTED Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW 19-B SHEET 2 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker

Baker Environmental, Inc

PROJECT: SGI - CTO82 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW19-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger, T = Shelby Tube, W = Wash, R = Air Rotary, C = Core, D = Denison, P = Piston, N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	HNU ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
31–32.0	S-16	2.0	12 12 11 19		<1	Continued from Sheet 2 SAND, FINE AND MEDIUM GRAIN, LITTLE SILT, GREY, SHELL AND LIMESTONE [illegible] CEMENTED, [illegible] MEDIUM DENSE	WELL SOCK FROM 0.0 TO 38.0 FT WELL CASING FROM 0.0 TO 33.0 FT	
32.0–34.0	S-17	2.0	8 12 16 23		<1	SAND, FINE GRAIN, SOME MEDIUM GRAIN, LITTLE SILT, GREY, SHELL AND LIMESTONE FRAGMENTS; WET, DENSE		-22.10
34.0–36.0	S-18	2.0	12 13 19 36		<1	SAND, FINE AND MEDIUM GRAIN, LITTLE SILT SHELL AND LIMESTONE FRAGMENTS, GREY PARTIALLY CEMENTED LIMESTONE DENSE TO VERY DENSE	WELL SCREEN FROM 33.0 TO 38.0 FT	
36.0–38.0	S-19	2.0	14 14 13 20		<1	SAND, FINE AND MEDIUM GRAIN, LITTLE TO SOME SILT; SHELL AND LIMESTONE FRAGMENTS GREY, MEDIUM DENSE 37.5 SAND, FINE SILT, [illegible]	BOTTOM PLUG	-26.60 -27.10
38–50						END OF BORING @ 38.0 FT		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW19-B SHEET 3 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW19-C

COORDINATES: EAST: 2465719.1571 NORTH: 363445.7345

ELEVATION: SURFACE: 10.90 TOP OF STEEL CASING: -

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3¼ ID		4/15/96	0-26.5	70's SUNNY	6	0 Hr
LENGTH			5 FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE

- S = Split Spoon
- T = Shelby Tube
- R = Air Rotary
- D = Denison
- A = Auger
- W = Wash
- C = Core
- P = Piston
- N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1.0 dia	0	21.5
Well Screen	1"	PVC Slotted 0.01 SLOT	21.5	26.5

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL SOCK FROM 0.0 TO 26.5 FT	
2								
3							WELL CASING FROM 0.0 TO 21.5 FT	
4								
5	A-N					SEE BORING LOG TW19-B FOR SOIL INFORMATION		
6								
7								
8								
9								
10						Match to Sheet 2		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E DAVIS

DRILLER: WALLY BORING NO.: TW19-C SHEET 1 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker

Baker Environmental, Inc

PROJECT: SGI-CTO 232-SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW19-C

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger, T = Shelby Tube, W = Wash, R = Air Rotary, C = Core, D = Denison, P = Piston, N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
						Continued from Sheet 1	WELL SOCK 0.0 FT TO 26.5 FT	
11								
12								
13							WELL CASING 0.0 FT TO 21.5 FT	
14								
15								
16						SEE BORING LOG TW19-B FOR SOIL INFORMATION		
17	A-N							
18								
19								
20								
21							WELL SCREEN FROM 21.5 FT TO 26.5 FT	-10.60
22								
23								
24								
25								
26	26.5						BOTTOM 26.5	-15.60
27						END OF BORING @ 26.5 FT		
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E DAVIS
DRILLER: WALLY BORING NO.: TW19-C SHEET 2 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker

Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 20-A
COORDINATES: EAST: 2465686.1840 NORTH: 363473.5132
ELEVATION: SURFACE: 10.60 TOP OF STEEL CASING: -

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3¼ ID		4/15/96	0-15	60's CLOUDY	6	0 HRS.
LENGTH			5 FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" dia.	0	5
Well Screen	1"	PVC Slotted 0.01" slot	5	15

Depth (Ft.)	Sample Type and No	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class or Per Rate	Lab Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL SOCK FROM 0.0 TO 15.0 FT	
2								
3							WELL CASING FROM 0.0 TO 5.0 FT	
4						SEE BORING TW 20-B FOR SOIL INFORMATION		
5	A-N						WELL SCREEN FROM 5.0 TO 15.0 FT	5.60
6								
7								
8								
9								
10								

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW 20-A SHEET 1 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker

Baker Environmental, Inc

PROJECT: SCI - CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW-20 A

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger, T = Shelby Tube, W = Wash, R = Air Rotary, C = Core, D = Denison, P = Piston, N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
11						Continued from Sheet 1	WELL SOCK FROM 0.0 TO 15.0 FT	
12	A-N					SEE BORING LOG TW 20-B FOR SOIL INFORMATION	WELL SCREEN FROM 5.0 TO 15.0 FT	
13								
14								
15 (15.0)						END OF BORING @ 15.0 FT	BOTTOM PLUG	-4.40
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW 20-A SHEET 2 OF 2

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000 - 03600 BORING NO.: TW20-B
COORDINATES: EAST: 2465686.1840 NORTH: 363437.5132
ELEVATION: SURFACE: 10.60 TOP OF STEEL CASING: -

RIG: CME 850 TRACK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43 IN		3 1/4 ID		0-38	4/15/96	60's CLOUDY	6	0 HRS
LENGTH	2 FT		5 FT						
TYPE	SS		HS						
HAMMER WT.	140 lbs								
FALL	30 IN								
STICK UP									

REMARKS: TW 21 - A, B & C NOT INSTALLED DUE TO FIELD STAKING ERROR

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" dia.	0	23
Well Screen	1"	PVC Slotted 0.01 slot	23	28

Depth (Ft)	Sample Type and No	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class or Pen. Rate	HNU ~~Lab.~~ Moist ~~%~~ (ppm)	Visual Description	Well Installation Detail	Elevation
1 2 — 2.0	S-1	0.5	1 2 2 2		<1	SAND, FINE GRAIN, LITTLE SILT, GREY, BROWN BLACK, FEW ROOTS, DAMP, SOFT	WELL SOCK FROM 0.0 TO 38.0 FT	
3 4 — 4.0	S-2	2.0	2 3 2 2		<1	SAND, FINE GRAIN, BROWN, DAMP, SOFT — 3.0 SAND AND SILT, FINE GRAIN, SOME CLAY WET, BROWN, SOFT — 4.0		7.60 6.60
5 6 — 6.0	S-3	2.0	4 5 5 6		<1	SAND, FINE GRAIN, LITTLE MEDIUM GRAIN, WET, GREY, GREEN, LITTLE SILT, SOME LIMESTONE AND SHELL FRAGMENTS 6.0		4.60
7 8 — 8.0	S-4	2.0	3 3 3 3		<1	SAND AND SILT, SOME CLAY, FINE GRAIN, BROWN, GREY, MOTTLED, WET, SOFT SAND AND SILT, SOME CLAY, FINE GRAIN, BROWN, GREY MOTTLED WET, SOFT 8.5		2.10
9 10 — 10.0	S-5	1.5	4 4 4 6		2	SAND, FINE AND MEDIUM GRAIN, LITTLE SILT, BROWN, GREY, WET, LOOSE		

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIC BORING NO.: TW20-B SHEET 1 OF 2

Baker

Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 20B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; T = Shelby Tube; R = Air Rotary; D = Denison; A = Auger; W = Wash; C = Core; P = Piston; N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5'); RQD = Rock Quality Designation (%); Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
						Continued from Sheet 1		
11 – 12.0	S-6	2.0	3 4 4 7		5	SAND, FINE GRAIN, LITTLE MEDIUM GRAIN, LITTLE SILT, BROWN + GREY, WET, MEDIUM DENSE to LOOSE	WELL SOCK FROM 0.0 TO 38.0 FT	
12 – 14.0	S-7	2.0	2 2 3 4		2	SAND, FINE GRAIN, LITTLE MEDIUM GRAIN, LITTLE SILT, BROWN, GREY, WET, MEDIUM LOOSE,	WELL CASING FROM 0.0 TO 33.0 FT	
14 – 16.0	S-8	2.0	WOT 1 1 1		<1	SAND, FINE GRAIN, TRACE MEDIUM GRAIN, LITTLE SILT, BROWN, GREY, WET, LOOSE		
16 – 18.0	S-9	2.0	WOR WOR WOR WOR		<1	SAND, FINE GRAIN, TRACE TO LITTLE MEDIUM GRAIN, LITTLE SILT, BROWN, WET, LOOSE TO VERY LOOSE 18.0		-7.40
18 – 20.0	S-10	2.0	16 9 16 18		<1	SAND, FINE AND MEDIUM GRAIN, GREY, BROWN, SHELL FRAGMENTS, LIMESTONE FRAGMENTS. LITTLE SILT, PARTIALLY CEMENTED LIMESTONE/SHELL FRAGMENTS DENSE, WET		
20 – 22.0	S-11	2.0	22 23 31 24		<1	SAND, FINE GRAIN, LITTLE MEDIUM GRAIN, LITTLE SILT, SHELL FRAGMENTS AND LIMESTONE FRAGMENTS.		
22 – 24.0	S-12	2.0	16 34 27 26		<1	SAND, FINE GRAIN, LITTLE MEDIUM GRAIN, LITTLE SILT, SHELL FRAGMENTS LIMESTONE FRAGMENTS. LITTLE TO SOME PARTIALLY CEMENTED LIMESTONE FRAGMENTS. WET, DENSE TO VERY DENSE		
24 – 26.0	S-13	2.0	17 16 24 22		<1	SAND, FINE GRAIN, LITTLE MEDIUM GRAIN, LITTLE TO SOME SILT, SHELL AND LIMESTONE FRAGMENTS, PARTIALLY CEMENTED LIMESTONE FRAGMENTS, WET, DENSE TO VERY DENSE, GREY, GREEN 27.0		
26 – 28.0	S-14	2.0	23 22 23 20		<1	SAND, FINE AND MEDIUM GRAIN, SHELL AND LIMESTONE FRAGMENTS, PARTIALLY CEMENTED LIMESTONE, WET, DENSE TO MEDIUM DENSE		-16.40
28 – 30.0	S-15	2.0	15 18 21 30		<1	SAND, FINE GRAIN AND MEDIUM GRAIN		
						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFE BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW 20-B SHEET 2 OF 3

Baker

Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI-CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW20-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger T = Shelby Tube W = Wash R = Air Rotary C = Core D = Denison P = Piston N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
31 32 — 32.0	S-16	2.0	18 14 12 17		<1	Continued from Sheet SAND, FINE GRAIN, LITTLE MEDIUM GRAIN, SHELL AND LIMESTONE FRAGMENTS, LITTLE SILT, PARTIALLY CEMENTED SHELL AND LIMESTONE FRAGMENTS, WET, DENSE — 32.5	WELL SOCK FROM 0.0 TO 3[illegible].0 FT	-21.90
33 34 — 34.0	S-17	1.5	19 13 14 19		<1	SAND, FINE GRAIN, LITTLE MEDIUM GRAIN, SOME SILT, DENSE, GREEN GREY, WET	WELL CASING FROM 33.0 TO 38.0 FT	-22.40
35 36 — 36.0	S-18	2.0	10 13 15 23		<1	SAND, FINE AND MEDIUM GRAIN, LITTLE COARSE GRAIN, SOME SILT, MEDIUM DENSE GREEN, GREY, WET, SHELL AND LIMESTONE FRAGMENTS — 37.0		
37 38 — 38.0	S-19	2.0	21 17 13 12		<1	SAND AND SILT, LITTLE CLAY, GREEN, STIFF WET		-26.40 -27.40
39						END OF BORING @ 38.0 FT		
40								
41								
42								
43								
44								
45								
46								
47								
48								
49								
50								

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW 20-B SHEET 3 OF 3

Baker
Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 20-C
COORDINATES: EAST: 2465686.1840 NORTH: 363473.5132
ELEVATION: SURFACE: 10.60 TOP OF STEEL CASING: -

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	-		3¼ ID		4/15/96	0-26.5	60's cloudy	6	0 hrs.
LENGTH			5 FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded	0	21.5
Well Screen	1"	PVC Slotted	21.5	26.5

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL SOCK 0.0 TO 26.5 FT	
2								
3								
4						SEE BORING LOG TW20-B FOR SOIL INFORMATION	WELL CASING 0.0 TO 21.5 FT	
5	A-N							
6								
7								
8								
9								
10								

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW 20-C SHEET 1 OF

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 20-C

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger, T = Shelby Tube, W = Wash, R = Air Rotary, C = Core, D = Denison, P = Piston, N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5'); RQD = Rock Quality Designation (%); Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
						Continued from Sheet 1	WELL SOCK FROM 0.0 TO 26.5 FT	
11								
12								
13							WELL CASING FROM 0.0 TO 26.5 FT	
14								
15								
16								
17								
18								
19						SEE BORING LOG TW 20-B FOR SOIL INFORMATION		
20	A-N						WELL SCREEN FROM 21.5 TO 26.5 FT	
21								
22								-10.90
23								
24								
25								
26								
26.5							BOTTOM PLUG	-15.90
27						END OF BORING @ 26.5 FT		
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF
CHIP

BAKER REP.: BRIAN E. DAVIS

TW 20-C

Baker

Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW22-A

COORDINATES: EAST: 2465657.4640 NORTH: 363497.1786

ELEVATION: SURFACE: 9.60 TOP OF STEEL CASING: —

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3¼ ID		4/14/96	0-15	70's SUNNY	6	0 Hrs.
LENGTH			5 FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded	0	5
Well Screen	1"	PVC Slotted	5	15

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL SOCK 0.0 TO 15.0 FT	
2								
3							WELL CASING 0.0 TO 5.0 FT	
4								
5	A-N					SEE BORING LOG TW22-B FOR SOIL INFORMATION	WELL SCREEN FROM 5.0 FT TO 15.0	4.60
6								
7								
8								
9								
10								

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF WALLY BAKER REP.: BRIAN E. DAVIS

TW 22-A

TEST BORING AND WELL CONSTRUCTION RECORD

Baker

Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW22-A

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger, T = Shelby Tube, W = Wash, R = Air Rotary, C = Core, D = Denison, P = Piston, N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
11						Continued from Sheet 1	WELL SOCK 0.0 TO 15.0 FT	
12	A-N					SEE BORING LOG TW22-A FOR SOIL INFORMATION	WELL SCREEN FROM 5.0 TO 15.0	
13								
14								
15 (15.0)						END OF BORING @ 15.0 FT	BOTTOM PLUG	-5.40
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: WALLY BORING NO.: TW22-A SHEET 2 OF 2

Baker
Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI-CTO 232-SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 22-B
COORDINATES: EAST: 2465657.4640 NORTH: 363497.1786
ELEVATION: SURFACE: 9.60 TOP OF STEEL CASING: -

RIG: CME 850 TRACK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43IN		3¼ ID		4/14/96	0-16	70's Sunny	6	0HR
LENGTH	2FT.		5'		4/15/96	16-38	60's Sunny	6	0HR
TYPE	SS.		HS						
HAMMER WT.	140 lbs								
FALL	30IN								
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" dia.	0	33
Well Screen	1"	PVC Slotted 0.01" slot	33	38

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
1 – 2.0	S-1	1.0	WOH WOH 1 1		<1	SAND, FINE GRAIN, GREY, BROWN, FEW ROOTS, DAMP TO MOIST, LOOSE	WELL SOCK FROM 0.0 FT to 38.0 FT	
						3.0	WELL CASING FROM 0.0 FT TO 33.0 FT	6.60
2 – 4.0	S-2	1.5	1 1 1 1		<1	SAND AND SILT, LITTLE CLAY, BROWN, GREY MOTTLED, MOIST, SOFT		
4 – 6.0	S-3	2.0	1 2 2 2		<1	SAND AND SILT, FINE GRAIN, SOME CLAY BROWN, GREY, MOTTLED, MOIST TO WET		
						7.0		2.60
6 – 8.0	S-4	2.0	1 2 2 3		<1	SAND, FINE GRAIN, LITTLE MEDIUM GRAIN, BROWN, GREY MOTTLED, WET		
8 – 10.0	S-5	2.0	WOT WOT WOT 1		<1			

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
CHIP TW22-B

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc.

PROJECT: SGI-CTO232-SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW22-B

SAMPLE TYPE		DEFINITIONS
S = Split Spoon	A = Auger	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
T = Shelby Tube	W = Wash	RQD = Rock Quality Designation (%)
R = Air Rotary	C = Core	Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
D = Denison	P = Piston	Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis
N = No Sample		

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu (ppm) ~~Lab. Moist %~~	Visual Description	Well Installation Detail	Elevation
						Continued from Sheet 1		
11–12.0	S-6	1.5	1 1 1 1		<1	SAND, FINE GRAIN, GREY, BROWN, WET LITTLE SILT.	WELL SOCK FROM 0.0 TO 38.0 FT	
12.0–14.0	S-7	2.0	12 28 8 6		<1	SAND, FINE GRAIN, GREY, BROWN LITTLE SILT, WET MEDIUM DENSE	WELL CASING FROM 0.0 TO 33.0 FT	
14.0–16.0	S-8	2.0	3 5 8 10		<1	SAND, FINE GRAIN, GREY, GREEN, BROWN, WET MEDIUM DENSE 15.5		-5.
						SAND, FINE AND MEDIUM GRAIN, GREY WET. LITTLE SHELL FRAGMENTS 16.5		-6.90
16.0–18	S-9	2.0	4 7 8 10		<1	SAND, FINE GRAIN, SOME SILT, TRACE CLAY, LIMESTONE AND SHELL FRAGMENTS, BROWN, GREY, WET, MEDIUM DENSE 18.0		-8.40
18–20.0	S-10	2.0	14 14 17 19		<1	SAND, FINE GRAIN, LITTLE MEDIUM GRAIN, TRACE SILT, BROWN, GREY, WET		
20.0–22.0	S-11	2.0	12 24 25 12		<1	SAND, FINE AND MEDIUM GRAIN. LITTLE COARSE GRAIN, TRACE SILT, BROWN, GREY, WET, FEW SHELL AND LIMESTONE FRAGMENTS, FEW PARTIALLY CEMENTED LIMESTONE/SHELL FRAGMENTS, DENSE		
22.0–24.0	S-12	2.0	15 10 14 23		<1	SAND, FINE AND MEDIUM GRAIN, LITTLE SILT, WET, GREY, FEW SHELL AND LIMESTONE FRAGMENTS, DENSE [illegible]		
24.0–26.0	S-13	1.0	14 23 23 30		<1	SAND, FINE GRAIN, LITTLE MEDIUM GRAIN, SOME SILT, FEW LIMESTONE AND SHELL FRAGMENTS GREY, GREEN, WET, DENSE TO [illegible] DENSE		
26.0–28.0	S-14	2.0	29 15 10 10		<1	SAND, FINE GRAIN, LITTLE MEDIUM GRAIN SOME SILT, FEW LIMESTONE AND SHELL FRAGMENTS, GREY, WET, DENSE		
28.0–30.0	S-15	2.0	15 31 15 13		<1	SAND, FINE AND MEDIUM GRAIN, LITTLE SILT, LIMESTONE AND SHELL FRAGMENTS GREY, [illegible] WET, DENSE SOME [illegible]		
						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF
DRILLER: CHIP
BAKER REP.: BRIAN E. DAVIS
BORING NO.: TW22-B
SHEET 2 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc.

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-~~03~~600 BORING NO.: TW22-B

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS
SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
31 – 32.0	S-16	2.0	16, 13, 14, 16		<1	Continued from Sheet 2. SAND, FINE AND MEDIUM GRAIN, SOME COARSE GRAIN, TRACE SILT, LIMESTONE AND SILT FRAGMENTS; SOME CEMENTED LIMESTONE FRAGMENTS	WELL SOCK FROM 0.0 TO 38.0 FT	
32 – 34.0	S-17	2.0	13, 15, 17, 22		<1	SAND, FINE AND MEDIUM GRAIN, LIMESTONE AND SHELL FRAGMENTS, LITTLE CEMENTED LIMESTONE FRAGMENTS, DENSE TO VERY DENSE, LITTLE SILT, GREY, GREEN, WET	WELL CASING FROM 0.0 TO 33.0 FT	-23.40
34 – 36.0	S-18	2.0	10, 12, 14, 15		<1	SAND, FINE AND MEDIUM GRAIN, LIMESTONE AND SHELL FRAGMENTS, SOME SILT, LITTLE PARTIALLY CEMENTED LIMESTONE FRAGMENTS, MEDIUM DENSE, GREY, GREEN, WET	WELL SCREEN FROM 33.0 TO 38.0 FT	
36 – 38.0	S-19	1.5	13, 14, 16, 18		<1	37.0 SAND, SOME SILT, LITTLE CLAY, GREEN, MEDIUM DENSE, WET	BOTTOM PLUG	-28.40
38						END OF BORING @ 38.0 FT		

Depth scale: 31 – 50

DRILLING CO.: PARRATT WOLFF
DRILLER: [illegible]
BAKER REP.: BRIAN E. DAVIS
BORING NO.: TW22-B
SHEET 3 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI-CTO232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW-22C

COORDINATES: EAST: 2465657.4640 NORTH: 363497.1786

ELEVATION: SURFACE: 9.60 TOP OF STEEL CASING: -

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3¼ ID		4/15/96	0-26.5	60's cloudy	6	0 hrs.
LENGTH			5 FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" Dia	0	21.5
Well Screen	1"	PVC Slotted 0.01" Slot	21.5	26.5

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL SOCK FROM 0.0 TO 26.5 FT.	
2								
3								
4							WELL CASING FROM 0.0 TO 21.5 FT	
5	A-N					SEE BORING LOG TW-22C FOR SOIL INFORMATION		
6								
7								
8								
9								
10						Match to Sheet 2		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E DAVIS

DRILLER: CHIP BORING NO.: TW-22C SHEET 1 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker

Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW-22C

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
11						Continued from Sheet 1	WELL SOCK FROM 0.0 TO 26.5FT	
12								
13							WELL CASING FROM 0.0 TO 21.5FT	
14								
15								
16								
17								
18								
19	A-N					SEE BORING LOG TW-22C FOR SOIL INFORMATION	WELL SCREEN FROM 21.5 TO 26.5FT	
20								
21								-11.90
22								
23								
24								
25								
26 26.5							BOTTOM PLUG	-16.90
27						END OF BORING @ 26.5 FT		
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW-22C SHEET 2 OF 2

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 64270-232-0000-03600 BORING NO.: TW 23-A

COORDINATES: EAST: 2465610.9966 NORTH: 363543.1637

ELEVATION: SURFACE: 9.10 TOP OF STEEL CASING: –

RIG: MOBILE 55 TRUCK MOUNT					DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
	SPLIT SPOON	CASING	AUGERS	CORE BARREL					
SIZE (DIAM.)			3 1/4 ID		4-14-95	0-15	70's SUNNY	6	0 Hrs.
LENGTH			5 FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1.0" dia	0	5
Well Screen	1"	PVC Slotted 0.01" SLOT	5	15

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL SOCK FROM 0.0 TO 15.0 FT	
2								
3							WELL CASING FROM 0.0 TO 5.0 FT	
4						SEE BORING LOG TW 23-C		
5	A-N					FOR SOIL INFORMATION	WELL SCREEN FROM 5.0 TO 15.0 FT	4.10
6								
7								
8								
9								
10						Match to Sheet 2		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW 23-A SHEET 1 OF 2

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 64270 - 232 - 0000 - 03600 BORING NO.: TW 23-A

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
11						Continued from Sheet 1	WELL SOCK FROM 5.0 TO 15.0 FT	
12						SEE BORING LOG TW 23-B FOR SOIL INFORMATION		
13	A-N						WELL SCREEN FROM 5.0 TO 15.0 FT	
14								
15 (15.0)							BOTTOM PLUG	-5.90
16						END OF BORING @ 15.0 FT		
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW 23-A SHEET 2 OF 2

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW23 -B
COORDINATES: EAST: 2465610.9966 NORTH: 363543.1637
ELEVATION: SURFACE: 9.10 TOP OF STEEL CASING: –

RIG: CME 850 TRACK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43 IN.		3/4 ID		4/14/96	0 - 35.0	70's SUNNY	6	0 Hrs.
LENGTH	2 FT		5 FT						
TYPE	SS		HS						
HAMMER WT.	140 lbs.								
FALL	30 IN.								
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" dia	0	30
Well Screen	1"	PVC Slotted 0.01" slot	30	35

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist~~ % ppm	Visual Description	Well Installation Detail	Elevation
0–2.0	S-1	2.0	1, 1, 1, 2			SAND, FINE GRAIN, LITTLE SILT, BROWN, BLACK, GREY. FEW ROOTS, SOFT, MOIST	WELL SOIL FROM 0.0 TO 35.0 FT	
2.0–4.0	S-2	1.0	1, 1, 1, 1			SAND, FINE GRAIN, LITTLE SILT, BLACK, GREY. TRACE CLAY. FEW ROOTS	WELL CASING FROM 0.0 TO 30.0 FT	
4.0–6.0	S-3	1.5	3, 3, 3, 4			SAND, FINE GRAIN, LITTLE SILT, BROWN TRACE CLAY, WET - - - - - - - - - - - - SWT SAND, FINE GRAIN, LITTLE SILT, GREY WET, SOFT 6.5		3.6 4.6
6.0–8.0	S-4	2.0	3, 3, 2, 6			SAND AND SILT, LITTLE CLAY. BROWN GREY. MOTTLED, MOIST TO WET, SOFT TO MEDIUM STIFF		
8.0–10.0	S-5		4, 4, 4, 3			SAND AND SILT, SOME CLAY, BROWN GREY, WET 9.0 SAND, FINE GRAIN, LITTLE SILT, GREY LOOSE TO MEDIUM DENSE, WET		0.10

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW23-B SHEET 1 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker

Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW23-B

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
10.0–12.0	S-6	2.0	2 3 3 4		<1	Continued from Sheet 1 SAND, FINE GRAIN, SOME MEDIUM GRAIN GREY, WET, MEDIUM DENSE	WELL SOCK FROM 0.0 TO 35.0 FT	
12.0–14.0	S-7	2.0	1 1 1 1		<1	SAND, FINE GRAIN, LITTLE MEDIUM GRAIN GREY to 13.0. BROWN&GREY From 13.0 to 14.0, WET	WELL CASING FROM 0.0 TO 30.0 FT	
14.0–16.0	S-8	<0.5	1 WOT WOT WOT		<1	SAND, GREY, WET 17.0		
16.0–18.0	S-9	1.0	2 3 10 23		<1	SAND, MEDIUM AND FINE GRAIN, Little Silt, trace Clay, GREY, SHELL AND LIMESTONE FRAGMENTS, WET DENSE, LITTLE PARTIALLY CEMENTED LIMESTONE FRAGMENTS		-7.90
18.0–20.0	S-10	2.0	30 22 15 16		<1	SAND, MEDIUM AND FINE GRAIN, LITTLE COARSE GRAIN; LITTLE SILT, TRACE CLAY, GREY SHELL, PARTIALLY CEMENTED LIMESTONE FRAGMENTS, DENSE		
20.0–22.0	S-11	2.0	20 21 21 22		<1	SAND, MEDIUM AND FINE GRAIN, SOME COARSE GRAIN, LITTLE SILT, SHELL AND LIMESTONE FRAGMENTS, WET, DENSE		
22.0–24.0	S-12	2.0	28 30 31 32		<1	SAND, MEDIUM AND FINE GRAIN, SOME COARSE SAND, LITTLE TO TRACE SILT, FEW SHELL AND LIMESTONE FRAGMENTS, WET, DENSE		
24.0–26.0	S-13	2.0	18 20 23 25		<1	SAND, MEDIUM AND FINE GRAIN, LITTLE COARSE SAND, FEW SHELL FRAGMENTS VERY DENSE, WET		
26.0–28.0	S-14	2.0	17 18 28 33		<1	SAND, MEDIUM AND FINE GRAIN, LITTLE COARSE SAND, FEW SHELL FRAGMENTS, VERY DENSE, WET, TRACE SILT		
28.0–30.0	S-15	2.0	9 12 15 21		<1	SAND, MEDIUM AND FINE GRAIN, SOME SILT, FEW SHELL FRAGMENTS, GREY, GREEN, LITTLE TO FEW LIMESTONE FRAGMENTS MEDIUM DENSE Match to Sheet 3	WELL SCREEN FROM 30.0 TO 35.0 FT	-20.90

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. OAKS

DRILLER: CHIP BORING NO.: TW23-B SHEET 2 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc.

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 23-B

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS
SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
31–32 (32.0)	S-16	2.0	10 10 11 12		4	Continued from Sheet 2 SAND, MEDIUM AND FINE GRAIN, LITTLE COARSE GRAIN, SOME SILT, SHELL AND LIMESTONE FRAGMENTS, GREY, GREEN, WET, MEDIUM DENSE TO DENSE	WELL SOCK FROM 0.0 TO 35.0 FT WELL SCREEN FROM 30.0 FT TO 35.0 FT	
32–34 (34.0)	S-17	2.0	10 12 28 42		<1	SAND, MEDIUM AND FINE GRAIN, LITTLE COARSE GRAIN, LITTLE TO SOME SILT, GREY, GREEN, SHELL AND LIMESTONE FRAGMENTS, WET, DENSE TO VERY DENSE LITTLE PARTIALLY CEMENTED LIMESTONE AND SHELL FRAGMENTS 34.5		
34–36 (36.0)	S-18		7 15 10 12			SAND, FINE GRAIN, SOME SILT, LITTLE CLAY GREEN, WET 36.0	BOTTOM PLUG HOLE CAVED FROM 36.0 TO 35.0 FT	-25.40 -25.90 -26.90
36–50						END OF BORING @ 36.0 FT		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW 23-B SHEET 3 OF 3

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI-CTO 232 -SCREENING
S.O. NO.: 62470-232-0000-03600
BORING NO.: TW23-C
COORDINATES: EAST: 2465610.9966
NORTH: 363543.1637
ELEVATION: SURFACE: 9.10
TOP OF STEEL CASING: -

RIG: MOBILE55 TRUCK MOUNT									
	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3¼" ID		4-14-96	0 - 25	70's Sunny	6	0 hrs.
LENGTH			5 ft						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded	0	20
Well Screen	1"	PVC Slotted	20	25

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL SOCK FROM 0.0 TO 25 FT	
2								
3								
4							WELL CASING FROM 0.0 TO 20.0 FT	
5	AN					SEE BORING LOG TW23-B FOR SOIL INFORMATION		
6								
7								
8								
9								
10						Match to Sheet 2		

DRILLING CO.: PARRATT WOLFF
WALLY

BAKER REP.: BRIAN E DAVIS
TW23-C

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW23-C

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger, T = Shelby Tube, W = Wash, R = Air Rotary, C = Core, D = Denison, P = Piston, N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5'); RQD = Rock Quality Designation (%); Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
11						Continued from Sheet 1	WELL SOCK FROM 0.0 TO 25.0 FT	
12								
13								
14							WELL CASING FROM 0.0 TO 20.0 FT	
15								
16								
17						SEE BORING LOG TW23-B FOR SOIL INFORMATION		
18	A-N							
19								
20							WELL SCREEN FROM 20.0 TO 25.0 FT	-10.90
21								
22								
23								
24								
25	25.0						25.0	-15.90
26						END OF BORING @ 25.0 FT		
27								
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: WALLY BORING NO.: TW23-C SHEET 2 OF ?

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI -CTO 232- SCREENING
S.O. NO.: 62470-232-
BORING NO.: TW24-A
COORDINATES: EAST: 2465591.8938
NORTH: 363601.7530
ELEVATION: SURFACE: 10.70
TOP OF STEEL CASING: -

RIG: CME 850 TRACK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3 1/4 ID		4-14-96	0-15	70's SUNNY	6	0 hrs.
LENGTH			5FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon
T = Shelby Tube
R = Air Rotary
D = Denison
A = Auger
W = Wash
C = Core
P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" dia.	0	5
Well Screen	1"	PVC Slotted 0.01" SLOT	5	15

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL SOCK FROM 0.0 TO 15.0 FT	
2								
3							WELL CASING FROM 0.0 TO 5.0 FT	
4								
5	AN					SEE BORING LOG TW24-B FOR SOIL INFORMATION		5.70
6							WELL SCREEN FROM 5.0 TO 15.0 FT	
7								
8								
9								
10								

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF
BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP
BORING NO.: TW24-A
SHEET 1 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGT - CTO 232 - SCREENING
S.O. NO.: 62470 - 232 - 0000 - 03600 BORING NO.: TW 24-A

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; A = Auger; T = Shelby Tube; W = Wash; R = Air Rotary; C = Core; D = Denison; P = Piston; N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5'); RQD = Rock Quality Designation (%); Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
11						Continued from Sheet 1	WELL SOCK FROM 0.0 TO 15.0 FT	
12	A-N					SEE BORING LOG TW24-B FOR SOIL INFORMATION	WELL SCREEN FROM 5.0 TO 15.0 FT	
13								
14								
15 (15.0)						END OF BORING @ 15 FT	BOTTOM PLUG	-4.30
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW 24-A SHEET 2 OF 2

Baker
Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW24-B
COORDINATES: EAST: 2465591.8938 NORTH: 363601.7530
ELEVATION: SURFACE: 10.70 TOP OF STEEL CASING: -

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43 IN		3¼ ID		4/14/96	0 - 40	70's SUNNY	6	0 Hrs
LENGTH	2 FT		5 FT						
TYPE	SS		HS						
HAMMER WT.	140 lbs.								
FALL	30 IN.								
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" dia	0	35
Well Screen	1"	PVC Slotted 0.01" SLOT	35	40

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	HNU ~~Lab. Moist %~~ (PPM)	Visual Description	Well Installation Detail	Elevation
0-2.0	S-1	2.0	WOR ~~15~~ 1		<1	SAND, FINE GRAIN, LITTLE SILT, GREY BLACK BROWN, SOFT, MOIST	WELL SOCK FROM 0.0 TO 40.0 FT	
2.0-4.0	S-2	2.0	1 1 1 3		<1	SAND, FINE GRAIN, LITTLE SILT, GREY, BROWN, SOFT, MOIST 4.0	WELL CASING FROM 0.0 TO 35.0 FT	6.70
4.0-6.0	S-3	2.0	3 4 4 4		<1	SAND, SOME SILT, BROWN, GREY, MOTTLED, WET, TRACE CLAY		
6.0-8.0	S-4	1.0	2 3 4 6		<1	SAND, SOME SILT, LITTLE TO TRACE CLAY, BROWN, WET 8.5		2.2
8.0-10.0	S-5	2.0	2 3 3 2			SAND, FINE AND MEDIUM GRAIN, LITTLE SILT, TRACE CLAY, GREY, SOFT, WET		

Match to Sheet 2

DRILLING CO.: PARRATT WOLFE BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW24-B SHEET 1 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc.

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW24-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, T = Shelby Tube, R = Air Rotary, D = Denison, A = Auger, W = Wash, C = Core, P = Piston, N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
						Continued from Sheet 1		
11–12.0	S-6	2.0	2, 4, 4, 4		<1	SAND, FINE GRAIN, LITTLE MEDIUM GRAIN, GREY, BROWN, SOFT	WELL SOCK FROM 0.0 TO 40.0 FT	
12.0–14.0	S-7	2.0	2, 2, 4, 6		<1	SAND, FINE GRAIN, LITTLE MEDIUM GRAIN GREY, BROWN, WET, SOFT — — 13.0 Sand, FINE AND MEDIUM GRAIN, LITTLE TO TRACE SILT, WET BROWN FROM 13.0 TO 13.5 FT (possible petroleum Staining)	WELL CASING FROM 0.0 TO 35.0 FT	-2.80
14.0–16.0	S-8	2.0	6, 7, 5, 7		<1	Sand, FINE Grain, LITTLE MEDIUM Grain, Little silt, BROWN, WET		
16.0–18.0	S-9	2.0	5, 7, 8, 9		<1	17.5		-6.80
18.0–20.0	S-10	2.0	24, 24, 25, 27		<1	SAND, MEDIUM AND FINE GRAIN, LITTLE SILT TRACE CLAY, GREY, SOME SHELL AND LIMESTONE FRAGMENTS GREY, WET, MEDIUM DENSE, LITTLE PARTIALLY CEMENTED LIMESTONE FRAGMENTS		
20.0–22.0	S-11	1.5	14, 16, 23, 24		<1			
22.0–24.0	S-12	2.0	14, 18, 19, 23		<1	SAND, MEDIUM AND FINE GRAIN, LITTLE SILT, GREY. SOME SHELL AND LIMESTONE FRAGMENT. LITTLE PARTIALLY CEMENTED LIMESTONE, VERY DENSE, WET		
24.0–26.0	S-13	2.0	20, 22, 28, 13		<1	~~GREY~~ - - - - - - - - 25.5 SAND, MEDIUM AND FINE GRAIN, LITTLE SILT, GREY; GREEN, SHELL AND LIMESTONE FRAGMENT, DENSE, WET PARTIALLY CEMENTED SHELL AND LIMESTONE FRAGMENTS		-14.80
26.0–28.0	S-14	2.0	18, 22, 18, 19		<1			
28.0–30.0	S-15		14, [illegible], 14, 18		<1	SAND, MEDIUM AND FINE GRAIN, SOME SILT SHELL AND LIMESTONE FRAGMENTS, GREEN GREY, PARTIALLY CEMENTED, DENSE WET		

Match to Sheet 3

DRILLING CO.: PARRATT WOLFE BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW 24-B

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI-CTO232-SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW-24B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger, T = Shelby Tube, W = Wash, R = Air Rotary, C = Core, D = Denison, P = Piston, N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows 0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
31–32.0	S-16	1.0	4 4 4 8		<1	Continued from Sheet 2 SAND, FINE AND MEDIUM GRAIN, LITTLE SILT, GREY, SHELL AND LIMESTONE FRAGMENTS, LITTLE CEMENTATION, WET, MEDIUM DENSE	WELL SOCK FROM 0.0 TO 40.0 FT	
32.0–34.0	S-17	1.5	12 24 15 20		<1	33.5 SAND, FINE GRAIN, SOME SILT, LITTLE CLAY, GREY 34.0	WELL CASING FROM 0.0 TO 35.0 FT	-22.80 -23.30
34.0–36.0	S-18	2.0	10 10 10 10		<1	SAND, FINE AND MEDIUM GRAIN, LITTLE COARSE GRAIN, SHELL AND LIMESTONE FRAGMENTS, LITTLE CEMENTATION, WET, MEDIUM DENSE	WELL SCREEN FROM 35.0 TO 40.0 FT	
36.0–38.0	S-19	2.0	13 16 20 20		<1	SAND, MEDIUM AND FINE, LITTLE COARSE GRAIN, SHELL AND LIMESTONE FRAGMENTS, LITTLE CEMENTATION, WET MEDIUM DENSE TO DENSE 38.0		-27.30
38.0–40.0	S-20	2.0	3 4 4 4		<1	SAND, SOME SILT, LITTLE CLAY, GREEN, WET, MEDIUM DENSE,	BOTTOM PLUG	-29.30
40–50						END OF BORING @ 40.0 FT		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW-24B SHEET 3 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600
BORING NO.: TW24-C
COORDINATES: EAST: 2465591.8938
NORTH: 363601.7530
ELEVATION: SURFACE: 10.70
TOP OF STEEL CASING: –

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3¼ ID		4/14/96	0 – 27.5	70's SUNNY	6	0 HRS
LENGTH			5FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon
T = Shelby Tube
R = Air Rotary
D = Denison
A = Auger
W = Wash
C = Core
P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" dia.	0	22.5
Well Screen	1"	PVC Slotted 0.01 SLOT	22.5	27.5

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL SOCK	
2							FROM 0.0 TO 27.5 FT	
3							WELL CASING	
4							FROM 0.0	
5	A-N					SEE BORING LOG TW24-B FOR SOIL INFORMATION	TO 22.5 FT.	
6								
7								
8								
9								
10						Match to Sheet 2		

DRILLING CO.: PARRATT WOLFE
BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP
BORING NO.: TW24-C
SHEET 1 OF 2

Baker
Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW24-C

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger, T = Shelby Tube, W = Wash, R = Air Rotary, C = Core, D = Denison, P = Piston, N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
						Continued from Sheet 1	WELL SOCK FROM 0.0 TO 27.5 FT	
11								
12								
13							WELL CASING FROM 0.0 TO 22.5 FT	
14								
15								
16								
17								
18	A-N					SEE BORING LOG TW24-B FOR SOIL INFORMATION		
19								
20							WELL SCREEN FROM 22.5 TO 27.5	
21								
22								-11.80
23								
24								
25								
26								
27	27.5						BOTTOM PLUG	-16.80
28						END OF BORING @ 27.5		
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF
DRILLER: CHIP
BAKER REP.: BRIAN E. DAVIS
BORING NO.: TW24-C

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI-CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 25-A

COORDINATES: EAST: 2465570.6022 NORTH: 363625.9719

ELEVATION: SURFACE: 11.10 TOP OF STEEL CASING: -

RIG: MOBILE 55 TRUCKMOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3 1/4 ID		4/13/96	0-15	70's SUNNY	6	0 hrs.
LENGTH			5 FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" dia.	0	10
Well Screen	1"	PVC Slotted 0.01 SLOT	10	15

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1								
2								
3								
4								
5	A-N					SEE BORING LOG TW25-B FOR SOIL INFORMATION		
6								
7								
8								
9								
10						Match to Sheet 2		1.10

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW 25-A SHEET 1 OF 2

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW25-A

SAMPLE TYPE

S = Split Spoon, A = Auger
T = Shelby Tube, W = Wash
R = Air Rotary, C = Core
D = Denison, P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
11						Continued from Sheet 1		
12								
13	A-N							
14								
15 (1510)							BOTTOM PLUG	-3.90
16						END OF BORING @ 15.0 FT		
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW25-A SHEET 2 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc.

PROJECT: SGI-CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600
BORING NO.: TW-25-B
COORDINATES: EAST: 2465570.6022
NORTH: 363625.9719
ELEVATION: SURFACE: 11.10
TOP OF STEEL CASING: -

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43		3¼ ID		4/13/96	0 - 40	70's SUNNY	6.5	0 hrs.
LENGTH	2 FT		5 FT						
TYPE	SS		HS						
HAMMER WT.	140 lbs.								
FALL	30 in.								
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" Dia	0	35
Well Screen	1"	PVC Slotted 0.01 slot	35	40

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	HNU ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
0-2.0	S-1	2.0	1 1 2 3		<1	SAND, FINE GRAIN, SOME SILT, TRACE CLAY BLACK, BROWN, SOFT, FEW ROOTS DAMP, LOOSE	WELL SOCK FROM 0.0 TO 40.0 FT WELL CASING FROM 0.0 FT TO 35.0 FT	
2.0-4.0	S-2	2.0	3 3 3 3		<1	SAND, FINE GRAIN, SOME SILT, TRACE CLAY, BROWN, MOIST, LOOSE TO MEDIUM DENSE		
4.0-6.0	S-3	2.0	6 4 4 2		<1	4.5 SAND, FINE GRAIN, SOME SILT, LITTLE CLAY BROWN, GREY, WET, MOTTLED, SOFT		6.60
6.0-8.0	S-4	2.0	5 3 3 5		<1	SAND, FINE GRAIN, SOME SILT AND CLAY, BROWN, GREY, WET, MOTTLED, SOFT		
8.0-10.0	S-5	2.0	8 3 5 4		<1	8.5 SILT AND CLAY, BROWN, BLACK, GREY MOTTLED, LITTLE SAND, WET, SOFT 9.0 SAND, FINE AND MEDIUM GRAIN, LITTLE SILT TRACE CLAY, SOFT, GREY		2.60 3.10

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF
BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP
BORING NO.: TW 25-B
SHEET 1 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-02600 BORING NO.: TW25-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; A = Auger; T = Shelby Tube; W = Wash; R = Air Rotary; C = Core; D = Denison; P = Piston; N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5'); RQD = Rock Quality Designation (%); Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab.~~ Moist % (ppm)	Visual Description	Well Installation Detail	Elevation
11–12.0	S-6	2.0	3 3 3 3		<1	Continued from Sheet 1 SAND, FINE GRAIN, GREY, BROWN, WET LITTLE SILT TRACE CLAY. 12.0		-0.90
12.0–14.0	S-7	2.0	9 8 7 9		1	SAND, FINE GRAIN, LITTLE MEDIUM GRAIN, LITTLE to trace silt, GREY, BROWN, WET MEDIUM DENSE LITTLE BROWN LAYER FROM 12.5 to 13.5 FT - SLIGHT PETROLEUM ODOR		
14.0–16.0	S-8	2.0	6 4 4 4		<1	SAND, FINE GRAIN, LITTLE MEDIUM GRAIN, LITTLE SILT, BROWN, WET, MEDIUM DENSE		
16.0–18.0	S-9	2.0	1 3 12 12		<1	18.5		-7.40
18.0–20.0	S-10	2.0	10 20 25 50/.4		<1	SAND, MEDIUM AND FINE GRAIN, LITTLE SILT, TRACE CLAY, GREY, SHELL AND LIMESTONE FRAGMENTS, DENSE BROWN FROM 19.0 TO 20.0 FT		
20.0–22.0	S-11	2.0	25 32 39 41		<1	SAND, MEDIUM AND FINE GRAIN, BROWN, GREY SHELL AND LIMESTONE FRAGMENTS 21.5 SAND AND GRAVEL, LITTLE SILT, TRACE CLAY, GREY, GREEN, SHELL AND LIMESTONE FRAGMENTS, VERY DENSE, WET PARTIALLY CEMENTED 22.0		-10.40 -10.90
22.0–24.0	S-12	1.5	12 36 39 41		<1	SAND, MEDIUM AND FINE GRAIN, LITTLE SILT, TRACE CLAY, GREY, SHELL AND LIMESTONE FRAGMENTS, DENSE FEW PARTIALLY CEMENTED FRAGMENTS		
24.0–26.0	S-13	1.0	46 50/.5			SAND, FINE AND MEDIUM GRAIN, LITTLE COARSE GRAIN, LIMESTONE AND SHELL FRAGMENTS GREY, GREEN, LITTLE CEMENTED FRAGMENTS WET, VERY DENSE		
26.0–28.0	S-14	1.5	36 36 50/.1		<1	SAND, FINE GRAIN, SOME MEDIUM GRAIN, LITTLE SILT, LIMESTONE AND SHELL FRAGMENTS, FEW CEMENTED FRAGMENTS GREY, GREEN, WET, VERY DENSE		
28.0–30.0	S-15	0.5	50/.5		<1	SAND, SHELL AND LIMESTONE FRAGMENTS PARTIALLY CEMENTED, GREY, GREEN, WET VERY DENSE Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
CHIP TW25-B

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 25-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; A = Auger T = Shelby Tube; W = Wash R = Air Rotary; C = Core D = Denison; P = Piston N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
31–32.0	S-16	1.5	39, 17, 15, 17		<1	Continued from Sheet SAND, FINE AND MEDIUM GRAIN, LITTLE COARSE GRAIN, GREY, GREEN, SHELL AND LIMESTONE FRAGMENTS, PARTIALLY CEMENTED, WET	WELL SOCK FROM 0.0 TO 40.0 FT	
32–34.0	S-17	1.5	23, 39, 39, 35		<1	SAND, FINE GRAIN, LITTLE MEDIUM GRAIN, GREY, GREEN, SHELL AND LIMESTONE FRAGMENTS, WET, VERY DENSE, LITTLE SILT	WELL CASING FROM 0.0 FT TO 35.0 FT	
34–36.0	S-18	2.0	18, 19, 24, 27		<1	SAND, FINE AND MEDIUM GRAIN, FEW COARSE GRAIN, GREY GREEN, TRACE SILT, WET, VERY DENSE, SHELL AND LIMESTONE FRAGMENTS, VERY DENSE TO DENSE, SOME PARTIALLY CEMENTED LIMESTONE FRAGMENTS	WELL SCREEN FROM 35.0 TO 40.0 FT	-23.90
36–38.0	S-19	2.0	19, 24, 26, 28		<1	SAND, FINE AND MEDIUM GRAIN; DENSE PARTIALLY CEMENTED LIMESTONE AND SHELL FRAGMENTS, WET, GREEN 38.0		
38–40.0	S-20	2.0	13, 16, 18, 14		<1	SAND, SOME SILT, FINE GRAIN, LITTLE CLAY, GREEN, WET MEDIUM DENSE 40.0	BOTTOM PLUG	-28.90
40						END OF BORING @ 40.0 FT		
41								
42								
43								
44								
45								
46								
47								
48								
49								

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW25-B SHEET 3 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI-CTO232-SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 25-C

COORDINATES: EAST: 2465570.6022 NORTH: 363625.9719

ELEVATION: SURFACE: 11.10 TOP OF STEEL CASING: -

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)		-	3¼ ID		4/14/96	0-27.5	70's SUNNY	6	0 hrs.
LENGTH			5 FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" dia.	0	
Well Screen	1"	PVC Slotted 0.01 SLOT	22.5	27.5

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1								
2								
3								
4								
5	A-N					SEE BORING LOG TW25-B FOR SOIL INFORMATION		
6								
7								
8								
9								
10								

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: TW25-C SHEET 1 OF 2

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 25-C

SAMPLE TYPE

S = Split Spoon
T = Shelby Tube
R = Air Rotary
D = Denison
A = Auger
W = Wash
C = Core
P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
11						Continued from Sheet 1	WELL SOCK FROM 0.0 TO 27.5 FT	
12								
13							WELL CASING FROM 0.0 FT TO 22.5 FT	
14								
15								
16						SEE BORING LOG TW25-B FOR SOIL INFORMATION		
17								
18	A-N							
19								
20								
21								
22							WELL SCREEN FROM 22.5 FT TO 27.5 FT	-11.40
23								
24								
25								
26								
27								
27.5						END OF BORING @ 27.5 FT	BOTTOM PLUG	-16.40
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF
CHIP

BAKER REP.: BRIAN E. DAVIS

TW 25-C

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc.

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW26-A
COORDINATES: EAST: 2465538.7507 NORTH: 363678.6989
ELEVATION: SURFACE: 10.80 TOP OF STEEL CASING: -

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3¼ IN		4/13/96	0-15	70's SUNNY	6	0 hrs.
LENGTH			5FT						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" DIA.	0	5
Well Screen	1"	PVC Slotted 0.01" SLOT	5	15

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1								
2								
3								
4						SEE BORING LOG TW26-B FOR SOIL INFORMATION		
5	A-N							5.80
6								
7								
8								
9								
10								

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E DAVIS
DRILLER: CHIP BORING NO.: TW 26-A SHEET 1 OF 2

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 26-A

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; A = Auger T = Shelby Tube; W = Wash R = Air Rotary; C = Core D = Denison; P = Piston N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
11						Continued from Sheet 1	WELL SOCK FROM 0.0 TO 15.0FT	
12	A-N					SEE BORING LOG TW26-B FOR SOIL INFORMATION	WELL SCREEN FROM 5.0 TO 15.0FT	
13								
14								
15	15.0						BOTTOM PLUG	-4.20
16						END OF BORING @ 15.0 FT		
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E DAVIS

DRILLER: CHIP BORING NO.: TW26-A SHEET 2 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker

Baker Environmental, Inc

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.:
BORING NO.: TW 26-B
COORDINATES: EAST: 2465538.7507 NORTH: 363678.6989
ELEVATION: SURFACE: 10.80 TOP OF STEEL CASING: –

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43 IN		3¼ ID		4/13/96	0 - 40	70's SUNNY	7.0	0 Hrs.
LENGTH	2 FT		5 FT						
TYPE	SS		HS						
HAMMER WT.	140 lbs.								
FALL	30 IN								
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded flush	0	35
Well Screen	1"	PVC Slotted 0.01" SLOT	35	40

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	HNU Lab. Moist % (PPM)	Visual Description	Well Installation Detail	Elevation
1–2.0	S-1	0.9	1 3 5 6		1	SAND, FINE GRAIN, BROWN, BLACK, MOIST. LITTLE SILT,	WELL SOCK FROM 0.0 TO 40.0 FT	
2–4.0	S-2	2.0	2 3 2 2		<1	SAND, FINE GRAIN, LITTLE SILT, BROWN, DAMP TO MOIST, SOFT	WELL CASING FROM 0.0 TO 35.0 FT	
4–6.0	S-3	1.5	6 5 7 8		<1	SAND FINE GRAIN, LITTLE SILT, BROWN, GREY, SOFT TO MEDIUM STIFF 6.5		4.30
6–8.0	S-4	2.0	4 5 5 6		<1	SAND, MEDIUM and FINE GRAIN, LITTLE SILT TRACE CLAY + BROWN, WET, 7.5		3.30
8–10.0	S-5		5 4 4 3		<1	SILT AND CLAY, GREY, BROWN, MOTTLED SOME FINE GRAIN SAND, MOIST TO WET 9.0		1.80
						SAND, FINE AND MEDIUM GRAIN, LITTLE SILT, TRACE CLAY, SOFT, WET		

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW 26-B SHEET 1 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - CTO - 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW26-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger T = Shelby Tube, W = Wash R = Air Rotary, C = Core D = Denison, P = Piston N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	HNU ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
11–12.0	S-6	1.0	3 3 3 3		<1	Continued from Sheet 1 SAND, FINE GRAIN, LITTLE SILT, TRACE CLAY, SOFT, WET, BROWN 13.0	WELL SOCK FROM 0.0 TO 40.0 FT WELL CASING FROM 0.0 TO 35.0 FT	-2.20
12–14.0	S-7	2.0	2 2 3 3		<1	SAND, FINE GRAIN, LITTLE MEDIUM GRAIN, LITTLE TO TRACE SILT, GREY, WET, LOOSE		
14–16.0	S-8	2.0	3 3 3 3		<1			
16–18.0	S-9	2.0	1 WOH WOH WOH		<1	SAND, FINE GRAIN, LITTLE TO TRACE MEDIUM GRAIN, LITTLE TO TRACE SILT, GREY/BROWN WET, LOOSE 17.5 SAND, FINE GRAIN, LITTLE TO SOME SILT, BROWN, WET, SOFT		-6.70
18–20.0	S-10	2.0	4 1 1 30		<1	18.5 SAND, MEDIUM AND FINE GRAIN, LITTLE SILT, TRACE CLAY, GREY, BROWN, SHELL FRAGMENTS, LIMESTONE FRAGMENTS DENSE		-8.70
20–22.0	S-11	1.0	10 14 24 28		<1	PARTIALLY CEMENTED SAND @ 21.5 TO 22.0 FT		
22–24.0	S-12	0.5	28 30 35 48		<1	SAND, MEDIUM AND FINE GRAIN, SOME COARSE GRAIN, BROWN, GREY, LIMESTONE FRAGMENTS, DENSE TO VERY DENSE, WET		
24–26.0	S-13	1.5	18 23 24 27		<1	SAND, MEDIUM AND FINE GRAIN, SOME COARSE GRAIN, GREY, GREEN, LIMESTONE AND SHELL FRAGMENTS, PARTIALLY CEMENTED DENSE TO VERY DENSE		
26–28.0	S-14	2.0	18 28 37 38		<1	SAND, FINE AND MEDIUM GRAIN, LITTLE COARSE GRAIN, GREY GREEN, TRACE SILT, LITTLE PARTIALLY CEMENTED, LIMESTONE AND SHELL FRAGMENTS, VERY DENSE, WET		
28–30.0	S-15		14 31 26 18		<1	SAND, MEDIUM AND FINE GRAIN, SOME COARSE & GREY, GREEN, TRACE SILT, SOME PARTIALLY CEMENTED LIMESTONE AND SHELL FRAGMENTS, VERY DENSE WET Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: PHIP BORING NO.: TW26-B

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc.

PROJECT: SGI - CTO232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 26-B

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D-1586) (Blows 0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist~~ (ppm)	Visual Description	Well Installation Detail	Elevation
31 – 32.0	S-16	2.0	14 17 16 18		<1	Continued from Sheet 2 SAND, MEDIUM AND FINE GRAIN, SOME COARSE GRAIN, GREY, GREEN, TRACE SILT, SOME PARTIALLY CEMENTED LIMESTONE AND SHELL FRAGMENTS, DENSE, WET	WELL SOCK FROM 0.0 TO 40.0 FT	
32 – 34.0	S-17	2.0	16 32 26 28		<1	SAND, FINE AND MEDIUM GRAIN, GREY, GREEN, TRACE SILT, LITTLE PARTIALLY CEMENTED LIMESTONE AND SHELL FRAGMENTS, VERY DENSE, WET	WELL CASING FROM 0.0 TO 35.0 FT	
34 – 36.0	S-18	2.0	10 24 21 20		<1	SAND, MEDIUM AND COARSE GRAIN, SOME FINE GRAIN, LIMESTONE AND SHELL FRAGMENTS GREEN, GREY, VERY DENSE, WET	WELL SOCK FROM 35.0 TO 40.0 FT	-24.20
36 – 38.0	S-19	2.0	32 44 42 42		<1	SAND, FINE AND MEDIUM GRAIN, SOME SILT, LITTLE CLAY, LIMESTONE AND SHELL FRAGMENTS, VERY DENSE, WET		
38 – 40.0	S-20	2.0	28 12 12 14		<1	39.5 SAND, FINE GRAIN, SOME SILT, GREEN, MEDIUM DENSE WET, TRACE CLAY END OF BORING @ 40.0	Bottom Plug	-28.70 -29.20

DRILLING CO.: PARRATT WOLFF
DRILLER: CHIP
BAKER REP.: BRIAN E. DAVIS
BORING NO.: TW 26-B
SHEET 3 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING

S.O. NO.: 62470-232-0000-03600 BORING NO.: TW26-C

COORDINATES: EAST: 2465538.7507 NORTH: 363678.6989

ELEVATION: SURFACE: 10.80 TOP OF STEEL CASING: -

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)			3¼ IN		4/13/96	0-27.5	70's SUNNY	6	0 Hrs
LENGTH			5 Ft						
TYPE			HS						
HAMMER WT.									
FALL									
STICK UP									

REMARKS:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded 1" dia	0	22.5
Well Screen	1"	PVC Slotted	22.5	27.5

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL SOCK FROM 0.0 TO 27.5 FT	
2								
3								
4							WELL CASING FROM 0.0 TO 22.5 FT	
5	A-N					SEE BORING LOG TW26-C FOR SOIL INFORMATION		
6								
7								
8								
9								
10								

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E DAVIS

DRILLER: CHIP BORING NO.: TW26-C SHEET 1 OF 2

Baker
Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - CTO 232 - SCREENING
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 26-C

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; A = Auger; T = Shelby Tube; W = Wash; R = Air Rotary; C = Core; D = Denison; P = Piston; N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows 0.5'); RQD = Rock Quality Designation (%); Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
						Continued from Sheet		
11							WELL SOIL FROM 0.0 to 27.5 FT	
12								
13								
14							WELL CASING FROM 0.0 TO 22.5 FT	
15								
16								
17						SEE BORING LOG TW 26-C FOR SOIL INFORMATION		
18								
19	A-N							
20								
21								
22								
23							WELL SCREEN FROM 22.5 to 27.5 FT	-11.70
24								
25								
26								
27								
27.5						END OF BORING @ 27.5 FT	Bottom Plug	-16.70
28								
29								
30								

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW 26-C SHEET 2 OF 2

Baker
Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Supplemental Groundwater Investigation at Site 35 - MCBCLEJ
CTO NO.: 62470-232 BORING NO.: 35-TW27B
COORDINATES: EAST: 2465873.5482 NORTH: 363238.2230
ELEVATION: SURFACE: 11.9 TOP OF PVC CASING: 11.90

RIG: Mobile B-53	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT.)	WEATHER	WATER DEPTH (FT.)	TIME
SIZE (DIAM.)	1 3/8" ID	-	3 1/4" ID	-	4/25	0.0-40.0	Sunny; 50s	-	-
LENGTH	2'	-	5'	-					
TYPE	Stainless	-	HSA	-					
HAMMER WT.	140 lbs	-	-	-					
FALL	30"	-	-	-					
STICK UP	-	-	-	-					

REMARKS: Well shrouded with well sock material; boring allowed to collapse around well

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

Well Information	Diam.	Type	Top Depth (ft.)	Bottom Depth (ft.)
	1" OD	Sch. 40 PVC Riser	-	33.0
	1" OD	Sch. 40 PVC Screen	33.0	38.0

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab Class. or Pen. Rate	PID (ppm) PS/BG	Visual Description	Well Installation Detail	Elevation (ft. MSL)
0–2.0	S-1	1.1 55%	2 2 2 3	-	1.0/1.0	FINE SAND, some silt, trace clay; dark brown; loose; damp		
2.0–4.0	S-2	0.9 45%	2 2 3 2	-	1.0/1.0	3.8		8.1
4.0–6.0	S-3	1.8 90%	2 4 4 4	-	0.8/0.8	FINE SAND & CLAY, some silt; lt. brown; m. stiff; moist 5.4		6.5
6.0–8.0	S-4	1.6 80%	6 6 6 6	-	0.8/0.8	FINE SAND, some silt & clay; lt. brown; m. stiff; moist to wet 6.9 FINE SAND, little silt, trace clay; gray; m. stiff 8.0	▽	5.0 3.9
8.0–10.0	S-5	1.0 50%	4 5 3 4	-	0.8/0.8	CLAY & SILT, trace fine sand-mottled; brown & gray; m. stiff; damp		
						Match Sheet 2		

DRILLING CO.: Parratt-Wolff BAKER REP.: Mark DeJohn
DRILLER: Chip Lafever BORING NO.: 35-TW27B SHEET 1 OF 3

Baker
Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Supplemental Groundwater Investigation at Site 35 - MCBCLEJ
CTO NO.: 62470-232 BORING NO.: 35-TW27B

SAMPLE TYPE		DEFINITIONS
S = Split Spoon	A = Auger	SPT = Standard Penetration Test (ASTM D-1586)(Blows/0.5')
T = Shelby Tube	W = Wash	RQD = Rock Quality Designation (%)
R = Air Rotary	C = Core	Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
D = Denison	P = Piston	Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis
N = No Sample		

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab Class. or Pen. Rate	PID (ppm) PS/BG	Visual Description	Well Installation Detail	Elevation (ft. MSL)
11–12.0	S-6	0.9 45%	3 3 3 4	-	0.8/0.8	Continued from Sheet 1 — 12.0		-0.1
12–14.0	S-7	1.4 70%	3 2 3 4	-	0.8/0.8	FINE SAND, some silt & clay; trace coarse sand; brown; gray; wet — 14.0		-2.1
14–16.0	S-8	2.0 100%	3 2 2 4	-	1.0/0.8	CLAY & SILT, little fine sand - mottled; brown & gray; soft; wet		
16–18.0	S-9	2.0 100%	2 3 3 4	-	1.0/0.8	18.0		-6.1
18–20.0	S-10	1.3 65%	2 1 2 1	-	1.0/0.8	CLAY, trace silt; dk gray; m. stiff; damp — 19.7		-7.8
20–22.0	S-11	1.8 90%	1 2 2 2	-	1.2/0.8	20.0 — FINE SAND, some silt & clay; dk gray; v. loose; wet		-8.1
22–24.0	S-12	1.6 80%	2 3 3 5	-	1.0/0.8	SILT, little to some clay, trace fine sand & leaves; dk red/brown; m. stiff; moist — 23.5		-11.6
24–26.0	S-13	0.6 30%	2 3 4 3	-	1.0/1.0	FINE SAND, some silt, little clay; dk gray; loose; wet		
26–28.0	S-14	2.0 100%	WOT 1 2 1	-	0.8/0.8	trace clay — 27.6		-15.7
28–30.0	S-15	0.6 30%	13 20 24 26	-	0.8/0.8	Match Sheet 3		

DRILLING CO.: Parratt-Wolff BAKER REP.: Mark DeJohn
DRILLER: Chip Lafeyer BORING NO.: 35-TW27B SHEET 2 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Supplemental Groundwater Investigation at Site 35 - MCBCLEJ

CTO NO.: 62470-232 BORING NO.: 35-TW27B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; A = Auger; T = Shelby Tube; W = Wash; R = Air Rotary; C = Core; D = Denison; P = Piston; N = No Sample	**SPT** = Standard Penetration Test (ASTM D-1586)(Blows/0.5'); **RQD** = Rock Quality Designation (%); **Lab. Class.** = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); **Lab. Moist.** = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab Class. or Pen. Rate	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
31–32.0	S-16	0.8 40%	13 2 2 1	-	0.8/0.8	Continued from Sheet 2 SHELL FRAGMENTS - partially cemented, little fine sand & silt; lt gray to gray; v. loose to v. dense; wet		
32.0–34.0	S-17	0.8 40%	2 2 2 12	-	0.8/0.8		33.0	-21.1
34.0–36.0	S-18	1.7 85%	13 14 13 17	-	0.8/0.8			
36.0–38.0	S-19	1.8 90%	14 40 42 45	-	0.8/0.8	38.0	38.0	-26.1
38.0–40.0	S-20	1.6 80%	15 10 10 9	-	0.8/0.8	FINE SAND, some silt, little clay; gray; v. stiff; damp 40.0	40.0	-28.1
40–50						BOH @ 40.0 ft		

DRILLING CO.: Parratt-Wolff BAKER REP.: Mark DeJohn

DRILLER: Chip Lafever BORING NO.: 35-TW27B SHEET 3 OF 3

Baker
Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - GROUNDWATER SCREENING - CTO 232
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW28-B
COORDINATES: EAST: 2465957.9580 NORTH: 363206.6879
ELEVATION: SURFACE: 11.50 TOP OF STEEL CASING: -

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43 IN.		3¼ ID		4-29-96	0 - 40.0	70's cloudy rain	~6	0 hrs
LENGTH	2 FT		5 FT						
TYPE	SS	-	HS						
HAMMER WT.	140 lbs.								
FALL	30 in.								
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded	0	33.0
Well Screen	1"	PVC Slotted	33.0	38.0

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	HNU ~~Lab.~~ ~~Moist~~ (ppm)	Visual Description	Well Installation Detail	Elevation
2.0	S-1	0.5	3 3 3 4		<1	SAND, FINE GRAIN, LITTLE MEDIUM GRAIN, GREY, BROWN, LITTLE SILT MOIST TO WET, LOOSE	WELL SOCK FROM 0.0 TO 38.0 FT WELL CASING FROM 0.0 TO 33.0 FT	
4.0	S-2	1.0	2 3 3 3		<1			
6.0	S-3	1.0	4 4 3 2		<1	SAND, FINE GRAIN, LITTLE MEDIUM GRAIN, GREY, BROWN, LITTLE SILT MOIST TO WET, LOOSE 5.5 SILT AND CLAY, BROWN, WET LITTLE FINE GRAIN SAND, SOFT		6.00
8.0	S-4	2.0	3 4 4 6					
10.0	S-5	2.0	4 6 6 6		<1	SILT AND CLAY, BROWN, GREY, RED WET, TRACE FINE GRAIN SAND, SOFT TO MEDIUM STIFF		

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW28-B SHEET 1 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc.

PROJECT: SGI- GROUNDWATER SCREENING - CTO 232
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 28-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger T = Shelby Tube W = Wash R = Air Rotary C = Core D = Denison P = Piston N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab.~~ Moist ~~%~~ (ppm)	Visual Description	Well Installation Detail	Elevation
11–12.0	S-6	1.0	5 5 10 10		4	Continued from Sheet 1 SILT AND CLAY, TRACE FINE SAND MEDIUM STIFF, WET, BROWN, GREY GRAY @ 11.0 FT 12.0	WELL SOCK FROM 0.0 TO 38.0 FT	-0.50
12–14.0	S-7	2.0	10 10 10 10		4	SAND, FINE GRAIN, LITTLE SILT, LITTLE MEDIUM GRAIN, GREY, WET MEDIUM DENSE	WELL CASING FROM 0.0 TO 33.0 FT	
14–16.0	S-8	1.5	7 7 6 7		<1	SAND, FINE GRAIN, LITTLE MEDIUM GRAIN, GREY, BROWN, WET		
16–18.0	S-9	2.0	4 4 6 7		<1	SAND, FINE AND MEDIUM GRAIN, BROWN, GREY, WET, LITTLE SILT 17.5 SAND, MEDIUM GRAIN, BROWN WET 17.75	WELL SCREEN FROM 33.0 TO 38.0 FT	-6.[illegible] -6.25
18–20.0	S-10	2.0	7 8 8 12		<1	SAND, FINE AND MEDIUM GRAIN, BROWN, GREY, WET, LITTLE SILT LOOSE TO MEDIUM DENSE		
20–22.0	S-11	2.0	8 8 7 7		<1	SAND, FINE AND MEDIUM GRAIN, LITTLE SILT, TRACE CLAY, GREY, WET		
22–24.0	S-12	2.0	6 7 8 8		<1	SAND, FINE AND MEDIUM GRAIN, LITTLE SILT, TRACE CLAY, GREY, BROWN WET, MEDIUM DENSE TO LOOSE 24.5		
24–26.0	S-13	1.0	2 WOR WOR WOR		<1	SAND, FINE AND MEDIUM GRAIN, BROWN, GREY, DENSE TO MEDIUM DENSE LIMESTONE AND SHELL FRAGMENTS.		13.00
26–28.0	S-14	1.0	WOR 7 8 9		<1	28.0		-16.50
28–30.0	S-15	1.0	24 40 50/0.1		<1	SAND, FINE AND MEDIUM GRAIN, BROWN LITTLE LIMESTONE AND SHELL FRAGMENT WET, MEDIUM DENSE LITTLE LIMESTONE AND SHELL FRAGMENTS Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHV BORING NO.: TW 28-B SHEET 2 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Baker

Baker Environmental, Inc

PROJECT: SGI - GROUNDWATER SCREENING CTO 232
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW28-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger T = Shelby Tube W = Wash R = Air Rotary C = Core D = Denison P = Piston N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
31–32 (32.0)	S-16	2.0	28 18 16 20		<1	Continued from Sheet 2 30.5 SAND, MEDIUM AND FINE GRAIN, LITTLE SILT, GREY, GREEN, WET, LIMESTONE AND SHELL FRAGMENTS, PARTIALLY CEMENTED, DENSE, LITTLE GRAVEL	WELL CASING FROM 0.0 TO 33.0 FT WELL SOIL FROM 0.0 TO 38.0 FT	-19.00
33–34 (34.0)	S-17	1.0	30 46 50/.4		<1	SAND, MEDIUM AND FINE GRAIN, LITTLE SILT, GREY, GREEN, WET, LIMESTONE AND SHELL FRAGMENTS PARTIALLY CEMENTED, VERY DENSE,	WELL SCREEN FROM 33.0 FT TO 38.0 FT	-21.50
35–36 (36.0)	S-18	1.0	17 18 11 18		<1			
37–38 (38.0)	S-19	0.2	50/0.2		<1	SAND, MEDIUM AND FINE GRAIN, LITTLE SILT, GREY, GREEN, WET, LIMESTONE AND SHELL FRAGMENTS PARTIALLY CEMENTED, VERY DENSE 38.0		
39–40 (40.0)	S-20	2.0	7 8 8 10			SAND, FINE GRAIN, GREEN, WET MEDIUM DENSE, SOME SILT, TRACE CLAY	BOTTOM PLUG HOLE CAVED FROM 38.0 TO 40.0	-26.50 -28.50
41–50						END OF BORING @ 38.0 FT		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: TW 28-B SHEET 3 OF 3

Baker
Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI-SCREENING -GTO 232
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW29-B
COORDINATES: EAST: 2466048.8526 NORTH: 360563.1448
ELEVATION: SURFACE: 13.20 TOP OF STEEL CASING: -

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43 ID		3¼ ID		4-30-96	0-42	60's WINDY	6.0	0 Hrs.
LENGTH	2FT		2FT						
TYPE	SS		HS						
HAMMER WT.	140 lbs.								
FALL	30 in.								
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	1"	PVC Threaded	0	35
Well Screen	1"	PVC Slotted	35	40

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Per. Rate	Hnu ~~Lab.~~ Moist % (ppm)	Visual Description	Well Installation Detail	Elevation
1 – 2.0	S-1	0.5	3 5 8 12		<1	SAND, FINE GRAIN, BROWN, GREY, DAMP TO MOIST, MEDIUM DENSE	WELL SOCK FROM 0.0 TO 40.0 FT	
2 – 4.0	S-2	1.5	8 10 24 18		<1		WELL CASING FROM 0.0 TO 35.0 FT	
4 – 6.0	S-3	2.0	6 8 6 6		<1	4.5 SAND, FINE GRAIN, SOME SILT, LITTLE CLAY, BROWN, RED GREY, SOFT, WET		8.7
7								
8	A-N							
9								
10						Match to Sheet 2		

DRILLING CO.: PARRATT-WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: WEILY BORING NO.: TW29-B SHEET 1 OF

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - SCREENING - CTO 232
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW 29-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; A = Auger; T = Shelby Tube; W = Wash; R = Air Rotary; C = Core; D = Denison; P = Piston; N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5'); RQD = Rock Quality Designation (%); Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
11–12 (12.0)	S-4	1.5	6 6 8 10		<1	Continued from Sheet 1 SAND AND SILT GREY, WET 11.0 / SAND, FINE AND MEDIUM GRAIN, LITTLE SILT, TRACE CLAY, WET, MEDIUM DENSE	WELL SOCK From 0.0 TO 40.0 FT; WELL CASING From 0.0 TO 35.0 FT	2.20
12–15 (15.0)	A-N							
15–17 (17.0)	S-5	2.0	7 9 10 4		4	SAND, FINE AND MEDIUM GRAIN, LITTLE SILT, TRACE CLAY, BROWN, GREY, MEDIUM DENSE		
17–20 (20.0)	A-N							
20–22 (22.0)	S-6	1.5	8 8 12 10		<1	21.0 / SAND, FINE GRAIN, GREY, SOME SILT SHELL FRAGMENTS, WET, TRACE CLAY, MEDIUM DENSE		-7.80
22–25 (25.0)	A-N							
25–27 (27.0)	S-7	2.0	10 15 26 31		<1	SAND FINE GRAIN, SOME SILT, GREY SHELL FRAGMENTS, WET, DENSE		
27–30 (30.0)						Match to Sheet 3		

DRILLING CO.: PARRATT-WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: WALLY BORING NO.: TW 29-B SHEET 2 OF 3

Baker
Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - SCREENING - CTO 232
S.O. NO.: 62470-232-0000-03600 BORING NO.: TW29-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger, T = Shelby Tube, W = Wash, R = Air Rotary, C = Core, D = Denison, P = Piston, N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5'); RQD = Rock Quality Designation (%); Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	~~Lab.~~ HNU Moist % (ppm)	Visual Description	Well Installation Detail	Elevation
31–32.0	S-8	2.0	6 10 20 24		<1	Continued from Sheet SAND, FINE AND MEDIUM GRAIN, SOME SILT, TRACE CLAY, GREY, WET DENSE, LIMESTONE AND SHELL FRAGMENTS LITTLE PARTIALLY CEMENTED FRAGMENTS	WELL SOCK FROM 0.0 TO 40.0 FT; WELL CASING FROM 0.0 TO 35.0 FT	
32.0–35.0	A-N							
35.0–37.0	S-9	2.0	6 14 24 20		<1	SAND, FINE AND MEDIUM GRAIN, SOME SILT, TRACE CLAY, GREY, GREEN WET, LIMESTONE AND SHELL FRAGMENTS LITTLE PARTIALLY CEMENTED FRAGMENTS	WELL SCREEN FROM 35.0 TO 40.0 FT	-21.80
37.0–40.0	A-N						BOTTOM PLUG	-26.80
40.0–42.0	S-10		19 21 16 14		<1	41.0 SAND AND SILT, GREEN, STIFF, LITTLE CLAY WET	HOLE CAVED FROM 42.0 TO 40.0	-28.80
						END OF BORING @ 42.0 FT		

DRILLING CO.: PARRATT-WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: WALLY BORING NO.: TW29-B SHEET 3 OF 3

Baker
Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Site 35 Supplemental Groundwater Investigation
CTO NO.: 232 BORING NO.: 35TW30A
COORDINATES: EAST: 2465953.7973 NORTH: 364054.1170
ELEVATION: SURFACE: 14.82 TOP OF PVC CASING: –

RIG: #58					DATE	PROGRESS (FT.)	WEATHER	WATER DEPTH (FT.)	TIME
Page 74	SPLIT SPOON	CASING	AUGERS	CORE BARREL					
SIZE (DIAM.)	1-3/8"		3 1/4"		8-3-96	0 – 19.5	overcast, rain humid, (70's)	≈ 11.0	
LENGTH	2.0		5'						
TYPE	Std.		HSA						
HAMMER WT.	140 lbs.								
FALL	30"								
STICK UP									

REMARKS: Augered to a 19.5' (bgs) depth. Temporary well set 8-3-96
HNu background is .4 ppm

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

Well Information	Diam.	Type	Top Depth (ft.)	Bottom Depth (ft.)
Riser	2.0"	Schedule 40 PVC	+2.5	-9.0
Screen	2.0"	Schedule 40 0.01 Slot	-9.0	-19.0

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab ID No.	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
1								
2								
3								
4							1" PVC riser	
5						Auger to 19.5' (bgs)		
6								
7								
8								
9								5.82
10							1" PVC screen	

Match to Sheet 2

DRILLING CO.: Parratt-Wolff BAKER REP.: J.E. Zimmerman
DRILLER: G. Lansing BORING NO.: 35TW30A SHEET 1 OF 2

Baker

Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Site 35 Supplemental Groundwater Investigation

CTO NO.: 323 BORING NO.: 35TW30A

SAMPLE TYPE		DEFINITIONS
S = Split Spoon	A = Auger	SPT = Standard Penetration Test (ASTM D-1586)(Blows/0.5')
T = Shelby Tube	W = Wash	RQD = Rock Quality Designation (%)
R = Air Rotary	C = Core	PID = Photoionization Detector
D = Denison	P = Piston	ppm = parts per million
N = No Sample		

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab ID No.	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
						Continued from Sheet 1		
11								3.82
12								
13							1" PVC screen	
14								
15						Auger to 19.5' (bgs)		
16								
17								
18								
19								-4.18
19.5								-4.68
20						End of Boring	well plug	
21						TD: 19.5' (bgs)		
22								
23								
24								
25								
26								
27								
28								
29								
30								

DRILLING CO.: Parratt-Wolff BAKER REP.: J.E. Zimmerman

DRILLER: G. Lansing BORING NO.: 35TW30A SHEET 2 OF

Baker
Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Site 35 Supplemental Groundwater Investigation
CTO NO.: 232 — BORING NO.: 35TW30B
COORDINATES: EAST: 2465953.7973 — NORTH: 364054.1170
ELEVATION: SURFACE: 14.82 — TOP OF PVC CASING: -

RIG: #58	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT.)	WEATHER	WATER DEPTH (FT.)	TIME
SIZE (DIAM.)	1-3/8"		3 1/4"		8-3-96	0 - 40.0	overcast, rain humid (70's)	≈ 10.5	
LENGTH	2.0		5'						
TYPE	Std.		HSA						
HAMMER WT.	140 lbs.								
FALL	30"								
STICK UP									

REMARKS: Sample borehole using 5' centers to 40.0' (bgs) Temporary well set 8-3-96. HNu background is .4 ppm

SAMPLE TYPE

S = Split Spoon — A = Auger
T = Shelby Tube — W = Wash
R = Air Rotary — C = Core
D = Denison — P = Piston
N = No Sample

Well Information	Diam.	Type	Top Depth (ft.)	Bottom Depth (ft.)
Riser	2.0"	Schedule 40 PVC	+2.5	-34.5
Screen	2.0"	Schedule 40 0.01 Slot	-34.5	-39.5

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab ID No.	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
1–5.0	A-N				.4/.4	Auger to 5.0' (bgs) 5.0	1" PVC riser	9.82
5.0–7.0	S-1	1.9/2.0 95%	6 10 10 12		.4/.4	Silty SAND, fine grained w/trace to little clay Brown, medium stiff, damp		
7.0–9.0	S-2	1.6/2.0 80%	6 6 7 4	04	.4/.4	Silty SAND, fine grained w/ little to some clay. Oxidation (orange brownish dark red staining is occasional). Gray, medium dense to medium stiff		
9.0–10.0	A-N	-	-		.4/.4			
10.0	S-3	65%			.4/.4			

Match to Sheet 2

DRILLING CO.: Parratt-Wolff — BAKER REP.: J. E. Zimmerman
DRILLER: G. Lansing — BORING NO.: 35TW30B — SHEET 1 OF 3

Baker

Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Site 35 Supplemental Groundwater Investigation
CTO NO.: 232   BORING NO.: 35TW30B

SAMPLE TYPE		DEFINITIONS
S = Split Spoon	A = Auger	SPT = Standard Penetration Test (ASTM D-1586)(Blows/0.5')
T = Shelby Tube	W = Wash	RQD = Rock Quality Designation (%)
R = Air Rotary	C = Core	PID = Photoionization Detector
D = Denison	P = Piston	ppm = parts per million
N = No Sample		

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab ID No.	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
11–12.0	S-3	1.3/2.0 65%	3 3 4 3		.4/.4	Continued from Sheet 1 damp to moist SAND, fine grained w/trace silt. Light brown, loose, wet	▽	4.32
12.0–15.0	A-N				.4/.4	15.0		-0.18
15.0–17.0	S-4	2.0/2.0 100%	6 5 7 8		.4/.4	SAND, fine grained w/trace silt. Light brown/brown, medium dense, wet		
17.0–20.0	A-N				.4/.4	20.0	1" PVC riser	-5.18
20.0–22.0	S-5	1.4/2.0 70%	4 4 6 6		.4/.4	SAND, fine grained w/trace silt. Oxidation (dark orange brownish red staining is very heavy). Brown to gray medium dense, wet		
22.0–25.0	A-N				.4/.4	25.0		-10.18
25.0–27.0	S-6	1.3/2.0 65%	1 3 4 3		.4/.4	SAND, fine to coarse grained w/trace silt, trace quartz gravel Oxidation (dark orange brownish red staining is very heavy). Brown, loose, wet.		
27.0–30.0	A-N				.4/.4	30.0		

DRILLING CO.: Parratt-Wolff   BAKER REP.: J.E. Zimmerman

DRILLER: G. Lansing   BORING NO.: 35TW30B   SHEET 2 OF

Baker
Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Site 35 Supplemental Groundwater Investigation
CTO NO.: 232
BORING NO.: 35TW30B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger, T = Shelby Tube, W = Wash, R = Air Rotary, C = Core, D = Denison, P = Piston, N = No Sample	SPT = Standard Penetration Test (ASTM D-1586)(Blows/0.5'); RQD = Rock Quality Designation (%); PID = Photoionization Detector; ppm = parts per million

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab ID No.	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
31–32.0	S-7	1.7 85%	20 22 19 18		.4/.4	Continued from Sheet 2. SAND, fine to medium grained w/ trace silt little cemented sand-stone nodules, cemented shell material and little shell fragments Brown to gray/white dense, wet	1" PVC riser	
32.0–35.0	A-N				.4/.4	35.0		-20.18
35.0–37.0	S-8	1.6/2.0 80%	21 24 23 29		.4/.4	FOSSILIFEROUS LIMESTONE w/ SAND, fine grained trace silt, trace cemented shell material/shell frags trace micrite cement Light gray/white, dense, wet. 39.1	1" PVC Screen	
37.0–38.0	A-N				.4/.4			
38.0–40.0	S-9	1.7/2.0 85%	18 17 15 39		.4/.4	SAND, fine grained, trace silt, trace clay, trace shell material. moist Dk. greenish gray/white, dense		-24.28 -24.69 -25.19
40.0						End of Boring	well plug	
41–50						TD: 40.0' (bgs)		

DRILLING CO.: Parratt-Wolff
BAKER REP.: J.E. Zimmerman
DRILLER: G. Lansing
BORING NO.: 35TW30B
SHEET 3 OF 3

Baker
Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Site 35 Supplemental Groundwater Investigation
CTO NO.: 232 BORING NO.: 35TW31A
COORDINATES: EAST: 2466236.0625 NORTH: 363508.9161
ELEVATION: SURFACE: 9.50 TOP OF PVC CASING: —

RIG: #58					DATE	PROGRESS (FT.)	WEATHER	WATER DEPTH (FT.)	TIME
pages 57→59	SPLIT SPOON	CASING	AUGERS	CORE BARREL					
SIZE (DIAM.)	1-3/8"		3 1/4"		8-2-96	0-19.5	overcast, rain muggy (80's)	≈11.0	
LENGTH	2.0		5'						
TYPE	Std.		HSA						
HAMMER WT.	140 lbs.								
FALL	30"								
STICK UP									

REMARKS: Augered to a 19.5' (bgs) depth. Temporary well set 8-2-96
Hnu background is .3 ppm

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

Well Information	Diam.	Type	Top Depth (ft.)	Bottom Depth (ft.)
Riser	2.0"	Schedule 40 PVC	+2.5	-9.0
Screen	2.0"	Schedule 40 0.01 Slot	-9.0	-19.0

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab ID No.	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
1								
2								
3								
4							1" PVC riser	
5								
6						Auger to 19.5' (bgs)		
7								
8								
9								0.50
10							1" PVC screen	

Match to Sheet 2

DRILLING CO.: Parratt-Wolff BAKER REP.: J.E. Zimmerman
DRILLER: G. Lansing BORING NO.: 35TW31A SHEET 1 OF 2

Baker
Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Site 35 Supplemental Groundwater Investigation
CTO NO.: 232
BORING NO.: 35TW31A

SAMPLE TYPE		DEFINITIONS
S = Split Spoon	A = Auger	SPT = Standard Penetration Test (ASTM D-1586)(Blows/0.5')
T = Shelby Tube	W = Wash	RQD = Rock Quality Designation (%)
R = Air Rotary	C = Core	PID = Photoionization Detector
D = Denison	P = Piston	ppm = parts per million
N = No Sample		

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab ID No.	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
						Continued from Sheet 1		
11								-1.50
12								
13								
14						Auger to 19.5' (bgs)	1" PVC screen	
15								
16								
17								
18								
19								-9.50
19.5								-10.00
20						End of Boring	well plug	
21						TD: 19.5' (bgs)		
22								
23								
24								
25								
26								
27								
28								
29								
30								

DRILLING CO.: Parratt-Wolff
BAKER REP.: J.E. Zimmerman

DRILLER: G. Lansing
BORING NO.: 35TW31A
SHEET 2 OF

Baker

Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Site 35 Supplemental Groundwater Investigation

CTO NO.: 232 | BORING NO.: 35TW31B

COORDINATES: EAST: 2466236.0625 | NORTH: 363508.9161

ELEVATION: SURFACE: 9.50 | TOP OF PVC CASING: –

RIG: #58

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT.)	WEATHER	WATER DEPTH (FT.)	TIME
SIZE (DIAM.)	1-3/8"		3 1/4"		8-2-96	0-40.0	overcast, rain muggy (80's)	≈11.0	
LENGTH	2.0		5'						
TYPE	Std.		HSA						
HAMMER WT.	140 lbs.								
FALL	30"								
STICK UP									

REMARKS: Sampled borehole using 5' centers to 40.0' (bgs). Temporary well set 8-2-96. HNu background is .3 ppm.

SAMPLE TYPE

S = Split Spoon, T = Shelby Tube, R = Air Rotary, D = Denison, A = Auger, W = Wash, C = Core, P = Piston, N = No Sample

Well Information	Diam.	Type	Top Depth (ft.)	Bottom Depth (ft.)
Riser	2.0"	Schedule 40 PVC	+2.5	-34.5
Screen	2.0"	Schedule 40 0.01 Slot	-34.5	-39.5

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab ID No.	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
0–5.0	A-N				.3/.3	Auger to 5.0' (bgs) 5.0	1" PVC riser	4.50
5.0–7.0	S-1	1.6/2.0 80%	4 8 12 12		.3/.3	Silty SAND, fine grained w/ trace to some clay. Oxidation (orange brownish dark red staining. Gray; loose to medium stiff, damp		
7.0–9.0	S-2	1.8/2.0 90%	2 4 4 5		.3/.3			
9.0–11.0	S-3	1.6/2.0 80%	4 5 7	05	.3/.3	Match to Sheet 2		-0.50

DRILLING CO.: Parratt-Wolff | BAKER REP.: J.E. Zimmerman

DRILLER: G. Lansing | BORING NO.: 35TW31B | SHEET 1 OF 3

Baker

Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Site 35 Supplemental Groundwater Investigation
CTO NO.: 232
BORING NO.: 35TW31B

SAMPLE TYPE		DEFINITIONS
S = Split Spoon	A = Auger	SPT = Standard Penetration Test (ASTM D-1586)(Blows/0.5')
T = Shelby Tube	W = Wash	RQD = Rock Quality Designation (%)
R = Air Rotary	C = Core	PID = Photoionization Detector
D = Denison	P = Piston	ppm = parts per million
N = No Sample		

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab ID No.	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
11.0	S-3	80%	10	05	.3/.3	Continued from Sheet 1 SAND, fine grained w/trace silt. Brown/light brown, medium dense, moist to wet.	▽	-1.50
11–15	A-N				.3/.3	15.0		
15.0–17.0	S-4	1.5/2.0 75%	3 3 3 3		.3/.3	SAND, fine grained w/trace silt. Light brown/brown, loose wet.		-5.50
17–20	A-N				.3/.3	20.0	1" PVC riser	
20.0–22.0	S-5	1.6/2.0 80%	5 4 1 1		.3/.3	SAND, fine grained w/trace silt, trace shell material. Oxidation (orangish brown staining is heavy). Brown & white, loose, wet		-10.50
22–25	A-N				.3/.3	25.0		
25.0–27.0	S-6	.5/2.0 25%	52 48 100/4"		.3/.3	SAND, fine to coarse grained w/trace silt, trace fine grained quartz gravel and shell material. Brown & white, very dense wet.		-15.50
27–30.0	A-N				.3/.3	30.0		-[illegible]0

DRILLING CO.: Parratt-Wolff
BAKER REP.: J.E. Zimmerman

DRILLER: G. Lansing
BORING NO.: 35TW31B
SHEET 2 O[illegible]

Baker
Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Site 35 Supplemental Groundwater Investigation
CTO NO.: 232 BORING NO.: 35TW31B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger, T = Shelby Tube, W = Wash, R = Air Rotary, C = Core, D = Denison, P = Piston, N = No Sample	SPT = Standard Penetration Test (ASTM D-1586)(Blows/0.5'), RQD = Rock Quality Designation (%), PID = Photoionization Detector, ppm = parts per million

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab ID No.	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
31–32.0	S-7	1.8/2.0 90%	22 22 20 22		.3/.3	Continued from Sheet 2. SAND, fine to medium grained w/trace silt, little cemented sandstone nodules, cemented shell material and little shell fragments. Brown to gray and white, dense, wet	1" PVC riser	
32.0–35.0	A-N				.3/.3			-25.00, -25.50
35.0–37.0	S-8	1.5/2.0 75%	12 30 31 39		.3/.3	FOSSILIFEROUS LIMESTONE w/SAND, fine grained trace silt, trace cemented shell material/fragments micrite cement. Light gray & white, very dense, wet	1" PVC screen	
37.0–38.0	A-N				.3/.3			
38.0–40.0	S-9	1.6/2.0 80%	8 10 11 10		.3/.3	SAND, fine grained w/ trace silt, trace clay. Dark greenish gray, medium dense, moist		-29.00, -30.00, -30.50
40						End of Boring. TD: 40.0' (bgs)	well plug	

DRILLING CO.: Parratt-Wolff BAKER REP.: J. E. Zimmerman
DRILLER: G. Lansing BORING NO.: 35TW31B SHEET 3 OF 3

Baker
Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Supplemental Groundwater Investigation at Site 35 - MCBCLEJ
CTO NO.: 62470-232 BORING NO.: 35-MW39B
COORDINATES: EAST: 2464273.7836 NORTH: 362383.7474
ELEVATION: SURFACE: 19.1 TOP OF PVC CASING: 18.83

RIG: Mobile B-53					DATE	PROGRESS (FT.)	WEATHER	WATER DEPTH (FT.)	TIME
	SPLIT SPOON	CASING	AUGERS	CORE BARREL					
SIZE (DIAM.)	1 3/8" ID	-		-	4/28	0.0-47.0	M Sunny, 70s	-	-
LENGTH	2'	-	5'	-					
TYPE	Stainless	-	HSA	-					
HAMMER WT.	140 lbs	-	-	-					
FALL	30"	-	-	-					
STICK UP	-	-	-	-					

REMARKS:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

Well Information	Diam.	Type	Top Depth (ft.)	Bottom Depth (ft.)
	2" OD	Sch 40 PVC Riser	-	40.0
(0.01" SLOTS)	2" OD	Sch 40 PVC Screen	40.0	45.0

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab Class. or Pen. Rate	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
1								
2								
3								
4								
5	A-N	-	-	-	-	See boring log for 35-TW01B for soil information		
6								
7								
8								
9								
10								

DRILLING CO.: Parratt-Wolff BAKER REP.: Mark DeJohn
DRILLER: Chip Lafever BORING NO.: 35-MW39B SHEET 1 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Supplemental Groundwater Investigation at Site 35 - MCBCLEJ

CTO NO.: 62470-232 BORING NO.: 35-MW39B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; A = Auger; T = Shelby Tube; W = Wash; R = Air Rotary; C = Core; D = Denison; P = Piston; N = No Sample	**SPT** = Standard Penetration Test (ASTM D-1586)(Blows/0.5'); **RQD** = Rock Quality Designation (%); **Lab. Class.** = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); **Lab. Moist.** = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab Class. or Pen. Rate	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

DRILLING CO.: Parratt-Wolff BAKER REP.: Mark DeJohn

DRILLER: Chip Lafever BORING NO.: 35-MW39B SHEET 2 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Supplemental Groundwater Investigation at Site 35 - MCBCLEJ

CTO NO.: 62470-232

BORING NO.: 35-MW39B

SAMPLE TYPE		DEFINITIONS
S = Split Spoon	A = Auger	SPT = Standard Penetration Test (ASTM D-1586)(Blows/0.5')
T = Shelby Tube	W = Wash	RQD = Rock Quality Designation (%)
R = Air Rotary	C = Core	Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
D = Denison	P = Piston	Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis
N = No Sample		

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab Class. or Pen. Rate	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
31								
32						BENTONITE GROUT		
33								
34								
35							35.6	-16.5
36						BENTONITE SEAL		
37								
38							38.0	-18.9
39						SAND PACK		
40							40.0	-20.9
41								
42								
43								
44								
45 (45.0)						45.0	45.0	-25.9
46	S-1	0.9 45%	4 6 10 10	-	0.2 / 0.2	FINE SAND, some silt, little clay; olive green; v. stiff; damp		
47 (47.0)						47.0	47.0	-27.9
48						BOH @ 47.0 ft		
49								
50								

DRILLING CO.: Parratt-Wolff

BAKER REP.: Mark DeJohn

DRILLER: Chip Lafeyer

BORING NO.: 35-MW39B

SHEET 3 OF 3

Baker

Baker Environmental, inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Supplemental Groundwater Investigation at Site 35 - MCBCLEJ

CTO NO.: 62470-232 BORING NO.: 35-MW40B

COORDINATES: EAST: 2464977.6125 NORTH: 362399.8893

ELEVATION: SURFACE: 17.8 TOP OF PVC CASING: 17.59

RIG: Mobile B-53

	SPLIT SPOON	CASING	AUGERS	CORE BARREL
SIZE (DIAM.)	1 3/8" ID	-	6 1/4" ID	-
LENGTH	2'	-	5'	-
TYPE	Stainless	-	HSA	-
HAMMER WT.	140 lbs	-	-	-
FALL	30"	-	-	-
STICK UP	-	-	-	-

DATE	PROGRESS (FT.)	WEATHER	WATER DEPTH (FT.)	TIME
4/27	0.0-47.0	Sunny, 70s	-	-

REMARKS:

SAMPLE TYPE

S = Split Spoon, A = Auger, T = Shelby Tube, W = Wash, R = Air Rotary, C = Core, D = Denison, P = Piston, N = No Sample

Well Information	Diam.	Type	Top Depth (ft.)	Bottom Depth (ft.)
	2" OD	Sch 40 PVC Riser	-	40.0
(0.010" slots	2" OD	Sch 40 PVC Screen	40.0	45.0

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab Class. or Pen. Rate	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
1								
2								
3								
4								
5	A-N	-	-	-	-	See boring log for 35-TW03B for soil information		
6								
7								
8								
9								
10								

DRILLING CO.: Parratt-Wolff BAKER REP.: Mark DeJohn

DRILLER: Chip Lafever BORING NO.: 35-MW40B SHEET 1 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Supplemental Groundwater Investigation at Site 35 - MCBCLEJ

CTO NO.: 62470-232 BORING NO.: 35-MW40B

SAMPLE TYPE		DEFINITIONS
S = Split Spoon	A = Auger	SPT = Standard Penetration Test (ASTM D-1586)(Blows/0.5')
T = Shelby Tube	W = Wash	RQD = Rock Quality Designation (%)
R = Air Rotary	C = Core	Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
D = Denison	P = Piston	Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis
N = No Sample		

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab Class. or Pen. Rate	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
11								
12								
13								
14								
15								
16								
17								
18								
19								
20	A-N	-	-	-	-			
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

DRILLING CO.: Parratt-Wolff BAKER REP.: Mark DeJohn

DRILLER: Chip Lafever BORING NO.: 35-MW40B SHEET 2 OF 3

Baker
Baker Environmental, inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Supplemental Groundwater Investigation at Site 35 - MCBCLEJ
CTO NO.: 62470-232
BORING NO.: 35-MW40B

SAMPLE TYPE		DEFINITIONS
S = Split Spoon	A = Auger	SPT = Standard Penetration Test (ASTM D-1586)(Blows/0.5')
T = Shelby Tube	W = Wash	RQD = Rock Quality Designation (%)
R = Air Rotary	C = Core	Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
D = Denison	P = Piston	Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis
N = No Sample		

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab Class. or Pen. Rate	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
31								
32								
33							BENTONITE GROUT	
34								
35							35.6	-17.8
36								
37							BENTONITE SEAL	
38	A-N						38.0	-20.2
39							SAND PACK	
40							40.0	-22.2
41								
42								
43								
44								
45						45.0	45.0	-27.2
46	S-1	1.6 80%	4 4 6 9	-	0.2 / 0.2	FINE SAND, some silt, little clay; olive green; stiff; damp		
47						47.0	47.0	-29.2
48						BOH@ 47.0 ft		
49								
50								

DRILLING CO.: Parratt-Wolff
BAKER REP.: Mark DeJohn
DRILLER: Chip Lafever
BORING NO.: 35-MW40B
SHEET 3 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Supplemental Groundwater Investigation at Site 35 - MCBCLEJ
CTO NO.: 62470-232 BORING NO.: 35-MW41B
COORDINATES: EAST: 2465911.8954 NORTH: 362391.8702
ELEVATION: SURFACE: 16.7 TOP OF PVC CASING: 16.43

RIG: Mobile B-53	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT.)	WEATHER	WATER DEPTH (FT.)	TIME
SIZE (DIAM.)	1 3/8" ID	-		-	4/28	0.0 - 47.0	M Sunny, 80's	-	-
LENGTH	2'	-	5'	-					
TYPE	Stainless	-	HSA	-					
HAMMER WT.	140 lbs	-	-	-					
FALL	30"	-	-	-					
STICK UP	-	-	-	-					

REMARKS: ~125-GAL OF WATER ADDED TO PREVENT RUNNING SANDS

SAMPLE TYPE

S = Split Spoon
T = Shelby Tube
R = Air Rotary
D = Denison
A = Auger
W = Wash
C = Core
P = Piston
N = No Sample

Well Information	Diam.	Type	Top Depth (ft.)	Bottom Depth (ft.)
	2" OD	Sch 40 PVC Riser	-	40.0
(0.01" slots)	2" OD	Sch 40 PVC Screen	40.0	45.0

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab Class. or Pen. Rate	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
1								
2								
3								
4								
5	A-N	-	-	-	-	See boring log for 35-TW10B for soil information		
6								
7								
8								
9								
10								

DRILLING CO.: Parratt-Wolff BAKER REP.: Mark DeJohn
DRILLER: Chip Lafever BORING NO.: 35-MW41B SHEET 1 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Supplemental Groundwater Investigation at Site 35 - MCBCLEJ
CTO NO.: 62470-232 BORING NO.: 35-MW41B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; A = Auger; T = Shelby Tube; W = Wash; R = Air Rotary; C = Core; D = Denison; P = Piston; N = No Sample	**SPT** = Standard Penetration Test (ASTM D-1586)(Blows/0.5'); **RQD** = Rock Quality Designation (%); **Lab. Class.** = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); **Lab. Moist.** = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab Class. or Pen. Rate	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
11								
12								
13								
14								
15								
16								
17								
18								
19								
20	A-N	-	-	-	-			
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

DRILLING CO.: Parratt-Wolff BAKER REP.: Mark DeJohn
DRILLER: Chip Lafever BORING NO.: 35-MW41B SHEET 2 OF 3

Baker

Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Supplemental Groundwater Investigation at Site 35 - MCBCLEJ

CTO NO.: 62470-232 BORING NO.: 35-MW41B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; A = Auger; T = Shelby Tube; W = Wash; R = Air Rotary; C = Core; D = Denison; P = Piston; N = No Sample	**SPT** = Standard Penetration Test (ASTM D-1586)(Blows/0.5') **RQD** = Rock Quality Designation (%) **Lab. Class.** = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) **Lab. Moist.** = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab Class. or Pen. Rate	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
31–35							BENTONITE GROUT	
35.1							35.1	-18.4
35.1–37.9							BENTONITE SEAL	
37.9							37.9	-21.2
37.9–45.0	A-N	-	-	-	-		SAND PACK	
40.0							40.0	-23.3
45.0						45.0	45.0	-28.3
45.0–47.0	S-1	1.0 50%	7 8 6 6	-	0.2/0.2	FINE SAND, some silt, little clay; olive green; stiff; damp		
47.0						47.0	47.0	-30.3
48–50								

DRILLING CO.: Parratt-Wolff BAKER REP.: Mark DeJohn

DRILLER: Chip Lafeyer BORING NO.: 35-MW41B SHEET 3 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - SCREENING - CTD 232

S.O. NO.: 62470-232-0000-03600 BORING NO.: 35-MW42-B

COORDINATES: EAST: 2465251.0135 NORTH: 361201.5610

ELEVATION: SURFACE: 15.20 TOP OF STEEL CASING: 15.12

RIG: MOBILE 65 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43		6¼ ID		5-1-96	0-42	70's SUNNY	6	0 Hrs
LENGTH	2 FT		5 FT						
TYPE	SS		HS						
HAMMER WT.	140 lbs								
FALL	30 IN								
STICK UP									

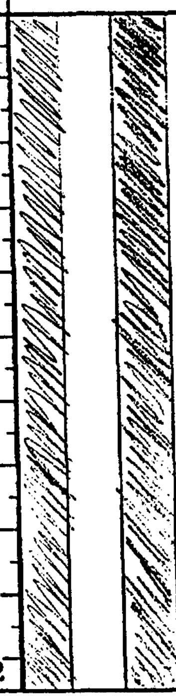
REMARKS:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	2"	PVC Threaded	0'	35'
Well Screen	2"	PVC Slotted	35'	40'

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Per. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL CASING FROM 0.0 TO 35.0 FT	
2								
3							CEMENT/ BENTONITE GROUT FROM 0.0 TO 24.0 FT	
4						SEE SOIL BORING TW12-B FOR SOIL INFORMATION		
5	A-N							
6								
7								
8								
9								
10								



Match to Sheet 2

DRILLING CO.: PARRATT - WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP BORING NO.: 35-MW42-B SHEET 1 OF:

Baker

Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - SCREENING - CTO 232

S.O. NO.: 62470-232-0000-03600 BORING NO.: 35-MW42-B

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
						Continued from Sheet 1	WELL CASING FROM 0.0 TO 35.0 FT	
11								
12								
13								
14								
15							CEMENT/ BENTONITE GROUT FROM 0.0 TO 24.0 FT	
16								
17								
18								
19						SEE SOIL BORING TW12-B FOR SOIL INFORMATION		
20	A-N							
21								
22								
23								
24								-8.80
25								
26							BENTONITE FROM 24.0 TO 33.0 FT	
27								
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT - WOLFF BAKER REP.: BRIAN E. DAVIS

DRILLER: CAIP BORING NO.: 35-MW42-B SHEET 2 OF 3

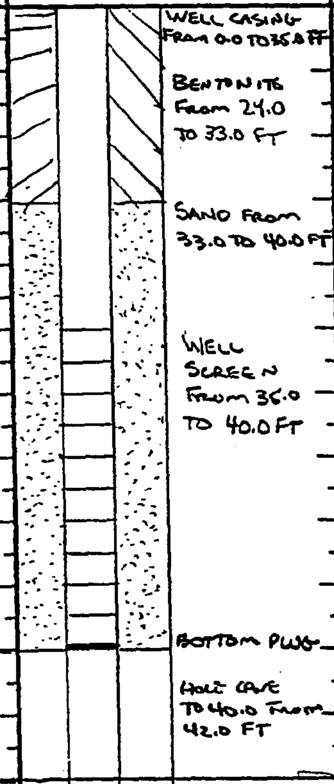
TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI SCREENING - CTO 232
S.O. NO.: 62470-232-0000-03600 BORING NO.: 35-MW42-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; A = Auger; T = Shelby Tube; W = Wash; R = Air Rotary; C = Core; D = Denison; P = Piston; N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5'); RQD = Rock Quality Designation (%); Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282); Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
31–40.0	A-N					Continued from Sheet 2 SEE SOIL BORING TW12-B FOR SOIL INFORMATION	WELL CASING FROM 0.0 TO 35.0 FT; BENTONITE FROM 24.0 TO 33.0 FT; SAND FROM 33.0 TO 40.0 FT; WELL SCREEN FROM 35.0 TO 40.0 FT; BOTTOM PLUG	-17.80 (33); -19.80 (35); -24.80 (40)
40.0–42.0	S-1	2.0	4 6 6 9		<1	SAND, FINE GRAIN, LITTLE SILT AND CLAY, GREEN, WET	HOLE CAVE TO 40.0 FROM 42.0 FT	-26.80 (42)
42.0–50						END OF BORING @ 42.0 FT		



DRILLING CO.: PARRATT-WOLFF BAKER REP.: BRIAN E. DAVIS
DRILLER: CHIP BORING NO.: 35-MW42-B SHEET 3 OF 3

TEST BORING AND WELL CONSTRUCTION RECORD

Baker
Baker Environmental, Inc

PROJECT: SGI - SCREENING - CTO 232
S.O. NO.: 62470-232-0000-03600 BORING NO.: 35-MW43-B
COORDINATES: EAST: 2465317.8687 NORTH: 361875.6941
ELEVATION: SURFACE: 15.30 TOP OF STEEL CASING: 15.01

RIG: MOBILE 55 TRUCK MOUNT

	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1.43 in		3¼ ID		5-1-96	0 - 42	70's SUNNY	6	0 HRS
LENGTH	2 FT		5 FT						
TYPE	SS		HS						
HAMMER WT.	140 lbs.								
FALL	30 in.								
STICK UP									

REMARKS:

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	2"	PVC Threaded	0	35
Well Screen	2"	PVC Slotted	35	40

Depth (Ft.)	Sample Type and No.	Samp. Rec. Ft & %	SPT or RQD	Lab. Class. or Per. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
1							WELL CASING FROM 0.0 TO 35.0 FT	
2							CEMENT/ BENONITE GROUT FROM 0.0 TO [illegible] FT	
3								
4						SEE SOIL BORING TW-9B		
5	A-N					FOR SOIL INFORMATION		
6								
7								
8								
9								
10								

Match to Sheet 2

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E DAVIS
DRILLER: CHIP BORING NO.: 35-MW43-B SHEET 1 OF 2

Baker
Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - SCREENING - CTO 232
S.O. NO.: 62470-232-0000-03600 BORING NO.: 35-MW 43-B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon, A = Auger T = Shelby Tube, W = Wash R = Air Rotary, C = Core D = Denison, P = Piston N = No Sample	SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5') RQD = Rock Quality Designation (%) Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282) Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Lab. Moist %	Visual Description	Well Installation Detail	Elevation
						Continued from Sheet 1	WELL CASING FROM 0.0 TO 35.0 FT	
11								
12							CEMENT/	
13							GROUT FROM 0.0 TO 27.0 FT	
14								
15								
16								
17								
18								
19								
20	A-N					SEE SOIL BORING TW9-B FOR SOIL INFORMATION		
21								
22								
23								
24								
25								
26								
27							BENTONITE FROM 27.0 TO 33.0 FT	-11.70
28								
29								
30						Match to Sheet 3		

DRILLING CO.: PARRATT WOLFF BAKER REP.: BRIAN E DAVIS
DRILLER: CHIP BORING NO.: 35-MW43-B SHEET 2 OF 3

Baker

Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SGI - SCREENING - CTO 232

S.O. NO.: 62470-232-0000-03600   BORING NO.: 35-MW43-B

SAMPLE TYPE

S = Split Spoon   A = Auger
T = Shelby Tube   W = Wash
R = Air Rotary   C = Core
D = Denison   P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D-1586) (Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (Ft.)	Sample Type and No.	Samp. Rec. (Ft. & %)	SPT or RQD	Lab. Class. or Pen. Rate	Hnu ~~Lab. Moist %~~ (ppm)	Visual Description	Well Installation Detail	Elevation
						Continued from Sheet	WELL CASING FROM 0.0 TO 35.0 FT	
31								
32							Bentonite from 27.0 to 33.0 FT	
33								-17.70
34							Sand from 33.0 to 40.0 FT	
35	A-N					SEE SOIL BORING 35-MW43-B FOR SOIL INFORMATION	WELL SCREEN FROM 35.0 TO 40.0 FT	-19.70
36								
37								
38								
39								
40 (40.0)							BOTTOM PLUG	-24.70
41	S-1	2.0	11 10 7 7		<1	41.0 SAND, FINE GRAIN, SOME SILT AND CLAY GREEN, WET, MEDIUM STIFF	HOLE CAVED FROM 40.0 TO 42.0 FT	
42 (42.0)						END OF BORING @ 42.0 FT		-26.70
43								
44								
45								
46								
47								
48								
49								
50								

DRILLING CO.: PARRATT - WOLFF   BAKER REP.: BRIAN E. DAVIS

DRILLER: CHIP   BORING NO.: 35-MW43-B   SHEET 3 OF 3

Baker

Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Site 35 Supplemental Groundwater Investigation
CTO NO.: 232 BORING NO.: 35MW44A
COORDINATES: EAST: 2466156.2755 NORTH: 363676.3309
ELEVATION: SURFACE: 7.60 TOP OF PVC CASING: 10.08

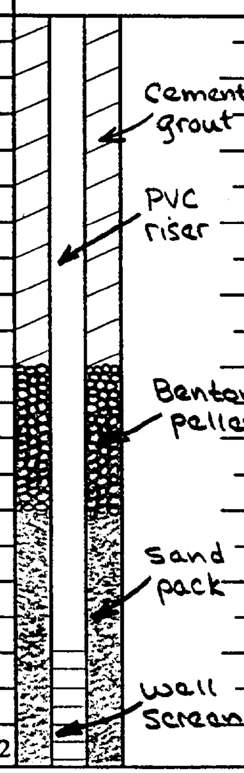
RIG:					DATE	PROGRESS (FT.)	WEATHER	WATER DEPTH (FT.)	TIME
Page 28 -> 30	SPLIT SPOON	CASING	AUGERS	CORE BARREL					
SIZE (DIAM.)	1-3/8"		6 1/4"		8-1-96	0 - 19.5	Partly cloudy (70's) humid	11.0	
LENGTH	2.0		5'						
TYPE	Std.		HSA						
HAMMER WT.	140 lbs.								
FALL	30"								
STICK UP									

REMARKS: Augered to a 19.5' (bgs) depth. Type II well set 8-1-96
HNu background range is .4 to 1.3 ppm.

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

Well Information	Diam.	Type	Top Depth (ft.)	Bottom Depth (ft.)
Riser	2.0"	Schedule 40 PVC	+2.5	-9.0
Screen	2.0"	Schedule 40 0.01 Slot	-9.0	-19.0

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab ID No.	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
1								
2								
3								
4								
5	A-N				1.3 / 1.3	Auger to 19.5' (bgs)		2.60
6								
7								0.60
8								
9								-1.40
10						Match to Sheet 2		



DRILLING CO.: Parratt-Wolff BAKER REP.: J.E. Zimmerman
DRILLER: G. Lansing BORING NO.: 35MW44A SHEET 1 OF 2

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

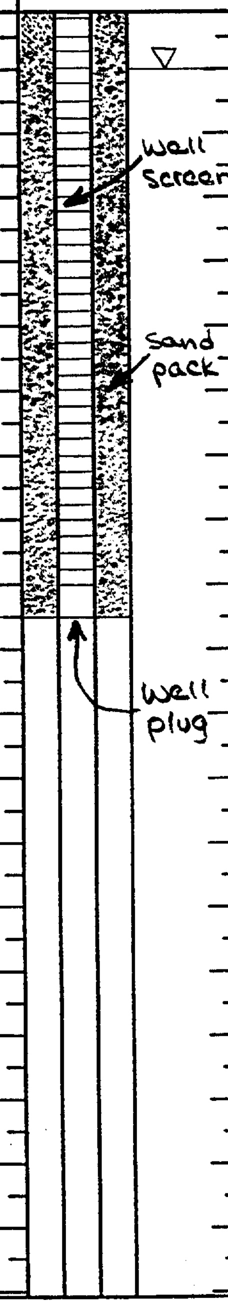
PROJECT: Site 35 Supplemental Groundwater Investigation

CTO NO.: 232

BORING NO.: 35MW44A

SAMPLE TYPE		DEFINITIONS
S = Split Spoon	A = Auger	SPT = Standard Penetration Test (ASTM D-1586)(Blows/0.5')
T = Shelby Tube	W = Wash	RQD = Rock Quality Designation (%)
R = Air Rotary	C = Core	PID = Photoionization Detector
D = Denison	P = Piston	ppm = parts per million
N = No Sample		

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab ID No.	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
						Continued from Sheet 1		
11								-3.40
12								
13								
14	A-N				.7/.7	Auger to 19.5' (bgs)		
15								
16								
17								
18								
19								-11.40
19.5								-11.90
20						End of Boring		
21						TD: 19.5' (bgs)		
22								
23								
24								
25								
26								
27								
28								
29								
30								



DRILLING CO.: Parratt-Wolff

BAKER REP.: J. E. Zimmerman

DRILLER: G. Lansing

BORING NO.: 35MW44A

SHEET 2 OF

Baker
Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	Site 35 Supplemental Groundwater Investigation		
CTO NO.:	232	BORING NO.:	35MW44B
COORDINATES: EAST:	2466146.9242	NORTH:	363675.9649
ELEVATION: SURFACE:	7.10	TOP OF PVC CASING:	9.59

RIG: #58					DATE	PROGRESS (FT.)	WEATHER	WATER DEPTH (FT.)	TIME
Pages 19 -> 21	SPLIT SPOON	CASING	AUGERS	CORE BARREL					
SIZE (DIAM.)	1-3/8"		6 1/4"		7-31-96	0-35.5	partly cloudy, humid, (80's)	11.0	
LENGTH	2.0		5'						
TYPE	Std.		HSA						
HAMMER WT.	140 lbs.								
FALL	30"								
STICK UP									

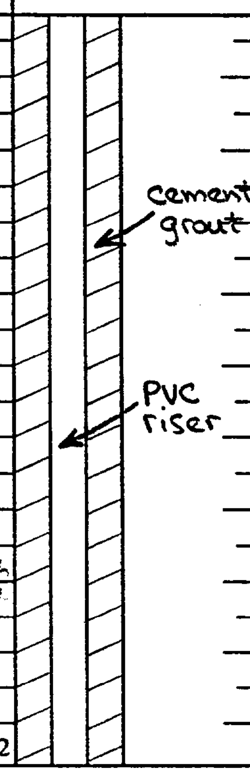
REMARKS: Single split spoon sample collected for laboratory analysis 7-9' (bgs). Augered to a 35.5' (bgs) depth. Type II well set 7-31-96. HNu background is .4 ppm

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

Well Information	Diam.	Type	Top Depth (ft.)	Bottom Depth (ft.)
Riser	2.0"	Schedule 40 PVC	+2.5	-30.0
Screen	2.0"	Schedule 40 0.01 Slot	-30.0	-35.0

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab ID No.	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
1–7.0	A-N				.4/.4	Auger to 7.0' (bgs) 7.0		0.10
7.0–9.0	S-1	1.6/2.0 80%	3 3 5 5	04	.4/.4	Silty SAND, fine grained w/ trace to little clay. Oxidation (orange/brownish red staining) is trace of fe. Gray, loose to medium stiff, damp 9.0		-1.90
10	A-N				.4/4	Auger to 35.5' (bgs) Match to Sheet 2		



DRILLING CO.: Parratt-Wolff BAKER REP.: J.E. Zimmerman
DRILLER: G. Lansing BORING NO.: 35MW44B SHEET 1 OF 3

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Site 35 Supplemental Groundwater Investigation

CTO NO.: 232

BORING NO.: 35MW44B

SAMPLE TYPE		DEFINITIONS
S = Split Spoon	A = Auger	SPT = Standard Penetration Test (ASTM D-1586)(Blows/0.5')
T = Shelby Tube	W = Wash	RQD = Rock Quality Designation (%)
R = Air Rotary	C = Core	PID = Photoionization Detector
D = Denison	P = Piston	ppm = parts per million
N = No Sample		

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab ID No.	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
						Continued from Sheet 1		
11							▽	
12								
13								
14								
15							cement grout	
16								
17								
18								
19	1A-N				.4/.4	Auger to 35.5' (bgs)		
20								
21							PVC riser	
22								
23								
24								
25								
26								-18.90
27							Bentonite pellets	
28								-20.90
29							Sand pack	
30								[illegible]

DRILLING CO.: Parratt-Wolff

BAKER REP.: J.E. Zimmerman

DRILLER: G. Lansing

BORING NO.: 35MW44B

SHEET 2 OF

Baker
Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Site 35 Supplemental Groundwater Investigation
CTO NO.: 232 BORING NO.: 35MW44B

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; A = Auger	SPT = Standard Penetration Test (ASTM D-1586)(Blows/0.5')
T = Shelby Tube; W = Wash	RQD = Rock Quality Designation (%)
R = Air Rotary; C = Core	PID = Photoionization Detector
D = Denison; P = Piston	ppm = parts per million
N = No Sample	

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab ID No.	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
						Continued from Sheet		
31								
32	A-N				4/.4		Well screen	
33						Auger to 35.5' (bgs)		
34							Sand pack	
35								-27.90
35.5								-28.40
36						End of Boring		
37						TD: 35.5' (bgs)	Well plug	
38								
39								
40								
41								
42								
43								
44								
45								
6								
7								
8								
9								
0								

DRILLING CO.: Parratt-Wolff BAKER REP.: J. E. Zimmerman

DRILLER: G. Lansing BORING NO.: 35MW44B SHEET 3 OF 3

Baker
Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Supplemental Groundwater Investigation at Site 35 - MCBCLEJ
CTO NO.: 62470-232 BORING NO.: 35-GWD06
COORDINATES: EAST: 2464972.2662 NORTH: 362400.0135
ELEVATION: SURFACE: 17.8 TOP OF PVC CASING: 17.57

RIG: Mobile B-53					DATE	PROGRESS (FT.)	WEATHER	WATER DEPTH (FT.)	TIME
	SPLIT SPOON	CASING	AUGERS	CORE BARREL					
SIZE (DIAM.)	1 3/8" ID	-	6 1/4" ID	-	4/25	0.0-47.0	Sunny, 70's	-	-
LENGTH	2'	-	5'	-	4/26	47.0-52.0	P. Sunny, 80's	-	-
TYPE	Stainless	-	HSA	-	4/27	52.0-69.0	P. Sunny, 70's	-	-
HAMMER WT.	140 lbs	-	-	-					
FALL	30"	-	-	-					
STICK UP	-	-	-	-					

REMARKS:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = ~~Air~~ Rotary (Mud) C = Core
D = Denison P = Piston
N = No Sample

Well Information	Diam.	Type	Top Depth (ft.)	Bottom Depth (ft.)
	2" OD	Sch 40 PVC Riser	-	63
(0.01" SLOT)	2" OD	Sch 40 PVC Screen	63	68

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab Class. or Pen. Rate	PID (ppm) PS/BG	Visual Description	Well Installation Detail	Elevation (ft. MSL)
1								
2								
3								
4								
5	A-N	-	-	-	-	See boring log for 35-TW03B for soil information		
6								
7								
8								
9								
10								

DRILLING CO.: Parratt-Wolff BAKER REP.: Mark DeJohn
DRILLER: Chip Lafever BORING NO.: 35-GWD06 SHEET 1 OF 4

Baker

Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Supplemental Groundwater Investigation at Site 35 - MCBCLEJ

CTO NO.: 62470-232 BORING NO.: 35-GWD06

SAMPLE TYPE		DEFINITIONS
S = Split Spoon	A = Auger	SPT = Standard Penetration Test (ASTM D-1586)(Blows/0.5')
T = Shelby Tube	W = Wash	RQD = Rock Quality Designation (%)
R = ~~Air~~ Rotary (Mud)	C = Core	Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
D = Denison	P = Piston	Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis
N = No Sample		

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab Class. or Pen. Rate	PID (ppm) PS/BG	Visual Description	Well Installation Detail	Elevation (ft. MSL)
11								
12								
13								
14								
15								
16								
17								
18								
19								
20	A-N	-	-	-	-			
21								
22								
23								
24								
25								
26								
27								
28								
29								
30 30.0						30.0		

DRILLING CO.: Parratt-Wolff BAKER REP.: Mark DeJohn

DRILLER: Chip Lafever BORING NO.: 35-GWD06 SHEET 2 OF 4

Baker

Baker Environmental, inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Supplemental Groundwater Investigation at Site 35 - MCBCLEJ

CTO NO.: 62470-232 BORING NO.: 35-GWD06

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = ~~Air~~ Rotary (Mud) C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D-1586)(Blows/0.5')
RQD = Rock Quality Designation (%)
Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab Class. or Pen. Rate	PID (ppm) BS/BZ	Visual Description	Well Installation Detail	Elevation (ft. MSL)
31–32.0	S-1	1.3 65%	8 12 15 17	-	0.1/0.1	SHELL FRAGMENTS, trace to little silt; gray; m. dense; wet		
32.0–34.0	S-2	1.0 50%	24 24 20 20	-	0.1/0.1	some silt, trace clay; dense 33.5		-15.7
34.0–36.0	S-3	1.5 75%	24 27 26 13	-	0.1/0.1	FINE-MED SAND, little shell frag. & silt; gray; v. dense; wet 36.0		-18.2
36.0–38.0	S-4	1.8 90%	12 13 13 19		0.1/0.1	FINE SAND, some silt, trace shell frag. & clay; gray; m. dense; moist		
38.0–44.0	A-N	-	-	-	-			
44.0–46.0	S-5	1.8 90%	4 5 8 12	-	0.1/0.1	45.1 FINE SAND, some silt, little clay; olive green; stiff to v. stiff; moist		-27.3
46.0–47.0	A-N	-	-	-	-		47.0	(OUTER CASING) -29.2
47.0–50.0	R-N	-	-	-	-			

DRILLING CO.: Parratt-Wolff BAKER REP.: Mark DeJohn

DRILLER: Chip Lafever BORING NO.: 35-GWD06 SHEET 3 OF 4

Baker

Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Supplemental Groundwater Investigation at Site 35 - MCBCLEJ

CTO NO.: 62470-232 BORING NO.: 35-GWD06

SAMPLE TYPE		DEFINITIONS
S = Split Spoon	A = Auger	SPT = Standard Penetration Test (ASTM D-1586)(Blows/0.5')
T = Shelby Tube	W = Wash	RQD = Rock Quality Designation (%)
R = ~~Air~~ Rotary (Mud)	C = Core	Lab. Class. = USCS (ASTM D-2487) or AASHTO (ASTM D-3282)
D = Denison	P = Piston	Lab. Moist. = Moisture Content (ASTM D-2216) Dry Weight Basis
N = No Sample		

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab Class. or Pen. Rate	PID (ppm) PS/BG	Visual Description	Well Installation Detail	Elevation (ft. MSL)
51–52.0	S-6	1.3 65%	10 12 12 13	-	0.4/0.4	BENTONITE GROUT		
52–54.0	S-7	0.8 40%	10 20 24 40	-	0.2/0.2	hard		
54–56.0	S-8	1.8 90%	9 12 20 22	-	0.2/0.2	trace to little shell frag; greenish gray; moist		
56–58.0	S-9	1.7 85%	20 24 27 31	-	0.2/0.2	57.7	58.0	-39.9 / -40.2
58–66.0	R-N	-	-	-	-	FINE SAND, some shell frag; silt, little clay; gray; v. dense; wet BENTONITE SEAL SAND PACK	60.0 63.0	-42.2 -45.2
66–68.0	S-10	2.0 100%	16 20 22 25	-	0.2/0.2	greenish gray; dense; wet	68.0	-50.2
68–69.0	R-N	-	-	-	-	69.0	69.0	-51.2
70						BOH @ 69.0 ft		

DRILLING CO.: Parratt-Wolff BAKER REP.: Mark DeJohn

DRILLER: Chip Lafever BORING NO.: 35-GWD06 SHEET 4 OF 4

Baker
Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Site 35 Supplemental Groundwater Investigation
CTO NO.: 232 — BORING NO.: 35GWD07
COORDINATES: EAST: 2466150.9595 — NORTH: 363667.6343
ELEVATION: SURFACE: 7.30 — TOP OF PVC CASING: 9.41

RIG: #58					DATE	PROGRESS (FT.)	WEATHER	WATER DEPTH (FT.)	TIME
4→9 36→37	SPLIT SPOON	CASING	AUGERS	CORE BARREL					
SIZE (DIAM.)	1-3/8"	6"	3¼"/8¼"		7-30-96	0-37.0	Partly cloudy humid (80's)	11.0'	
LENGTH	2.0	37.0	5'		8-1-96	37.0-51.5	overcast, humid (70's)		
TYPE	Std.	Steel	HSA						
HAMMER WT.	140 lbs.								
FALL	30"								
STICK UP									

REMARKS: Borehole continuously sampled to a 51.5' (bgs) depth. Type III well set 8-1-96. HNu background range is .4ppm to .9 ppm.

SAMPLE TYPE

S = Split Spoon — A = Auger
T = Shelby Tube — W = Wash
R = Air Rotary — C = Core
D = Denison — P = Piston
N = No Sample

Well Information	Diam.	Type	Top Depth (ft.)	Bottom Depth (ft.)
Riser	2.0"	Schedule 40 PVC	+2.5	-46.0
Screen	2.0"	Schedule 40 0.01 Slot	-46.0	-51.0

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab ID No.	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
1–2 (2.0)	S-1	1.2/2.0 60%	4 5 5 7		.6/.6	SAND, fine grained w/trace silt, trace/little rooted mat. Silty SAND, fine grained w/trace to little clay. Oxidation present. Brownish gray to brown	Cement grout	6.60 / 5.30
3–4 (4.0)	S-2	1.0/2.0 50%	6 5 4 4		.6/.6	SAND, fine grained w/trace silt. Brownish gray, loose to medium dense, damp 4.0	6" steel casing	3.30
5 (5.0)	A-N				.6/.6	5.0		2.30
6–7 (7.0)	S-3	2.0/2.0 100%	4 5 6 6		.6/.6	Silty SAND, fine grained w/trace to little clay. Oxidation (orange staining). Grayish brown to brown, medium dense/medium stiff damp to moist.		
8–9 (9.0)	S-4	2.0/2.0 100%	5 7 9 8		.9/.9		2" PVC riser	
10	S-5	2.0/2.0 100%	5 8 12 10		.6/.6	Match to Sheet 2		

DRILLING CO.: Parratt-Wolff — BAKER REP.: J.E. Zimmerman
DRILLER: G. Lansing — BORING NO.: 35GWD07 — SHEET 1 OF 4

Baker

Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Site 35 Supplemental Groundwater Investigation

CTO NO.: 232 BORING NO.: 35GW007

SAMPLE TYPE		DEFINITIONS
S = Split Spoon	A = Auger	SPT = Standard Penetration Test (ASTM D-1586)(Blows/0.5')
T = Shelby Tube	W = Wash	RQD = Rock Quality Designation (%)
R = Air Rotary	C = Core	PID = Photoionization Detector
D = Denison	P = Piston	ppm = parts per million
N = No Sample		

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab ID No.	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
11.0	S-5	100%			.6/.6	Continued from Sheet 1 10.8		-3.50 -3.70
13.0	S-6	1.8/2.0 90%	3 4 6 7		.6/.6	SAND, fine grained w/ trace silt, Brown to light brown to gray to brown, medium dense to loose, moist to wet	cement grout	
15.0	S-7	2.0/2.0 100%	3 3 4 3		.6/.6			
17.0	S-8	1.2/2.0 60%	3 3 4 6		.6/.6		6" steel casing	
19.0	S-9	1.7/2.0 85%	3 2 5 7		.6/.6			
21.0	S-10	1.8/2.0 90%	2 2 2 2		.6/.6	21.6		
23.0	S-11	1.0/2.0 50%	3 3 6 7		.6/.6	cemented sandstone nodules		-14.30 -14.70
25.0	S-12	.6/2.0 30%	7 8 13 17		.6/.6	SAND, fine to medium grained w/ trace silt and little cemented shell material/fragments. Light gray to brown & white, very dense to dense, wet.	2" PVC riser	
27.0	S-13	1.6/2.0 80%	12 24 38 20		.6/.6			
29.0	S-14	2.0/2.0 100%	14 18 22 26		.6/.6			
30	S-15	2.0/2.0	22 24		.6/.6			

DRILLING CO.: Parratt-Wolff BAKER REP.: J.E. Zimmerman

DRILLER: G. Lansing BORING NO.: 35GW007 SHEET 2 OF

Baker

Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Site 35 Supplemental Groundwater Investigation

CTO NO.: 232 BORING NO.: 35GW007

SAMPLE TYPE	DEFINITIONS
S = Split Spoon; A = Auger; T = Shelby Tube; W = Wash; R = Air Rotary; C = Core; D = Denison; P = Piston; N = No Sample	SPT = Standard Penetration Test (ASTM D-1586)(Blows/0.5'); RQD = Rock Quality Designation (%); PID = Photoionization Detector; ppm = parts per million

Depth (ft.)	Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab ID No.	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
31 (31.0)	S-15	100%	18 19		.6/.6	Continued from Sheet 2 30.5 FOSSILIFEROUS LIMESTONE w/SAND, fine grained	cement grout	-23.20
32, 33 (33.0)	S-16	1.3/2.0 65%	18 24 28 32		.6/.6	trace silt, trace cemented shell material/fragments		
34, 35 (35.0)	S-17	1.8/2.0 90%	12 12 24 18		.6/.6	micrite cement. Brown to light gray and white, dense, wet	6" steel casing	-27.20
36, 37 (37.0)	S-18	.6/2.0 30%	4 5 11 11		.6/.6	SAND, fine grained trace silt, trace		-29.70
38, 39 (39.0)	S-19	1.6/2.0 80%	5 6 7 11		.4/.4	clay, trace shell material. Dark greenish gray and white, dense to	Bentonite slurry	
40, 41 (41.0)	S-20	1.5/2.0 75%	11 16 21 29		.4/.4	medium dense. moist 41.0	2" PVC riser	
42, 43 (43.0)	S-21	1.4/2.0 70%	36 24 24 38		.4/.4	FOSSILIFEROUS LIMESTONE w/SAND, fine grained trace silt, little cemented shell		-33.70
44, 45 (45.0)	S-22	1.5/2.0 75%	38 47 44 46		.4/.4	material, trace shell fragments, micrite cement. Light gray & white, dens/v. dense, wet.		-36.70 -37.70
46, 47 (47.0)	S-23	1.8/2.0 90%	12 13 24 28		.4/.4	SAND, fine grained w/trace silt, trace	Sand pack	-38.70
48, 49 (49.0)	S-24	1.6/2.0 80%	38 49 56 68		.4/.4	shell fragments. Olive & white, dense to very dense, wet.	Well Screen	
50	S-25	2.0/2.0	17 26		.4/.4			

DRILLING CO.: Parratt-Wolff BAKER REP.: J.E. Zimmerman

DRILLER: G. Lansing BORING NO.: 35GW007

Baker

Baker Environmental, Inc

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Site 35 Supplemental Groundwater Investigation

CTO NO.: 232 BORING NO.: 35GW007

SAMPLE TYPE		DEFINITIONS
S = Split Spoon	A = Auger	SPT = Standard Penetration Test (ASTM D-1586)(Blows/0.5')
T = Shelby Tube	W = Wash	RQD = Rock Quality Designation (%)
R = Air Rotary	C = Core	PID = Photoionization Detector
D = Denison	P = Piston	ppm = parts per million
N = No Sample		

Depth (ft.)		Samp. Type and No.	Samp. Rec. (ft. & %)	SPT or RQD	Lab ID No.	PID (ppm)	Visual Description	Well Installation Detail	Elevation (ft. MSL)
51	51.0	S-25	100%	31 38		.4/.4	Continued from Sheet 3	Sand pack	-43.70
	51.5	A-N				.4/.4			-44.20
52							End of Boring	Well screen	
53							TD: 51.5' (bgs)		
54								Well plug	
55									
56									
57									
58									
59									
60									
1									
2									
3									
4									
5									
6									
7									
8									
9									
0									

DRILLING CO.: Parratt-Wolff BAKER REP.: J.E. Zimmerman

DRILLER: G. Lansing BORING NO.: 35GW007 SHEET 4 OF 4

APPENDIX E
SGI SAMPLE SUMMARY

SEDIMENT SAMPLING SUMMARY
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Date Sampled	TPH 5030/8015m Gasoline	TPH 3550/8015m Diesel	Mercury	Zinc	Percent Solids	Duplicate	MS/MS
35-SD01-06-02	8/08/95	X	X	X	X	X		
35-SD01-612-02	8/08/95	X	X	X	X	X		
35-SD02-06-02	8/08/95	X	X	X	X	X		
35-SD02-612-02	8/08/95	X	X	X	X	X		
35-SD03-06-02	8/07/95	X	X	X	X	X		
35-SD03-612-02	8/07/95	X	X	X	X	X		
35-SD04-06-02	8/07/95	X	X	X	X	X		
35-SD04-612-02	8/07/95	X	X	X	X	X		
35-SD05-06-02	8/07/95	X	X	X	X	X		
35-SD05-612-02	8/07/95	X	X	X	X	X		
35-SD06-06-02	8/07/95	X	X	X	X	X	X	
35-SD06-612-02	8/07/95	X	X	X	X	X		
35-SD07-06-02	8/08/95	X	X	X	X	X		
35-SD07-612-02	8/08/95	X	X	X	X	X		
36-SD05-06-02	8/08/95	X	X	X	X	X		
36-SD05-612-02	8/08/95	X	X	X	X	X		
36-SD06-06-02	8/07/95	X	X	X	X	X		
36-SD06-612-02	8/07/95	X	X	X	X	X		
36-SD07-06-02	8/07/95	X	X	X	X	X	X	X
36-SD07-612-02	8/07/95	X	X	X	X	X		

SOIL SAMPLE SUMMARY
SOIL SCREENING INVESTIGATION
SITE 35, CAMP GEIGER FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION
CONTRACT TASK ORDER 0232

Sample Location	Date Collected	Borehole Depth** (ft bgs)	Sampling Interval** (ft bgs)	PARAMETERS ***		
				BTEX	DCE/TC	MTBE
35-TW01B-00	4/09/96	44	0-.5	X	X	X
35-TW01B-03	4/09/96	4	4-6	X	X	X
35-TW02B-00	4/09/96	47	0-.5	X	X	X
35-TW02B-03	4/09/96	47	4-6	X	X	X
35-TW03B-00	4/09/96	47	0-.5	X	X	X
35-TW03B-03	4/09/96	47	4-6	X	X	X
35-TW04B-00	4/10/96	42	0-.5	X	X	X
35-TW04B-03	4/10/96	42	4-6	X	X	X
35-TW05B-00	4/10/96	42	0-.5	X	X	X
35-TW05B-03	4/10/96	42	4-6	X	X	X
35-TW06B-00	4/11/96	47	0-.5	X	X	X
35-TW06B-03	4/11/96	47	4-6	X	X	X
35-TW07B-00	4/11/96	47	0-.5	X	X	X
35-TW07B-03	4/11/96	47	4-6	X	X	X
35-TW08B-00	4/11/96	42	0-.5	X	X	X
35-TW08B-03	4/11/96	42	4-6	X	X	X
35-TW09B-00	4/12/96	42	0-.5	X	X	X
35-TW09B-03	4/12/96	42	4-6	X	X	X
35-TW10B-00	4/12/96	47	0-.5	X	X	X
35-TW10B-03	4/12/96	47	4-6	X	X	X
35-TW11B-00	4/12/96	42	0-.5	X	X	X
35-TW11B-03	4/12/96	42	4-6	X	X	X
35-TW30B-01*	7/31/96	40	0-2	X	X	
35-TW31B-05*	8/02/96	40	8-10	X	X	
35-MW60B-04*	8/02/96	40	6-8	X	X	

* These samples were also analyzed for vinyl chloride, chloroform, 1,1,1-TCA, tetrachloride and PCE.

** ft bgs = feet below ground surface

*** BTEX = Benzene, toluene, ethylbenzene, and xylenes.
DCE/TCE = cis-1,2 dichcloroethylene, trans-1,2 dichloroethylene, and trichloroethylene.
MTBE = methyl tertiary butylether

GROUNDWATER SAMPLE SUMMARY
NAOC,GROUNDWATER SCREENING INVESTIGATION
SITE 35, CAMP GEIGER FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION
CONTRACT TASK ORDER 0232

Sample Location	Date Collected	On-Site Mobile Lab Parameters *			Fixed-base Lab Parameters	
		BTEX	DCE/TCE	MTBE	TCL VOCs	MTBE
35-TW16A	4/17/96	X	X	X		
35-TW16B	4/17/96	X	X	X		
35-TW16C	4/17/96	X	X	X		
35-TW17A	4/17/96	X	X	X		
35-TW17B	4/17/96	X	X	X		
35-TW17C	4/17/96	X	X	X		
35-TW18A	4/17/96	X	X	X		
35-TW18B	4/16/96	X	X	X		
35-TW18C	4/16/96	X	X	X		
35-TW19A	4/16/96	X	X	X		
35-TW19B	4/16/96	X	X	X		
35-TW19C	4/16/96	X	X	X		
35-TW20A	4/15/96	X	X	X		
35-TW20B	4/15/96	X	X	X		
35-TW20C	4/15/96	X	X	X		
35-TW22A	4/15/96	X	X	X		
35-TW22B	4/15/96	X	X	X		
35-TW22C	4/15/96	X	X	X		
35-TW23A	4/15/96	X	X	X		
35-TW23B	4/15/96	X	X	X		
35-TW23C	4/15/96	X	X	X		
35-TW24A	4/14/96	X	X	X		
35-TW24B	4/14/96	X	X	X		
35-TW24C	4/14/96	X	X	X		
35-TW25A	4/14/96	X	X	X		
35-TW25B	4/14/96	X	X	X		
35-TW25C	4/14/96	X	X	X		
35-TW26A	4/13/96	X	X	X		
35-TW26B	4/13/96	X	X	X		
35-TW26C	4/13/96	X	X	X		
35-TW27B	4/25/96	X	X	X	X	X
35-TW28B	4/29/96	X	X	X	X	X
35-TW30A**	8/4/96	X	X	X	X	X
35-TW30B**	8/4/96	X	X	X	X	X
35-TW31A**	8/4/96	X	X	X	X	X
35-TW31B**	8/4/96	X	X	X	X	X
35-MW16S	4/14/96	X	X	X		
35-MW16D	4/14/96	X	X	X		
35-MW17S	4/13/96	X	X	X		
35-MW17D	4/13/96	X	X	X		
35-MW18S	4/13/96	X	X	X		
35-MW18D	4/13/96	X	X	X		
35-MW19S	4/14/96	X	X	X		
35-MW19D	4/14/96	X	X	X		
35-MW60A**	8/4/96	X	X	X	X	X
35-MW60B**	8/4/96	X	X	X	X	X

* BTEX = Benzene, toluene, ethylbenzene, and xylenes.
DCE/TCE = cis-1,2 dichcloroethylene, trans-1,2 dichloroethylene, and trichloroethylene.
MTBE = methyl tertiary butylether

** Mobile laboratory anlysis included cis-1,2 DCE,trans-1,2 DCE, TCE, vinyl chloride, chloroform, carbon tetrachloride, 1,1,1-TCA, and PCE

GROUNDWATER SAMPLE SUMMARY
SAOC, GROUNDWATER SCREENING INVESTIGATION
SITE 35, CAMP GEIGER FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION
CONTRACT TASK ORDER 0232

Sample Location	Date Collected	On-Site Mobile Lab Parameters *			Fixed-base Lab Parameters	
		BTEX	DCE/TCE	MTBE	TCL VOCs	MTBE
35-TW01A	4/10/96	X	X	X		
35-TW01B	4/09/96	X	X	X		
35-TW02A	4/09/96	X	X	X		
35-TW02B	4/09/96	X	X	X		
35-TW03A	4/10/96	X	X	X		
35-TW03B	4/9/96	X	X	X		
35-TW04A	4/10/96	X	X	X		
35-TW04B	4/10/96	X	X	X		
35-TW05A	4/10/96	X	X	X		
35-TW05B	4/10/96	X	X	X		
35-TW06A	4/11/96	X	X	X		
35-TW06B	4/11/96	X	X	X		
35-TW07A	4/15/96	X	X	X		
35-TW07B	4/11/96	X	X	X		
35-TW08A	4/11/96	X	X	X		
35-TW08B	4/11/96	X	X	X		
35-TW09A	4/13/96	X	X	X		
35-TW09B	4/13/96	X	X	X		
35-TW10A	4/13/96	X	X	X		
35-TW10B	4/13/96	X	X	X		
35-TW11A	4/12/96	X	X	X		
35-TW11B	4/12/96	X	X	X		
35-TW12B	4/26/96				X	X
35-TW13B	4/26/96				X	X
35-TW14B	4/29/96				X	X
35-TW15B	4/30/96				X	X
35-TW29B	4/30/96				X	X
35-MW30A	4/08/96	X	X	X		

* BTEX = Benzene, toluene, ethylbenzene, and xylenes.
DCE/TCE = cis-1,2 dichloroethylene, trans-1,2 dichloroethylene, and trichloroethylene.
MTBE = methyl tertiary butylether

GROUNDWATER SAMPLE SUMMARY
ROUND 3 GROUNDWATER INVESTIGATION
SITE 35, CAMP GEIGER FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION
CONTRACT TASK ORDER 0232

Sample Location	Date Collected	Parameters		Duplicates	MS/MSD
		TAL Metals	TSS/TDS		
35-MW09S-02	8/12/95	X	X		
35-MW09D-02	8/12/95	X	X		
35-MW10S-02	8/09/95	X	X		
35-MW10D-02	8/09/95	X	X		
35-MW14S-02	8/10/95	X	X		
35-MW14D-02	8/10/95	X	X		
35-MW16S-02	8/10/95	X	X	X	
35-MW16D-02	8/09/95	X	X		
35-MW19S-02	8/11/95	X	X	X	X
35-MW19D-02	8/11/95	X	X		
35-MW22S-02	8/13/95	X	X		
35-MW22D-02	8/13/95	X	X		
35-MW29A-02	8/12/95	X	X		
35-MW29B-02	8/12/95	X	X		
35-MW33A-02	8/12/95	X	X		
35-MW33B-02	8/12/95	X	X		
35-EMW03-02	8/10/95	X	X		
35-EMW05-02	8/11/95	X	X		
35-EMW07-02	8/10/95	X	X		
35-GWD05-02	8/11/95	X	X		

GROUNDWATER SAMPLE SUMMARY
ROUND 4, GROUNDWATER INVESTIGATION
SITE 35, CAMP GEIGER FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION
CONTRACT TASK ORDER 0232

Sample Location	Date Collected	Parameters		Duplicates	MS/MSD
		TCL VOCS	MTBE		
35-MW09D-04	4/27/96	X	X		
35-MW10D-04	4/27/96	X	X	X	
35-MW14D-02	4/26/96	X	X		
35-MW19S-02	4/27/96	X	X		
35-MW19D-02	4/27/96	X	X	X	X
35-MW30B-04	4/27/96	X	X		
35-MW32A-04	4/27/96	X	X		
35-MW35A-04	4/27/96	X	X		
35-MW36A-04	4/27/96	X	X		
35-MW36B-04	4/27/96	X	X		
35-MW37B-04	4/28/96	X	X		
35-MW39B-04	5/02/96	X	X		
35-MW40B-04	5/01/96	X	X		
35-MW41B-04	5/02/96	X	X		
35-MW42B-04	5/01/96	X	X	X	
35-MW43B-04	5/03/96	X	X		
35-MW60A-04	8/04/96	X	X		
35-MW60B-04	8/04/96	X	X	X	X
35-EMW03-02	4/26/96	X	X		
35-GWD06-04	4/30/96	X	X		
35-GWD07-04	4/30/96	X	X		

APPENDIX F
SOIL AND GROUNDWATER SCREENING RESULTS
MOBILE LABORATORY DATA

MICROSEEPS

University of Pittsburgh Applied Research Center
220 William Pitt Way, Pittsburgh, PA 15238
(412) 826-5245
FAX (412) 826-3433

April 19, 1996

Mr. Mike Smith
Baker Environmental, Inc.
Airport Office Park, Bldg. 3
420 Rouser Road
Coraopolis, PA 15108

Dear Mr. Smith:

Attached are copies of the data listings and a copy of the analysis logs for your project at Camp LeJeune.

Please give me a call if you have questions or I can be of further assistance. Thank you for using MICROSEEPS.

Sincerely,

David J. Masdea

DJM/lsp

Attachment: 961023

961023

----- BAKER ENVIRONMENTAL -----

----- PROJECT: SGI/CAMP LEJEUNE -----

----- PROJECT LOCATION: SOUTH AREA -----

----- H2O CONCENTRATIONS IN (ug/l) -----

SAMPLE NAME	TIME COLLECTED	BENZENE (ug/l)	TOLUENE (ug/l)	ETHYL BENZENE (ug/l)	M&P-XYLENE (ug/l)	O-XYLENE (ug/l)	trans-1,2-DCE (ug/l)	cis-1,2-DCE (ug/l)	TCE (ug/l)	MTBE (ug/l)	FILE NAME	DATE COLLECTED	DATE ANALYZED
35-MW-30A	1830	<1	<1	<1	<1	<1	<1	<1	<.1	<5	M10 78	04/08/96	04/09/96
35-MW16D-04	1710	8	<1	<1	<1	<1	<1	15	0.3	<5	M10 168	04/14/96	04/14/96
35-MW16S-04	1658	557	51	275	885	26	<1	<1	<.1	16	M10 169	04/14/96	04/14/96
35-MW17D-04	1119	<1	<1	<1	<1	<1	<1	<1	<.1	<5	M10 149	04/13/96	04/13/96
35-MW17S-04	1125	<1	1	<1	<1	<1	<1	<1	<.1	<5	M10 150	04/13/96	04/13/96
35-MW18D-04	1258	<1	<1	<1	<1	<1	<1	10	0.7	<5	M10 151	04/13/96	04/13/96
35-MW18S-04	1303	99	<1	2	<1	<1	<1	4	0.5	63	M10 152	04/13/96	04/13/96
35-MW19D-04	1212	<1	<1	<1	<1	<1	68	266	379.2	<5	M10 164	04/14/96	04/14/96
35-MW19S-04	1233	<1	<1	<1	<1	<1	2	13	12.0	<5	M10 163	04/14/96	04/14/96
35-TWTB1-04	1905	<1	<1	<1	<1	<1	<1	<1	<.1	<5	M10 87	04/09/96	04/10/96
35-FB01-04I	----	<1	<1	<1	<1	<1	<1	<1	<.1	<5	M10 124	04/12/96	04/12/96

MICROSEEPS

961023

----- BAKER ENVIRONMENTAL -----

----- PROJECT: SGI/CAMP LEJEUNE -----

----- PROJECT LOCATION: NORTH AREA -----

----- H2O CONCENTRATIONS IN (ug/l) -----

SAMPLE NAME	TIME COLLECTED	BENZENE (ug/l)	TOLUENE (ug/l)	ETHYL BENZENE (ug/l)	M&P-XYLENE (ug/l)	O-XYLENE (ug/l)	trans-1,2-DCE (ug/l)	cis-1,2-DCE (ug/l)	TCE (ug/l)	MTBE (ug/l)	FILE NAME	DATE COLLECTED	DATE ANALYZED
35-TW01A-04I	1809	<1	<1	<1	<1	<1	<1	<1	<.1	<5	M10 85	04/09/96	04/10/96
35-TW01B-04I	1716	<1	<1	<1	<1	<1	2	48	1.1	<5	M10 86	04/09/96	04/10/96
35-TW02A-04	1100	<1	<1	<1	<1	<1	<1	<1	<.1	<5	M10 95	04/10/96	04/10/96
35-TW02B-04I	1020	<1	<1	<1	<1	<1	18	211	7.6	<5	M10 96	04/10/96	04/10/96
35-TW03A-04I	1505	<1	<1	<1	<1	<1	<1	<1	<.1	<5	M10 97	04/10/96	04/10/96
35-TW03B-04I	2121	<1	<1	<1	<1	<1	5	125	13.5	<5	M10 88	04/09/96	04/10/96
35-TW04A-04I	1734	<1	<1	<1	<1	<1	<1	<1	<.1	<5	M10 100	04/10/96	04/10/96
35-TW04B-04I	1900	<1	<1	<1	<1	<1	2	46	24.6	<5	M10 104	04/10/96	04/10/96
35-TW05A-04I	1915	<1	<1	<1	<1	<1	<1	<1	<.1	<5	M10 105	04/10/96	04/10/96
35-TW05B-04I	1923	<1	<1	<1	<1	<1	<1	13	1.7	<5	M10 106	04/10/96	04/10/96
35-TW06A-04I	1425	<1	<1	<1	<1	<1	<1	<1	<.1	<5	M10 116	04/11/96	04/11/96
35-TW06B-04I	1414	<1	<1	<1	<1	<1	<1	<1	<.1	<5	M10 115	04/11/96	04/11/96
35-TW07A-04I	1758	<1	<1	<1	<1	<1	<1	<1	<.1	<5	M10 119	04/11/96	04/11/96
35-TW07B-04I	1733	<1	<1	<1	<1	<1	<1	<1	<.1	<5	M10 120	04/11/96	04/11/96
35-TW08A-04I	1910	<1	<1	<1	<1	<1	<1	<1	<.1	<5	M10 121	04/11/96	04/11/96
35-TW08B-04I	1913	<1	<1	<1	<1	<1	<1	7	1.3	<5	M10 123	04/11/96	04/11/96
35-TW09A-04I	1130	<1	<1	<1	<1	<1	<1	<1	<.1	<5	M10 136	04/12/96	04/12/96
35-TW09B-04I	1250	<1	<1	<1	<1	<1	1	38	9.6	<5	M10 131	04/12/96	04/12/96
35-TW10A-04I	1644	<1	<1	<1	<1	<1	<1	<1	<.1	<5	M10 137	04/12/96	04/12/96
35-TW10B-04I	1651	<1	<1	<1	<1	<1	<1	11	<.1	<5	M10 138	04/12/96	04/12/96
35-TW11A-04I	1900	<1	<1	<1	<1	<1	<1	<1	<.1	<5	M10 141	04/12/96	04/12/96
35-TW11B-04I	1904	<1	<1	<1	<1	<1	<1	6	0.5	<5	M10 142	04/12/96	04/12/96

MICROSEEPS

961023

----- BAKER ENVIRONMENTAL -----

----- PROJECT: SGI/CAMP LEJEUNE -----

----- PROJECT LOCATION: NORTH AREA -----

----- SOIL CONCENTRATIONS IN (ng/g) -----

SAMPLE NAME	TIME COLLECTED	BENZENE (ng/g)	TOLUENE (ng/g)	ETHYL BENZENE (ng/g)	M&P-XYLENE (ng/g)	O-XYLENE (ng/g)	trans-1,2-DCE (ng/g)	cis-1,2-DCE (ng/g)	TCE (ng/g)	MTBE (ng/g)	FILE NAME	DATE COLLECTED	DATE ANALYZED
35-TW01B-00	830	<2	<2	<2	<2	<2	<2	<2	<1	<10	M10 79	04/09/96	04/09/96
35-TW01B-03	853	<2	<2	<2	<2	<2	<2	<2	<1	<10	M10 80	04/09/96	04/09/96
35-TW02B-00	1313	<2	<2	<2	<2	<2	<2	<2	<1	<10	M10 81	04/09/96	04/10/96
35-TW02B-03	1345	<2	<2	<2	<2	<2	<2	<2	<1	<10	M10 82	04/09/96	04/10/96
35-TW03B-00	1659	<2	<2	<2	<2	<2	<2	<2	<1	<10	M10 83	04/09/96	04/10/96
35-TW03B-03	1715	<2	<2	<2	<2	<2	<2	<2	<1	<10	M10 84	04/09/96	04/10/96
35-TW04B-00	917	<2	<2	<2	<2	<2	<2	<2	<1	<10	M10 93	04/10/96	04/10/96
35-TW04B-03	935	<2	<2	<2	<2	<2	<2	<2	<1	<10	M10 94	04/10/96	04/10/96
35-TW05B-00	1258	<2	<2	<2	<2	<2	<2	<2	<1	<10	M10 98	04/10/96	04/10/96
35-TW05B-03	1314	<2	<2	<2	<2	<2	<2	<2	<1	<10	M10 99	04/10/96	04/10/96
35-TW06B-00	734	<2	<2	<2	<2	<2	<2	<2	<1	<10	M10 109	04/11/96	04/11/96
35-TW06B-03	755	<2	<2	<2	<2	<2	<2	<2	<1	<10	M10 110	04/11/96	04/11/96
35-TW07B-00	1059	<2	<2	<2	<2	<2	<2	<2	<1	<10	M10 113	04/11/96	04/11/96
35-TW07B-03	1115	<2	<2	<2	<2	<2	<2	<2	<1	<10	M10 114	04/11/96	04/11/96
35-TW08B-00	1428	<2	<2	<2	<2	<2	<2	<2	<1	<10	M10 117	04/11/96	04/11/96
35-TW08B-03	1440	<2	<2	<2	<2	<2	<2	<2	<1	<10	M10 118	04/11/96	04/11/96
35-TW09B-00	810	<2	<2	<2	<2	<2	<2	<2	<1	<10	M10 127	04/12/96	04/12/96
35-TW09B-03	822	<2	<2	<2	<2	<2	<2	<2	<1	<10	M10 126	04/12/96	04/12/96
35-TW10B-00	1224	<2	<2	<2	<2	<2	<2	<2	<1	<10	M10 132	04/12/96	04/12/96
35-TW10B-03	1236	<2	<2	<2	<2	<2	<2	<2	<1	<10	M10 133	04/12/96	04/12/96
35-TW11B-00	1520	<2	<2	<2	<2	<2	<2	<2	<1	<10	M10 134	04/12/96	04/12/96
35-TW11B-03	1540	<2	<2	<2	<2	<2	<2	<2	<1	<10	M10 135	04/12/96	04/12/96

MICROSEEPS

961023

----- BAKER ENVIRONMENTAL -----

----- PROJECT: SGI/CAMP LEJEUNE -----

----- PROJECT LOCATION: SOUTH AREA -----

----- H2O CONCENTRATIONS IN (ug/l) -----

SAMPLE NAME	TIME COLLECTED	BENZENE (ug/l)	TOLUENE (ug/l)	ETHYL BENZENE (ug/l)	M&P-XYLENE (ug/l)	O-XYLENE (ug/l)	trans-1,2-DCE (ug/l)	cis-1,2-DCE (ug/l)	TCE (ug/l)	MTBE (ug/l)	FILE NAME	DATE COLLECTED	DATE ANALYZED
35-TW16A-04I	1300	<1	<1	<1	<1	<1	<1	2	0.4	<5	M10 201	04/16/96	04/16/96
35-TW16B-04I	1225	<1	<1	<1	<1	<1	338	1317	1540.4	<5	M10 202	04/16/96	04/16/96
35-TW16C-04I	1216	<1	<1	<1	<1	<1	6	91	17.0	<5	M10 203	04/16/96	04/16/96
35-TW17A-04I	1050	<1	<1	<1	<1	<1	<1	6	2.0	<5	M10 200	04/16/96	04/16/96
35-TW17B-04I	919	<1	<1	<1	<1	<1	422	1417	2054.2	<5	M10 198	04/16/96	04/16/96
35-TW17C-04I	1012	<1	<1	<1	<1	<1	54	159	153.7	<5	M10 199	04/16/96	04/16/96
35-TW18A-04I	1616	<1	<1	<1	<1	<1	4	32	24.6	<5	M10 191	04/16/96	04/16/96
35-TW18B-04I	1619	<1	<1	<1	<1	<1	118	410	719.5	<5	M10 192	04/16/96	04/16/96
35-TW18C-04I	1622	<1	<1	<1	<1	<1	32	165	167.0	<5	M10 193	04/16/96	04/16/96
35-TW19A-04I	1204	2	<1	<1	2	<1	<1	<1	0.3	<5	M10 188	04/16/96	04/16/96
35-TW19B-04I	1208	<1	<1	<1	<1	<1	141	611	834.1	<5	M10 189	04/16/96	04/16/96
35-TW19C-04I	1213	<1	<1	<1	<1	<1	7	107	21.0	<5	M10 190	04/16/96	04/16/96
35-TW20A-04I	1747	215	883	353	445	158	2	42	8.8	<5	M10 180	04/15/96	04/15/96
35-TW20B-04I	1750	<1	2	<1	<1	<1	63	318	246.3	<5	M10 181	04/15/96	04/15/96
35-TW20C-04I	1753	37	174	28	61	30	8	124	34.4	<5	M10 182	04/15/96	04/15/96
35-TW22A-04I	1536	1654	3636	629	1293	720	<1	16	4.5	<5	M10 179	04/15/96	04/15/96
35-TW22B-04I	1500	11	14	4	6	3	5	77	10.5	<5	M10 177	04/15/96	04/15/96
35-TW22C-04I	1506	33	58	12	23	14	9	137	37.9	<5	M10 178	04/15/96	04/15/96
35-TW23A-04I	1242	3296	7392	708	1795	969	<1	9	2.2	58	M10 174	04/15/96	04/15/96
35-TW23B-04I	1255	4	6	2	3	2	3	70	11.6	<5	M10 175	04/15/96	04/15/96
35-TW23C-04I	1247	224	315	37	79	44	3	47	10.9	8	M10 176	04/15/96	04/15/96
35-TW24A-04I	1508	586	3	37	7	<1	<1	<1	0.2	85	M10 165	04/14/96	04/14/96
35-TW24B-04I	1521	<1	<1	<1	<1	<1	<1	17	0.5	<5	M10 166	04/14/96	04/14/96
35-TW24C-04I	1515	5	<1	<1	<1	<1	<1	15	0.8	<5	M10 167	04/14/96	04/14/96
35-TW25A-04I	953	312	2	11	<1	<1	<1	<1	<.1	19	M10 160	04/14/96	04/14/96
35-TW25B-04I	1000	<1	<1	<1	<1	<1	<1	<1	<.1	<5	M10 161	04/14/96	04/14/96
35-TW25C-04I	947	3	<1	<1	<1	<1	<1	3	<.1	<5	M10 162	04/14/96	04/14/96
35-TW26A-04I	1555	5	<1	3	<1	<1	<1	<1	<.1	<5	M10 154	04/13/96	04/13/96
35-TW26B-04I	1711	<1	<1	<1	<1	<1	<1	<1	<.1	<5	M10 155	04/13/96	04/13/96
35-TW26C-04I	1622	3	<1	<1	<1	<1	<1	<1	<.1	<5	M10 153	04/13/96	04/13/96

MICROSEEPS, INC. | ***** ONSITE ANALYSIS ***** | PAGE 1 OF 1

LABORATORY LOCATION: CAMP LEJEUNE | PROJECT: BAKER ENVIRONMENTAL 96023 - SGI | ANALYSIS: BTEX, Chloro., MTBE in Soil/H_2O

PATH: C:\CP\M10\ | BASE FILE NAME: M10A / M10AB *.*

ANALYSIS DATE	SAMPLE ID	CYCLE #	HSS #	PID MET/CAL	ECD MET/CAL	FID MET/CAL	COMMENTS
1/9/96	H_2O BLANK	66	1	NA	M10BEAB	M10BEA	
	WSTD LS R6	67	2				
	R6	68	3				
	R5	69	4				
	R5	70	5				
	R4	71	6				
	R4	72	7				
	R2	73	8				
	R2	74	9				
	MTBE R4	75	10				
	MTBE R4	76	11				
	H_2O BLANK	77	12				
	35-MW-30A 1830	78	13				
	-TW01B-00 830	79	14		M10BEASB	M10BEAS	5.2
	-03 853	80	15				5.1
	-TW02B-00 ~~[illegible]~~	81	16				5.7
	-03 1345 ~~1609~~	82	17				4.9
	-TW03B-00 1649 ~~[illegible]~~	83	18				5.1
	-03 1715 ~~1804~~	84	19				5.8
	35-TW01A-04I 1804 ~~[illegible]~~	85	20		M10BEAB	M10BEA	
	-TW01B-04I 1716 ~~1908~~	86	21				
	-TWTB1-04 1905	87	22				
	-TW03B-04I 2121	88	23				
	-TW02A-04I 2134	89	24				GC stopped?
	WSTD LS R5	90	25				

MICROSEEPS, INC.

***** ONSITE ANALYSIS *****

LABORATORY LOCATION: Camp Lejeune

PROJECT: 961023 - SGI

ANALYSIS: BTEX, Chlorin., MTBE Soil / H2O

PATH: C:\CP\M10\

BASE FILE NAME: M10A/M10AB xx.xx

ANALYSIS DATE	SAMPLE ID	CYCLE #	HSS #	PID MET/CAL	ECD MET/CAL	FID MET/CAL	COMMENTS
	WSTD L5 R4	91	26	NA	M10BEAB	M10BEA	
	H2O BLANK	92	27		|	|	
4/10/96	35-TW04A-00 917	93	28		M10BEASB	M10BEAS	5.2
	-03 930	94	29		|	|	5.0
	-TW02A-04 1100	95	30		M10BEAB	M10BEA	
	-TW02B-04I 1020	96	31		|	|	
	-TW03A-04I 1505	97	32		|	|	
	-TW05B-00 1258	98	33		M10BEASB	M10BEAS	5.0
	-TW05B-03 1314	99	34		|	|	6.4
	-TW04A-04 1734	100	35		M10BEAB	M10BEA	
	WSTD L5 R6	101	36		|	|	
	WSTD L5 R4	102	37		|	|	
	H2O BLANK	103	38		|	|	
	35-TW04B-04I 1900	104	39		|	|	
	-TW05A-04I 1915	105	40		|	|	
	-TW05B-04I 1923	106	41		|	|	
4/11/96	H2O BLANK	107	1		|	|	
	WSTD L5 R4	108	2		|	|	
	35-TW06B-00 734	109	3		M10BEASB	M10BEAS	5.1
	-03 755	110	4		|	|	5.0
	WSTD C15 R4	111	5		M10BEAB	M10BEA	
	R4	112	6		|	|	
	35-TW07B-00 1054	113	7		M10BEASB	M10BEAS	5.3
	-03 1115	114	8				5.2
	-TW06B-04I 1414	115	9		M10BEAB	M10BEA	

MICROSEEPS, INC.

***** ONSITE ANALYSIS *****

LABORATORY LOCATION: CAMP LEJEUNE

PROJECT: 961023 - SGI

ANALYSIS: BTEX, Chlor's, MTBE soil/water

PATH: C:\CP\M10

BASE FILE NAME: M10A/M10AB

ANALYSIS DATE	SAMPLE ID	CYCLE #	HSS #	PID MET/CAL	ECD MET/CAL	FID MET/CAL	COMMENTS
4/11/96	35-TW06A-04I 1425	116	10	NA	M10BEAB	M10BEA	
	-TW08B-00 1428	117	11		M10BEASB	M10BEAS	5.7
	-03 1437	118	12		|	|	5.5
	-TW07A-04I 1258	119	13		M10BEAB	M10BEA	
	-TW07B-04I 1731	120	14		|	|	
	WSTD L5 R4	121	15				
	35-TW08A-04I 1910	122	16				
	-TW08B-04I 1913	123	17				
4/12/96	~~EB~~ 35-FB01-04	124	1				
	WSTD L5 R4	125	2				
	35-TW09B-00 810	126	3		M10BEASB	M10BEAS	5.2
	-03 822	127	4		|	|	5.8
	WSTD MTBE R4	128	5		M10BEAB	M10BEA	
	35-TW09B-04I 1250	129	1				Sample problem no run.
	-TW09A-04I 1300	130	2				
35-TW09B-04I	~~TW10B-00~~ 1244	131	3				~~5.4~~
	-TW10B-00 1234	132	4		M10BEASB	M10BEAS	~~5.5~~ 5.1
	-03 1236	133	5				5.5
	-TW11B-00 1520	134	6				5.0
	-03 1540	135	7				5.1
	35- TW09A-04I 1300	136	8		M10BEA4	M10BEA	
	-TW10A-04I 1644	137	9				
	-TW10B-04I 1651	138	10				
	~~WSTD L5 R5~~ CIS R4	139	11				
	~~WSTD R5 CIS R4~~ H2O BLANK	140	12				

MICROSEEPS, INC. ***** ONSITE ANALYSIS *****

LABORATORY LOCATION: CAMP LEJEUNE PROJECT: 96023 - SGI ANALYSIS: BTEX, MTBE, Chloro's Soil / Water

PATH: C:\CP\M10 BASE FILE NAME: M10YAB

ANALYSIS DATE	SAMPLE ID	CYCLE #	HSS #	PID MET/CAL	ECD MET/CAL	FID MET/CAL	COMMENTS
4/12/96	35-TW11A-04I 1900	141	13	NA	M10BEAB	M10BEA	
	-TW11B-04I 1904	142	14				
4/13/96	H2O BLANK	143	1				
	WSTD L5 R4	144	2				
	WSTD MTBE R4	145	3				
	" R2	146	4				
	" R2	147	5				
	H2O BLANK	148	6				
	35-MW17D-04 1119	149	7				
	-MW17S-04 1125	152	8				
	-MW18D-04 1258	151	9				
	-MW18S-04 1302	152	10				
	-TW26C-04I 1622	153	11				
	-TW26A-04I 1555	154	12				
	-TW26B-04I 1711	155	13				
4/14/96	H2O BLANK	156	1				
	WSTD L5 R4	157	2				
	CIS R4	158	3				
	MTBE R4	159	4				
	35-TW25A-04I 0953	160	5				
	35-TW25B-04I 1000	161	6				
	-TW25C-04I 0947	162	7				
	-MW19S-04 1224	163	8				
	-MW19D-04 1212	164	9				
	-TW24A-04I 1508	165	10				

MICROSEEPS, INC.

***** ONSITE ANALYSIS *****

LABORATORY LOCATION: CAMP LEJEUNE

PROJECT: 461023 SGI

ANALYSIS: BTEX, Chloro's, MTBE Soil/water

PATH: C:\CP\M10

BASE FILE NAME: M10A/AB

ANALYSIS DATE	SAMPLE ID	CYCLE #	HSS #	PID MET/CAL	ECD MET/CAL	FID MET/CAL	COMMENTS
4/14/96	35-TW24B-04I 1521	166	11	NA	MICBEAB	MICBEA	
	-TW24C-04I 1515	167	12				
	-MW16D-04 1710	168	13				
	-MW16S-04 1658	169	14				
	WSTD L5 R4	170	15				
	H2O BLANK	171	16				
4/15/96	H2O BLANK	172	1				
	WSTD L5 R4	173	2				
	35-TW23A-04I 1242	174	3				
	-TW23B-04I 1255	175	4				
	-TW23C-04I 1247	176	5				
	-TW22B-04I 1520	177	6				
	-TW22C-04I 1506	178	7				
	-TW22A-04I 1536	179	8				
	-TW20A-04I 1747	180	9				
	-TW20B-04I 1752	181	10				
	-TW20C-04I 1753	182	11				
4/16/96	H2O BLANK	183	1				
	WSTD L5 R4	184	2				
	WSTD CIS R4	185	3				
	WSTD MTBE R4	186	4				
	H2O BLANK	187	5				
	35-TW19A-04I 1200	188	6				
	-TW19B-04I 1208	189	7				
	-TW19C-04I 1213	190	8				

MICROSEEPS, INC.

***** ONSITE ANALYSIS *****

PAGE 6 OF 6

LABORATORY LOCATION: Camp Lejeune

PROJECT: ~~[illegible]~~ 96103 SG-I

ANALYSIS: BTEX, MTBE, chloro soil / water

PATH: C:\CP\MIO

BASE FILE NAME: [illegible]

ANALYSIS DATE	SAMPLE ID	CYCLE #	HSS #	PID MET/CAL	ECD MET/CAL	FID MET/CAL	COMMENTS
4/16/96	H20 BLANK	191	9	NA	MIOBEHB	MIOBEH	
	35-TW18A-04I 1616	192	10				
	-TW18B-04I 1619	193	11				
	-TW18C-04I 1622	194	12				
4/17/96	H20 BLANK ~~Test~~	195	1				
	WSTD LS R4	196	2				
	H20 BLANK TEST	197	3				
	~~WSTD CTS~~	~~198~~	~~4~~				
	35-TW17B-04I 0919	198	4				
	-TW17C-04I 1012	199	5				
	-TW17A-04I 1032	200	6				
	35-TW16A-04I 1200	201	7				
	-TW16B-04I 1225	202	8				
	-TW16C-04I 1216	203	9				

MICROSEEPS

961048

VER. 5

----- BAKER ENVIRONMENTAL -----

----- PROJECT: CAMP LEJEUNE -----

----- SOIL CONCENTRATIONS IN (ng/g) -----

SAMPLE NAME	BENZENE (ng/g)	TOLUENE (ng/g)	ETHYL BENZENE (ng/g)	M&P-XYLENE (ng/g)	O-XYLENE (ng/g)	VINYL CHLORIDE (ng/g)	trans-1,2-DCE (ng/g)	cis-1,2-DCE (ng/g)	CHLORO FORM (ng/g)	1,1,1-TCA (ng/g)	CARBON TETRA CHLORIDE (ng/g)	TCE (ng/g)	PCE (ng/g)	FILE NAME	DATE COLLECTED	TIME COLLECTED
35-MW44B-04	<2	<2	<2	<2	<2	<100	<2	<2	<1	<1	<1	<1	<1	M10 366	07/31/96	1225
35-MW31B-05	<2	<2	<2	<2	<2	<100	<2	<2	<1	<1	<1	<1	<1	M10 389	08/02/96	1030
35-TW30B-01	<2	<2	<2	<2	<2	<100	<2	<2	<1	<1	<1	<1	<1	M10 400	08/03/96	813

----- H2O CONCENTRATIONS IN (ug/l) -----

SAMPLE NAME	BENZENE (ug/l)	TOLUENE (ug/l)	ETHYL BENZENE (ug/l)	M&P-XYLENE (ug/l)	O-XYLENE (ug/l)	VINYL CHLORIDE (ug/l)	trans-1,2-DCE (ug/l)	cis-1,2-DCE (ug/l)	CHLORO FORM (ug/l)	1,1,1-TCA (ug/l)	CARBON TETRA CHLORIDE (ug/l)	TCE (ug/l)	PCE (ug/l)	FILE NAME	DATE COLLECTED	TIME COLLECTED
35-TW31A	<1	<1	<1	<1	<1	<50	<1	<1	1.9	<.1	<.1	<.1	<.1	M10 393	08/02/96	----
35-TW31B	<1	<1	<1	<1	<1	<50	<1	<1	0.6	<.1	<.1	<.1	<.1	M10 394	08/02/96	----
35-TW30B	<1	<1	<1	<1	<1	<50	<1	<1	1.0	<.1	<.1	<.1	<.1	M10 422	08/04/96	----
35-TW~~31A~~	<1	<1	<1	<1	<1	<50	<1	<1	1.5	<.1	<.1	<.1	<.1	M10 423	08/04/96	1310
35-TW~~31A~~ 30A	<1	<1	<1	<1	<1	<50	<1	<1	3.7	<.1	<.1	<.1	<.1	M10 424	08/04/96	1527
35-TW31B	<1	<1	<1	<1	<1	<50	<1	<1	0.3	<.1	<.1	<.1	<.1	M10 425	08/04/96	1322
35-MW~~44A~~ 60A	<1	<1	<1	<1	<1	<50	<1	<1	1.5	<.1	<.1	<.1	<.1	M10 426	08/04/96	1146
35-MW~~44B~~ 60B	<1	<1	<1	<1	<1	<50	<1	<1	0.2	<.1	<.1	<.1	<.1	M10 427	08/04/96	----

Changes per log entry MDS. 8/4/96

APPENDIX G
SGI CHAIN-OF-CUSTODY RECORDS

WESTON Analytics Use Only

Custody Transfer Record/Lab Work Request

WESTON

Page ____ of ____

Client
Est. Final Proj. Sampling Date
Work Order #
Project Contact/Phone #
AD Project Manager
QC ____ Del ____ TAT
Date Rec'd ____ Date Due ____
Account # ____

Refrigerator #

#/Type Container	Liquid							
	Solid							
Volume	Liquid							
	Solid							
Preservatives								
ANALYSES REQUESTED →	ORGANIC: VOA	BNA	Pest/PCB	Herb		INORG: Metal	CN	

WESTON Analytics Use Only

MATRIX CODES:
S - Soil
SE - Sediment
SO - Solid
SL - Sludge
W - Water
O - Oil
A - Air
DS - Drum Solids
DL - Drum Liquids
L - EP/TCLP Leachate
WI - Wipe
X - Other
F - Fish

Lab ID	Client ID/Description	Matrix QC Chosen (✓) MS	MSD	Matrix	Date Collected	Time Collected	VOA
	35-7608-04	MS	MSD	W	7/15/[illegible]	1545	X

FIELD PERSONNEL: COMPLETE ONLY SHADED AREAS

Special Instructions:
SEVEN DAY TURNAROUND
IF [illegible]
DL [illegible]

DATE/REVISIONS:
____ 1. ____
____ 2. ____
____ 3. ____
____ 4. ____
____ 5. ____
____ 6. ____

WESTON Analytics Use Only

Samples were:
1) Shipped ___ or Hand Delivered ___
Airbill # ________
2) Ambient or Chilled
3) Received in Good Condition Y or N
4) Labels Indicate Properly Preserved Y or N
5) Received Within Holding Times Y or N

COC Tape was:
1) Present on Outer Package Y or N
2) Unbroken on Outer Package Y or N
3) Present on Sample Y or N
4) Unbroken on Sample Y or N
COC Record Present Upon Sample Rec't Y or N

Relinquished by	Received by	Date	Time	Relinquished by	Received by	Date	Time

Discrepancies Between Samples Labels and COC Record? Y or N
NOTES:

RFW 21-21-001/A-7/91 ____ L372 ____ L373 ____ L375 ____ L377 ____ L378 Ref# ________ Cooler# ________ 381-596a

WESTON Analytics Use Only

Custody Transfer Record/Lab Work Request

WESTON

Page ____ of ____

Client
Est. Final Proj. Sampling Date
Work Order #
Project Contact/Phone #
AD Project Manager
QC ______ Del ______ TAT ______

Date Rec'd ______ Date Due ______
Account # ______

Refrigerator #																
#/Type Container	Liquid															
	Solid															
Volume	Liquid															
	Solid															
Preservatives																
ANALYSES REQUESTED →		ORGANIC							INORG							
		VOA	BNA	Pest/PCB	Herb				Metal	CN						

MATRIX CODES:
S - Soil
SE - Sediment
SO - Solid
SL - Sludge
W - Water
O - Oil
A - Air
DS - Drum Solids
DL - Drum Liquids
L - EP/TCLP Leachate
WI - Wipe
X - Other
F - Fish

Lab ID	Client ID/Description	Matrix QC Chosen (✓) MS	MSD	Matrix	Date Collected	Time Collected	WESTON Analytics Use Only														

FIELD PERSONNEL: COMPLETE ONLY SHADED AREAS

Special Instructions:
7/14 DAY TURN
*TCLP [illegible], VOA, SVOA,
Pest/Herb, Metals

DATE/REVISIONS:
______ 1. ______
______ 2. ______
______ 3. ______
______ 4. ______
______ 5. ______
______ 6. ______

WESTON Analytics Use Only

Samples were:
1) Shipped ___ or Hand Delivered ___
Airbill # ______
2) Ambient or Chilled
3) Received in Good Condition Y or N
4) Labels Indicate Properly Preserved Y or N
5) Received Within Holding Times Y or N

COC Tape was:
1) Present on Outer Package Y or N
2) Unbroken on Outer Package Y or N
3) Present on Sample Y or N
4) Unbroken on Sample Y or N
COC Record Present Upon Sample Rec't Y or N

Relinquished by	Received by	Date	Time	Relinquished by	Received by	Date	Time
MD Smith		8/6	16:00				

Discrepancies Between Samples Labels and COC Record? Y or N
NOTES:

RFW 21-21-001/A-[illegible]1 ____ L372 ____ L373 ____ L375 ____ L377 ____ L378 Ref# ______ Cooler# ______ 381-596a

COC# 5-3046

WESTON Analytics Use Only

Custody Transfer Record/Lab Work Request

WESTON MANAGERS DESIGNERS/CONSULTANTS

Page ____ of ____

Client BAKER

Est. Final Proj. Sampling Date MAY 3, 1996

Work Order # 62470-232

Project Contact/Phone # DAN BONK 412 269 2063

AD Project Manager Denise Woltman

QC ______ Del ______ TAT ______

Date Rec'd ______ Date Due ______

Account # ______

Refrigerator #

#/Type Container: Liquid / Solid

Volume: Liquid / Solid

Preservatives

ANALYSES REQUESTED →

ORGANIC: VOA, BNA, Pest/PCB, Herb

INORG: Metal, CN

WESTON Analytics Use Only

MATRIX CODES:
S - Soil
SE - Sediment
SO - Solid
SL - Sludge
W - Water
O - Oil
A - Air
DS - Drum Solids
DL - Drum Liquids
L - EP/TCLP Leachate
WI - Wipe
X - Other
F - Fish

Lab ID	Client ID/Description	MS	MSD	Matrix	Date Collected	Time Collected	Analyses
	35-TB07-04			[illegible]	[illegible]	[illegible]	[illegible]
	35-[illegible]-04			[illegible]	[illegible]	[illegible]	[illegible]
	35-[illegible]-04			[illegible]	[illegible]	[illegible]	[illegible]
	35-MW42-04	X	X	[illegible]	[illegible]	[illegible]	[illegible]
	35-MW42-04D			[illegible]	[illegible]	[illegible]	[illegible]
	35-MW40S-04			[illegible]	[illegible]	[illegible]	[illegible]
	35-IDWTK-04			[illegible]	[illegible]	[illegible]	X X X X X X X X
	35-IDWRB-04			[illegible]	[illegible]	[illegible]	X X X X X

FIELD PERSONNEL: COMPLETE ONLY SHADED AREAS

Special Instructions:

35-IDWTK-04 } 7 DAY
35-IDWRB-04 } TURN
ALL OTHERS STANDARD

DATE/REVISIONS:
1. ______
2. ______
3. ______
4. ______
5. ______
6. ______

WESTON Analytics Use Only

Samples were:
1) Shipped __ or Hand Delivered __
Airbill # ______
2) Ambient or Chilled
3) Received in Good Condition Y or N
4) Labels Indicate Properly Preserved Y or N
5) Received Within Holding Times Y or N

COC Tape was:
1) Present on Outer Package Y or N
2) Unbroken on Outer Package Y or N
3) Present on Sample Y or N
4) Unbroken on Sample Y or N
COC Record Present Upon Sample Rec't Y or N

Relinquished by	Received by	Date	Time	Relinquished by	Received by	Date	Time
MDS		5/3	1530				

Discrepancies Between Samples Labels and COC Record? Y or N
NOTES:

WESTON Analytics Use Only

Custody Transfer Record/Lab Work Request

WESTON

Page ____ of ____

Client	[illegible]
Est. Final Proj. Sampling Date	[illegible]
Work Order #	[illegible]
Project Contact/Phone #	[illegible]
AD Project Manager	[illegible]
QC ____ Del ____ TAT	
Date Rec'd ____ Date Due ____	
Account #	

			VOA	BNA	Pest/PCB	Herb				Metal	CN						
Refrigerator #																	
#/Type Container	Liquid		[illegible]														
	Solid																
Volume	Liquid		[illegible]														
	Solid																
Preservatives																	
ANALYSES REQUESTED →			ORGANIC							INORG							

MATRIX CODES:
S - Soil
SE - Sediment
SO - Solid
SL - Sludge
W - Water
O - Oil
A - Air
DS - Drum Solids
DL - Drum Liquids
L - EP/TCLP Leachate
WI - Wipe
X - Other
F - Fish

Lab ID	Client ID/Description	Matrix QC Chosen (✓) MS	MSD	Matrix	Date Collected	Time Collected	7th VOA														
	[illegible]																				
	[illegible]																				

WESTON Analytics Use Only

FIELD PERSONNEL: COMPLETE ONLY SHADED AREAS

Special Instructions:
STANDARD TURN
28 DAY

DATE/REVISIONS:
____ 1. ____
____ 2. ____
____ 3. ____
____ 4. ____
____ 5. ____
____ 6. ____

WESTON Analytics Use Only

Samples were:
1) Shipped ___ or Hand Delivered ___
Airbill # ____
2) Ambient or Chilled
3) Received in Good Condition Y or N
4) Labels Indicate Properly Preserved Y or N
5) Received Within Holding Times Y or N

COC Tape was:
1) Present on Outer Package Y or N
2) Unbroken on Outer Package Y or N
3) Present on Sample Y or N
4) Unbroken on Sample Y or N
COC Record Present Upon Sample Rec't Y or N

Relinquished by	Received by	Date	Time	Relinquished by	Received by	Date	Time
MAS		5/2	1500				

Discrepancies Between Samples Labels and COC Record? Y or N
NOTES:

RFW 21-21-00('91 ____ L372 ____ L373 ____ L375 ____ L377 ____ L378 Ref# ____ Cooler# ____ 381-596a

ZOC# 430096 AIRBILL 162660661Z

WESTON Analytics Use Only

Custody Transfer Record/Lab Work Request

WESTON

Page ____ of ____

Client [illegible]
Est. Final Proj. Sampling Date [illegible]
Work Order # [illegible]
Project Contact/Phone # [illegible]
AD Project Manager [illegible]
QC ____ Del ____ TAT ____

Date Rec'd ________ Date Due ________
Account # ________

Refrigerator #

#/Type Container	Liquid	[illegible]	[illegible]	[illegible]	[illegible]										
	Solid														
Volume	Liquid	[illegible]	[illegible]	[illegible]	[illegible]										
	Solid														
Preservatives															
ANALYSES REQUESTED →		ORGANIC							INORG						
		VOA	BNA	Pest/PCB	Herb				Metal	CN-					

MATRIX CODES:
S - Soil
SE - Sediment
SO - Solid
SL - Sludge
W - Water
O - Oil
A - Air
DS - Drum Solids
DL - Drum Liquids
L - EP/TCLP Leachate
WI - Wipe
X - Other
F - Fish

Lab ID	Client ID/Description	Matrix QC Chosen (✓) MS	MSD	Matrix	Date Collected	Time Collected	TCLVOA	ANTBE	WESTON Analytics Use Only												
	[illegible]			[illegible]	[illegible]	[illegible]															
	[illegible]			[illegible]	[illegible]	[illegible]															
	[illegible]			[illegible]	[illegible]	[illegible]															
	[illegible]			[illegible]	[illegible]	[illegible]															
	35-TW29B-04			[illegible]	[illegible]	[illegible]															
	[illegible]			[illegible]	[illegible]	[illegible]															

FIELD PERSONNEL: COMPLETE ONLY SHADED AREAS

Special Instructions:

35-TW15B-04 }
35-GW006-04 } ONE DAY TURNAROUND
35-TW29B-04 }
All others standard.

DATE/REVISIONS:
____ 1. ________
____ 2. ________
____ 3. ________
____ 4. ________
____ 5. ________
____ 6. ________

WESTON Analytics Use Only

Samples were:
1) Shipped ___ or Hand Delivered ___
Airbill # ________
2) Ambient or Chilled
3) Received in Good Condition Y or N
4) Labels Indicate Properly Preserved Y or N
5) Received Within Holding Times Y or N

COC Tape was:
1) Present on Outer Package Y or N
2) Unbroken on Outer Package Y or N
3) Present on Sample Y or N
4) Unbroken on Sample Y or N
COC Record Present Upon Sample Rec't Y or N

Relinquished by	Received by	Date	Time	Relinquished by	Received by	Date	Time
MDS		4/30	1600				

Discrepancies Between Samples Labels and COC Record? Y or N
NOTES:

RFW 21-21-001/A-7/91 ____ L372 ____ L373 ____ L375 ____ L377 ____ L378 Ref# ________ Cooler# ________ 381-596a

COC# 429046

WESTON Analytics Use Only

Custody Transfer Record/Lab Work Request

WESTON

Client: BAKER
Est. Final Proj. Sampling Date: [illegible]
Work Order #: [illegible]
Project Contact/Phone #: [illegible]
AD Project Manager: [illegible]
QC: Del TAT

Date Rec'd ______ Date Due ______
Account # ______

Refrigerator #	
#/Type Container	Liquid [illegible] / Solid
Volume	Liquid [illegible] / Solid
Preservatives	
ANALYSES REQUESTED →	ORGANIC: VOA, BNA, Pest/PCB, Herb; INORG: Metal, CN

MATRIX CODES:
S - Soil
SE - Sediment
SO - Solid
SL - Sludge
W - Water
O - Oil
A - Air
DS - Drum Solids
DL - Drum Liquids
L - EP/TCLP Leachate
WI - Wipe
X - Other
F - Fish

Lab ID	Client ID/Description	Matrix QC Chosen (✓) MS	MSD	Matrix	Date Collected	Time Collected	VOA	BNA	Pest/PCB	Herb				Metal	CN					
	35-[illegible]				[illegible]	[illegible]														
	35-[illegible]																			
	35-[illegible]																			
	35-[illegible]																			
	35-[illegible]																			
	[illegible]																			
	[illegible]																			
	[illegible]																			
	35-TW[illegible]-04																			
	35-TW27-[illegible]																			

FIELD PERSONNEL: COMPLETE ONLY SHADED AREAS

Special Instructions:
35-TW27-04 AND
35-TW14-04 1 DAY TURN
All others 28 DAY TURN

DATE/REVISIONS:
1. ______
2. ______
3. ______
4. ______
5. ______
6. ______

WESTON Analytics Use Only

Samples were:
1) Shipped ___ or Hand Delivered ___
Airbill # ______
2) Ambient or Chilled
3) Received in Good Condition Y or N
4) Labels Indicate Properly Preserved Y or N
5) Received Within Holding Times Y or N

COC Tape was:
1) Present on Outer Package Y or N
2) Unbroken on Outer Package Y or N
3) Present on Sample Y or N
4) Unbroken on Sample Y or N
COC Record Present Upon Sample Rec't Y or N

Relinquished by	Received by	Date	Time	Relinquished by	Received by	Date	Time
[illegible]		4/29	1800				

Discrepancies Between Samples Labels and COC Record? Y or N
NOTES:

RFW 21-21-001/A-7/91 ____ L372 ____ L373 ____ L375 ____ L377 ____ L378 Ref# ______ Cooler# ______ 381-596a

COC# 429096

WESTON Analytics Use Only

Custody Transfer Record/Lab Work Request

WESTON

Page 2 of 2

Client: Baker
Est. Final Proj. Sampling Date: MAY 15 1996
Work Order #: 62470-752
Project Contact/Phone #: DAN BECKER [illegible]
AD Project Manager: [illegible]
QC ______ Del ______ TAT ______

Date Rec'd ______ Date Due ______
Account # ______

Refrigerator #																					
#/Type Container	Liquid	4 x 40 ml VOA VIALS															
	Solid																
Volume 3	Liquid	2 x 40 ml VIALS (+ [illegible] 11 samples)															
	Solid																
Preservatives																	
ANALYSES REQUESTED →		ORGANIC							INORG								
		VOA	BNA	Pest/PCB	Herb				Metal	CN							

MATRIX CODES:
S - Soil
SE - Sediment
SO - Solid
SL - Sludge
W - Water
O - Oil
A - Air
DS - Drum Solids
DL - Drum Liquids
L - EP/TCLP Leachate
WI - Wipe
X - Other
F - Fish

WESTON Analytics Use Only

Lab ID	Client ID/Description	Matrix QC Chosen (✓) MS	MSD	Matrix	Date Collected	Time Collected	VOA	BNA	Pest/PCB	Herb				Metal	CN						
	35-TWHB-24				[illegible]	[illegible]	RILEY														

FIELD PERSONNEL: COMPLETE ONLY SHADED AREAS

Special Instructions:

see page 1

DATE/REVISIONS:
______ 1. ______
______ 2. ______
______ 3. ______
______ 4. ______
______ 5. ______
______ 6. ______

WESTON Analytics Use Only

Samples were:
1) Shipped ___ or Hand Delivered ___
Airbill # ______
2) Ambient or Chilled
3) Received in Good Condition Y or N
4) Labels Indicate Properly Preserved Y or N
5) Received Within Holding Times Y or N

COC Tape was:
1) Present on Outer Package Y or N
2) Unbroken on Outer Package Y or N
3) Present on Sample Y or N
4) Unbroken on Sample Y or N
COC Record Present Upon Sample Rec't Y or N

Relinquished by	Received by	Date	Time	Relinquished by	Received by	Date	Time
mps		4/24	1800				

Discrepancies Between Samples Labels and COC Record? Y or N
NOTES:

427096   AirBill 1626606785

WESTON Analytics Use Only

Custody Transfer Record/Lab Work Request

WESTON

Client: Baker
Est. Final Proj. Sampling Date: MAY 15 1996
Work Order #: 62470-232
Project Contact/Phone #: Dan Ber 412-269-2063
AD Project Manager: Denise Wolthm[illegible]
QC ______ Del ______ TAT ______
Date Rec'd ______ Date Due ______
Account # ______

Refrigerator #
#/Type Container — Liquid: 40ml vials — Solid:
Volume — Liquid: 2 - 40ml vials — Solid:
Preservatives: [illegible]

ANALYSES REQUESTED → ORGANIC: VOA, BNA, Pest/PCB, Herb; INORG: Metal, CN

MATRIX CODES: S - Soil, SE - Sediment, SO - Solid, SL - Sludge, W - Water, O - Oil, A - Air, DS - Drum Solids, DL - Drum Liquids, L - EP/TCLP Leachate, WI - Wipe, X - Other, F - Fish

WESTON Analytics Use Only

Lab ID	Client ID/Description	Matrix QC Chosen (✓) MS	MSD	Matrix	Date Collected	Time Collected	VOA
	35-MW14B-04			W	4/27	0830	X
	35-MW36B-04			W	4/27	1020	X
	35-MW36A-04			W	4/27	1000	X
	35-MW19A-04			W	4/27	1215	X
	35-MW19B-04	X	X	W	4/27	1210	X
	35-MW19B-04D			W	4/27	1210	X
	35-MW35A-04			W	4/27	2310	X
	35-MW09D-04			W	4/27	1230	X
	35-TB-03-04			W	4/27	0745	X

FIELD PERSONNEL: COMPLETE ONLY SHADED AREAS

Special Instructions:
Standard 28 DAY TURN.

DATE/REVISIONS:
1.
2.
3.
4.
5.
6.

WESTON Analytics Use Only

Samples were:
1) Shipped ___ or Hand Delivered ___
Airbill # ______
2) Ambient or Chilled
3) Received in Good Condition Y or N
4) Labels Indicate Properly Preserved Y or N
5) Received Within Holding Times Y or N

COC Tape was:
1) Present on Outer Package Y or N
2) Unbroken on Outer Package Y or N
3) Present on Sample Y or N
4) Unbroken on Sample Y or N
COC Record Present Upon Sample Rec't Y or N

Relinquished by	Received by	Date	Time	Relinquished by	Received by	Date	Time
MDS	1300	4/27					

Discrepancies Between Samples Labels and COC Record? Y or N
NOTES:

RFW 21-21-001/A 7/91 ___ L372 ___ L373 ___ L375 ___ L377 ___ L378 Ref# ______ Cooler# ______ 381-596a

WESTON Analytics Use Only

Custody Transfer Record/Lab Work Request

WESTON Page ____ of ____

Client: BAKER
Est. Final Proj. Sampling Date: MAY 15 1996
Work Order #: 62470-232-0000
Project Contact/Phone #: DL BONK 412-269-2063
AD Project Manager: Denise Wohlman
QC ____ Del ____ TAT ____
Date Rec'd ____ Date Due ____
Account # ____

Refrigerator #	
#/Type Container – Liquid	18 40ml vials
#/Type Container – Solid	
Volume – Liquid	40ml x 18 10
Volume – Solid	
Preservatives	HCl

ANALYSES REQUESTED → ORGANIC: VOA, BNA, Pest/PCB, Herb, MTBE; INORG: Metal, CN

WESTON Analytics Use Only

MATRIX CODES: S - Soil, SE - Sediment, SO - Solid, SL - Sludge, W - Water, O - Oil, A - Air, DS - Drum Solids, DL - Drum Liquids, L - EP/TCLP Leachate, WI - Wipe, X - Other, F - Fish

Lab ID	Client ID/Description	MS	MSD	Matrix	Date Collected	Time Collected	VOA (TCL)	BNA	Pest/PCB	Herb	MTBE	Other
	35-TW12B-04			W	4/26	1250	X					1 DAY TURN
	35-EMW03-04			W	4/26	925	X				X	28 DAY TURN
	35-RBW02-04			W	4/26	1416	X	HOLD				
	35-TB02-04			W	4/10	1545	X	TRIP BLANK				28 DAY TURN
	35-TW13B-04			W	4/26	1540	X					1 DAY TURN

FIELD PERSONNEL: COMPLETE ONLY SHADED AREAS

Special Instructions:

MTBE TO BE RUN WITH 35-EMW03-04 NO additional bottles for MTBE. 35-TW12B-04 & 35-TW13B-04 1-DAY TURN

DATE/REVISIONS:
1. ____
2. ____
3. ____
4. ____
5. ____
6. ____

Relinquished by	Received by	Date	Time	Relinquished by	Received by	Date	Time
MDSmith		4/26	1800				

Discrepancies Between Samples Labels and COC Record? Y or N
NOTES:

WESTON Analytics Use Only

Samples were:
1) Shipped ___ or Hand Delivered ___ Airbill # ____
2) Ambient or Chilled
3) Received in Good Condition Y or N
4) Labels Indicate Properly Preserved Y or N
5) Received Within Holding Times Y or N

COC Tape was:
1) Present on Outer Package Y or N
2) Unbroken on Outer Package Y or N
3) Present on Sample Y or N
4) Unbroken on Sample Y or N
COC Record Present Upon Sample Rec't Y or N

RFW 21-21-001/A-7/91 ____ L372 ____ L373 ____ L375 ____ L377 ____ L378 Ref# ____ Cooler# ____ 381-596a

C.O.C # 425096

WESTON Analytics Use Only

Custody Transfer Record/Lab Work Request

WESTON

Page ____ of ____

Client BAKER ENVIRONMENTAL INC.
Est. Final Proj. Sampling Date 4/15/96
Work Order # 62470-232
Project Contact/Phone # DAN BONK 412-269-6000
AD Project Manager DAN BONK 412 269-6000
QC ______ Del ______ TAT ______
Date Rec'd ______ Date Due ______
Account # ______

Refrigerator #
#/Type Container: Liquid / Solid
Volume: Liquid / Solid
Preservatives

ANALYSES REQUESTED →

ORGANIC							INORG							
VOA	BNA	Pest/PCB	Herb				Metal	CN						

MATRIX CODES:
S - Soil
SE - Sediment
SO - Solid
SL - Sludge
W - Water
O - Oil
A - Air
DS - Drum Solids
DL - Drum Liquids
L - EP/TCLP Leachate
WI - Wipe
X - Other
F - Fish

Lab ID	Client ID/Description	Matrix QC Chosen (✓) MS	MSD	Matrix	Date Collected	Time Collected	TCL VOA
	35-TW27B-04			W	4/25/96	1510	X
	35-TR-100			W	4/25/96	1600	X
	35-ERW01-04			W	4/25/96	1630	X

WESTON Analytics Use Only

FIELD PERSONNEL: COMPLETE ONLY SHADED AREAS

Special Instructions: NOTE: 35-TW27B-04 HAS 1-DAY TURN - REPORT RESULTS DIRECTLY TO DAN BONK.
TRIP BLANK & RINSATE ~~IS~~ ARE ROUTINE TURN.
FedEx # 1126606634

DATE/REVISIONS:
1. ______
2. ______
3. ______
4. ______
5. ______
6. ______

Relinquished by	Received by	Date	Time	Relinquished by	Received by	Date	Time
[signature]		4/25/96	1600				

WESTON Analytics Use Only

Samples were:
1) Shipped ___ or Hand Delivered ___
Airbill # ______
2) Ambient or Chilled
3) Received in Good Condition Y or N
4) Labels Indicate Properly Preserved Y or N
5) Received Within Holding Times Y or N

COC Tape was:
1) Present on Outer Package Y or N
2) Unbroken on Outer Package Y or N
3) Present on Sample Y or N
4) Unbroken on Sample Y or N
COC Record Present Upon Sample Rec't Y or N

Discrepancies Between Samples Labels and COC Record? Y or N
NOTES:

RFW 21-21-001 ... 91 ____ L372 ____ L373 ____ L375 ____ L377 ____ L378 Ref# ______ Cooler# ______ 381-596a

Inchcape T[...]ng Services Dallas 1089 East Collins Blvd., [...]ardson, TX 75081 (214) 238-5591

CHAIN OF CUSTODY REC[...]

Report to:		Invoice to	
Company:	Baker Env	Company:	
Address:	420 Rouser Rd, Bld 3	Address:	
	Coraopolis, PA 15108		Same
Contact:	Dan Burk	Contact:	
Phone:	412-269-6090	Phone:	
Fax:		PO/SO #:	

ANALYSIS REQUESTED: TPH; Mercury CLP-SOW; Zinc CLP-SOW

Lab use only
Due Date:
Temp. of coolers when received (C°): 1 | 2 | 3 | 4 | 5
Custody Seal N / Y
Intact N / Y
Screened For Radioactivity ☐

Sampler's Name: Mike Smith, Aaron Bernhardt

Sampler's Signature: [signature]

Proj. No. | Project Name | No./Type of Containers[2]

Matrix[1]	Date	Time	Comp	Grab	Identifying Marks of Sample(s)	VOA	A/G 1 Lt.	250 ml	P/O	TPH	Mercury CLP-SOW	Zinc CLP-SOW	Lab Sample ID (Lab Use Only)
S	8-7-95	1130		X	35-SD04-612-02			2		X	X	X	
S	8-7-95	1117		X	35-SD03-06-02			2		X	X	X	
S	8-7-95	1115		X	35-SD03-612-02			2		X	X	X	
GW	8-8-95				35-TB01	7/1 amb				X			

Turn around time ☐ Priority 1 or Standard ☐ Priority 2 or 50% ☐ Priority 3 or 100% ☐ Priority 4 ERS * * BTEX (602/8020), TPH (418.1 or 8015), VOLATILES (624/8240), IGNITABILITY, TOTAL LEAD (6010)

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
[signature]	8-8-95	1900			

Remarks

Client's delivery of samples constitutes acceptance of Inchcape/ITS-Dallas terms and conditions contained in the Price Schedule.

[1] Matrix WW - Wastewater W - Water S - Soil SD - Solid L - Liquid A - Air Bag C - Charcoal tube SL - Sludge O - Oil
[2] Container VOA - 40 ml vial A/G - Amber / Or Glass 1 Liter 250 ml - Glass wide mouth P/O - Plastic or other______

ITS - Dallas cannot accept verbal changes. Please Fax written changes to 214-238-5592

OFFICE USE ONLY

Inchcape Testing Services Dallas 1089 East Collins Blvd., Richardson, TX 75081 (214) 238-5591 **CHAIN OF CUSTODY RECORD**

Report to:		Invoice to	
Company:	Baker Env	Company:	Baker
Address:	420 Rouser Rd, Bldg 3 Coraopolis PA 15108	Address:	Same
Contact:	Dan Bonk	Contact:	
Phone:	412-269-6000	Phone:	
Fax:		PO/SO #:	

Analysis Requested: TPH; Mercury CLP SOW; Zinc CLP SOW

Lab use only
Due Date:
Temp. of coolers when received (C°): 1 2 3 4 5
Custody Seal N / Y
Intact N / Y
Screened For Radioactivity ☐

Sampler's Name: Aaron Bernhardt
Sampler's Signature: [signature]

Proj. No. 323 62470-228
Project Name:

Matrix[1]	Date	Time	Comp	Grab	Identifying Marks of Sample(s)	VOA	A/G 1 Lt.	250 ml	P/O	TPH	Mercury CLP SOW	Zinc CLP SOW		Lab Sample ID (Lab Use Only)
SW	8-8-95	1335		X	35-ER01-02	2	1			X	X	X	RUN	
SW	8-8-95	1345		X	35-ER02-02	2	1			X	X	X	HOLD	
S	8-7-95	1144		X	35-SD07-06-02 ✓			2		X	X	X		
S	8-7-95	1144		X	35-SD07-06D-02 ✓			2		X	X	X		
S	8-7-95	1142		X	35-SD07-612-02 ✓			2		X	X	X		
S	8-7-95	1242		X	35-SD06-06-02 ✓			2		X	X	X		
S	8-7-95	1240		X	35-SD06-612-02 ✓			2		X	X	X		
S	8-7-95	1212		X	35-SD05-06-02 ✓			2		X	X	X		
S	8-7-95	1210		X	35-SD05-~~6~~612-02 ✓			2		X	X	X		
S	8-7-95	1132		X	35-SD04-06-02 ✓			2		X	X	X		

Turn around time ☐ Priority 1 or Standard ☐ Priority 2 or 50% ☐ Priority 3 or 100% ☐ Priority 4 ERS * * BTEX (602/8020), TPH (418.1 or 8015), VOLATILES (624/8240), IGNITABILITY, TOTAL LEAD (6010)

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
[signature]	8-8-95	1700			

Remarks

Client's delivery of samples constitutes acceptance of Inchcape/ITS-Dallas terms and conditions contained in the Price Schedule.

[1] Matrix WW - Wastewater W - Water S - Soil SD - Solid L - Liquid A - Air Bag C - Charcoal tube SL - Sludge O - Oil
[2] Container VOA - 40 ml vial A/G - Amber / Or Glass 1 Liter 250 ml - Glass wide mouth P/O - Plastic or other________

ITS - Dallas cannot accept verbal changes. Please Fax written changes to 214-238-5592

OFFICE USE ONLY

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Inchcape T ng Services Dallas 1089 East Collins Blvd. ardson, TX 75081 (214) 238-5591

CHAIN OF CUSTODY RECO

Report to:
Company: Bake Env
Address: 420 Rouse Rd, Bldg 3
Coraopolis PA 15106
Contact: Dan Bonk
Phone: 412-269-6006
Fax:

Invoice to
Company:
Address: Same
Contact:
Phone:
PO/SO #:

ANALYSIS REQUESTED: TPH; Mercury - CLP-SOW; Zinc - CLP-SOW

Lab use only
Due Date:
Temp. of coolers when received (C°): 1 2 3 4 5
Custody Seal N / Y
Intact N / Y
Screened For Radioactivity ☐

Sampler's Name Mike Smith
Anne Bernhardt
Sampler's Signature

Proj. No.	Project Name	No./Type of Containers[2]
62470-323		

Matrix[1]	Date	Time	Comp	Grab	Identifying Marks of Sample(s)	VOA	A/G 1 Lt.	250 ml	P/O	TPH	Mercury - CLP-SOW	Zinc - CLP-SOW							Lab Sample ID (Lab Use Only)
S	8-7-95	1910		X	36-SD05-612-02			2		X	X	X							
W	8-8-95				35-TB02	2	amb			X									

Turn around time ☐ Priority 1 or Standard ☐ Priority 2 or 50% ☐ Priority 3 or 100% ☐ Priority 4 ERS * * BTEX (602/8020), TPH (418.1 or 8015), VOLATILES (624/8240), IGNITABILITY, TOTAL LEAD (6010)

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
[signature]	8-8-95	1700			
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:

Remarks

Client's delivery of samples constitutes acceptance of Inchcape/ITS-Dallas terms and conditions contained in the Price Schedule.

[1] Matrix WW - Wastewater W - Water S - Soil SD - Solid L - Liquid A - Air Bag C - Charcoal tube SL - Sludge O - Oil
[2] Container VOA - 40 ml vial A/G - Amber / Or Glass 1 Liter 250 ml - Glass wide mouth P/O - Plastic or other

ITS - Dallas cannot accept verbal changes. Please Fax written changes to 214-238-5592

OFFICE USE ONLY
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329-0000

Inchcape Testing Services Dallas 1089 East Collins Blvd., Richardson, TX 75081 (214) 238-5591

CHAIN OF CUSTODY RECORD

Report to:		Invoice to	
Company:	Baker Env	Company:	
Address:	420 Rouse Rd, Bld 3	Address:	
	Coraopolis PA 15108		Same
Contact:	Dan Buck	Contact:	
Phone:	412-269-6066	Phone:	
Fax:	/	PO/SO #:	

Sampler's Name: Mike Curtis / Aaron Bernhardt

Sampler's Signature: [signature]

ANALYSIS REQUESTED: TPH; Mercury - CLP-SOW; Zinc CLP-SOW

Lab use only
Due Date:

Temp. of coolers when received (C°): 1 | 2 | 3 | 4 | 5

Custody Seal N / Y

Intact N / Y

Screened For Radioactivity ☐

Proj. No.: 62470-323

Project Name:

Matrix[1]	Date	Time	Comp	Grab	Identifying Marks of Sample(s)	VOA	A/G 1 Lt.	250 ml	P/O	TPH	Mercury - CLP-SOW	Zinc CLP-SOW							Lab Sample ID (Lab Use Only)
S	8-8-95	0747		X	35-SD01-06-02 ✓			2		X	X	X							
S	8-8-95	0745		↓	35-SD01-612-02 ✓			2		X	X	X							
S	8-8-95	0728			35-SD02-06-02 ✓			2		X	X	X							
S	8-8-95	0725			35-SD02-612-02 ✓			2		X	X	✓							
S	8-7-95	1947			36-SD07-06-02 ✓ (MS/MSD)			4		X	X	X							
S	↓	1947			36-SD07-06D-02 ✓			2		X	X	X							
S		1945			36-SD07-612-02			2		X	X	X							
S		1928			36-SD06-06-02 ✓			2		X	X	X							
S		1926			36-SD06-612-02 ✓			2		X	X	X							
S	↓	1912		↓	36-SD05-06-02 ✓			2		X	X	X							

Turn around time ☐ Priority 1 or Standard ☐ Priority 2 or 50% ☐ Priority 3 or 100% ☐ Priority 4 ERS * * BTEX (602/8020), TPH (418.1 or 8015), VOLATILES (624/8240), IGNITABILITY, TOTAL LEAD (6010)

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
[signature]	8-8-95	1700			

Remarks

Client's delivery of samples constitutes acceptance of Inchcape/ITS-Dallas terms and conditions contained in the Price Schedule.

[1] Matrix: WW - Wastewater; W - Water; S - Soil; SD - Solid; L - Liquid; A - Air Bag; C - Charcoal tube; SL - Sludge; O - Oil

[2] Container: VOA - 40 ml vial; A/G - Amber / Or Glass 1 Liter; 250 ml - Glass wide mouth; P/O - Plastic or other______

ITS - Dallas cannot accept verbal changes. Please Fax written changes to 214-238-5592

OFFICE USE ONLY

Inchcape Te ng Services Dallas 1089 East Collins Blvd., rdson, TX 75081 (214) 238-5591 CHAIN OF CUSTODY RECC

Report to:	Invoice to
Company: Baker ENVIRONMENTAL	Company: SAME
Address: 420 ROUSER RD	Address:
CORAOPOLIS, PA	
Contact: D.L. BONK, P.E.	Contact: SAME
Phone: 412-269-2063	Phone:
Fax: 412-269-2002	PO/SO #:

ANALYSIS REQUESTED: TAL METALS (CLP); TSS/TDS

Lab use only
Due Date:

Temp. of coolers when received (C°): 1 2 3 4 5

Custody Seal N / Y
Intact N / Y
Screened For Radioactivity ☐

Sampler's Name: MIKE SMITH
Sampler's Signature: Michael D. Smith

Proj. No.: 323
Project Name: SITE 35, CAMP GEIGER FUEL FARM
No./Type of Containers[2]

Matrix[1]	Date	Time	Comp	Grab	Identifying Marks of Sample(s)	VOA	A/G 1 Lt.	250 ml	P/O	TAL METALS (CLP)	TSS/TDS	Lab Sample ID (Lab Use Only)
W	8/9	1800		✓	35-ER03-02		✓			✓		
W	8/10	1242		✓	35-ER04-02		✓			✓		
W	8/10	850		✓	35-MW16S-02		✓			✓	✓	
W	8/10	850		✓	35-MW16S-02D		✓			✓	✓	
W	8/9	1633		✓	35-MW16D-02		✓			✓	✓	
W	8/9	1003		✓	35-MW10S-02		✓			✓	✓	
W	8/9	1211		✓	35-MW10D-02		✓			✓	✓	
W	8/10	1310		✓	35-MW14S-02		✓			✓	✓	
W	8/10	1220		✓	35-MW14D-02		✓			✓	✓	

Turn around time ☒ Priority 1 or Standard ☐ Priority 2 or 50% ☐ Priority 3 or 100% ☐ Priority 4 ERS * * BTEX (602/8020), TPH (418.1 or 8015), VOLATILES (624/8240), IGNITABILITY, TOTAL LEAD (6010)

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
Michael D. Smith	8/10/95	1500			
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:

Remarks

Client's delivery of samples constitutes acceptance of Inchcape/ITS-Dallas terms and conditions contained in the Price Schedule.

[1] Matrix WW - Wastewater W - Water S - Soil SD - Solid L - Liquid A - Air Bag C - Charcoal tube SL - Sludge O - Oil
[2] Container VOA - 40 ml vial A/G - Amber / Or Glass 1 Liter 250 ml - Glass wide mouth P/O - Plastic or other

ITS - Dallas cannot accept verbal changes. Please Fax written changes to 214-238-5592

OFFICE USE ONLY

Inchcape Testing Services Dallas 1089 East Collins Blvd., Richardson, TX 75081 (214) 238-5591

CHAIN OF CUSTODY RECORD

Report to:		Invoice to	
Company:	Baker Environmental Inc	Company:	SAME
Address:	420 Rouser Rd Coraopolis, Pa AOP BLDg 3	Address:	
Contact:	DL Bonk, PE	Contact:	
Phone:	412-269-2063	Phone:	
Fax:	412-269-2002	PO/SO #:	

Sampler's Name: MD SMITH

Sampler's Signature: Michael D. Smith

Proj. No.: CTO 323

Project Name: CTO 323, SITE 35, Camp Geiger Fuel Farm

ANALYSIS REQUESTED: TAL METALS; TSS/TDS; CLP SOW MERCURY & ZINC; TPH (5030/8015); TPH (3550/8015)

Lab use only
Due Date:
Temp. of coolers when received (C°): 1 | 2 | 3 | 4 | 5
Custody Seal N / Y
Intact N / Y
Screened For Radioactivity ☐

Matrix[1]	Date	Time	Comp	Grab	Identifying Marks of Sample(s)	VOA	A/G 1 Lt.	250 ml	P/O	TAL METALS	TSS/TDS	CLP SOW MERCURY & ZINC	TPH (5030/8015)	TPH (3550/8015)				Lab Sample ID (Lab Use Only)
W	8/10	1830			35-EMW03-02		2			✓	✓							
W	8/10	1855			35-EMW07-02		2			✓	✓							
W	8/11	1400			35-ER02 -02	1	2					✓	✓			Hold		
W	8/11	1350			35-ER01 -02	1	2					✓	✓		~~HOLD~~	RUN		
W	8/11	1335			35ER05 -02		1					✓	✓			RUN		for metals
W	8/11	0900			35-MW19D -02		2			✓	✓							
W	8/11	0900			35-MW19S -02 (MS/MSD)		4			✓	✓							
W	8/11	0900			35-MW19S -02D		2			✓	✓							
W	8/11	1542			35-GW05 -02		2			✓	✓							

Turn around time ☒ Priority 1 or Standard ☐ Priority 2 or 50% ☐ Priority 3 or 100% ☐ Priority 4 ERS *

* BTEX (602/8020), TPH (418.1 or 8015), VOLATILES (624/8240), IGNITABILITY, TOTAL LEAD (6010)

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
Michael D. Smith	8/11	1800			
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:

Remarks: These 35-ER02-02 & 35-ER01-02 REPLACE THOSE SENT ON 8/8/95. THOSE SENT ON 8/8/95 HAVE THE SAME SAMPLE ID

Client's delivery of samples constitutes acceptance of Inchcape/ITS-Dallas terms and conditions contained in the Price Schedule.

[1] Matrix WW - Wastewater W - Water S - Soil SD - Solid L - Liquid A - Air Bag C - Charcoal tube SL - Sludge O - Oil

[2] Container VOA - 40 ml vial A/G - Amber / Or Glass 1 Liter 250 ml - Glass wide mouth P/O - Plastic or other

ITS - Dallas cannot accept verbal changes. Please Fax written changes to 214-238-5592

OFFICE USE ONLY

Inchcape Te[illegible]ig Services Environmental Laboratories 1089 East Collins Blvd., Richardson, TX 75081 (214) 238-5591 CHAIN OF CUSTODY RE[illegible]D

Report to:
Company: Baker Environmental
Address: 420 Rouser Rd
Coraopolis, PA
Contact: D.L. Book P.E.
Phone: 412-269-2063
Fax: 412-269-2002

Invoice to
Company: Same
Address:
Contact:
Phone:
PO/SO #:

Sampler's Name: MD. SMITH
Sampler's Signature: Michael D Smith

Proj. No.: 323
Project Name: Site 35, Camp Geiger Fuel Farm

ANALYSIS REQUESTED: TSS/TDS; TAL METALS (CLP); TCL VOLATILES; TCL SEMIVOLATILES; TCL PEST/PCBs; RCRA CORROSIVITY; RCRA IGNITABILITY; RCRA REACTIVITY (S); RCRA REACTIVITY (CN)

Lab use only
Due Date:
Temp. of coolers when received (C°): 1 | 2 | 3 | 4 | 5
Custody Seal N / Y
Intact N / Y
Screened For Radioactivity ☐

Matrix[1]	Date	Time	Comp	Grab	Identifying Marks of Sample(s)	VOA	A/G 1 Lt.	250 ml	P/O	TSS/TDS	TAL METALS (CLP)	TCL VOLATILES	TCL SEMIVOLATILES	TCL PEST/PCBs	RCRA CORROSIVITY	RCRA IGNITABILITY	RCRA REACTIVITY (S)	RCRA REACTIVITY (CN)	Lab Sample ID (Lab Use Only)
W	8/12	1025		✓	35-MW33A-02		2			✓	✓								
	8/12	1235		✓	35-MW09D-02		2			✓	✓								
	8/12	1140		✓	35-MW33D-02		2			✓	✓								
	8/12	0850		✓	35-MW29A-02		2			✓	✓								
	8/12	0935		✓	35-MW29B-02		2			✓	✓								
	8/11	1845		✓	35-EMW05-02		2			✓	✓								
	8/12	1750		✓	35-MW09S-02		2			✓	✓								
	8/13	1640		✓	35-MW22D-02		2			✓	✓								
	8/13	1525		✓	35-MW22S-02		2			✓	✓								
	8/12	1830		✓	35-ER06-02		2			✓	✓								HOLD

Turn around time ☐ Priority 1 or Standard ☐ Priority 2 or 50% ☐ Priority 3 or 100% ☐ Priority 4 ERS * * BTEX (602/8020), TPH (418.1 or 8015), VOLATILES (624/8240), IGNITABILITY, TOTAL LEAD (6010)

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
Michael D Smith	8/14	1800			

Remarks: 2 PAGES, THIS ONE'S 1/2

Client's delivery of samples constitutes acceptance of Inchcape/ITS-Dallas terms and conditions contained in the Price Schedule.

[1] Matrix WW - Wastewater W - Water S - Soil SD - Solid L - Liquid A - Air Bag C - Charcoal tube SL - Sludge O - Oil
[2] Container VOA - 40 ml vial A/G - Amber / Or Glass 1 Liter 250 ml - Glass wide mouth P/O - Plastic or other

Inchcape cannot accept verbal changes. Please Fax written changes to 214-238-5592

OFFICE USE ONLY

Inchcape Testing Services Environmental Laboratories 1089 East Collins Blvd., #100 Richardson, TX 75081 (214) 238-5591

CHAIN OF CUSTODY RECORD

Report to:
Company: Baker Environmental
Address: 420 Rouser Rd
Coraopolis, PA
Contact: DL Bonk, P.E.
Phone: 412-269-2063
Fax: 412-269-2002

Invoice to
Company: Same
Address:
Contact:
Phone:
PO/SO #:

ANALYSIS REQUESTED: TSS/TDS; TAL METALS (CLP); TCL VOLATILES (CLP); TCL SEMIVOLATILES (CLP); TCL PEST/PCB (CLP); RCRA CORROSIVITY; RCRA IGNITABILITY; RCRA REACTIVITY (S); RCRA REACTIVITY (CN)

Lab use only
Due Date:
Temp. of coolers when received (C°): 1 2 3 4 5
Custody Seal N / Y
Intact N / Y
Screened For Radioactivity ☐

Sampler's Name: MD Smith
Sampler's Signature

Proj. No. 323
Project Name: Site 35, Camp Geiger Fuel Farm

Matrix[1]	Date	Time	Comp	Grab	Identifying Marks of Sample(s)	VOA	A/G 1 Lt.	250 ml	P/O	TSS/TDS	TAL Metals	TCL Volatiles	TCL Semivolatiles	TCL Pest/PCB	RCRA Corrosivity	RCRA Ignitability	RCRA Reactivity (S)	RCRA Reactivity (CN)	Lab Sample ID (Lab Use Only)
W	8/13	1835		✓	35-ER07-02		1												RUN
W	8/14	0930		✓	35-IDW01-02	2	10			✓	✓	✓	✓	✓	✓	✓	✓	✓	
W	8/14	1040		✓	35-FB01-02		1				✓								
W	7/21	—		✓	35-TB01-02	2						✓							

VOA HCL HCL

Turn around time ☐ Priority 1 or Standard ☐ Priority 2 or 50% ☐ Priority 3 or 100% ☐ Priority 4 ERS * * BTEX (602/8020), TPH (418.1 or 8015), VOLATILES (624/8240), IGNITABILITY, TOTAL LEAD (6010)

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
Michael D Smith	8/14	1800			

Remarks: 2 PAGES, THIS IS 2/2
35-TB01-02 WAS prepared by lab.

Client's delivery of samples constitutes acceptance of Inchcape/ITS-Dallas terms and conditions contained in the Price Schedule.

[1] Matrix WW - Wastewater W - Water S - Soil SD - Solid L - Liquid A - Air Bag C - Charcoal tube SL - Sludge O - Oil
[2] Container VOA - 40 ml vial A/G - Amber / Or Glass 1 Liter 250 ml - Glass wide mouth P/O - Plastic or other

Inchcape cannot accept verbal changes. Please Fax written changes to 214-238-5592

OFFICE USE ONLY

APPENDIX H
SGI WELL DEVELOPMENT RECORDS

FIELD WELL DEVELOPMENT RECORD

Baker

Baker Environmental, Inc.

PROJECT: SITE 35, SGI

CTO NO.: Ø232 WELL NO.: 35-MW39B

DATE: 5/1/96

GEOLOGIST/ENGINEER: P. MONDAY

TIME START	0920
TIME FINISH	1110
INITIAL WATER LEVEL (FT)	5.0
TOTAL WELL DEPTH (TD)	50.0
WELL DIAMETER (INCHES)	2.0
CALCULATED WELL VOLUME	7.33
BOREHOLE DIAMETER (INCHES)	—
BOREHOLE VOLUME	—
AMOUNT OF WATER ADDED DURING DRILLING	—
DEVELOPMENT METHOD	PUMPING
PUMP TYPE	(WATTERA) INERTIAL
TOTAL TIME (A)	1 HR, 50 min.
AVERAGE FLOW (GPM)(B)	1.91 gpm
TOTAL ESTIMATED WITHDRAWAL AxB=	210 gal
HNU/OVA READING	

DEVELOPMENT DATA

TIME	CUMULATIVE VOLUME (gallons)	pH	TEMP (°C)	SPEC. COND. (µmhos/cm)	TEMP (°C)	COLOR AND TURBIDITY
0934	45	7.48	19.7	488	20.9	>200 NTU
0959	55	7.64	20.8	488	21.7	103.6 NTU
1004	75	7.62	20.3	482	21.7	70.3 NTU
1010	100	7.60	22.3	486	21.4	61.0 NTU
1015	110	7.57	21.4	486	22.1	93.6 NTU
1019	130	7.60	22.1	486	22.5	42.6 NTU
1024	155	7.63	22.9	485	22.8	32.8 NTU
1030	165	7.65	23.3	484	23.4	26.1 NTU
1102	185	7.69	24.1	488	23.9	36.7 NTU
1106	210	7.65	24.2	483	23.7	19.2 NTU

OBSERVATIONS/NOTES

DEVELOPMENT.

FIELD WELL DEVELOPMENT RECORD

Baker

Baker Environmental, Inc.

PROJECT: SITE 35, SGI

CTO NO.: 0232 WELL NO.: 35-MW40B

DATE: 4/29/96

GEOLOGIST/ENGINEER: P. MONDAY

TIME START: 0818

TIME FINISH: 1033

INITIAL WATER LEVEL (FT): 6.04

TOTAL WELL DEPTH (TD): 44.2

WELL DIAMETER (INCHES): 2.0

CALCULATED WELL VOLUME: 6.2 gal

BOREHOLE DIAMETER (INCHES): —

BOREHOLE VOLUME: —

AMOUNT OF WATER ADDED DURING DRILLING: —

DEVELOPMENT METHOD: Pumping

PUMP TYPE: (Wattera) Inertial

TOTAL TIME (A): 2hrs. 15min

AVERAGE FLOW (GPM)(B): 1.7 gpm

TOTAL ESTIMATED WITHDRAWAL AxB = gal

HNU/OVA READING:

DEVELOPMENT DATA

TIME	CUMULATIVE VOLUME (gallons)	pH	TEMP (°C)	SPEC. COND. (µmhos/cm)	TEMP (°C)	COLOR AND TURBIDITY
0903	60	7.30	27.8	575	29.6	13.2 NTU
0924	67	7.26	27.8	573	30.5	42.6 NTU
WELL SURGED FROM 0930 to 0950						
1002	120	7.24	23.4	576	24.2	49.4 NTU
1008	140	7.26	23.7	574	24.3	26.3 NTU
1012	160	7.	23.8	572	24.3	24.0 NTU
1020	200	7.50	23.8	572	24.3	21.0 NTU
1030	220	7.53	24.9	571	25.7	6.3 NTU
1033	230	7.57	25.2	574	25.6	5.0 NTU

OBSERVATIONS/NOTES

DEVELOPMENT

FIELD WELL DEVELOPMENT RECORD

Baker

Baker Environmental, Inc

PROJECT: SITE 35, SGI

CTO NO.: 0232 WELL NO.: 35-MW41B

DATE: 5/1/96

GEOLOGIST/ENGINEER: P. MONDAY

TIME START	1322
TIME FINISH	1523
INITIAL WATER LEVEL (FT)	7.3
TOTAL WELL DEPTH (TD)	44.1
WELL DIAMETER (INCHES)	2.0
CALCULATED WELL VOLUME	6.0 gal
BOREHOLE DIAMETER (INCHES)	—
BOREHOLE VOLUME	—
AMOUNT OF WATER ADDED DURING DRILLING	—
DEVELOPMENT METHOD	Pumping
PUMP TYPE	(WATTERA) INERTIAL
TOTAL TIME (A)	1 hr. 27 min.
AVERAGE FLOW (GPM)(B)	1.5 gpm
TOTAL ESTIMATED WITHDRAWAL AxB =	220 gal
HNU/OVA READING	

DEVELOPMENT DATA

TIME	CUMULATIVE VOLUME (gallons)	pH	TEMP (°C)	SPEC. COND. (μmhos/cm)	TEMP (°C)	COLOR AND TURBIDITY
1356	20	7.57	26.1	968	22.8	>200 NTU
1405	40	7.59	26.8	1013	23.0	105.3 NTU
1412	55	7.56	26.4	1018	23.3	100.3 NTU
1419	75	7.57	25.5	1013	23.8	48.7 NTU
1427	95	7.56	25.3	1020	22.8	61.9 NTU
1434	110	7.54	25.7	1013	23.1	53.9 NTU
1441	130	7.54	27.0	1002	23.0	54.1 NTU
1450	155	7.53	25.9	992	23.4	35.0 NTU
1457	165	7.55	25.3	997	23.2	32.4 NTU
1507	185	7.53	26.8	996	24.1	23.1 NTU
1517	210	7.53	25.6	994	24.0	27.7 NTU
1523	220	7.58	27.7	1000	27.9	13.9 NTU

OBSERVATIONS/NOTES

DEVELOPMENT

FIELD WELL DEVELOPMENT RECORD

Baker

Baker Environmental, Inc.

PROJECT: SITE 35, SGI

CTO NO.: Ø232 WELL NO.: 35-MW42B

DATE: 5/3/96

GEOLOGIST/ENGINEER: M Smith

TIME START	1045
TIME FINISH	1215
INITIAL WATER LEVEL (FT)	5.8
TOTAL WELL DEPTH (TD)	39.3'
WELL DIAMETER (INCHES)	2.0
CALCULATED WELL VOLUME	5.5 gal
BOREHOLE DIAMETER (INCHES)	—
BOREHOLE VOLUME	—
AMOUNT OF WATER ADDED DURING DRILLING	—
DEVELOPMENT METHOD	Pumping
PUMP TYPE	(Wattera) Inertial
TOTAL TIME (A)	1 hr. 30 min.
AVERAGE FLOW (GPM)(B)	2.8 gpm
TOTAL ESTIMATED WITHDRAWAL AxB =	250 gal
HNU/OVA READING	

DEVELOPMENT DATA

TIME	CUMULATIVE VOLUME (gallons)	pH	TEMP (°C)	SPEC. COND. (µmhos/cm)	TEMP (°C)	COLOR AND TURBIDITY
1045	0	7.75	26.5	531	24.3	> 200 NTU
1048	10	7.0	24.1	—	—	> 200 NTU
1055	45	7.72	24.1	519	24.1	> 200 NTU
1059	55	7.71	24.1	516	23.9	98 NTU
1103	80	—	—	—	—	
SURGED WELL FROM 1117 to 1137						
1142	85	7.82	25.3	491	24.6	> 200 NTU
1146	100	7.84	24.3	487	23.8	> 200 NTU
1153	135	7.89	24.8	508	23.8	176 NTU
1156	150	7.89	24.8	489	23.7	136 NTU
1204	190	7.85	24.4	489	24.0	71 NTU
1208	230	—	—	—	—	43 NTU
1212	240	7.85	25.1	489	24.0	35 NTU
1215	250	—	—	—	—	10 NTU

OBSERVATIONS/NOTES

DEVELOPMENT

FIELD WELL DEVELOPMENT RECORD

Baker

Baker Environmental, Inc.

PROJECT: Site 35, SGI

CTO NO.: 0232 WELL NO.: 35-MW43B

DATE: 5/2/96

GEOLOGIST/ENGINEER: B. Davis

TIME START	1410
TIME FINISH	1710
INITIAL WATER LEVEL (FT)	4.76
TOTAL WELL DEPTH (TD)	38.8
WELL DIAMETER (INCHES)	2.0
CALCULATED WELL VOLUME	5.5 gal
BOREHOLE DIAMETER (INCHES)	—
BOREHOLE VOLUME	—
AMOUNT OF WATER ADDED DURING DRILLING	—
DEVELOPMENT METHOD	Pumping
PUMP TYPE	(Wattera) Inertial
TOTAL TIME (A)	3 hours
AVERAGE FLOW (GPM)(B)	1.39 gpm
TOTAL ESTIMATED WITHDRAWAL AxB=	250
HNU/OVA READING	

DEVELOPMENT DATA

TIME	CUMULATIVE VOLUME (gallons)	pH	TEMP (°C)	SPEC. COND. (µmhos/cm)	TEMP (°C)	COLOR AND TURBIDITY
	50	—	—	—	—	> 200 NTU
	100	—	—	—	—	> 200 NTU
	150	—	—	—	—	> 200 NTU
	200	7.11	—	700	24	53 NTU
	220	6.33	—	700	22	37.8 NTU
	230	6.58	—	700	22	28.0 NTU
	250	6.49	—	700	22	26.4 NTU

OBSERVATIONS/NOTES

Development

FIELD WELL DEVELOPMENT RECORD

Baker

Baker Environmental, Inc.

PROJECT: Site 35, SGI

CTO NO.: 0232 WELL NO.: 35-MW60A

DATE: 8/4/96

GEOLOGIST/ENGINEER: M. Smith

TIME START	1128
TIME FINISH	1455
INITIAL WATER LEVEL (FT)	6.00'
TOTAL WELL DEPTH (TD)	15.94'
WELL DIAMETER (INCHES)	2.0
CALCULATED WELL VOLUME	3.0
BOREHOLE DIAMETER (INCHES)	—
BOREHOLE VOLUME	—
AMOUNT OF WATER ADDED DURING DRILLING	—
DEVELOPMENT METHOD	Pumping
PUMP TYPE	(Waterra) Inertial
TOTAL TIME (A)	3Hr. 27 min.
AVERAGE FLOW (GPM)(B)	0.54 gpm
TOTAL ESTIMATED WITHDRAWAL AxB=	112.0 gal
HNU/OVA READING	

DEVELOPMENT DATA

TIME	CUMULATIVE VOLUME (gallons)	pH	TEMP (°C)	SPEC. COND. (µmhos/cm)	TEMP (°C)	COLOR AND TURBIDITY
1135	28	4.48	25	180	—	—
1140	48	4.38	25	188.4	20.1	28.3 NTU
1144	80	4.48	25	180	20	12.9 NTU
1452	100	4.49	24.8	167	21.4	4.0 NTU
1455	112	4.51	21.3	155.2	20.4	3.9 NTU

OBSERVATIONS/NOTES

DEVELOPMENT

FIELD WELL DEVELOPMENT RECORD

Baker
Baker Environmental, Inc.

PROJECT: Site 35, SGI

CTO NO.: 0232 WELL NO.: 35-MW60B

DATE: 8/4/96

GEOLOGIST/ENGINEER: M. Smith

TIME START: 1000

TIME FINISH: 1115

INITIAL WATER LEVEL (FT): 5.56

TOTAL WELL DEPTH (TD): 37.41

WELL DIAMETER (INCHES): 2.0

CALCULATED WELL VOLUME: 5.5 gals

BOREHOLE DIAMETER (INCHES): —

BOREHOLE VOLUME: —

AMOUNT OF WATER ADDED DURING DRILLING: —

DEVELOPMENT METHOD: Pumping

PUMP TYPE: (Wattera) Inertial

TOTAL TIME (A): 1 hr 15 min.

AVERAGE FLOW (GPM)(B): 1.0 gpm

TOTAL ESTIMATED WITHDRAWAL AxB = 75 gal

HNU/OVA READING:

DEVELOPMENT DATA

TIME	CUMULATIVE VOLUME (gallons)	pH	TEMP (°C)	SPEC. COND. (µmhos/cm)	TEMP (°C)	COLOR AND TURBIDITY
1000	0	—	—	—	—	—
1006	6	4.28	25.0	573	21.2	6.20 NTU
1012	21	4.65	21.4	468.0	25	4.13 NTU
1027	27	4.8	21.0	551	25.8	2.97 NTU
1035	35	4.87	25.0	547	20.9	2.5 NTU
1042	46	5.09	25.0	545	—	7 200 NTU
1049	50	—	—	—	—	91 NTU
1052	53	5.30	25.0	557	22.5	48 NTU
1055	56	—	—	—	—	32 NTU
1101	60	—	—	—	—	19 NTU
1104	65	—	—	—	—	16 NTU
1115	75	5.82	25.0	554	22.5	10 NTU

OBSERVATIONS/NOTES

Development

FIELD WELL DEVELOPMENT RECORD

Baker

Baker Environmental, Inc.

PROJECT: SITE 35, SGI

CTO NO.: 0232 WELL NO.: 35-GWD6

DATE: 4/28/96

GEOLOGIST/ENGINEER: P. MONDAY

TIME START	1522
TIME FINISH	1813
INITIAL WATER LEVEL (FT)	8.34
TOTAL WELL DEPTH (TD)	67.0
WELL DIAMETER (INCHES)	2
CALCULATED WELL VOLUME	9.5
BOREHOLE DIAMETER (INCHES)	—
BOREHOLE VOLUME	—
AMOUNT OF WATER ADDED DURING DRILLING	—
DEVELOPMENT METHOD	Pumping
PUMP TYPE	(Waltera) Inertial
TOTAL TIME (A)	2 hrs. 51 min.
AVERAGE FLOW (GPM)(B)	1.64
TOTAL ESTIMATED WITHDRAWAL AxB=	280
HNU/OVA READING	

DEVELOPMENT DATA

TIME	CUMULATIVE VOLUME (gallons)	pH	TEMP (°C)	SPEC. COND. (µmhos/cm)	TEMP (°C)	COLOR AND TURBIDITY
1522	10	7.05	26.1	519	23.2	>200 NTU
1530	30	7.77	23.7	483	22.4	>200 NTU
1538	50	7.82	23.9	475	22.3	101.8 NTU
1542	60	7.89	22.8	477	22.1	86.5 NTU
1546	70	7.88	22.8	475	21.9	62.3 NTU
1550	80	7.89	22.9	469	21.9	58.2 NTU
1558	100	7.89	23.3	467	22.1	54.9 NTU
1602	110	7.90	23.4	471	22.0	58.2 NTU
1606	120	7.90	22.8	471	21.9	62.9 NTU
1617	140	7.94	21.8	475.8	21.6	47.5 NTU
1622	150	7.92	21.5	475	21.6	56.3 NTU
1627	160	7.92	21.5	474	21.6	55.5 NTU
1632	170	7.90	21.6	474	21.6	54.7 NTU
1734	200	8.85	20.9	507	21.0	74 NTU
1800	240	8.29	20.6	514	20.9	4.9 NTU
1813	280	8.05	20.7	485	21	3.9 NTU

OBSERVATIONS/NOTES

DEVELOPMENT

FIELD WELL DEVELOPMENT RECORD

Baker

Baker Environmental, Inc.

PROJECT: Site 35, SGI

CTO NO.: Ø232 WELL NO.: 35-GWD7

DATE: 8-3-96

GEOLOGIST/ENGINEER: M. Smith

TIME START	1542
TIME FINISH	1818
INITIAL WATER LEVEL (FT)	3.9
TOTAL WELL DEPTH (TD)	51.66
WELL DIAMETER (INCHES)	2.0
CALCULATED WELL VOLUME	8.12 gal
BOREHOLE DIAMETER (INCHES)	—
BOREHOLE VOLUME	—
AMOUNT OF WATER ADDED DURING DRILLING	—
DEVELOPMENT METHOD	Pumping
PUMP TYPE	(Wattera) Inertial
TOTAL TIME (A)	2hr. 36min
AVERAGE FLOW (GPM)(B)	0.5gpm
TOTAL ESTIMATED WITHDRAWAL AxB=	80gal
HNU/OVA READING	

DEVELOPMENT DATA

TIME	CUMULATIVE VOLUME (gallons)	pH	TEMP (°C)	SPEC. COND. (µmhos/cm)	TEMP (°C)	COLOR AND TURBIDITY
1607	5	—	—	—	—	—
1613	10	—	—	—	—	—
1621	15	—	—	—	—	—
1642	20	6.55	25	528	20.1	99 NTU
1658	25	6.31	19.4	491	19.7	44 NTU
1715	40	5.61	19.4	490	19.0	57 NTU
1728	50	5.26	18.9	489	18.0	23 NTU
1742	60	—	—	—	—	—
1818	80	—	—	500	18.0	10 NTU

OBSERVATIONS/NOTES

Development.

APPENDIX I
SGI IDW MANAGEMENT AND DISPOSAL INFORMATION

bcc: 'Pajak/CF; JWMentz/PRGM File; DLBo 'RJ File;
MDSmith/PRJ File; MDBartman; RPWattras(ck); Daily File
S.O.# 62470-323-SRN
Subfile # 2 8
Initials RRW

Baker

Baker Environmental, Inc.
Airport Office Park, Building 3
420 Rouser Road
Coraopolis, Pennsylvania 15108

(412) 269-6000
FAX (412) 269-2002

November 7, 1995

Commander
Atlantic Division
Naval Facilities Engineering Command
1510 Gilbert Street (Building N-26)
Norfolk, Virginia 23511-2699

Attn: Ms. Katherine Landman
Navy Technical Representative
Code 18232

Re: Contract N62470-89-D-4814
Navy CLEAN, District III
Contract Task Order (CTO) 0323
August 1995, Groundwater and Sediment Sampling
Operable Unit No. 10 (Site 35)
MCB, Camp Lejeune, North Carolina

Dear Ms. Landman:

This letter report presents the results of groundwater and sediment sampling conducted under CTO-0323, RAC Design Package For Surficial Groundwater Remediation Operable Unit 10, Site 35 - Camp Geiger Area Fuel Farm. A field investigation was performed during July and August that included well development, groundwater and sediment sample collection and measurement of static water levels. Concurrent with the field investigation, a site survey was performed. Laboratory analytical and validation activities began with the submission of the first sample and were completed during September and October of 1995. Preliminary results indicate that Total Petroleum Hydrocarbon (TPH) contamination is present in the sediment of Brinson Creek and the levels of total inorganic contamination in surficial groundwater were substantially reduced through the use of low flow sampling procedures.

The data collected will be used in the design of a surficial groundwater remediation system to be completed under this CTO. The data will also be included in the site-wide Remedial Investigation (RI) Report to be completed in 1996 under CTO-0232.

FIELD INVESTIGATION

Groundwater Investigation

The goal of the groundwater investigation was to more accurately quantify total metals contamination in the surficial aquifer by reducing sediment disturbance during sampling. To meet this goal the following tasks were performed in the field: well development, low flow groundwater sampling, and measurement of static water levels. Groundwater samples were collected from 20 wells identified in the Final RI as having total inorganic contamination that exceeded federal Maximum Contaminant Levels (MCLs), Secondary Maximum

Contaminant Levels (SMCLs), and North Carolina Water Quality Standards (NCWQS). Initially, 24 wells were identified as exceeding these standards. However, four wells were abandoned as part of the soil remediation at Site 35 and, therefore, only 20 wells were sampled.

Well Development

Each of the 20 wells sampled were developed to remove fine-grained sediment from the screen and establish hydraulic communication between the well and the aquifer. Prior to development, the groundwater within each well and sand pack was agitated with a surge block for approximately 20 minutes to stir up sediments. Two pumping systems were used during redevelopment. Shallow and intermediate wells were redeveloped with a centrifugal pumping system, and the deep wells were developed with an inertial pumping system (Wattera system). Hoses used for surging and development were dedicated to each well to minimize the potential for cross contamination and discarded upon completion. During redevelopment eight to 127 well volumes were removed from wells until the pH, conductivity and temperature had stabilized and groundwater was essentially sediment free. Turbidity levels were monitored as a measurement of sediment content. Groundwater was considered sediment free when turbidity measurements of less than 10 nephelometer turbidity units (NTUs) were achieved. Wells were redeveloped for no more than three hours. Groundwater collected during the redevelopment process was temporarily stored in a 200-gallon polyethylene tank or 55 gallon drums, then transferred to a 9,000-gallon tank truck.

Redevelopment activities occurred between July 24 1995 and August 8, 1995. Average flows at each well ranged from one gallon per minute (gpm) to five gpm. In general, most wells reached turbidity levels of 10 NTUs or less within three hours. However, turbidity in well MW-16S remained greater than 200 NTUs for the duration of redevelopment, approximately three hours. Groundwater collected from this well maintained a slight orange color during redevelopment. Well redevelopment records will be included in the site-wide RI report.

Groundwater Sampling

Groundwater samples were collected from 20 wells to determine the levels of total inorganic contamination in the upper and lower portion of the surficial aquifer. To purge and sample, polyethylene tubing was inserted into each monitoring well approximately two to four feet below the static water level and a steady flow of approximately 0.25 gpm or less was established using a peristaltic pump. Tubing used for purging and sampling was dedicated to each well to minimize the potential for cross contamination and discarded upon completion. Prior to sampling, wells were purged of three to five well volumes until the pH, conductivity and temperature had stabilized, and groundwater was essentially sediment free. Turbidity levels were monitored as a measurement of sediment content. Groundwater was considered sediment free when turbidity measurements of less than 10 NTUs using a peristaltic pump.

Samples were introduced directly into laboratory prepared sample containers from the discharge side of the peristaltic pump and stored on ice. Groundwater samples were prepared and handled in accordance with procedures outlined in accordance with the Remedial Investigation/Feasibility Study Field Sampling and

Analysis Plan for Operable Unit No. 10 (Site 35) (FSAP, Baker, 1993) and USEPA Region IV Standard Operating Procedures (SOPs).

Groundwater was sampled between August 8, 1995 and August 16, 1995. It should be noted that groundwater sampling was performed immediately after contaminated soils were excavated from the above ground storage tank (ASTs) area at Site 35.

Static Water Levels

A round of static water levels was collected on August 12, 1995 in order to assess groundwater flow patterns in the surficial aquifer during the sampling event. The measurements were recorded using an electronic measuring tape to the nearest 0.01-foot from the top of the casing. Data were collected from deep, intermediate and shallow wells during a four hour period

Sediment Investigation

Sediment samples were obtained from 10 sampling stations along Brinson Creek established during the previous RI field effort. These stations include three locations (35-SD01 through 35-SD03) upstream of Site 35 and seven locations (35-SD04 through 35-SD07 and 36-SD-05 through 35-SD07) adjacent and downstream of Site 35. The purpose of this effort was to provide data regarding the extent of organic contamination that was "masked" by tentatively identified compounds (TICs) in previous results and to replace mercury and zinc data that was rejected during validation performed for the previous RI.

At each sediment sampling station samples were collected at a depth of zero to six inches and six to 12 inches. Because the sediment samples were collected from near the bank where the water was shallow, it was not necessary to use a coring device. A plastic liner with an eggshell was pushed into the sediment a minimum depth of 15 inches, or until refusal, whichever was encountered first. If less than 12 inches of sediment were obtained, the first six inches were placed in the zero to six inch container, and the remaining sediment was placed into the six to 12 inch container. An extruding device was not needed to extract sediment from the liner. Samples were introduced directly into laboratory prepared sample bottles and stored on ice. Sediment samples were prepared and handled in accordance with procedures outlined in accordance with the FSAP (Baker, 1993) and USEPA Region IV SOPs.

SITE SURVEY

A topographic survey was performed at the site in the area of the proposed site access roads. This data will be used to produce a topographic base map with one-foot contour intervals. The area covered by this survey generally included the ground surface between the eastern edge of the proposed row for a six-lane highway and the western edge of Brinson Creek. The northern boundary is approximately an extension of Second Street from First Street and the southern boundary is approximately the west face of the Camp Geiger Sewage Treatment Facility. The survey was performed during August and September 1995. Flooding in the wetlands area delayed work in this area for several weeks.

SAMPLE ANALYSIS AND VALIDATION

Groundwater and sediment samples were packed and shipped to Inchcape Testing Services NRDC Laboratories in Richardson, Texas between August 7 and 14, 1995. Groundwater samples were analyzed for Target Analyte List (TAL) metals and sediments were analyzed by for TPH (EPA Methods 5030/8015 and 3550/8015), mercury (EPA Method E245.3) and zinc (EPA Method E 200.7). A copy of the Chain-of-Custody (COCs) will be included in the state-wide RI.

Sample Design Groups (SDGs) with analytical results were submitted by Inchcape to Baker for review and Heartland Environmental for validation between September 13 and 21, 1995. Validation was performed based on EPA CLP SOW. The validated data were received from Heartland Environmental between October 5 and 12, 1995.

INVESTIGATION RESULTS

A preliminary review of the groundwater and sediment data was performed as part of this report. Data from both media will be further evaluated as part of an addendum to the Final RI. Positive detection summaries for sediment and groundwater are included in Tables 1, 2, and 3. The analytical results of this field effort can be summarized as follows:

- No sediment, groundwater, QA/QC or IDW sample was rejected by the validator.

- Total metals concentrations in groundwater samples appeared to be substantially lower than detected during the previous sampling round where 23 of 24 samples submitted for TAL inorganics exceeded either federal MCLs or NCWQS for drinking water. Specific inorganics that exceeded these standards included arsenic, barium, beryllium, cadmium, chromium, lead, manganese, mercury, and nickel. In the current investigation nine of 22 samples submitted for TAL inorganics exceeded either federal MCLs or NCWQS for drinking water. Specific inorganics that exceeded these standards included antimony, lead and manganese.

- Both diesel and gasoline fractions were detected by the TPH analysis in Brinson Creek sediments. Gasoline fractions were detected in 17 of 22 samples submitted for TPH. Levels ranged between 0.1 mg/kg and 29.7 mg/kg. Diesel fractions were detected in 16 of 22 samples that were submitted with levels ranging between 54.9 mg/kg and 7,420 mg/kg. During the previous RI only toluene was detected in one of 20 samples that were submitted for TCL volatile analysis.

- Mercury was detected in three of 22 samples, and zinc was detected in 21 of 22 samples. Three of the 22 samples submitted for mercury exceeded the USEPA Region IV sediment screening value for mercury of 0.15 mg/kg. None of the 22 samples submitted for zinc exceeded the USEPA Region IV sediment screening value of 120 mg/kg.

The mercury and zinc data generated from the results of this sampling effort along with the low flow groundwater sampling for metals should enable Baker to determine whether or not Site 35 is the source of elevated zinc and/or mercury concentrations in Brinson Creek water and fish. In addition, groundwater data gathered at Site 35 will be used to further evaluate the human health and environmental risks associated with Site 35. The TPH data will be used to evaluate where Brinson Creek sediments are most profoundly impacted by petroleum contamination, and will aid in the placement of the groundwater remediation system.

Baker appreciates the opportunity to serve LANTDIV on this project. If you have any questions, please do not hesitate to contact me at (412) 269-2063.

Sincerely,

BAKER ENVIRONMENTAL, INC.

Daniel L. Bonk, P.E.
Project Manager

Attachments

TABLES

TABLE 1
POSITIVE DETECTION SUMMARY
GROUNDWATER
INORGANICS
SITE 35 CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
CONTRACT TASK ORDER 0323

Location	MCL	NCWQS	35-EMW03-02	35-EMW05-02	35-EMW07-02	35-GW05-02m	35-MW09D-02
Lab Id.	Groundwater	Groundwater	D95-7537-1	D95-7597-6	D95-7537-2	D95-7537-8	D95-7597-2
Date Sampled	[ug/L]	[ug/L]	08/10/95	08/11/95	08/10/95	08/11/95	08/12/95
ANALYTES (ug/L)							
Aluminum	NC	NA	96.5	93.2 J	20 U	25.9	26.2 J
Antimony	6	NA	20 U	20 U	20 U	20 U	20 U
Arsenic	50	50	2 U	8.7 J	2 U	2 U	1.4 U
Barium	2000	2000	20 U	21.7 J	20 U	20 U	20.9 J
Calcium	NC	NA	89900	45100	105000	56900	104000
Cobalt	NC	NA	9 J	3.8 J	2.8 J	2 U	2 U
Iron	NC	300	3350	20200	106	337	1650
Lead	15	15	1 UJ	12.1 J	1 UJ	1 U	1 UJ
Magnesium	NC	NA	2240 J	3610 J	3480 J	2280	2260 J
Manganese	NC	50	22.9	51.7	26.2	22.1	19.7
Potassium	NC	NA	734 J	1160 J	2150 J	4400	844 J
Selenium	50	50	2.5 UJ	2.5 UJ	2.5 U	2.5 U	2.5 UJ
Silver	NC	18	2 U	2 U	2 U	2 U	2 U
Sodium	NC	NA	8120	9090	7940	31900	8740
Thallium	2	NA	0.7 U	9.9 U	0.7 U	1	9.9 U
Vanadium	NC	NA	2 U	2 U	2 U	2 U	2 U
Zinc	NC	2100	10.5 J	5 U	10.6 J	6.7	10.9 U

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POSITIVE DETECTION SUMMARY
GROUNDWATER
INORGANICS
SITE 35 CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
CONTRACT TASK ORDER 0323

Location	MCL	NCWQS	35-MW09S-02	[illegible]	35-MW10S-02	35-MW14D-02	35-MW14S-02
Lab Id.	Groundwater	Groundwater	D95-7597-7	95-7537-15	95-7537-14	95-7537-17	95-7537-16
Date Sampled	(ug/L)	(ug/L)	08/12/95	08/09/95	08/09/95	08/10/95	08/10/95
ANALYTES (ug/L)							
Aluminum	NA	NA	198 J	20 U	303	28.6 J	20 U
Antimony	6	NA	20 U	20 U	20 U	20 U	20 U
Arsenic	50	50	3.2 J	2 U	3.5 J	2 U	4.2 J
Barium	2000	2000	57.7 J	20 U	20 U	33.7 J	27.1 J
Calcium	NA	NA	98600	122000	75000	119000	142000
Cobalt	NA	NA	2 U	2 U	2 U	2 U	2.9 J
Iron	NA	300	162	1490	152	1070	4490
Lead	15	15	1 UJ	1	1 U	15.4	1 U
Magnesium	NA	NA	4110 J	2420	1800 J	2450 J	4520 J
Manganese	NA	50	38.6	19	7.5 J	23.4	44.6
Potassium	NA	NA	3350 J	811	860 J	1270 J	1460 J
Selenium	50	50	3.4 J	2.5 U	2.5 U	2.5 U	2.5 UJ
Silver	NA	18	2 U	2 U	2 U	2 U	2 U
Sodium	NA	NA	29000	8390	9970	9560	10400
Thallium	2	NA	9.9 U	0.7 U	0.7 U	0.7 U	0.7 UJ
Vanadium	NA	NA	5.5 J	2 U	9.1 J	2 U	2 U
Zinc	NA	2100	18.5 U	13.8	6.5 J	29.5	22.5

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GROUNDWATER
INORGANICS
SITE 35 CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
CONTRACT TASK ORDER 0323

Location	MCL	NCWQS	35-MW16D-02	35-MW16S-02	35-MW16S-02D	35-MW19D-02	35-MW19S-02
Lab Id.	Groundwater	Groundwater	95-7537-13	95-7537-11	95-7537-12	D95-7537-5	D95-7537-6
Date Sampled	[ug/L]	[ug/L]	08/09/95	08/10/95	08/10/95	08/11/95	08/11/95
ANALYTES (ug/L)							
Aluminum	NA	NA	20 U	20 U	20 U	47.8 J	282
Antimony	6	NA	20 U	20 U	20 U	20 U	20 U
Arsenic	50	50	2 U	10.3	11.1	2 U	2 U
Barium	2000	2000	20 U	32.2 J	31.3 J	20 U	20 U
Calcium	NA	NA	96900	124000	121000	109000	35600
Cobalt	NA	NA	6.1 J	16 J	16.9 J	2.2 J	4.4 J
Iron	NA	300	$\boxed{2580}$	$\boxed{40400}$	$\boxed{42200}$	113	266
Lead	15	15	1 U	8.9	2.9 J	1 UJ	1 U
Magnesium	NA	NA	3440 J	4580 J	4540 J	4990 J	1880 J
Manganese	NA	50	$\boxed{275}$	$\boxed{141}$	$\boxed{139}$	36.7	$\boxed{102}$
Potassium	NA	NA	970 J	793 J	728 J	3360 J	2650 J
Selenium	50	50	2.5 U	2.5 UJ	2.5 U	2.5 U	2.5 U
Silver	NA	18	2 U	10.9	2 U	2 U	2 U
Sodium	NA	NA	8380	4350 J	4520 J	10500	11300
Thallium	2	NA	0.7 UJ	0.9 J	1.1 J	0.7 J	0.7 U
Vanadium	NA	NA	2 U	2 U	2 U	2 U	2 U
Zinc	NA	2100	12.9 J	11.5 J	5 U	10.4 J	9.9 J

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TABLE 1
POSITIVE DETECTION SUMMARY
GROUNDWATER
INORGANICS
SITE 35 CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
CONTRACT TASK ORDER 0323

Location	MCL	NCWQS	35-MW19S-02D	35-MW22D-02	35-MW22S-02	35-MW29A-02	35-MW29B-02
Lab Id.	Groundwater	Groundwater	D95-7537-7	D95-7597-8	D95-7597-9	D95-7597-4	D95-7597-5
Date Sampled	(ug/L)	(ug/L)	08/11/95	08/13/95	08/13/95	08/12/95	08/12/95
ANALYTES (ug/L)							
Aluminum	NA	NA	205	22.6 J	123 U	357	20 U
Antimony	6	NA	20 U	20 U	20 J	20 U	20 U
Arsenic	50	50	2 U	1.4 U	7.1 J	13.3	1.4 U
Barium	2000	2000	20 U	24.7 J	32.5 U	81.7 J	20 U
Calcium	NA	NA	34500	104000	133000	7460	93500
Cobalt	NA	NA	4.1 J	2 U	5.6 J	3.3 J	2 U
Iron	NA	300	215	1110	15700	9360	933
Lead	15	15	1 U	2.5 J	1 UJ	1 UJ	1.4 J
Magnesium	NA	NA	1770 J	3020 J	3230 J	1550 J	1890 J
Manganese	NA	50	98.1	41.2	63.5	29.2	17.1
Potassium	NA	NA	2600 J	1120 J	2320 J	2170 J	1110 J
Selenium	50	50	2.5 U	2.5 UJ	2.5 UJ	2.5 UJ	2.5 UJ
Silver	NA	18	2 U	2 U	2 U	2 U	2 U
Sodium	NA	NA	11200	7050	5080	14600	6460
Thallium	2	NA	1.3 J	9.9 U	9.9 U	9.9 U	9.9 U
Vanadium	NA	NA	2 U	2 U	2 U	2 U	2 U
Zinc	NA	2100	11.7 J	5.9 U	5 U	17.4 U	11.6 U

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POSITIVE DETECTION SUMMARY
GROUNDWATER
INORGANICS
SITE 35 CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
CONTRACT TASK ORDER 0323

Location	MCL	NCWQS	35-MW33A-02	35-MW33D-02
Lab Id.	Groundwater	Groundwater	D95-7597-1	D95-7597-3
Date Sampled	[ug/L]	[ug/L]	08/12/95	08/12/95
ANALYTES (ug/L)				
Aluminum	NA	NA	520	20 U
Antimony	6	NA	20 U	20 U
Arsenic	50	50	1.4 U	1.4 U
Barium	2000	2000	98.4 J	20 U
Calcium	NA	NA	6380	102000
Cobalt	NA	NA	2 U	2 U
Iron	NA	300	58.4 J	648
Lead	15	15	6 J	1.5 J
Magnesium	NA	NA	3620 J	2170 J
Manganese	NA	50	8.8 J	20.1
Potassium	NA	NA	1840 J	929 J
Selenium	50	50	2.6 J	2.5 UJ
Silver	NA	18	2 U	2 U
Sodium	NA	NA	5370	7340
Thallium	2	NA	9.9 U	9.9 U
Vanadium	NA	NA	2 U	2 U
Zinc	NA	2100	7.6 U	24.3 U

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INORGANICS
SITE 35 CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
CONTRACT TASK ORDER 0323

Location Lab Id. Date Sampled	number exceeding MCL Groundwater	number exceeding NCWQS Groundwater	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
ANALYTES (ug/L)					
Aluminum	NC	NC	520	35-MW33A-02	13/22
Antimony	1/22	NC	20 J	35-MW22S-02	1/22
Arsenic	0/22	0/22	13.3	35-MW29A-02	8/22
Barium	0/22	0/22	98.4 J	35-MW33A-02	10/22
Calcium	NC	NC	142000	35-MW14S-02	22/22
Cobalt	NC	NC	16.9 J	35-MW16S-02D	12/22
Iron	NC	15/22	42200	35-MW16S-02D	22/22
Lead	1/22	1/22	15.4	35-MW14D-02	9/22
Magnesium	NC	NC	4990 J	35-MW19D-02	22/22
Manganese	NC	7/22	275	35-MW16D-02	22/22
Potassium	NC	NC	4400	35-GW05-02m	22/22
Selenium	0/22	0/22	3.4 J	35-MW09S-02	2/22
Silver	NC	0/22	10.9	35-MW16S-02	1/22
Sodium	NC	NC	31900	35-GW05-02m	22/22
Thallium	0/22	NC	1.3 J	35-MW19S-02D	5/22
Vanadium	NC	NC	9.1 J	35-MW10S-02	2/22
Zinc	NC	0/22	29.5	35-MW14D-02	12/22

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TABLE 2
POSITIVE DETECTION SUMMARY
SEDIMENTS
TOTAL PETROLEUM HYDROCARBONS
SITE 35 CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
CONTRACT TASK ORDER 0323

Location	35-SD01-06-02	35-SD01-612-02	35-SD02-06-02	35-SD02-612-02	35-SD03-06-02	35-SD03-612-02
Lab Id.	D95-7350-1	D95-7350-2	D95-7350-3	D95-7350-4	95-7354-10	95-7354-11
Date Sampled	08/08/95	08/08/95	08/08/95	08/08/95	08/07/95	08/07/95
TPH mg/kg						
Gasoline 5030/8015M	0.069 U	0.061 U	0.062 U	0.164	0.759	0.07 U
Diesel 3550/8015M	69 U	36.7 U	37.4 U	104	54.9	84.5

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mg/kg = milligrams per kilogram.
ug/kg = micrograms per kilogram.

TABLE 2
POSITIVE DETECTION SUMMARY
SEDIMENTS
TOTAL PETROLEUM HYDROCARBONS
SITE 35 CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
CONTRACT TASK ORDER 0323

Location	35-SD04-06-02	35-SD04-612-02	35-SD05-06-02	35-SD05-612-02	35-SD06-06-02	35-SD06-612-02
Lab Id.	D95-7354-8	D95-7354-9	D95-7354-6	D95-7354-7	D95-7354-4	D95-7354-5
Date Sampled	08/07/95	08/07/95	08/07/95	08/07/95	08/07/95	08/07/95
TPH mg/kg						
Gasoline 5030/8015M	2.39	29.7	5.6	3.65	14.2	1.07 J
Diesel 3550/8015M	735	459	550	1100	7420	234

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SEDIMENTS
TOTAL PETROLEUM HYDROCARBONS
SITE 35 CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
CONTRACT TASK ORDER 0323

Location	35-SD07-06-02	35-SD07-06D-02	35-SD07-612-02	36-SD05-06-02	36-SD05-612-02	36-SD06-06-02
Lab Id.	D95-7354-1	D95-7354-2	D95-7354-3	95-7350-10	95-7350-11	D95-7350-8
Date Sampled	08/08/95	08/08/95	08/07/95	08/07/95	08/08/95	08/07/95
TPH mg/kg						
Gasoline 5030/8015M	0.188 J	0.364	1.42	0.102	0.143	0.099
Diesel 3550/8015M	239	180 U	292	41.8 U	64.5	92.2

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POSITIVE DETECTION SUMMARY
SEDIMENTS
TOTAL PETROLEUM HYDROCARBONS
SITE 35 CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
CONTRACT TASK ORDER 0323

Location	36-SD06-612-02	36-SD07-06-02	36-SD07-06D-02	36-SD07-612-02
Lab Id.	D95-7350-9	D95-7350-5	D95-7350-6	D95-7350-7
Date Sampled	08/07/95	08/07/95	08/07/95	08/07/95
TPH mg/kg				
Gasoline 5030/8015M	0.892	2.28	2.24	0.115 U
Diesel 3550/8015M	444	708	1140	68.8 U

NOTES:
(NO CODE) = Confirmed identification.
U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
mg/kg = milligrams per kilogram.
ug/kg = micrograms per kilogram.

TABLE 2
POSITIVE DETECTION SUMMARY
SEDIMENTS
TOTAL PETROLEUM HYDROCARBONS
SITE 35 CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
CONTRACT TASK ORDER 0323

Location Lab Id. Date Sampled	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
TPH mg/kg			
Gasoline 5030/8015M	29.7	35-SD04-612-02	17/22
Diesel 3550/8015M	7420	35-SD06-06-02	16/22

TABLE 3
POSITIVE DETECTION SUMMARY
SEDIMENTS
INORGANICS
SITE 35 CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
CONTRACT TASK ORDER 0323

Location	35-SD01-06-02	35-SD01-612-02	35-SD02-06-02	35-SD02-612-02	35-SD03-06-02	35-SD03-612-02
Lab Id.	D95-7350-1	D95-7350-2	D95-7350-3	D95-7350-4	95-7354-10	95-7354-11
Date Sampled	08/08/95	08/08/95	08/08/95	08/08/95	08/07/95	08/07/95
ANALYTES (mg/kg)						
Mercury	0.13 U	0.12 U	0.12 U	0.26 U	0.15 U	0.13 U
Zinc	12.6	4.1	27.1	62.1	26.6	11.4

NOTES: (NO CODE) = Confirmed identification.
U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
ug/kg = micrograms per kilogram.

TABLE 3
POSITIVE DETECTION SUMMARY
SEDIMENTS
INORGANICS
SITE 35 CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
CONTRACT TASK ORDER 0323

Location	35-SD04-06-02	35-SD04-612-02	35-SD05-06-02	35-SD05-612-02	35-SD06-06-02	35-SD06-612-02
Lab Id.	D95-7354-8	D95-7354-9	D95-7354-6	D95-7354-7	D95-7354-4	D95-7354-5
Date Sampled	08/07/95	08/07/95	08/07/95	08/07/95	08/07/95	08/07/95
ANALYTES (mg/kg)						
Mercury	0.14 U	0.14 U	0.25 U	0.23 U	0.28 U	0.36
Zinc	34.2	42.2	106	104	92.9	9.9

NOTES:
(NO CODE) = Confirmed identification.
U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
ug/kg = micrograms per kilogram.

TABLE 3
POSITIVE DETECTION SUMMARY
SEDIMENTS
INORGANICS
SITE 35 CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
CONTRACT TASK ORDER 0323

Location	35-SD07-06-02	35-SD07-06D-02	35-SD07-612-02	36-SD05-06-02	36-SD05-612-02	36-SD06-06-02
Lab Id.	D95-7354-1	D95-7354-2	D95-7354-3	95-7350-10	95-7350-11	D95-7350-8
Date Sampled	08/08/95	08/08/95	08/07/95	08/07/95	08/08/95	08/07/95
ANALYTES (mg/kg)						
Mercury	0.19 U	0.17 U	0.13 U	0.13 U	0.13 U	0.16
Zinc	72.6	61.7	45.6	28.4	18.2	22.6

NOTES: (NO CODE) = Confirmed identification.
U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
ug/kg = micrograms per kilogram.

TABLE 3
POSITIVE DETECTION SUMMARY
SEDIMENTS
INORGANICS
SITE 35 CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
CONTRACT TASK ORDER 0323

Location	36-SD06-612-02	36-SD07-06-02	36-SD07-06D-02	36-SD07-612-02
Lab Id.	D95-7350-9	D95-7350-5	D95-7350-6	D95-7350-7
Date Sampled	08/07/95	08/07/95	08/07/95	08/07/95
ANALYTES (mg/kg)				
Mercury	0.16	0.34 U	0.34 U	0.31 U
Zinc	10.1	65.8	94.5	2.2 U

NOTES:
(NO CODE) = Confirmed identification.
U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
ug/kg = micrograms per kilogram.

TABLE 3
POSITIVE DETECTION SUMMARY
SEDIMENTS
INORGANICS
SITE 35 CAMP GEIGER AREA FUEL FARM
MCB CAMP LEJEUNE, NORTH CAROLINA
CONTRACT TASK ORDER 0323

Location Lab Id. Date Sampled	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
ANALYTES (mg/kg)			
Mercury	0.36	35-SD06-612-02	3/22
Zinc	106	35-SD05-06-02	21/22

Baker

Baker Environmental, Inc.
Airport Office Park, Building 3
420 Rouser Road
Coraopolis, Pennsylvania 15108

(412) 269-6000
FAX (412) 269-2002

August 29, 1996

Commander
Atlantic Division
Naval Facilities Engineering Command
1510 Gilbert Street (Building N-26)
Norfolk, Virginia 23511-2699

Attn: Ms. Katherine Landman
Navy Technical Representative
Code 18232

Re: Contract N62470-89-D-4814
Navy CLEAN, District III
Contract Task Order (CTO) 0232
Operable Unit No. 10 (Site 35)
MCB, Camp Lejeune, North Carolina
IDW Handling and Disposal

Dear Ms. Landman:

This letter report describes the sample collection activities, results, and recommendations for the disposal of solid and liquid investigative-derived waste (IDW) present on Onslow County property adjacent to Site 35, Camp Geiger Area Fuel Farm, Marine Corps Base, Camp Lejeune, North Carolina. Analytical results are provided in Attachment A.

The IDW was generated via monitoring well installation, development, and sampling activities conducted in August, 1996 on Onslow County as part of the Supplemental Groundwater Investigation (SGI). The solid IDW consists of approximately 15 cubic feet of drill cuttings that are containerized in a roll-off box. The liquid IDW consists of approximately 1,300 gallons of development and purge water that is containerized in two portable polyethylene tanks. Both the roll-off box and polyethylene tanks are presently located next to the Onslow County Animal Control Facility on Georgetown Road in Jacksonville, North Carolina.

Sample Collection and Analysis

Liquid IDW

One grab sample was collected from each of the polyethylene storage tanks and composited in a one-gallon glass container, and given the sample identification 35-IDWL2-04. This sample was analyzed for full Target Compound List (TCL) organics, Target Analyte List (TAL) inorganics, Total Suspended Solids (TSS), Total Dissolved Solids (TDS), and Resource Conservation Recovery Act (RCRA) characteristics (corrosivity, ignitability, and reactivity).

Solid IDW

Five solid grab samples were collected from random locations within the roll-off box. A representative sample was collected from each of these grab samples and given the sample identification 35-IDWS2-04. This sample was analyzed for full Toxic Characteristic Leaching Procedure (TCLP) organics and metals, Target Compound List (TCL) PCBs, and Resource Conservation Recovery Act (RCRA) characteristics for defining a hazardous waste.

Results

Liquid IDW

Sample 35-IDWL2-04 exhibited a single semivolatile organic contaminant [i.e., bis (2-Ethylhexyl)phthalate = 62 ug/L]. No volatiles, pesticides, or PCBs were detected in this sample. The detection of bis (2-Ethylhexyl) phthalate is not considered to be site-related contamination, but rather contamination originating from the polyethylene storage tanks used to store the IDW.

A variety of inorganics were detected in sample 35-IDWL02-04. The concentrations of these inorganics are all are well below the regulatory limits that would render the liquid IDW characteristically hazardous. However, the following contaminants were detected at concentrations which exceed groundwater or drinking water standards for the protection of public health.

INORGANIC DETECTIONS

Contaminant	Actual (ug/L)	MCL (ug/L)	N.C. REGS (ug/L)
Aluminum	34,600	50	NSA
Antimony	24.8	6	NSA
Beryllium	5.6	4	NSA
Chromium	138	100	50
Iron	36,000	300	300
Lead	22.8	15	15
Manganese	305	50	50

NSA = No Standard Available

The levels of TSS and TDS were 11,000 mg/L and 1,400 mg/L, respectively. Based on discussions with OHM Remediation Services Inc., these levels of TSS and TDS will not foul treatment equipment at the Lot 203 Groundwater Treatment Facility. In addition, this sample is not characteristically hazardous due to reactivity, ignitability, or corrosivity.

Solid IDW

Sample 35-IDWS2-04 did not have any detections of organic or inorganic contaminants and was not found to be characteristically hazardous due to reactivity, ignitability, or corrosivity.

Conclusions and Recommendations

Liquid IDW

The analytical results indicate that the liquid IDW is not a hazardous waste, but does contain levels of metals above groundwater standards. Consequently, disposing liquid IDW directly to the ground would, in effect, contaminate previously uncontaminated soils. Therefore, it is recommended that the liquid IDW be treated at a base groundwater treatment facility. Upon LANTDIV's approval of these disposal recommendations, Baker will arrange for transport of liquid IDW to the Lot 203 Groundwater Treatment Facility. Baker will coordinate these disposal activities with base personnel.

Solid IDW

The analytical results indicate the solid IDW is not a hazardous waste and displays no evidence of contamination. At other remedial investigation sites at MCB Camp Lejeune, where solid IDW has been determined to be nonhazardous and inert, the contents of roll-off boxes have been dumped onto the ground and graded-off. However, this IDW is on Onslow County property and on-site disposal of the solid IDW is not recommended by Baker for the following reasons:

- Drilling mud is not aesthetically pleasing when dumped on the ground. Dumping at this site cannot be done in a secluded location due to site conditions. Such an eyesore could generate complaints from nearby City residents, and County employees that work at the Onslow County Animal Control Facility, or the nearby Onslow County Administrative Offices.

- The disposal site would be adjacent to the access road that leads to the sewer easement adjacent to Brinson Creek. This area may be subject to an enforcement action according to the Army Corp of Engineers (COE). Disposing waste adjacent to an area under an enforcement action could generate complaints from public officials that are responsible for addressing COE concerns.

- Onslow County granted permission to access the sewer easement and install wells. Specific permission to dispose IDW on County property was never granted. Approval to dispose the waste on-site would be required approval from the Onslow County Board of Commissioners. This process could take months and substantial rental costs for the roll-off box would be incurred.

As an alternative to on-site disposal, Baker is proposing that the roll-off box be transported to Camp Geiger (Site 35) and the contents deposited on the ground at the location where solid IDW from previous SGI field activities was deposited. After this material has dried it can be graded-off.

Baker has proposed a letter of concurrence that presents this alternative to Mr. Neal Paul, Director of the Environmental Management Department (EMD) at MCB Camp Lejeune. Upon receiving concurrence from the EMD, Baker will coordinate disposal activities with the necessary base personnel and implement the previously mentioned alternative.

Baker

Ms. Katherine Landman
August 29, 1996
Page 4

Baker appreciates the opportunity to serve LANTDIV on this project. If you have any questions, please do not hesitate to contact me at (412) 269-2063 or Mr. Matt Bartman at (412) 269-2053.

Sincerely,

BAKER ENVIRONMENTAL, INC.

MD. Smith for DL Bonk

Daniel L. Bonk, P.E.
Project Manager

DLB/MDS/lq

Attachments

cc: Mr. Neal Paul, MCB, Camp Lejeune (w/attachments)
Mr. John Riggs, MCB, Camp Lejeune (w/attachments)

Attachment A

Weston Environmental Metrics, Inc. (Gulf Coast)
VOLATILES BY GC/MS, HSL LIST

Report Date: 08/19/96 19:28

RFW Batch Number: 9608G675 Client: Baker-Lejeune #232 Work Order: 0000-00-0 Page: 1a

	Cust ID:	35-IDWL2-04		VBLKGD		VBLKGD BS	
Sample Information	RFW#:	001		96GVE269-MB1		96GVE269-MB1	
	Matrix:	WATER		WATER		WATER	
	D.F.:	1		1		1	
	Units:	ug/L		ug/L		ug/L	
	1,2-Dichloroethane-d4	99	%	106	%	109	%
Surrogate	Toluene-d8	91	%	98	%	99	%
Recovery	4-Bromofluorobenzene	96	%	102	%	105	%
Chloromethane		10	U	10	U	10	U
Bromomethane		10	U	10	U	10	U
Vinyl chloride		10	U	10	U	10	U
Chloroethane		10	U	10	U	10	U
Methylene Chloride		10	U	10	U	10	U
Acetone		10	U	10	U	10	U
Carbon Disulfide		10	U	10	U	10	U
1,1-Dichloroethene		10	U	10	U	118	%
1,1-Dichloroethane		10	U	10	U	10	U
1,2-Dichloroethene (total)		10	U	10	U	10	U
Chloroform		10	U	10	U	10	U
1,2-Dichloroethane		10	U	10	U	10	U
2-Butanone		10	U	10	U	10	U
1,1,1-Trichloroethane		10	U	10	U	10	U
Carbon Tetrachloride		10	U	10	U	10	U
Bromodichloromethane		10	U	10	U	10	U
1,2-Dichloropropane		10	U	10	U	10	U
cis-1,3-Dichloropropene		10	U	10	U	10	U
Trichloroethene		10	U	10	U	98	%
Dibromochloromethane		10	U	10	U	10	U
1,1,2-Trichloroethane		10	U	10	U	10	U
Benzene		10	U	10	U	108	%
trans-1,3-Dichloropropene		10	U	10	U	10	U
Bromoform		10	U	10	U	10	U
4-Methyl-2-pentanone		10	U	10	U	10	U
2-Hexanone		10	U	10	U	10	U
Tetrachloroethene		10	U	10	U	10	U
1,1,2,2-Tetrachloroethane		10	U	10	U	10	U
Toluene		10	U	10	U	97	%

*= Outside of EPA CLP QC limits.

Cust ID:	35-IDWL2-04		VBLKGD		VBLKGD BS	
RFW#:	001		96GVE269-MB1		96GVE269-MB1	
Chlorobenzene	10	U	10	U	104	%
Ethylbenzene	10	U	10	U	10	U
Styrene	10	U	10	U	10	U
Xylene (total)	10	U	10	U	10	U

*= Outside of EPA CLP QC limits.

Weston Environmental Metrics, Inc. (Gulf Coast)
SEMIVOLATILES BY GC/MS, HSL LIST

Report Date: 08/15/96 12:40

RFW Batch Number: 9608G675 Client: Baker-Lejeune #232 Work Order: 0000-00-0 Page: 1a

	Cust ID:	35-IDWL2-04		35-IDWL2-04		35-IDWL2-04		SBLKOV		SBLKOV BS		SBLKOV BSD	
Sample Information	RFW#:	001		001 MS		001 MSD		96GB0397-MB1		96GB0397-MB1		96GB0397-MB1	
	Matrix:	WATER		WATER		WATER		WATER		WATER		WATER	
	D.F.:	1		1		1		1		1		1	
	Units:	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L	
Surrogate Recovery	Nitrobenzene-d5	42	%	61	%	44	%	53	%	63	%	72	%
	2-Fluorobiphenyl	45	%	58	%	49	%	56	%	63	%	64	%
	p-Terphenyl-d14	29 *	%	40	%	37	%	54	%	46	%	52	%
	Phenol-d5	38	%	57	%	38	%	45	%	53	%	63	%
	2-Fluorophenol	41	%	58	%	40	%	49	%	52	%	66	%
	2,4,6-Tribromophenol	54	%	69	%	61	%	53	%	68	%	72	%
	2-Chlorophenol-d4	41	%	57	%	40	%	51	%	56	%	66	%
	1,2-Dichlorobenzene-d4	40	%	54	%	39	%	51	%	53	%	63	%
Phenol		10	U	62	%	41	%	10	U	55	%	64	%
bis(2-Chloroethyl)ether		10	U	20	U	20	U	10	U	10	U	10	U
2-Chlorophenol		10	U	55	%	40	%	10	U	52	%	65	%
1,3-Dichlorobenzene		10	U	20	U	20	U	10	U	10	U	10	U
1,4-Dichlorobenzene		10	U	52	%	37	%	10	U	50	%	62	%
1,2-Dichlorobenzene		10	U	20	U	20	U	10	U	10	U	10	U
2-Methylphenol		10	U	20	U	20	U	10	U	10	U	10	U
2,2'-oxybis(1-Chloropropane)		10	U	20	U	20	U	10	U	10	U	10	U
4-Methylphenol		10	U	20	U	20	U	10	U	10	U	10	U
N-Nitroso-di-n-propylamine		10	U	66	%	42	%	10	U	67	%	73	%
Hexachloroethane		10	U	20	U	20	U	10	U	10	U	10	U
Nitrobenzene		10	U	20	U	20	U	10	U	10	U	10	U
Isophorone		10	U	20	U	20	U	10	U	10	U	10	U
2-Nitrophenol		10	U	20	U	20	U	10	U	10	U	10	U
2,4-Dimethylphenol		10	U	20	U	20	U	10	U	10	U	10	U
bis(2-Chloroethoxy)methane		10	U	20	U	20	U	10	U	10	U	10	U
2,4-Dichlorophenol		10	U	20	U	20	U	10	U	10	U	10	U
1,2,4-Trichlorobenzene		10	U	59	%	45	%	10	U	60	%	73	%
Naphthalene		10	U	20	U	20	U	10	U	10	U	10	U
4-Chloroaniline		10	U	20	U	20	U	10	U	10	U	10	U
Hexachlorobutadiene		10	U	20	U	20	U	10	U	10	U	10	U
4-Chloro-3-methylphenol		10	U	68	%	51	%	10	U	62	%	70	%
2-Methylnaphthalene		10	U	20	U	20	U	10	U	10	U	10	U
Hexachlorocyclopentadiene		10	U	20	U	20	U	10	U	10	U	10	U

*= Outside of EPA CLP QC limits.

RFW Batch Number: 9608G675 Client: Baker-Lejeune #232 Work Order: 0000-00-0 Page: 1b

Cust ID:	35-IDWL2-04		35-IDWL2-04		35-IDWL2-04		SBLKOV		SBLKOV BS		SBLKOV BSD	
RFW#:	001		001 MS		001 MSD		96GB0397-MB1		96GB0397-MB1		96GB0397-MB1	
2,4,6-Trichlorophenol	10	U	20	U	20	U	10	U	10	U	10	U
2,4,5-Trichlorophenol	25	U	50	U	50	U	25	U	25	U	25	U
2-Chloronaphthalene	10	U	20	U	20	U	10	U	10	U	10	U
2-Nitroaniline	25	U	50	U	50	U	25	U	25	U	25	U
Dimethylphthalate	10	U	20	U	20	U	10	U	10	U	10	U
Acenaphthylene	10	U	20	U	20	U	10	U	10	U	10	U
2,6-Dinitrotoluene	10	U	20	U	20	U	10	U	10	U	10	U
3-Nitroaniline	25	U	50	U	50	U	25	U	25	U	25	U
Acenaphthene	10	U	62	%	51	%	10	U	66	%	69	%
2,4-Dinitrophenol	25	U	50	U	50	U	25	U	25	U	25	U
4-Nitrophenol	25	U	70	%	52	%	25	U	58	%	64	%
Dibenzofuran	10	U	20	U	20	U	10	U	10	U	10	U
2,4-Dinitrotoluene	10	U	66	%	53	%	10	U	64	%	68	%
Diethylphthalate	10	U	20	U	20	U	10	U	10	U	10	U
4-Chlorophenyl-phenylether	10	U	20	U	20	U	10	U	10	U	10	U
Fluorene	10	U	20	U	20	U	10	U	10	U	10	U
4-Nitroaniline	25	U	50	U	50	U	25	U	25	U	25	U
4,6-Dinitro-2-methylphenol	25	U	50	U	50	U	25	U	25	U	25	U
N-Nitrosodiphenylamine (1)	10	U	20	U	20	U	10	U	10	U	10	U
4-Bromophenyl-phenylether	10	U	20	U	20	U	10	U	10	U	10	U
Hexachlorobenzene	10	U	20	U	20	U	10	U	10	U	10	U
Pentachlorophenol	25	U	71	%	68	%	25	U	73	%	79	%
Phenanthrene	10	U	20	U	20	U	10	U	10	U	10	U
Anthracene	10	U	20	U	20	U	10	U	10	U	10	U
Carbazole	10	U	20	U	20	U	10	U	10	U	10	U
Di-n-butylphthalate	10	U	20	U	20	U	10	U	10	U	10	U
Fluoranthene	10	U	20	U	20	U	10	U	10	U	10	U
Pyrene	10	U	75	%	79	%	10	U	74	%	85	%
Butylbenzylphthalate	10	U	20	U	20	U	10	U	10	J	10	U
3,3'-Dichlorobenzidine	10	U	20	U	20	U	10	U	10	U	10	U
Benzo(a)anthracene	10	U	20	U	20	U	10	U	10	U	10	U
Chrysene	10	U	20	U	20	U	10	U	10	U	10	U
bis(2-Ethylhexyl)phthalate	*62		3	J	20	U	10	U	10	U	22	
Di-n-octylphthalate	10	U	20	U	20	U	10	U	10	U	10	U
Benzo(b)fluoranthene	10	U	20	U	20	U	10	U	10	U	10	U
Benzo(k)fluoranthene	10	U	20	U	20	U	10	U	10	U	10	U
Benzo(a)pyrene	10	U	20	U	20	U	10	U	10	U	10	U
Indeno(1,2,3-cd)pyrene	10	U	20	U	20	U	10	U	10	U	10	U
Dibenzo(a,h)anthracene	10	U	20	U	20	U	10	U	10	U	10	U
Benzo(g,h,i)perylene	10	U	20	U	20	U	10	U	10	U	10	U

(1) - [illegible] be separated from Diphenylamine. *= Outside [illegible] CLP QC limits.

Weston Environmental Metrics, Inc. (Gulf Coast)
PESTICIDE/PCBs BY GC, CLP LIST
Report Date: 08/26/96 11:00

RFW Batch Number: 9608G675 Client: Baker-Lejeune #232 Work Order: 00000-000-000-0000-00-000 Page: 1

Sample Information						
Cust ID:	35-IDWL2-04	35-IDWL2-04	35-IDWL2-04	35-IDWL2-04	35-IDWL2-04	35-IDWL2-04
RFW#:	001	001	001 MS	001 MS	001 MSD	001 MSD
Matrix:	WATER	WATER	WATER	WATER	WATER	WATER
D.F.:	1.00	1.00	1.00	1.00	1.00	1.00
Units:	ug/L	ug/L Col 2	ug/L	ug/L Col 2	ug/L	ug/L Col 2
Surrogate: Tetrachloro-m-xylene	75 %	70 %	75 %	65 %	75 %	80 %
Surrogate: Decachlorobiphenyl	20 * %	20 * %	25 * %	25 * %	20 * %	20 * %
	fl	fl	fl	fl	fl	fl
alpha-BHC	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U	0.10 U
beta-BHC	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U	0.10 U
delta-BHC	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U	0.10 U
gamma-BHC (Lindane)	0.050 U	0.050 U	96 %	74 %	98 %	90 %
Heptachlor	0.050 U	0.050 U	86 %	72 %	84 %	84 %
Aldrin	0.050 U	0.050 U	80 %	70 %	78 %	86 %
Heptachlor epoxide	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U	0.10 U
Endosulfan I	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U	0.10 U
Dieldrin	0.10 U	0.10 U	102 %	79 %	104 %	99 %
4,4'-DDE	0.10 U	0.10 U	0.20 U	0.20 U	0.20 U	0.20 U
Endrin	0.10 U	0.10 U	115 %	101 %	118 %	127 * %
Endosulfan II	0.10 U	0.10 U	0.20 U	0.20 U	0.20 U	0.20 U
4,4'-DDD	0.10 U	0.10 U	0.20 U	0.20 U	0.20 U	0.20 U
Endosulfan sulfate	0.10 U	0.10 U	0.20 U	0.20 U	0.20 U	0.20 U
4,4'-DDT	0.10 U	0.10 U	73 %	65 %	64 %	67 %
Methoxychlor	0.50 U	0.50 U	1.0 U	1.0 U	1.0 U	1.0 U
Endrin ketone	0.10 U	0.10 U	0.20 U	0.20 U	0.20 U	0.20 U
Endrin aldehyde	0.10 U	0.10 U	0.20 U	0.20 U	0.20 U	0.20 U
alpha-Chlordane	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U	0.10 U
gamma-Chlordane	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U	0.10 U
Toxaphene	5.0 U	5.0 U	10 U	10 U	10 U	10 U
Aroclor-1016	1.0 U	1.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Aroclor-1221	2.0 U	2.0 U	4.0 U	4.0 U	4.0 U	4.0 U
Aroclor-1232	1.0 U	1.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Aroclor-1242	1.0 U	1.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Aroclor-1248	1.0 U	1.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Aroclor-1254	1.0 U	1.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Aroclor-1260	1.0 U	1.0 U	2.0 U	2.0 U	2.0 U	2.0 U

U= Analyzed, not detected. J= Present below detection limit. B= Present in blank. NR= Not requested. NS= Not spiked.
%= Percent recovery. D= Diluted out. I= Interference. NA= Not Applicable. *= Outside of Advisory limits.

Weston Environmental Metrics, Inc. (Gulf Coast)
PESTICIDE/PCBs BY GC, CLP LIST
Report Date: 08/26/96 11:00

RFW Batch Number: 9608G675 Client: Baker-Lejeune #232 Work Order: 00000-000-000-0000-00-000 Page: 2

	Cust ID:	PBLKDK		PBLKDK		PBLKDK BS		PBLKDK BS		PBLKDK BSD		PBLKDK BSD	
Sample Information	RFW#:	96GP0867-MB1		96GP0867-MB1		96GP0867-MB1		96GP0867-MB1		96GP0867-MB1		96GP0867-MB1	
	Matrix:	WATER		WATER		WATER		WATER		WATER		WATER	
	D.F.:	1.00		1.00		1.00		1.00		1.00		1.00	
	Units:	ug/L		ug/L Col 2		ug/L		ug/L Col 2		ug/L		ug/L Col 2	
Surrogate:	Tetrachloro-m-xylene	90	%	85	%	85	%	95	%	80	%	70	%
Surrogate:	Decachlorobiphenyl	80	%	80	%	70	%	80	%	85	%	75	%
			fl		fl		fl		fl		fl		fl
alpha-BHC		0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U
beta-BHC		0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U
delta-BHC		0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U
gamma-BHC (Lindane)		0.050	U	0.050	U	106	%	98	%	104	%	76	%
Heptachlor		0.050	U	0.050	U	96	%	100	%	94	%	80	%
Aldrin		0.050	U	0.050	U	106	%	114	%	104	%	90	%
Heptachlor epoxide		0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U
Endosulfan I		0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U
Dieldrin		0.10	U	0.10	U	114	%	107	%	111	%	85	%
4,4'-DDE		0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U
Endrin		0.10	U	0.10	U	125 *	%	133 *	%	122 *	%	106	%
Endosulfan II		0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U
4,4'-DDD		0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U
Endosulfan sulfate		0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U
4,4'-DDT		0.10	U	0.10	U	114	%	123	%	111	%	98	%
Methoxychlor		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U
Endrin ketone		0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U
Endrin aldehyde		0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U
alpha-Chlordane		0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U
gamma-Chlordane		0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U
Toxaphene		5.0	U	5.0	U	5.0	U	5.0	U	5.0	U	5.0	U
Aroclor-1016		1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U
Aroclor-1221		2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U
Aroclor-1232		1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U
Aroclor-1242		1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U
Aroclor-1248		1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U
Aroclor-1254		1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U
Aroclor-1260		1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U

U= Analyzed, not detected. J= Present below detection limit. B= Present in blank. NR= Not requested. NS= Not spiked.
%= Perc recovery. D= Diluted out. I= Interference. NA= Not Applicable. *= Outside of Advisory limits.

ROY F. WESTON INC.

INORGANICS DATA SUMMARY REPORT 08/23/96

CLIENT: Baker-Lejeune #232 WESTON BATCH #: 9608G675
WORK ORDER: 00000-000-000-0000-00-000

SAMPLE	SITE ID	ANALYTE	RESULT		UNITS	REPORTING LIMIT
-001	35-IDWL2-04	Silver, Total	3.1	u	UG/L	3.1
		Aluminum, Total	34600		UG/L	21.9
		Arsenic, Total	15.8		UG/L	1.4
		Barium, Total	384		UG/L	1.4
		Beryllium, Total	5.6		UG/L	0.70
		Calcium, Total	743000		UG/L	19.0
		Cadmium, Total	2.6	u	UG/L	2.6
		Cobalt, Total	10.2		UG/L	3.6
		Chromium, Total	138		UG/L	3.3
		Copper, Total	46.1		UG/L	2.0
		Iron, Total	36000		UG/L	4.5
		Mercury, Total	0.10	u	UG/L	0.10
		Potassium, Total	19000		UG/L	690
		Magnesium, Total	13000		UG/L	20.8
		Manganese, Total	305		UG/L	1.6
		Sodium, Total	111000		UG/L	69.3
		Nickel, Total	31.5		UG/L	8.7
		Lead, Total	22.8		UG/L	1.2
		Antimony, Total	24.8		UG/L	14.4
		Selenium, Total	9.0	u	UG/L	9.0
		Thallium, Total	1.5	u	UG/L	1.5
		Vanadium, Total	83.8		UG/L	2.5
		Zinc, Total	312		UG/L	2.3
-003	35-IDWS2-04	Silver, TCLP	50.0	u	UG/L	50.0
		Arsenic, TCLP	100	u	UG/L	100
		Barium, TCLP	500	u	UG/L	500
		Cadmium, TCLP	50.0	u	UG/L	50.0
		Chromium, TCLP	50.0	u	UG/L	50.0
		Mercury, TCLP	10.0	u	UG/L	10.0
		Lead, TCLP	50.0	u	UG/L	50.0
		Selenium, TCLP	100	u	UG/L	100

WESTON

ROY F. WESTON INC.

INORGANICS DATA SUMMARY REPORT 08/19/96

CLIENT: Baker-Lejeune #232 WESTON BATCH #: 9608G675
WORK ORDER: 00000-000-000-0000-00-000

SAMPLE	SITE ID	ANALYTE	RESULT		UNITS	REPORTING LIMIT
001	35-IDWL2-04	Cyanide, Reactive	0.050	u	MG/L	0.050
		Corrosivity by pH	12.5		pH	0.20
		Flash Point, Closed Cup	158.81		DEG F	0.00
		Sulfide Reactive	1.0	u	MG/L	1.0
		Total Dissolved Solids	1400		MG/L	10
		Total Suspended Solids	11000		MG/L	5
-002	35-IDWS2-04	% Solids	77.1		%	0.10
		Cyanide, Reactive	0.31	u	MG/KG	0.31
		Corrosivity by pH	10.7		pH	0.20
		Flash Point, Closed Cup	>200		DEG F	0.00
		Sulfide Reactive	30.3	u	MG/KG	30.3

Note: Baker resampled both polyethylene tanks for pH with field monitoring equipment. Measured values were 11.6 and 10.2.

Weston Environmental Metrics, Inc. (Gulf Coast)
VOLATILES BY GC/MS, TCLP LEACHATE
Report Date: 08/19/96 20:15
RFW Batch Number: 9608G675 Client: Baker-Lejeune #232 Work Order: 00000-000-000-0 Page: 1a

	Cust ID:	35-IDWS2-04		35-IDWS2-04		VBLKIE		VBLKGH		VBLKGH BS	
Sample Information	RFW#:	004		004 MS		96GVE272-914		96GVE272-MB1		96GVE272-MB1	
	Matrix:	WATER		WATER		WATER		WATER		WATER	
	D.F.:	20		20		20		1		1	
	Units:	ug/L		ug/L		ug/L		ug/L		ug/L	
	1,2-Dichloroethane-d4	101	%	103	%	99	%	100	%	105	%
Surrogate	Toluene-d8	96	%	95	%	98	%	98	%	100	%
Recovery	4-Bromofluorobenzene	98	%	100	%	101	%	96	%	101	%
			fl		fl		fl		fl		fl
Vinyl chloride		200	U	64	%	200	U	10	U	70	%
1,1-Dichloroethene		100	U	103	%	100	U	5	U	113	%
2-Butanone		200	U	88	%	200	U	10	U	98	%
Chloroform		100	U	90	%	100	U	5	U	91	%
Carbon Tetrachloride		100	U	92	%	100	U	5	U	95	%
Benzene		100	U	92	%	100	U	5	U	93	%
1,2-Dichloroethane		100	U	94	%	100	U	5	U	96	%
Trichloroethene		100	U	82	%	100	U	5	U	86	%
Tetrachloroethene		100	U	84	%	100	U	5	U	92	%
Chlorobenzene		100	U	86	%	100	U	5	U	88	%

*= Outside of EPA CLP QC limits.

Weston Environmental Metrics, Inc. (Gulf Coast)
SEMIVOLATILES BY GC/MS, TCLP LEACHATE
Report Date: 08/16/96 09:32
RFW Batch Number: 9608G675 Client: Baker-Lejeune #232 Work Order: 00000-000-000-0 Page: 1a

	Cust ID:	35-IDWS2-04		35-IDWS2-04		SBLKPC		SBLKPC BS		SBLKPD		SBLKPE	
Sample Information	RFW#:	003		003 MS		96GB0404-MB1		96GB0404-MB1		96GB0404-TC1		96GB0404-TC2	
	Matrix:	WATER		WATER		WATER		WATER		WATER		WATER	
	D.F.:	1		1		1		1		1		1	
	Units:	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L	
Surrogate Recovery	2-Fluorophenol	84	%	78	%	74	%	80	%	59	%	87	%
	Phenol-d5	77	%	75	%	66	%	73	%	56	%	78	%
	Nitrobenzene-d5	84	%	88	%	80	%	86	%	64	%	88	%
	2-Fluorobiphenyl	94	%	102	%	92	%	96	%	66	%	94	%
	2,4,6-Tribromophenol	119	%	89	%	101	%	116	%	102	%	110	%
	p-Terphenyl-d14	52	%	43	%	58	%	58	%	52	%	57	%
			fl		fl		fl		fl		fl		fl
Pyridine		500	U	71	%	50	U	66	%	500	U	500	U
1,4-Dichlorobenzene		50	U	77	%	5	U	69	%	50	U	50	U
o-Cresol		60	U	77	%	6	U	73	%	60	U	60	U
meta & para-Cresol		30	U	74	%	3	U	75	%	30	U	30	U
Hexachloroethane		70	U	79	%	7	U	69	%	70	U	70	U
Nitrobenzene		40	U	89	%	4	U	83	%	40	U	40	U
Hexachlorobutadiene		80	U	88	%	8	U	84	%	80	U	80	U
2,4,6-Trichlorophenol		30	U	93	%	3	U	104	%	30	U	30	U
2,4,5-Trichlorophenol		40	U	91	%	4	U	97	%	40	U	40	U
2,4-Dinitrotoluene		20	U	97	%	2	U	116	%	20	U	20	U
Hexachlorobenzene		30	U	99	%	3	U	96	%	30	U	30	U
Pentachlorophenol		60	U	92	%	6	U	106	%	60	U	60	U

*= Outside of EPA CLP QC limits.

Weston Environmental Metrics, Inc. (Gulf Coast)
PESTICIDES BY GC, TCLP LEACHATE

Report Date: 08/21/96 14:03

RFW Batch Number: 9608G675 Client: Baker-Lejeune #232 Work Order: 00000-000-000-0 Page: 1

	Cust ID:	35-IDWS2-04		35-IDWS2-04		PBLKEB		PBLKEB BS		PBLKEC		PBLKED	
Sample Information	RFW#:	003		003 MS		96GP0887-MB1		96GP0887-MB1		96GP0887-TC1		96GP0887-TC2	
	Matrix:	WATER		WATER		WATER		WATER		WATER		WATER	
	D.F.:	10		10		10		10		10		10	
	Units:	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L	
Surrogate:	Tetrachloro-m-xylene	85	%	95	%	85	%	70	%	80	%	90	%
	Decachlorobiphenyl	70	%	75	%	55	%	40 *	%	70	%	70	%
			fl		fl		fl		fl		fl		fl
gamma-BHC (Lindane)		0.50	U	110	%	0.050	U	90	%	0.50	U	0.50	U
Heptachlor		0.60	U	90	%	0.060	U	90	%	0.60	U	0.60	U
Heptachlor epoxide		0.80	U	120	%	0.080	U	100	%	0.80	U	0.80	U
Chlordane		1.0	U	120	%	0.10	U	110	%	1.0	U	1.0	U
Endrin		3.0	U	125	%	0.30	U	120	%	3.0	U	3.0	U
Methoxychlor		7.0	U	99	%	0.70	U	110	%	7.0	U	7.0	U
Toxaphene		50	U	102	%	5.0	U	96	%	50	U	50	U

8-21-96

U= Analyzed, not detected. J= Present below detection limit. B= Present in blank. NR= Not requested. NS= Not spiked.
%= Percent recovery. D= Diluted out. I= Interference. NA= Not Applicable. *= Outside of EPA CLP QC

Weston Environmental Metrics, Inc. (Gulf Coast)
HERBICIDES BY GC, TCLP LEACHATE Report Date: 08/20/96 09:04
RFW Batch Number: 9608G675 Client: Baker-Lejeune #232 Work Order: 00000-000-000-0 Page: 1

	Cust ID:	35-IDWS2-04		35-IDWS2-04		PBLKEF		PBLKEF BS		PBLKEG		PBLKEH	
Sample Information	RFW#:	003		003 MS		96GP0892-MB1		96GP0892-MB1		96GP0892-TC1		96GP0892-TC2	
	Matrix:	WATER		WATER		WATER		WATER		WATER		WATER	
	D.F.:	10		10		10		10		10		10	
	Units:	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L	
Surrogate:	DCAA	90	%	84	%	92	%	88	%	86	%	83	%
			fl		fl		fl		fl		fl		fl
2,4-D		100	U	85	%	10	U	84	%	100	U	100	U
2,4,5-TP (Silvex)		10	U	82	%	1.0	U	83	%	10	U	10	U

U= Analyzed, not detected. J= Present below detection limit. B= Present in blank. NR= Not requested. NS= Not spiked.
%= Percent recovery. D= Diluted out. I= Interference. NA= Not Applicable. *= Outside of EPA CLP QC

WESTON

ROY F. WESTON INC.

INORGANICS DATA SUMMARY REPORT 08/23/96

CLIENT: Baker-Lejeune #232
WORK ORDER: 00000-000-000-0000-00-000

WESTON BATCH #: 9608G675

SAMPLE	SITE ID	ANALYTE	RESULT		UNITS	REPORTING LIMIT
-001	35-IDWL2-04	Silver, Total	3.1	u	UG/L	3.1
		Aluminum, Total	34600		UG/L	21.9
		Arsenic, Total	15.8		UG/L	1.4
		Barium, Total	384		UG/L	1.4
		Beryllium, Total	5.6		UG/L	0.70
		Calcium, Total	743000		UG/L	19.0
		Cadmium, Total	2.6	u	UG/L	2.6
		Cobalt, Total	10.2		UG/L	3.6
		Chromium, Total	138		UG/L	3.3
		Copper, Total	46.1		UG/L	2.0
		Iron, Total	36000		UG/L	4.5
		Mercury, Total	0.10	u	UG/L	0.10
		Potassium, Total	19000		UG/L	690
		Magnesium, Total	13000		UG/L	20.8
		Manganese, Total	305		UG/L	1.6
		Sodium, Total	111000		UG/L	69.3
		Nickel, Total	31.5		UG/L	8.7
		Lead, Total	22.8		UG/L	1.2
		Antimony, Total	24.8		UG/L	14.4
		Selenium, Total	9.0	u	UG/L	9.0
		Thallium, Total	1.5	u	UG/L	1.5
		Vanadium, Total	83.8		UG/L	2.5
		Zinc, Total	312		UG/L	2.3
-003	35-IDWS2-04	Silver, TCLP	50.0	u	UG/L	50.0
		Arsenic, TCLP	100	u	UG/L	100
		Barium, TCLP	500	u	UG/L	500
		Cadmium, TCLP	50.0	u	UG/L	50.0
		Chromium, TCLP	50.0	u	UG/L	50.0
		Mercury, TCLP	10.0	u	UG/L	10.0
		Lead, TCLP	50.0	u	UG/L	50.0
		Selenium, TCLP	100	u	UG/L	100

Weston Environmental Metrics, Inc. (Gulf Coast)
PCBs by GC

RFW Batch Number: 9608G675   Client: Baker-Lejeune #232   Report Date: 08/27/96 11:42   Work Order: 00000-000-000-0000-00-000   Page: 1

	Cust ID:	35-IDWS2-04		35-IDWS2-04		35-IDWS2-04		PBLKEJ 4		PBLKEJ BS	
Sample Information	RFW#:	002		002 MS		002 MSD		96GP0894-MB1		96GP0894-MB1	
	Matrix:	SOIL		SOIL		SOIL		SOIL		SOIL	
	D.F.:	1.00		1.00		1.00		1.00		1.00	
	Units:	ug/Kg		ug/Kg		ug/Kg		ug/Kg		ug/Kg	
Surrogate:	Tetrachloro-m-xylene	90	%	75	%	75	%	75	%	80	%
Surrogate:	Decachlorobiphenyl	85	%	80	%	85	%	85	%	90	%
Aroclor-1016		52	U	50	U	50	U	40	U	40	U
Aroclor-1221		52	U	50	U	50	U	40	U	40	U
Aroclor-1232		52	U	50	U	50	U	40	U	40	U
Aroclor-1242		52	U	50	U	50	U	40	U	40	U
Aroclor-1248		52	U	50	U	50	U	40	U	40	U
Aroclor-1254		100	U	88	%	92	%	80	U	87	%
Aroclor-1260		100	U	100	U	100	U	80	U	80	U

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%= Percent recovery. D= Diluted out. I= Interference. NA= Not Applicable. *= Outside of Advisory limits.

WESTON

ROY F. WESTON INC.

INORGANICS DATA SUMMARY REPORT 08/19/96

CLIENT: Baker-Lejeune #232
WORK ORDER: 00000-000-000-0000-00-000

WESTON BATCH #: 9608G675

SAMPLE	SITE ID	ANALYTE	RESULT		UNITS	REPORTING LIMIT
001	35-IDWL2-04	Cyanide, Reactive	0.050	u	MG/L	0.050
		Corrosivity by pH	12.5		pH	0.20
		Flash Point, Closed Cup	158.81		DEG F	0.00
		Sulfide Reactive	1.0	u	MG/L	1.0
		Total Dissolved Solids	1400		MG/L	10
		Total Suspended Solids	11000		MG/L	5
-002	35-IDWS2-04	% Solids	77.1		%	0.10
		Cyanide, Reactive	0.31	u	MG/KG	0.31
		Corrosivity by pH	10.7		pH	0.20
		Flash Point, Closed Cup	>200		DEG F	0.00
		Sulfide Reactive	30.3	u	MG/KG	30.3

Baker

Baker Environmental, Inc.
Airport Office Park, Building 3
420 Rouser Road
Coraopolis, Pennsylvania 15108

(412) 269-6000
FAX (412) 269-2002

August 29, 1996

Commanding General
ACS-EMD Building 67, Room 238
PSC Box 20004
Marine Corp Base
Camp Lejeune, NC 28542-0004

Attn: Mr. Neal Paul, Director
Environmental Management Department (EMD)

Re: Contract N62470-89-D-4814
Navy CLEAN, District III
Contract Task Order (CTO) 0232
Operable Unit No. 10 (Site 35)
MCB, Camp Lejeune, North Carolina
Solid IDW Handling and Disposal

Dear Mr Paul:

The purpose of this letter is to obtain your concurrence for the disposal of solid investigative-derived waste (IDW) generated during the Supplemental Groundwater Investigation (SGI) for Operable Unit (OU) No. 10 (Site 35), Camp Geiger Area Fuel Farm, Marine Corps Base, Camp Lejeune, North Carolina, that is presently stored on Onslow County property.

As you are aware, SGI field activities conducted on Onslow County property have recently concluded. During well construction activities, approximately 15 cubic feet of solid IDW was generated. This IDW consists of cuttings and drilling mud that are containerized in a roll-off box. This roll-off box is located next to the Onslow County Animal Control Facility on Georgetown Road in Jacksonville, North Carolina.

To assess disposal options a representative sample was collected from the roll-off box and analyzed for full Toxic Characteristic Leaching Procedure (TCLP) organics and metals, Target Compound List (TCL) PCBs, and Resource Conservation Recovery Act (RCRA) characteristics for defining a hazardous waste.

The analytical results indicate the solid IDW is not a hazardous waste and displays no evidence of contamination. At other remedial investigation sites at MCB Camp Lejeune, where solid IDW has been determined to be nonhazardous and inert, the contents of roll-off boxes have been dumped onto the ground and graded-off. However, this IDW is on Onslow County property and on-site disposal of the solid IDW is not recommended by Baker for the following reasons:

- Drilling mud is not aesthetically pleasing when dumped on the ground. Dumping at this site cannot be done in a secluded location due to site conditions. Such an eyesore could generate complaints from nearby City residents, and County employees that work at the Onslow County Animal Control Facility, or the nearby Onslow County Administrative Offices.

bcc: AERobb/CF; JWMentz/RPWattras/PRGM F; DLBonk/PJT F; MDSmith; Daily File
S.O.#62470-232-SRN
Subfile #8
Initials MDS

- The disposal site would be adjacent to the access road that leads to the sewer main easement. This area may be subject to an enforcement action according to the Army Corp of Engineers (COE). Disposing waste adjacent to an area under an enforcement action could generate complaints from public officials that are responsible for addressing COE concerns.

- Onslow County granted permission to access the sewer easement and install wells. Specific permission to dispose IDW on County property was never granted. Approval to dispose the waste on-site would be required approval from the Onslow County Board of Commissioners. This process could take months and substantial rental costs for the roll-off box would be incurred.

As an alternative, Baker is proposing that the roll-off box be transported to Camp Geiger (Site 35) and the contents deposited on the ground at the location where solid IDW from previous SGI field activities was deposited. After this material has dried it can be graded-off. Your concurrence with this recommendation can be indicated by signing in space provided below.

______________________________ __________
Neal Paul, Director EMD, MCB Lejeune Date

Baker appreciates the opportunity to serve LANTDIV on this project. If you have any questions, please do not hesitate to contact me at (412) 269-2063 or Matt Bartman at (412) 269-2053.

Sincerely,

BAKER ENVIRONMENTAL, INC.
MD Smith for DL Bonk

Daniel L. Bonk, P.E.
Project Manager

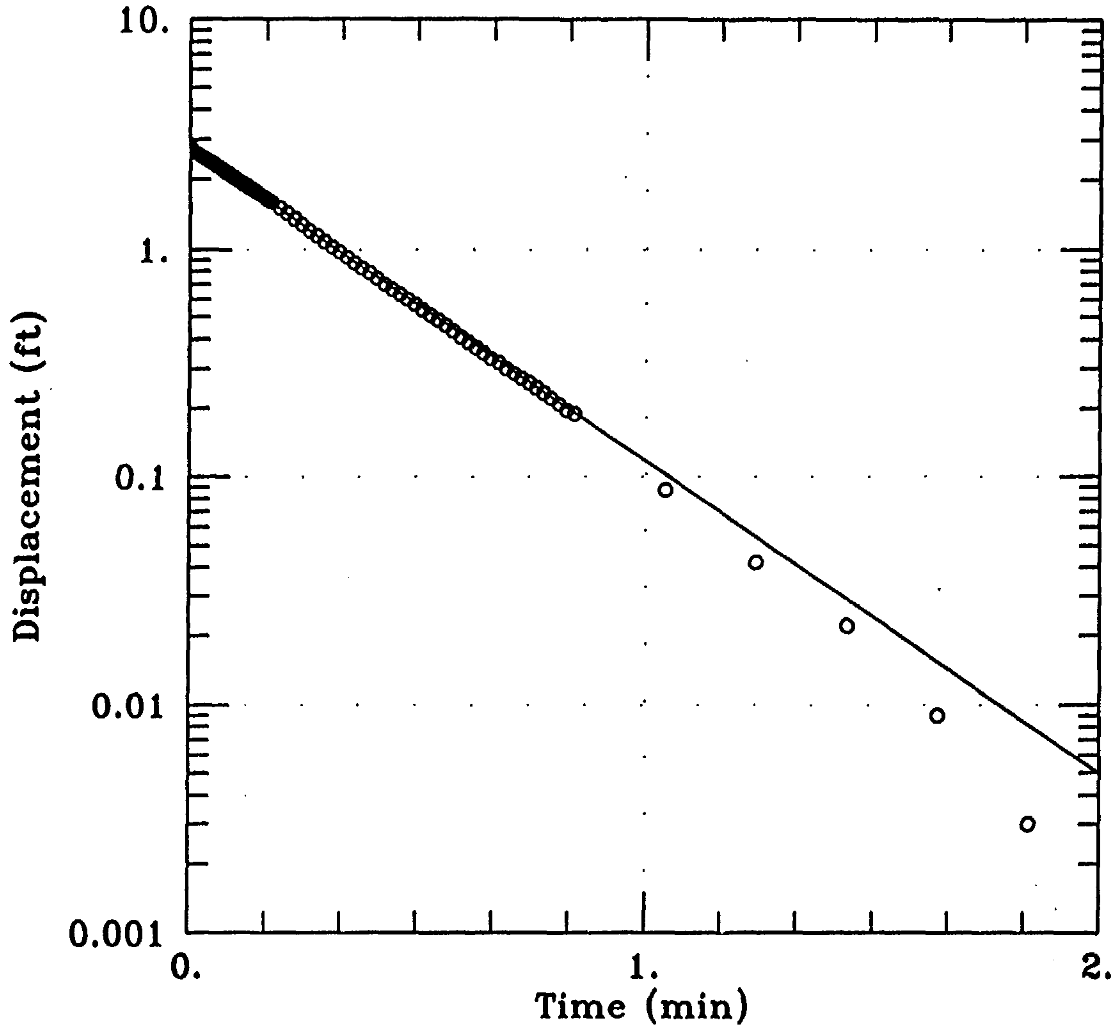
DLB/MDS/lq

cc: Ms. Katherine Landman, Code 18232, Navy Technical Representative
Mr. John Riggs, Environmental Control Specialist, MCB Camp Lejeune

APPENDIX J
SGI HYDRAULIC CONDUCTIVITY DATA

Client: LANTDIV	Company: Baker Environmental, Inc.
Location: MCB Camp Lejeune	Project: CTO-232

35MW39B FALLING HEAD TEST



DATA SET:
35MW39BF.DAT
07/15/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: May 2, 1996

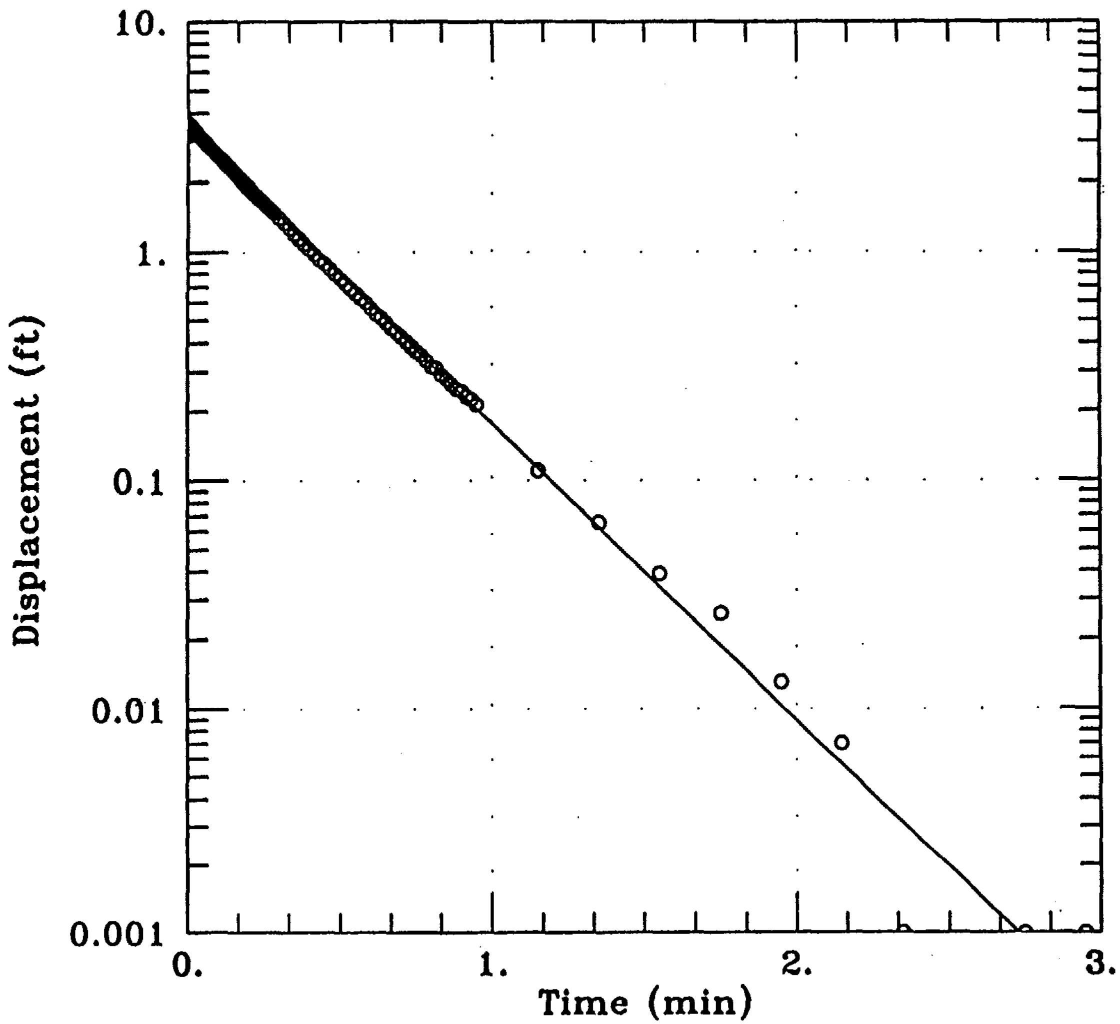
TEST DATA:
H0 = 2.727 ft
rc = 0.083 ft
rw = 0.5 ft
L = 5. ft
b = 40. ft
H = 38. ft

PARAMETER ESTIMATES:
K = 75.55 ft/day
y0 = 2.747 ft

AQTESOLV

Client: LANTDIV	Company: Baker Environmental, Inc.
Location: MCB Camp Lejeune	Project: CTO-232

35MW39B RISING HEAD TEST



DATA SET:
35MW39BR.DAT
07/15/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: May 2, 1996

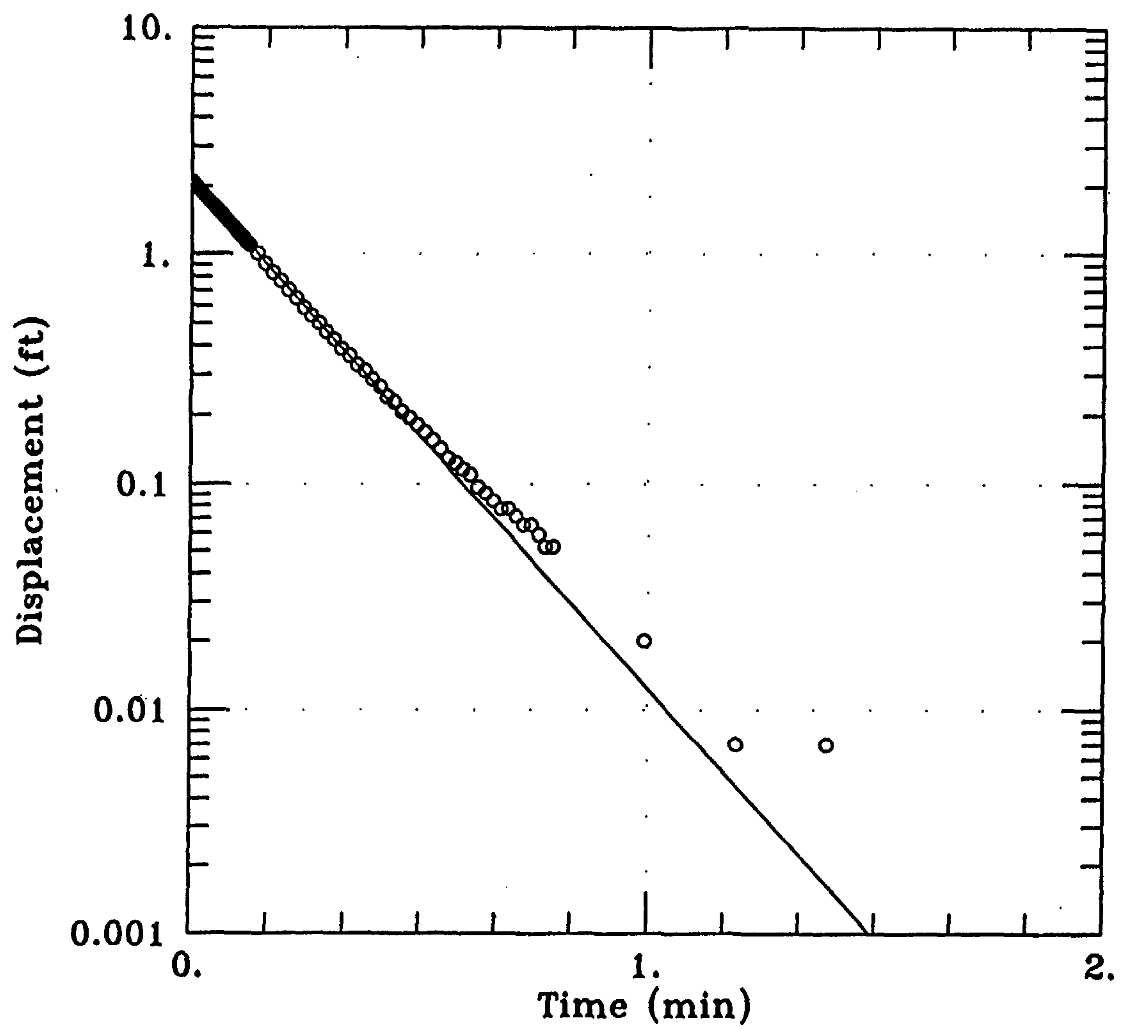
TEST DATA:
H0 = 3.589 ft
rc = 0.083 ft
rw = 0.5 ft
L = 5. ft
b = 40. ft
H = 38. ft

PARAMETER ESTIMATES:
K = 71.65 ft/day
y0 = 3.528 ft

AQTESOLV

Client: LANTDIV	Company: Baker Environmental, Inc.
Location: MCB Camp Lejeune	Project: CTO-232

35MW40B FALLING HEAD TEST



DATA SET:
35MW40BF.DAT
07/15/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: May 2, 1996

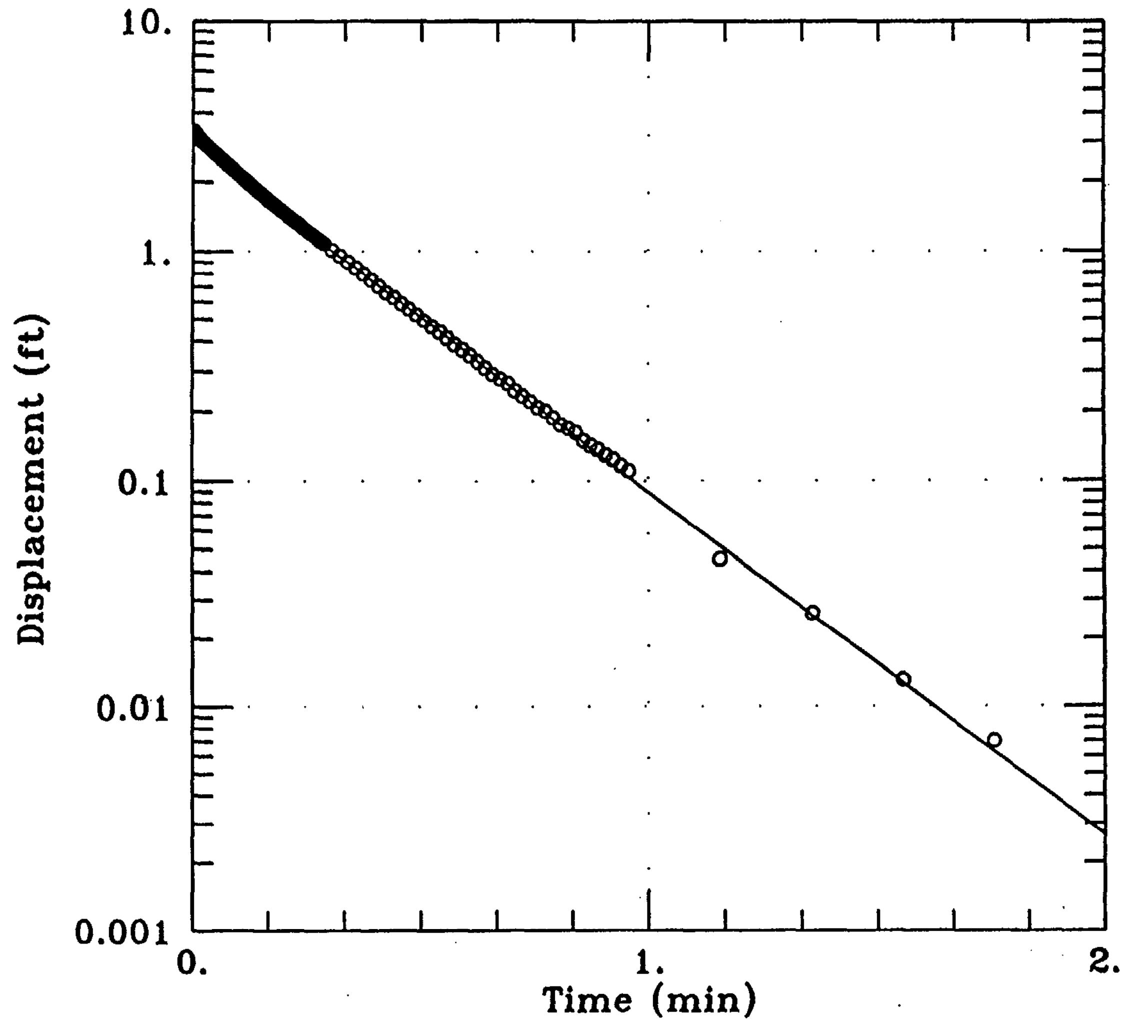
TEST DATA:
H0 = 2.069 ft
rc = 0.083 ft
rw = 0.5 ft
L = 5. ft
b = 40. ft
H = 38. ft

PARAMETER ESTIMATES:
K = 122.7 ft/day
y0 = 2.09 ft

AQTESOLV

Client: LANTDIV	Company: Baker Environmental, Inc.
Location: MCB Camp Lejeune	Project: CTO-232

35MW40B RISING HEAD TEST



DATA SET:
35MW40BR.DAT
07/15/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: May 2, 1996

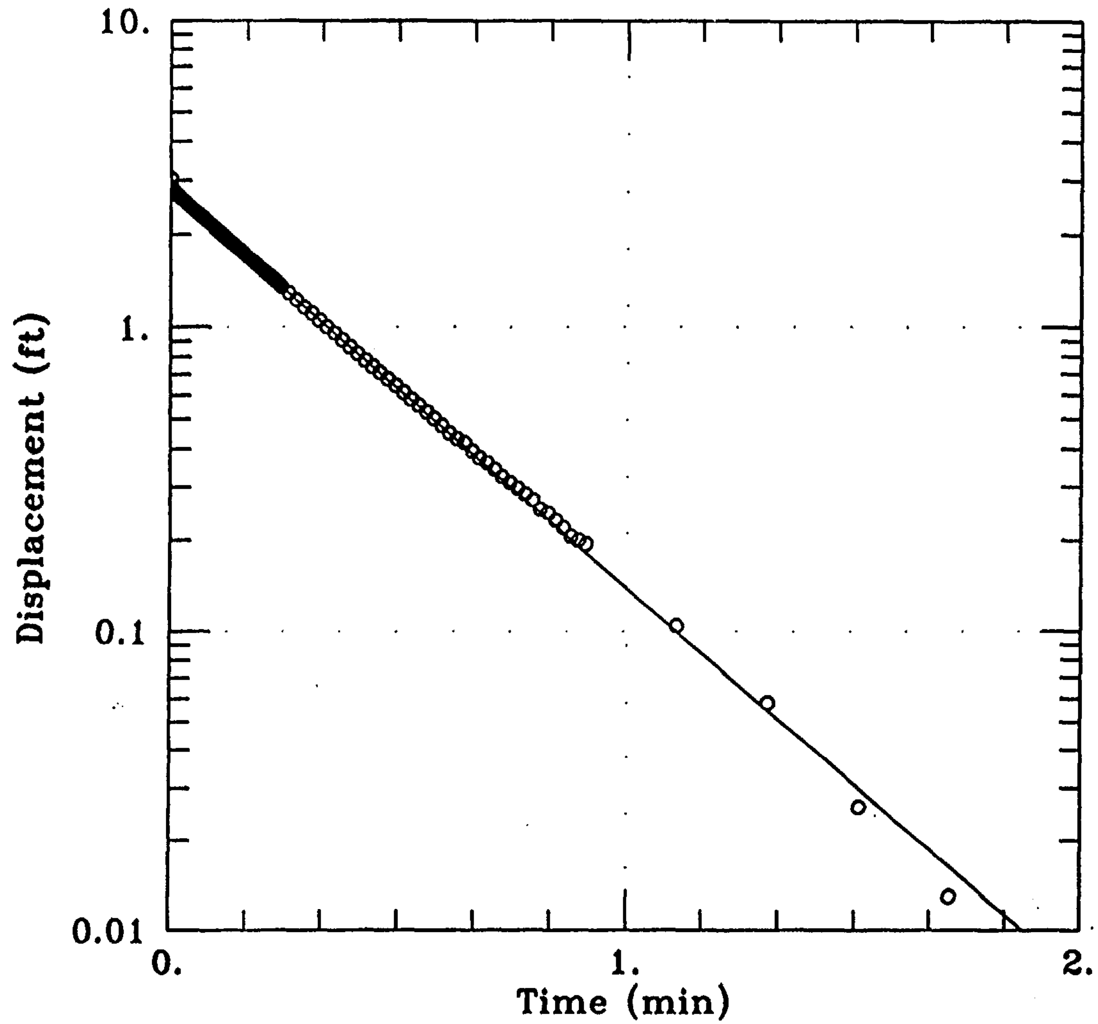
TEST DATA:
H0 = 3.343 ft
rc = 0.083 ft
rw = 0.5 ft
L = 5. ft
b = 40. ft
H = 38. ft

PARAMETER ESTIMATES:
K = 83.8 ft/day
y0 = 2.94 ft

AQTESOLV

Client: LANTDIV	Company: Baker Environmental, Inc.
Location: MCB Camp Lejeune	Project: CTO-232

35MW41B FALLING HEAD TEST



DATA SET:
35MW41BF.DAT
07/15/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: May 2, 1996

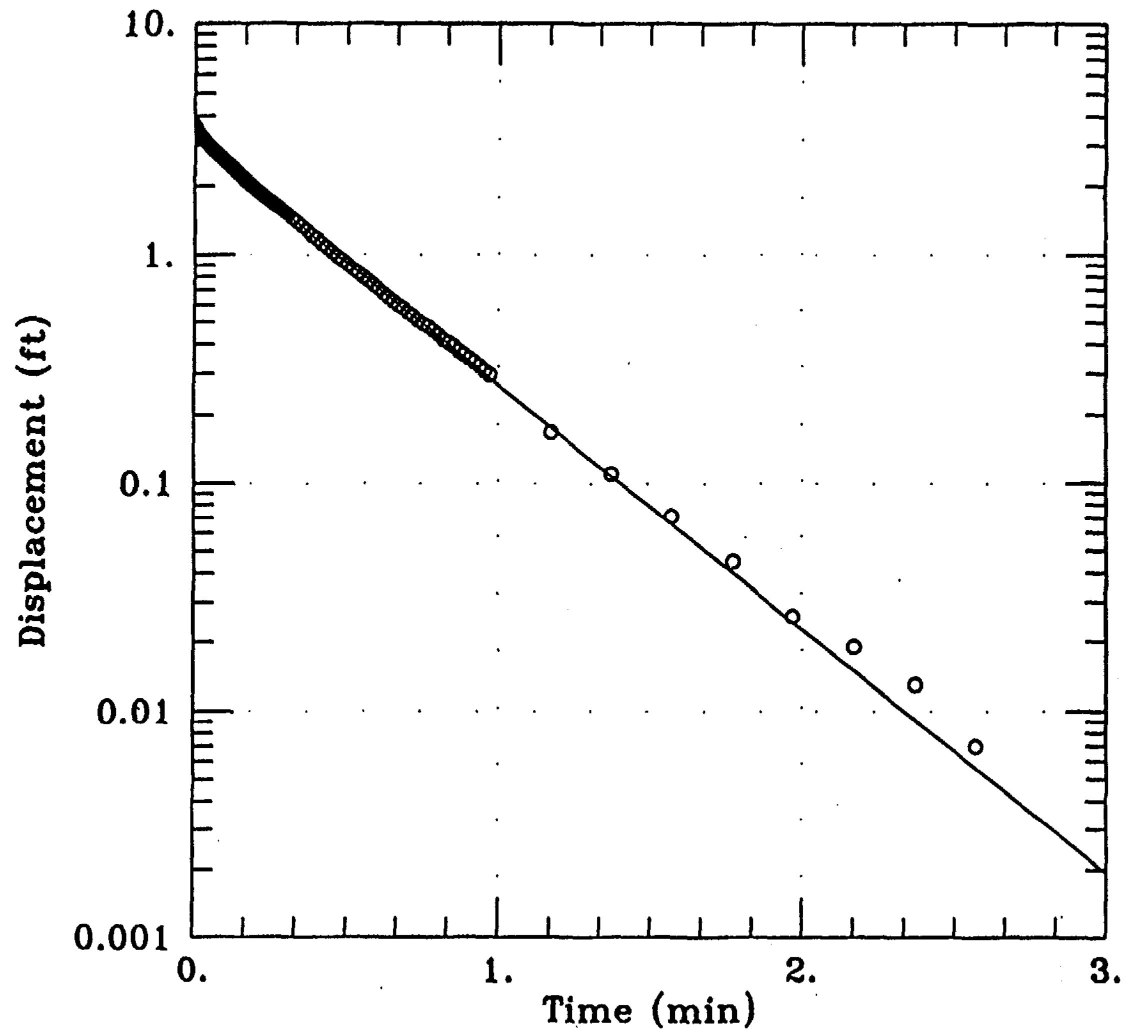
TEST DATA:
H0 = 3.023 ft
rc = 0.083 ft
rw = 0.5 ft
L = 5. ft
b = 40. ft
H = 37. ft

PARAMETER ESTIMATES:
K = 70.29 ft/day
y0 = 2.819 ft

AQTESOLV

Client: LANTDIV	Company: Baker Environmental, Inc.
Location: MCB Camp Lejeune	Project: CTO-232

35MW41B RISING HEAD TEST



DATA SET:
35MW41BR.DAT
07/15/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: May 2, 1996

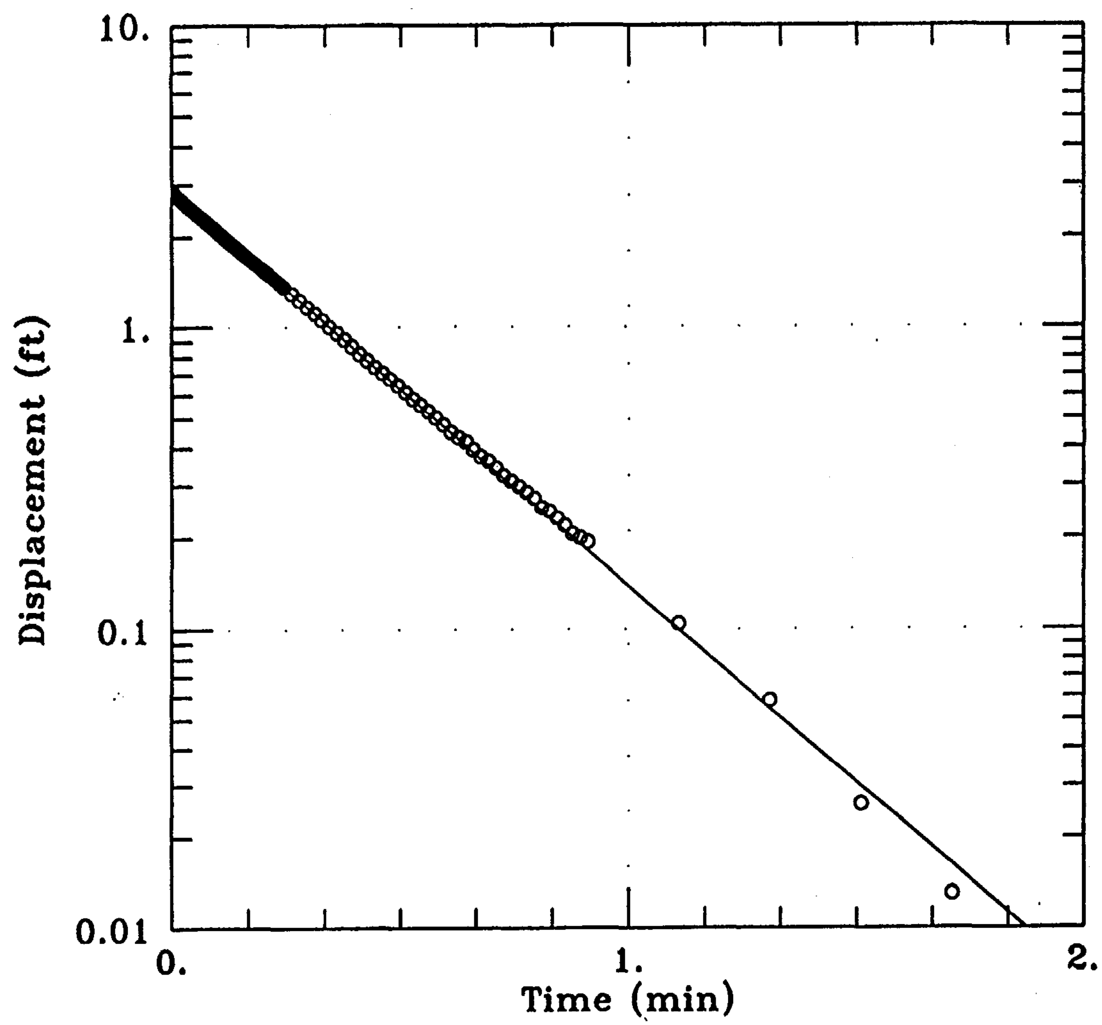
TEST DATA:
H0 = 3.646 ft
rc = 0.083 ft
rw = 0.5 ft
L = 5. ft
b = 40. ft
H = 37. ft

PARAMETER ESTIMATES:
K = 57.5 ft/day
y0 = 3.144 ft

AQTESOLV

Client: LANTDIV	Company: Baker Environmental, Inc.
Location: MCB Camp Lejeune	Project: CTO-232

35MW42B FALLING HEAD TEST



DATA SET:
35MW42BF.DAT
07/15/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: May 3, 1996

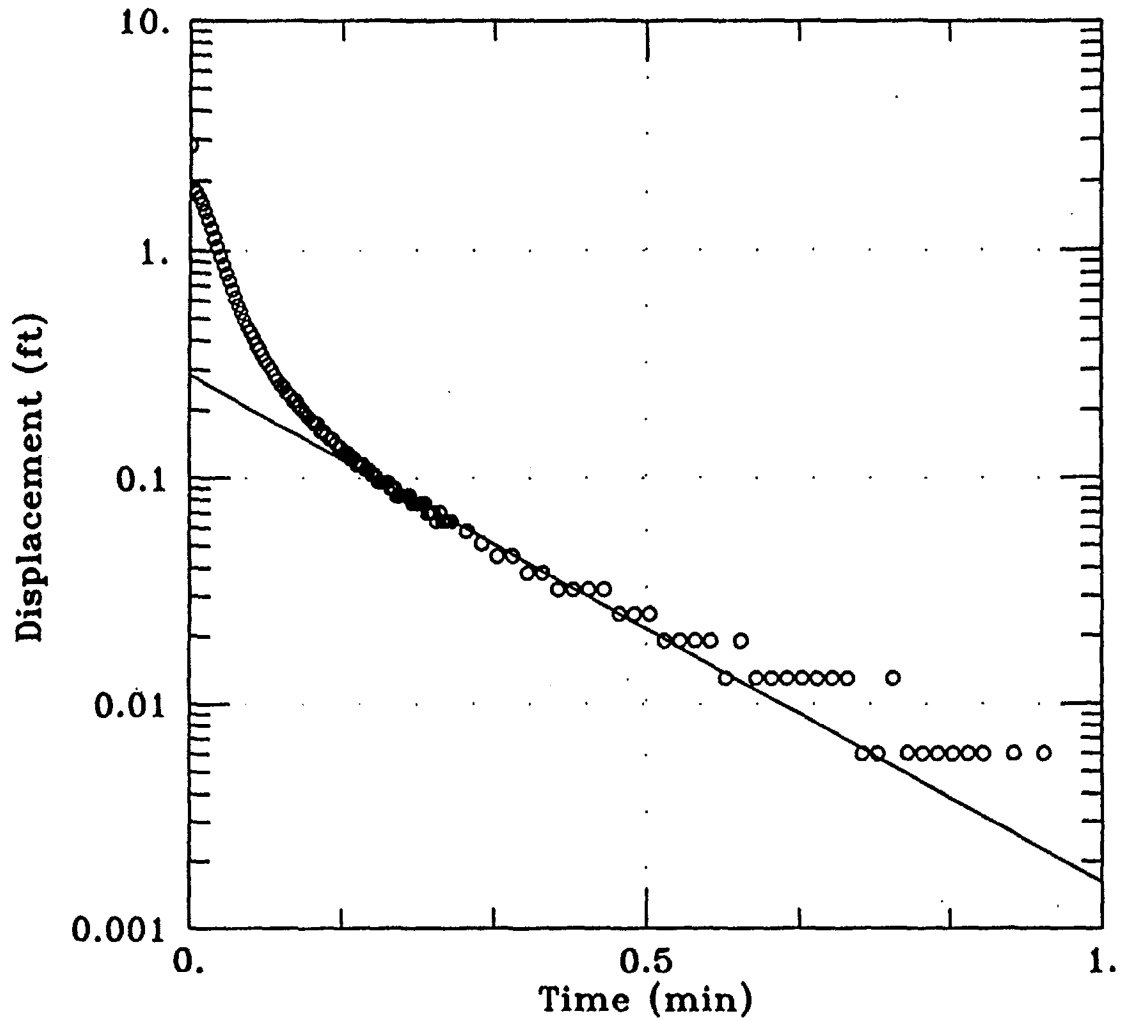
TEST DATA:
H0 = 2.836 ft
rc = 0.083 ft
rw = 0.5 ft
L = 5. ft
b = 35. ft
H = 35. ft

PARAMETER ESTIMATES:
K = 89.44 ft/day
y0 = 2.819 ft

AQTESOLV

Client: LANTDIV	Company: Baker Environmental, Inc.
Location: MCB Camp Lejeune	Project: CTO-232

35MW42B RISING HEAD TEST



DATA SET:
35MW42BR.DAT
07/15/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: May 3, 1996

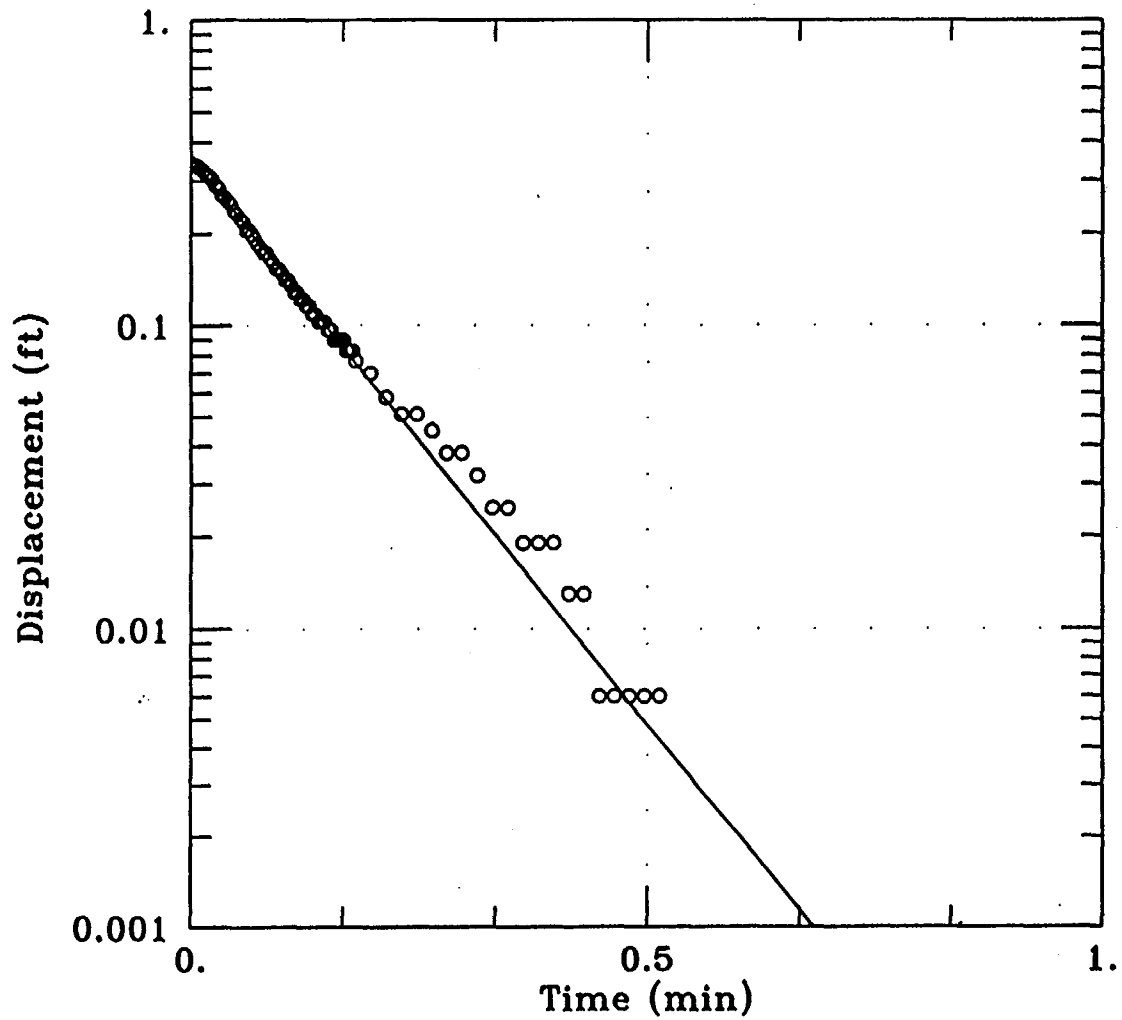
TEST DATA:
H0 = 2.836 ft
rc = 0.083 ft
rw = 0.5 ft
L = 5. ft
b = 35. ft
H = 35. ft

PARAMETER ESTIMATES:
K = 153.6 ft/day
y0 = 0.285 ft

AQTESOLV

Client: **LANTDIV**	Company: **Baker Environmental, Inc.**
Location: **MCB Camp Lejeune**	Project: **CTO-232**

35MW43B FALLING HEAD TEST



DATA SET:
35MW43BF.DAT
07/15/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: May 3, 1996

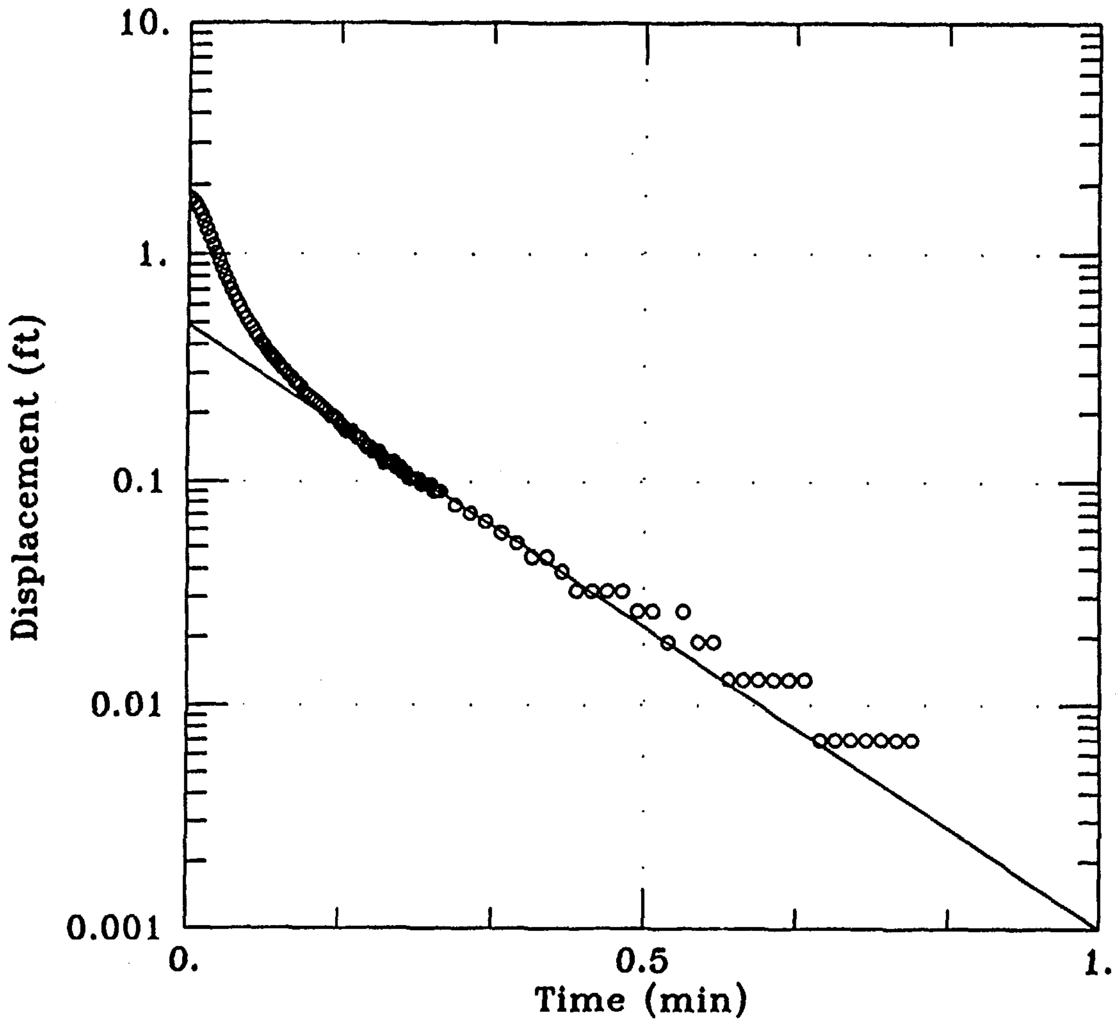
TEST DATA:
H0 = 0.341 ft
rc = 0.0833 ft
rw = 0.5 ft
L = 5. ft
b = 35. ft
H = 35. ft

PARAMETER ESTIMATES:
K = 256.1 ft/day
y0 = 0.3575 ft

AQTESOLV

Client: LANTDIV	Company: Baker Environmental, Inc.
Location: MCB Camp Lejeune	Project: CTO-232

35MW43B RISING HEAD TEST



DATA SET:
35MW43BR.DAT
07/15/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: May 3, 1996

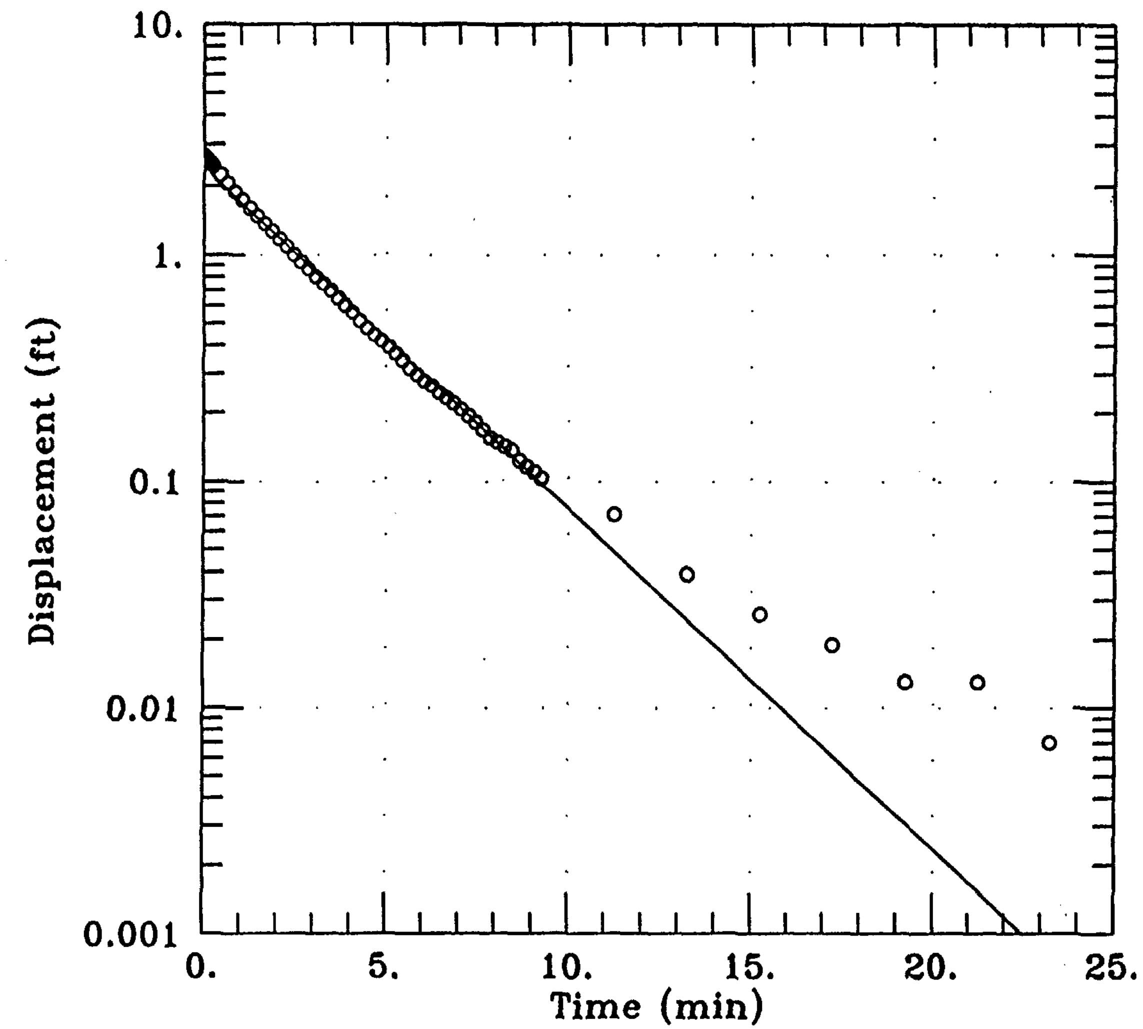
TEST DATA:
H0 = 1.758 ft
rc = 0.0833 ft
rw = 0.5 ft
L = 5. ft
b = 35. ft
H = 35. ft

PARAMETER ESTIMATES:
K = 184.2 ft/day
y0 = 0.4924 ft

AQTESOLV

Client: **LANTDIV**	Company: **Baker Environmental, Inc.**
Location: **MCB Camp Lejeune**	Project: **CTO-232**

35GWD06 FALLING HEAD TEST



DATA SET:
35GWD06F.DAT
07/15/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: May 2, 1996

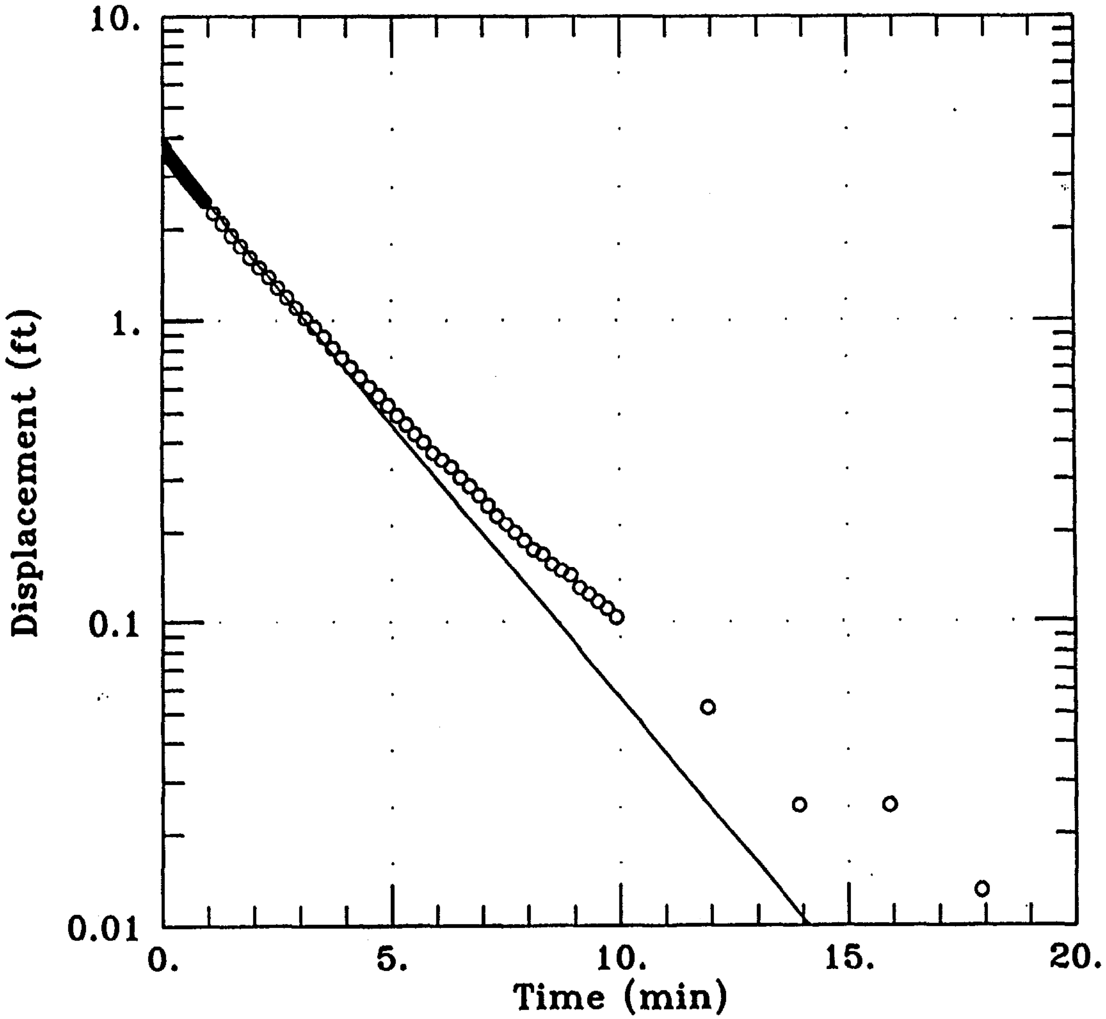
TEST DATA:
H0 = 2.676 ft
rc = 0.083 ft
rw = 0.5 ft
L = 5. ft
b = 200. ft
H = 60. ft

PARAMETER ESTIMATES:
K = 7.006 ft/day
y0 = 2.399 ft

AQTESOLV

Client: LANTDIV	Company: Baker Environmental, Inc.
Location: MCB Camp Lejeune	Project: CTO-232

35GWD06 RISING HEAD TEST



DATA SET:
35GWD06R.DAT
07/15/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: May 2, 1996

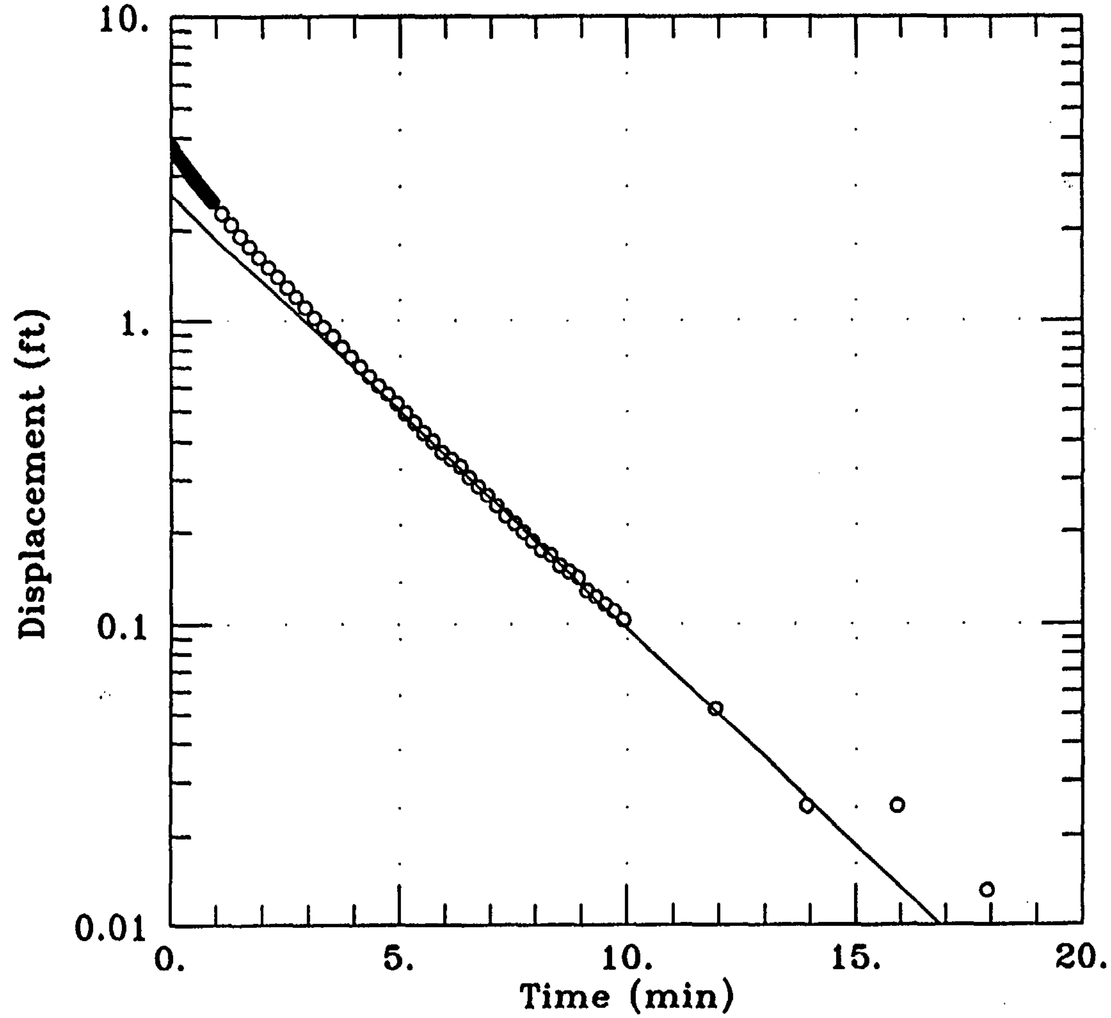
TEST DATA:
H0 = 3.752 ft
rc = 0.083 ft
rw = 0.5 ft
L = 5. ft
b = 200. ft
H = 60. ft

PARAMETER ESTIMATES:
K = 8.469 ft/day
y0 = 3.688 ft

AQTESOLV

Client: LANTDIV	Company: Baker Environmental, Inc.
Location: MCB Camp Lejeune	Project: CTO-232

35GWD06 RISING HEAD TEST



DATA SET:
35GWD06R.DAT
07/15/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: May 2, 1996

TEST DATA:
H0 = 3.752 ft
rc = 0.083 ft
rw = 0.5 ft
L = 5. ft
b = 200. ft
H = 60. ft

PARAMETER ESTIMATES:
K = 6.666 ft/day
y0 = 2.589 ft

AQTESOLV

Discussion of Slug Test Analyses at Site 35

A review of the test data indicates that not all the solutions appear representative of aquifer conditions. The hydraulic conductivity values obtained for wells 35-MW42B and 35-MW43B appear to be an order of magnitude higher than expected for the surficial aquifer. Previous slug testing performed at Camp Lejeune by Baker, as well as literature values suggest a hydraulic conductivity value range of 1 to 50 feet/day. An examination of the slug test conditions revealed two discrepancies from normal slug test procedures.

First, a falling or rising head test can considered complete when the water level is at least 95% of the initial (static) water level. This did not occur during the falling head tests at wells 35-MW42B and 35-MW43B. The recovery at 35-MW42B was approximately 85% of the static level, and was approximately 90% at 35-MW43B. If the next test (the rising head test) does not begin at static conditions, then the results will be inaccurate. Second, an initial displacement of at least 2 feet is desirable. A small initial displacement in of 0.3 feet was observed in the falling head test and 1.8 feet in the rising head test at well 35-MW43B. The resultant curve will be more shallow and the test will be shorter than desired to provide an representative solution.

Given the relatively high hydraulic conductivity values seen at these two wells, there is also the potential that drilling disturbed the surrounding formation to the extent that voids were created. These voids could represent zones of high groundwater conductivity. While this situation would not impact the ability to collect representative groundwater samples, it would effect the ability to obtain representative hydraulic conductivity values.

S.O. No. ______
Subject: ______
______ Sheet No. ______ of ______
______ Drawing No. ______
Computed by ______ Checked By ______ Date ______

Baker

SITE 35 SLUG TESTS

35-GWD06	SWL	7.55	
	FINAL	7.55	(100%)
35-MW40B	SWL	6.87	
	INT.	6.86	
	FINAL	6.86	
35-MW39B	SWL	7.32	
	INT.	7.19	(98%)
	FINAL	7.12	(97%)
35-MW41B	SWL	7.76	
	INT.	7.74	(99%)
	FINAL	7.74	(99%)
35-MW42B	SWL	5.82	
	INT.	4.93	(85%)
	FINAL	4.96	(85%)
35-MW43B	SWL	4.80	
	INT.	4.39	(91%)
	FINAL	4.32	(90%)

PROBLEM W/ FALLING HEAD TEST - SLUGS WOULD SUBMERGE. DATA LOGGED SANK (TEST THEN RERUN)

APPENDIX K
FSAP AND WORK PLAN AMENDMENTS

Baker

Baker Environmental, Inc.
Airport Office Park, Building 3
420 Rouser Road
Coraopolis, Pennsylvania 15108

(412) 269-6000
FAX (412) 269-2002

April 5, 1996

Commander
Atlantic Division
Naval Facilities Engineering Command
1510 Gilbert Street (Building N-26)
Norfolk, Virginia 23511-2699

Attn: Ms. Katherine Landman
Navy Technical Representative
Code 18232

Re: Contract N62470-89-D-4814
Navy CLEAN, District III
Contract Task Order (CTO) 0232
Final Project Plan Amendments
Supplemental Groundwater Investigation/Feasibility Study (SGI/FS)
Operable Unit (OU) No. 10, Site 35
MCB, Camp Lejeune, North Carolina

Dear Ms. Landman:

This letter presents final amendments to the Remedial Investigation/Feasibility Study (RI/FS) Work Plan and Sampling and Analysis Plan (SAP) for Operable Unit (OU) No. 10 (Site 35) Camp Geiger Area Fuel Farm. These amendments were necessary to support the additional work to be conducted under the Supplemental Groundwater Investigation (SGI) at OU No. 10. The majority of information provided in the original Final Work Plan and SAP (Baker, 1993) is still applicable to the work scheduled to occur under the SGI. Specific sections of the original Work Plan and SAP have been modified to accommodate changes to the project's tasks, schedule, and project team. The health and safety concerns addressed in the Final RI/FS Health and Safety Plan (HASP) (Baker, 1993) are applicable to the SGI. As such, no modifications to this document were necessary for it to be followed during SGI field investigation activities. Modifications to the Work Plan and SAP are as follows:

WORK PLAN AMENDMENTS

Included in the following subsections are the modifications and additions to the Final RI/FS Work Plan submitted to LANTDIV in December 1993. Sections 4.0 (Remedial Investigation/Feasibility Study Objectives) and Section 5.3 (Task 3 - Field Investigations) have been substantially modified to accommodate the additional work. Section 5.15 (Additional SGI tasks) presents two additional tasks, Data Management and Photo Album, that will be performed under the SGI. These tasks were also performed previously as part of the RI, however, they were not identified separately in the Final RI/FS Work Plan. Rather, these tasks were combined with other tasks. Two tasks presented in Sections 5.6 (Task 7 - Treatability Study/Pilot Testing) and 5.7 (Task 6 - Risk Assessment) of the Final RI/FS Work Plan will not be performed under the SGI. A treatability study-pilot test of in-situ air sparging (IAS technology) at Site 35 is the subject of work being performed under a different task order (CTO-0323). Based on the results of the RI, LANTDIV, Camp Lejeune, EPA Region IV, and the NC DEHNR concurred that no additional risk assessment is required under the SGI.

2.2 Site 35 - Camp Geiger Area Fuel Farm

This section discusses the locations of proposed SGI Activities.

2.2.1 Site Location and Setting

The SGI will be conducted in the two areas of concern (AOC) shown in Figure 1. The northern AOC is bisected by and extends approximately 900 feet along Brinson Creek between existing monitoring wells 35MW-23 and 35-MW-36. The southern AOC is roughly bounded to the north by Fifth Street; to the east by buildings TC569, TC611, TC609, and TC608; to the south by Seventh Street and to the west by "C" Street.

4.0 REMEDIAL INVESTIGATION/FEASIBILITY STUDY OBJECTIVES

The objectives of this work are based on the recommendations of the previous RI and the data needs of the proposed pilot-scale evaluation of IAS technology. The overall objectives of the SGI are as follows:

- Delineate the horizontal and vertical extent and locate sources of solvent-related groundwater contamination in the surficial aquifer south of Fifth Street.
- Determine if Brinson Creek is acting as a hydraulic barrier, preventing solvent-related groundwater contamination from migrating off-site onto Onslow County property.
- Provide a detailed vertical profile of solvent-related and BTEX groundwater contamination and subsurface geology in the immediate vicinity of the proposed IAS pilot study.

5.3 Task 3 - Field Investigations

The specific activities of the SGI are presented in the following sections and include: Site Survey, Soil and Groundwater Sample Screening, Soil Investigation, and Groundwater Investigation.

5.3.1 Site Survey

Survey data will be provided for all roads, building foundations, storm sewer inlets, sanitary sewer manholes, tree lines and monitoring well locations (temporary and permanent) in the AOCs not surveyed under the previous RI or Preparation of RAC Design Package for Surficial Groundwater Remediation (CTO-0323). Survey points will include a latitude coordinate, longitude coordinate and an elevation expressed in feet of mean sea level. The vertical accuracy will be within 0.01 feet and horizontal accuracy within 0.1 feet. In addition all points will be referenced to the North Carolina State Plain Coordinate System (NCSPCS). A sufficient number of points will be established to tie new survey data with previous surveys conducted at Site 35.

5.3.2 Soil and Groundwater Sample Screening

Sample screening activities will be conducted in both the northern and southern AOCs. These activities will include the installation of temporary monitoring well clusters and on-site analysis of soil and groundwater samples.

In the northern AOC, temporary wells will be installed on the both the Onslow County (northeast) side and Activity (southwest) side of Brinson Creek. On the Onslow County (northeast) side of Brinson Creek, two, two-wells clusters will be installed. A cluster of this side of Brinson Creek will consist of a shallow and an intermediate well. The locations of these clusters are shown in Figure 1. On the Activity (southwest) side of Brinson Creek, 10, three well clusters will be installed. A cluster on this side of Brinson Creek will consist of a shallow, semi-shallow and intermediate well. The locations of these clusters are shown in Figure 2. Groundwater and soil samples collected from wells installed on both sides of Brinson Creek will be analyzed for solvent and fuel-related contaminants.

In the southern AOC, 10, two-well clusters will be installed. A cluster in this area will consist of a shallow and/an intermediate well. The locations of the first five well clusters to be installed in the southern AOC are shown in Figure 1. The locations of the remaining well clusters will be based on the levels of contamination detected in the initial five-well installation and are not shown in Figure 1.

5.3.2.1 <u>Groundwater Sample Screening</u>

Temporary monitoring wells were selected as the screening method for both AOCs to limit the installation of a large number of permanent wells. A large number of permanent wells in the northern AOC could potentially impact the performance of the IAS pilot test and are more costly than temporary wells. In the southern AOC, the temporary wells will be used to establish the location of a limited number of permanent wells.

The objectives of the groundwater screening activities are as follows:

- Provide a detailed vertical profile of solvent-related and BTEX groundwater contamination and subsurface geology in the immediate vicinity of the in-situ air sparging pilot study (northern AOC).

- Determine if Brinson Creek is acting as a barrier to fuel and solvent-related groundwater contamination migrating off-site onto Onslow County property (northern AOC).

- Define the horizontal extent of solvent-related groundwater contamination in the upper portion of the surficial aquifer in the vicinity of Buildings TC470 and TC572 (southern AOC).

- Define the horizontal extent of solvent-related groundwater contamination in the lower portion of the surficial aquifer between Fifth and Seventh Street (southern AOC).

- Provide sufficient data to effectively locate permanent monitoring wells (southern AOC).

Northern AOC

To accomplish the objectives for the northern AOC, a total of 34 temporary wells will be installed. On the Activity (southwest) side of Brinson Creek three well clusters will be installed at 10 locations (30 wells, 35TW-16A,B,C through 35TW-25A,B,C) in the vicinity of existing monitoring well clusters 35MW-17, 35MW-18 ans 35MW-19 (see Figure 2). Well clusters in this area will consist of a shallow well screened across the water table (total depth approximately 5-10 feet below ground surface (bgs), a semi-shallow well screened midway between the confining layer and the water table (total depth approximately 20-25 feet bgs), and an intermediate well screened on top of the confining layer in the lower portion of the surficial aquifer (total depth approximately 35-40 feet bgs).

On the Onslow County (northeast) side of Brinson Creek, two-well clusters will be installed at two locations (four wells, 35TW-26A,B and 35TW-27A,B). These wells will be located opposite of existing well clusters 35MW-23 and 35MW-36, respectively, that are located on the Activity (southwest) side of Brinson Creek (see Figure 1). Well clusters in this area will consist of a shallow and an intermediate well as described in the previous paragraph.

Shallow wells will be designated with an "A" (e.g., 35TW-16A); semi-shallow wells will be designated with a "C" (e.g., 35TW-16C); and intermediate wells will be designated with a "B" (e.g.,35TW-16B). The proposed temporary shallow wells include 35TW-16A through -27A. The proposed temporary semi-shallow wells include 35TW-16C through -25C. The proposed temporary intermediate wells include 35TW-16B through -27B. Split-spoon soil samples will be collected continuously to depth from all intermediate borings for the purpose of geological identification and description. Temporary well installation and abandonment procedures are included in Section 5.2.1 of the SAP.

Groundwater samples collected from the northern AOC temporary wells will be analyzed using an on-site mobile laboratory for benzene, toluene, trichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, ethylbenzene, methyl tertiary butyl ether (MTBE) and total xylenes using modified EPA methods 8010A/8020A. Designations for these samples are presented in Table 1.

If groundwater sample screening activities conducted on the Onslow County (northeast) side of Brinson Creek indicate the presence of significant levels of VOC contamination, additional temporary well clusters will be installed to define the limits of contamination and to locate permanent monitoring wells. In addition, Baker will perform a field reconnaissance of this area to provide additional information regarding the presence of potential sources of contamination. A review of the available historical aerial photographs and U.S. G. S. maps conducted prior to the preparation of the project Plan Amendments did not identify any potential source of VOC contamination on the Onslow County (northeast) side of Brinson Creek.

Southern AOC

To accomplish the objectives of the SGI, a total of 30 temporary monitoring wells will be installed. These wells will be installed as well clusters at 15 locations (35TW-01A, B through 35TW-15A, B) within the limits of the well field (southern AOC) shown in Figure 1. Each cluster will consist of a shallow well screened in the upper portion of the surficial aquifer (total depth approximately 15- 20 feet bgs) and an intermediate well screened in the lower portion of the surficial aquifer (total depth approximately 35- 40 feet bgs). Proposed shallow wells have an "A" in the designation (e.g., 35TW-01A) and the intermediate wells have a "B" in the designation (e.g., 35TW-01B) so as to be consistent with the designations applied to the temporary wells installed in the northern AOC. The proposed temporary shallow wells will include 35TW-01A through -15A. The proposed intermediate temporary wells will include 35TW-01B through -15B. Split-spoon soil samples will be collected continuously to the water table and then at five-foot intervals to depth, from all intermediate borings for the purpose of geologic identification and description.

Initially, a line of five temporary well clusters (TW-01A, B through TW-05A, B) will be installed along the northside of Sixth Street between "C" Street and "D" Street to establish an east to west baseline of groundwater data that will be used as a reference for the installation of the remaining temporary well clusters. Sixth Street was selected as the location of the baseline because it is halfway between the southern-most solvent-related groundwater contamination detected under the RI and Seventh Street. The location of these well clusters are shown on Figure 1. Sample designations for this AOC are included in Table 2.

The remaining 10 temporary well clusters (35TW-06A, B through 35TW-15A,B) will be located based on the field screening results of groundwater samples obtained from the initial five temporary well clusters. If the on-site analytical results indicated solvent- related contamination is widespread, more than 15 wells may be required. Conversely, if the results indicate the horizontal extent of solvent- related contamination is relatively contained , less than 15 wells may be installed. Contaminated wells will be defined with levels of chlorinated solvents (i.e., trichloroethene, cis-1,2-dichchloroethene, and trans-1,2-dichloroethene) that exceed Federal Maximum Contaminant Levels (MCLs) or North Carolina Groundwater Quality Standards (NCGQS). These halogenated indicator compounds were selected based on the recommendations of the Phase I RI (Baker, 1995) which indicated the need to extend the RI south of Fifth Street to define the extent of solvent-related groundwater contamination in the surficial aquifer.

5.3.2.2 Soil Sample Screening

Soil sample screening will be conducted at the southern AOC only. The objective of this effort is to identify potential sources of solvent-related groundwater contamination. To achieve this, a total of 15 subsurface soil samples will be collected from intermediate temporary well borings (35TW-01B through 35TW-15B) each sample will be obtained from the soil interval located immediately above the groundwater table.

Samples will be analyzed via the on-site mobile laboratory for trichloroethene and cis-and trans-1, 2-dichloroethene. Soil screening sample designations are presented in Table 3.

5.3.3 Soil Investigation

5.3.3.2 Subsurface Soil Sampling

Subsurface soil sampling will be conducted in both the northern and southern AOC. The objectives of the subsurface soil sampling are as follows:

- Provide subsurface lithologic data in both the northern and southern AOCs.
- Confirm potential sources of solvent-related groundwater contamination in the southern AOC.
- Identify potential sources of solvent-related groundwater contamination on the northeast side of Brinson Creek.

To accomplish these objectives, subsurface soil samples will be collected from a total of six permanent intermediate well borings. Five of these environmental soil samples will be collected from intermediate monitoring well borings in the southern AOC (35MW-39B -40B, -41B, -42B, and-43B) and one from the intermediate monitoring well boring in the northern AOC (35MW-44B). The locations of the well borings in the southern AOC will be based on the results of temporary well soil and groundwater sample screening activities. The proposed location of 35MW-44B in the northern AOC is shown in Figure 1.

5.3.3.3 Soil Analysis

At each intermediate well boring, one soil sample will be collected from directly above the soil/groundwater interface or from an interval exhibiting Photo Ionization Detector (PID) readings above background levels. These samples will be packed and shipped to Weston Environmental Metrics in University Park, Illinois and analyzed for Target Compound List (TCL) volatile organic compounds (VOCs).

Sample designations for these soil samples are included in Table 4.

5.3.4 Groundwater Investigation

This phase of the SGI will include the installation and sampling of 14 new permanent monitoring wells and resampling 12 existing monitoring wells. The new wells will be installed as six two-well clusters (clusters consist of shallow (15-20 bgs), and intermediate (35-40 bgs) wells) and two deep wells (approximate depth 65 feet bgs). Five of the two-well clusters will be installed in the southern AOC and one cluster will be installed in the northern AOC on the northeast side of Brinson Creek. A single deep well will be installed in both the northern and southern AOCs. The two-well clusters will consist of a shallow well screened across the water table and an intermediate well screened in the lower portion of the surficial aquifer immediately above the confining layer. The deep wells will be installed through the confining layer and into the upper portion of the Castle Hayne aquifer. The 12 existing monitoring wells that are to be resampled consist of seven intermediate and five shallow wells located near or within the limits of the existing solvent-related groundwater contamination plume.

5.3.4.1 Shallow Groundwater Wells

The objectives of the groundwater investigation are as follows:

Northern AOC

- Determine if Brinson Creek is acting as a barrier to groundwater contamination migration.

Southern AOC

- Confirm the horizontal limits of the existing solvent-related groundwater contamination in the upper and lower portion of the surficial aquifer between Fifth Street and Seventh Street that were determined during SGI groundwater screening activities.

Previous Study Area and Northern AOC

- Determine if the levels of BTEX, MTBE, and solvent-related groundwater contamination have substantially changed since the previous RI was conducted in the spring of 1994.

To achieve the first objective, one or more permanent well cluster will be installed in the northern AOC on the northeastern side of Brinson Creek. The first permanent well cluster will be installed opposite existing well cluster 35MW-19A, B where solvent-related groundwater contamination exceeded 1,000μg/L in the lower portion of the surficial aquifer (see Figure 1). These wells will be designated as 35MW-44A, B. Determining if more than one permanent well cluster is needed will be based on the results of field screening of groundwater obtained from two temporary two-well clusters to be installed on the northeast side of Brinson Creek (see Figure 1). Additional permanent well clusters will be installed if significant contamination is encountered in the temporary wells. Their locations will be determined in the field based on these results.

To achieve the second objective, five permanent well clusters will be installed in the southern AOC. The exact locations of these well clusters will be based on the results of the groundwater screening effort. These clusters will be designated as 35MW-39 A, B through 35MW-43 A, B (shallow wells in a cluster are designated with an "A" and intermediate wells with a "B". The proposed permanent shallow wells include 35MW-39A through -43A. Proposed permanent intermediate wells include 35MW-39B through -43B. Permanent well clusters installed in the southern AOC, will be positioned to confirm either the presence or absence of solvent-related groundwater contamination. Three clusters will be located in areas where solvent-related contaminatants are detected during screening activities and two will be positioned just beyond the edge of the plume where no solvent-related groundwater contamination was detected.

At each permanent well cluster location, two, two-inch diameter, schedule 40 PVC wells will be installed. Each cluster will consist of a shallow well screened in the upper portion of the surficial aquifer (total depth approximately 15 - 20 feet bgs) and an intermediate well screened in the lower portion of the surficial aquifer (total depth approximately 40-45 feet bgs). Previous results indicate the water table will be encountered at approximately six to eight feet below the ground surface. The confining layer has been described as a greenish gray silt with some sand, little shells, and trace clay.

Both intermediate and shallow wells will be constructed with schedule 40 PVC casings and No.10 slot, two-inch diameter screens. The shallow wells will have 10-foot screens and the intermediate wells will have five-foot screens. All permanent monitoring wells constructed in the southern AOC will be flush mounted. The permanent wells constructed in the northern AOC will be installed with stick-up (two to three feet) steel casings, locking cap, and protective bollards.

To achieve the third objective, twelve existing monitoring wells (five shallow and seven intermediate) located in the previous study area adjacent to the southern AOC will be resampled to determine if the horizontal limits of the solvent-related contaminant plumes have changed substantially since the previous RI was conducted. To confirm known limits of solvent-related contaminant plumes, eight wells were selected from areas where moderate (50-100 µg/L) to high (1,000 µg/L) contaminant concentrations were previously detected. In addition, four wells were selected from areas where low to non-detectable levels of contamination were previously identified.

The five shallow existing wells that were selected for VOC resampling are located in the following areas:

- Moderate concentration area (50 µg/L) on the east side of F Street in the vicinity of the former ponded water area (35EMW-03).

- Moderate concentration area (50 µg/L) north of building TC474 and east of the former above ground storage tank farm (35MW-19A).
- Moderate concentration area (50 -100 µg/L) in the vicinity of buildings TC473 and TC470 (35MW-32A and 35MW-35A).
- Low concentration area (1 µg/L) east of buildings TC473 and TC470 (35MW-36A).

The seven intermediate wells that were selected for VOC resampling are located in the following areas.

- High concentration area (1,000 µg/L) in the vicinity of buildings TC474, TC473 and TC470 and east of the former above ground storage tank farm (35MW-19B).
- High concentration (1,000 µg/L) area near the intersection of E and Fourth Streets the east side of F Street (35MW-10B).
- Moderate concentration (100 µg/L) in the central area of the halogenated hydrocarbon plume (35MW-14B and 35MW-30B).
- Low concentration (1 µg/L) area that extends southwest from 35MW-25 along the edge of buildings TC341 to Fourth Street and south between buildings G531 and G534 to Fifth Street (MW-09B and MW-37B).
- Low concentration area east of building TC473 (35MW-36B).

Detailed well construction and installation information is included in the final RI/FS Work Plan and SAP (Baker, 1993).

5.3.4.2 Deep Groundwater Wells

A single deep groundwater monitoring well will be installed through the confining layer in the northern AOC. One (or more) deep wells will be installed in the southern AOC if significant contamination is detected in the intermediate zone during groundwater screening activities. The objective of this activity is as follows:

- Determine if solvent-related contamination, has migrated through the confining layer into the Castle Hayne Aquifer.

Deep well 35GWD-07 will be installed in the northern AOC on the northeast side of Brinson Creek adjacent to an area of high solvent-related groundwater contamination located in the vicinity of existing wells 35EMW-07 and 35MW19A, B (see Figure 1).

One or more deep wells will be installed in the southern AOC if contamination is detected in the intermediate zone temporary monitoring wells. For planning purposes one deep well (35GWD-06) was proposed in the southern AOC based on the results of the Phase I RI conducted by Baker in 1994. During this investigation five deep groundwater monitoring wells were installed. Four of these were installed directly through areas where significant levels of VOC contamination were detected in the intermediate and shallow zones. No VOC contaminants were detected in any of the five monitoring wells at levels above regulatory standards.

Detailed well construction information and well installation procedures are provided in the Final RI/FS and SAP (Baker, 1993).

5.3.4.3 Groundwater Sampling and Analysis

Samples collected from all 14 proposed permanent monitoring wells (35MW-39A, B through 35 MW-43A, B, 35GWD-06 and 35GWD-07) and the twelve existing monitoring wells (35EMW-03, 35MW-19A, -32A, -35A, -36A, -19B, -10B, -14B, -30B, -09B, -37B, and -36B) will be analyzed for TCL VOCs and MTBE.

Groundwater sample designations for existing permanent monitoring wells and new monitoring wells are included in Tables 5 and 6, respectively.

All samples will be packed and shipped to Weston Environmental Metrics for analysis. Raw data should be provided by the laboratory within 28 days.

5.15 Additional SGI Tasks

5.15.1 Data Management

Data Management involves the construction of data summary tables that combine validated data from the SGI with validated data acquired from the previous RI.

5.15.2 Photo Album

This task includes the preparation of an album of photographs to document SGI field activities. The photo album will include photo description and slides of each photo. Single copies of the photo album, with original photos and slides will be submitted to LANTDIV and MCB Camp Lejeune Environmental Coordinator.

6.0 PROJECT MANAGEMENT AND STAFFING

The proposed management and staffing of the SGI is presented below. The primary participants include:

Mr Matthew D. Bartman, Activity Coordinator
Mr. Daniel Bonk, P.E., Project Manager
Mr. Michael D. Smith, Site Manager/Project Engineer
Mr. Brian Davis, Site Geologist
Mr Thomas C. Fuller, QA/QC
Mr. Ronald Krivan, Health and Safety Officer

All field activities will be directed by Mr. Michael D. Smith, who will act as Site Manager.

Mr. Daniel L. Bonk will have overall responsibility for completing all deliverables. He will report directly to the Activity Coordinator, Mr. Matthew D. Bartman. Mr. Smith will be responsible for overseeing the SGI Report and FS Report/PRAP/ROD. He will report to Mr. Bonk and will be supported by geologist, engineers, biologists, chemists, environmental scientists, data technicians, drafters and clerical personnel, as needed.

Overall field and reporting QA/QC will be the responsibility of Mr. Thomas C. Fuller. Mr. John W. Mentz will provide Program Level technical and administrative support.

7.0 SCHEDULE

Figure 3 depicts the proposed schedule for SGI field work and Figure 4 is a revised schedule for all proposed RI/FS and SGI activities at Site 35. It is anticipated that field activities will commence the week of April 8, 1996 and to proceed through May 15, 1996. A summary of project deliverables is provided in Table 7.

SAMPLING AND ANALYSIS PLAN AMENDMENTS

Included in the following subsections are modifications to the RI/FS SAP submitted to LANTDIV in December 1993.

3.1 Soil and Groundwater Screening

Sample screening activities will be conducted in both the northern and southern AOCs. These activities will include the installation of temporary monitoring well clusters and on-site analysis of soil and groundwater samples.

In the northern AOC, temporary wells will be installed on the both the Onslow County (northeast) side and Activity (southwest) side of Brinson Creek. On the Onslow County (northeast) side of Brinson Creek, two, two-wells clusters will be installed. A cluster of this side of Brinson Creek will consist of a shallow and an intermediate well. The locations of these clusters are shown in Figure 1. On the Activity (southwest) side of Brinson Creek, 10, three well clusters will be installed. A cluster on this side of Brinson Creek will consist of a shallow, semi-shallow and intermediate well. The locations of these clusters are shown in Figure 2. Groundwater and soil samples collected from wells installed on both sides of Brinson Creek will be analyzed for solvent and fuel-related contaminants.

In the southern AOC, 10, two-well clusters will be installed. A cluster in this area will consist of a shallow and/an intermediate well. The locations of the first five well clusters to be installed in the southern AOC are shown in Figure 1. The locations of the remaining well clusters will be based on the levels of contamination detected in the initial five-well installation and are not shown in Figure 1.

3.1.1 Groundwater Sample Screening

Temporary monitoring wells were selected as the screening method for both AOCs to limit the installation of a large number of permanent wells. A large number of permanent wells in the northern AOC could potentially impact the performance of the IAS pilot test and are more costly than temporary wells. In the southern AOC, the temporary wells will be used to establish the location of a limited number of permanent wells.

The objectives of the groundwater, screening activities are as follows:

- Provide a detailed vertical profile of solvent-related and BTEX groundwater contamination and subsurface geology in the immediate vicinity of the in-situ air sparging pilot study (northern AOC).
- Determine if Brinson Creek is acting as a barrier to fuel and solvent-related groundwater contamination migrating off-site onto Onslow County property (northern AOC).
- Define the horizontal extent of solvent-related groundwater contamination in the upper portion of the surficial aquifer in the vicinity of Buildings TC470 and TC572 (southern AOC).
- Define the horizontal extent of solvent-related groundwater contamination in the lower portion of the surficial aquifer between Fifth and Seventh Street (southern AOC).
- Provide sufficient data to effectively locate permanent monitoring wells (southern AOC).

Northern AOC

To accomplish the objectives for the northern AOC, a total of 34 temporary wells will be installed. On the Activity (southwest) side of Brinson Creek three well clusters will be installed at 10 locations (30 wells, 35TW-16A,B,C through 35TW-25A,B,C) in the vicinity of existing monitoring well clusters 35MW-17, 35MW-18 ans 35MW-19 (see Figure 2). Well clusters in this area will consist of a shallow well screened across the water table (total depth approximately 5-10 feet below ground surface (bgs), a semi-shallow well screened midway between the confining layer and the water table (total depth approximately 20-25 feet bgs), and an intermediate well screened on top of the confining layer in the lower portion of the surficial aquifer (total depth approximately 35-40 feet bgs).

On the Onslow County (northeast) side of Brinson Creek, two-well clusters will be installed at two locations (four wells, 35TW-26A,B and 35TW-27A,B). These wells will be located opposite of existing well clusters 35MW-23 and 35MW-36, respectively, that are located on the Activity (southwest) side of Brinson Creek (see Figure 1). Well clusters in this area will consist of a shallow and an intermediate well as described in the previous paragraph.

Shallow wells will be designated with an "A" (e.g., 35TW-16A); semi-shallow wells will be designated with a "C" (e.g., 35TW-16C); and intermediate wells will be designated with a "B" (e.g.,35TW-16B). The proposed temporary shallow wells include 35TW-16A through -27A. The proposed temporary semi-shallow wells include 35TW-16C through -25C. The proposed temporary intermediate wells include 35TW-16B through -27B. Split-spoon soil samples will be collected continuously to depth from all intermediate borings for the purpose of geological identification and description. Temporary well installation and abandonment procedures are included in Section 5.2.1 of the SAP.

Groundwater samples collected from the northern AOC temporary wells will be analyzed using an on-site mobile laboratory for benzene, toluene, trichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, ethylbenzene, methyl tertiary butyl ether (MTBE) and total xylenes using modified EPA methods 8010A/8020A. Designations for these samples are presented in Table 1.

If groundwater sample screening activities conducted on the Onslow County (northeast) side of Brinson Creek indicate the presence of significant levels of VOC contamination, additional temporary well clusters will be installed to define the limits of contamination and to locate permanent monitoring wells. In addition, Baker will perform a field reconnaissance of this area to provide additional information regarding the presence of potential sources of contamination. A review of the available historical aerial photographs and U.S. G. S. maps conducted prior to the preparation of the project Plan Amendments did not identify any potential source of VOC contamination on the Onslow County (northeast) side of Brinson Creek.

Southern AOC

To accomplish the objectives of the SGI, a total of 30 temporary monitoring wells will be installed. These wells will be installed as well clusters at 15 locations (35TW-01A, B through 35TW-15A, B) within the limits of the well field (southern AOC) shown in Figure 1. Each cluster will consist of a shallow well screened in the upper portion of the surficial aquifer (total depth approximately 15- 20 feet bgs) and an intermediate well screened in the lower portion of the surficial aquifer (total depth approximately 35- 40 feet bgs). Proposed shallow wells have an "A" in the designation (e.g., 35TW-01A) and the intermediate wells have a "B" in the designation (e.g., 35TW-01B) so as to be consistent with the designations applied to the temporary wells installed in the northern AOC. The proposed temporary shallow wells will include 35TW-01A through -15A. The proposed intermediate temporary wells will include 35TW-01B through -15B. Split-spoon soil samples will be collected continuously to the water table and then at five-foot intervals to depth, from all intermediate borings for the purpose of geologic identification and description.

Initially, a line of five temporary well clusters (TW-01A, B through TW-05A, B) will be installed along the northside of Sixth Street between "C" Street and "D" Street to establish an east to west baseline of groundwater data that will be used as a reference for the installation of the remaining temporary well clusters. Sixth Street was selected as the location of the baseline because it is halfway between the southern-most solvent-related groundwater contamination detected under the RI and Seventh Street. The location of these well clusters are shown on Figure 1. Sample designations for this AOC are included in Table 2.

The remaining 10 temporary well clusters (35TW-06A, B through 35TW-15A,B) will be located based on the field screening results of groundwater samples obtained from the initial five temporary well clusters. If the on-site analytical results indicated solvent- related contamination is widespread, more than 15 wells may be required. Conversely, if the results indicate the horizontal extent of solvent- related contamination is relatively contained , less than 15 wells may be installed. Contaminated wells will be defined with levels of chlorinated solvents (i.e., trichloroethene, cis-1,2-dichchloroethene, and trans-1,2-dichloroethene) that exceed Federal Maximum Contaminant Levels (MCLs) or North Carolina Groundwater Quality Standards (NCGQS). These halogenated indicator compounds were selected based on the recommendations of the

Phase I RI (Baker, 1995) which indicated the need to extend the RI south of Fifth Street to define the extent of solvent-related groundwater contamination in the surficial aquifer.

3.1.2 Soil Sample Screening

Soil sample screening will be conducted at the southern AOC only. The objective of this effort is to identify potential sources of solvent-related groundwater contamination. To achieve this, a total of 15 subsurface soil samples will be collected from intermediate temporary well borings (35TW-01B through 35TW-15B) each sample will be obtained from the soil interval located immediately above the groundwater table.

Samples will be analyzed via the on-site mobile laboratory for trichloroethene and cis-and trans-1, 2-dichloroethene. Soil screening sample designations are presented in Table 3.

3.2 Soil Investigation

3.2.2 Subsurface Soil Sampling

Subsurface soil sampling will be conducted in both the northern and southern AOC. The objectives of the subsurface soil sampling are as follows:

- Provide subsurface lithologic data in both the northern and southern AOCs.
- Confirm potential sources of solvent-related groundwater contamination in the southern AOC.
- Identify potential sources of solvent-related groundwater contamination on the northeast side of Brinson Creek.

To accomplish these objectives, subsurface soil samples will be collected from a total of six permanent intermediate well borings. Five of these environmental soil samples will be collected from intermediate monitoring well borings in the southern AOC (35MW-39B -40B, -41B, -42B, and-43B) and one from the intermediate monitoring well boring in the northern AOC (35MW-44B). The locations of the well borings in the southern AOC will be based on the results of temporary well soil and groundwater sample screening activities. The proposed location of 35MW-44B in the northern AOC is shown in Figure 1.

3.2.3 Soil Analysis

At each intermediate well boring, one soil sample will be collected from directly above the soil/groundwater interface or from an interval exhibiting Photo Ionization Detector (PID) readings above background levels. These samples will be packed and shipped to Weston Environmental Metrics in University Park, Illinois and analyzed for Target Compound List (TCL) volatile organic compounds (VOCs).

Sample designations for these soil samples are included in Table 4.

3.3 Groundwater Investigation

This phase of the SGI will include the installation and sampling of 14 new permanent monitoring wells and resampling 12 existing monitoring wells. The new wells will be installed as six two-well clusters (clusters consist of shallow (15-20 bgs), and intermediate (35-40 bgs) wells) and two deep wells (approximate depth 65 feet bgs). Five of the two-well clusters will be installed in the southern AOC and one cluster will be installed in the northern AOC on the northeast side of Brinson Creek. A single deep well will be installed in both the northern and southern AOCs. The two-well clusters will consist of a shallow well screened across the water table and an intermediate well screened in the lower portion of the surficial aquifer immediately above the confining layer. The deep wells will be installed through the confining layer and into the upper portion of the Castle Hayne aquifer. The 12 existing monitoring wells that are to be resampled consist of seven intermediate and five shallow wells located near or within the limits of the existing solvent-related groundwater contamination plume.

3.3.1 Shallow Groundwater Wells

The objectives of the groundwater investigation are as follows:

Northern AOC

- Determine if Brinson Creek is acting as a barrier to groundwater contamination migration.

Southern AOC

- Confirm the horizontal limits of the existing solvent-related groundwater contamination in the upper and lower portion of the surficial aquifer between Fifth Street and Seventh Street that were determined during SGI groundwater screening activities.

Previous Study Area and Northern AOC

- Determine if the levels of BTEX, MTBE, and solvent-related groundwater contamination have substantially changed since the previous RI was conducted in the spring of 1994.

To achieve the first objective, one or more permanent well cluster will be installed in the northern AOC on the northeastern side of Brinson Creek. The first permanent well cluster will be installed opposite existing well cluster 35MW-19A, B where solvent-related groundwater contamination exceeded 1,000μg/L in the lower portion of the surficial aquifer (see Figure 1). These wells will be designated as 35MW-44A, B. Determining if more than one permanent well cluster is needed will be based on the results of field screening of groundwater obtained from two temporary two-well clusters to be installed on the northeast side of Brinson Creek (see Figure 1). Additional permanent well clusters will be installed if significant contamination is encountered in the temporary wells. Their locations will be determined in the field based on these results.

To achieve the second objective, five permanent well clusters will be installed in the southern AOC. The exact locations of these well clusters will be based on the results of the groundwater screening effort. These clusters will be designated as 35MW-39 A, B through 35MW-43 A, B (shallow wells in a cluster are designated with an "A" and intermediate wells with a "B". The proposed permanent shallow wells include 35MW-39A through -43A. Proposed permanent intermediate wells include 35MW-39B through -43B. Permanent well clusters installed in the southern AOC, will be positioned to confirm either the presence or absence of solvent-related groundwater contamination. Three clusters will be located in areas where solvent-related contaminants are detected during screening activities and two will be positioned just beyond the edge of the plume where no solvent-related groundwater contamination was detected.

At each permanent well cluster location, two, two-inch diameter, schedule 40 PVC wells will be installed. Each cluster will consist of a shallow well screened in the upper portion of the surficial aquifer (total depth approximately 15 - 20 feet bgs) and an intermediate well screened in the lower portion of the surficial aquifer (total depth approximately 40-45 feet bgs). Previous results indicate the water table will be encountered at approximately six to eight feet below the ground surface. The confining layer has been described as a greenish gray silt with some sand, little shells, and trace clay.

Both intermediate and shallow wells will be constructed with schedule 40 PVC casings and No.10 slot, two-inch diameter screens. The shallow wells will have 10-foot screens and the intermediate wells will have five-foot screens. All permanent monitoring wells constructed in the southern AOC will be flush mounted. The permanent wells constructed in the northern AOC will be installed with stick-up (two to three feet) steel casings, locking cap, and protective bollards.

To achieve the third objective, twelve existing monitoring wells (five shallow and seven intermediate) located in the previous study area adjacent to the southern AOC will be resampled to determine if the horizontal limits of the solvent-related contaminant plumes have changed substantially since the previous RI was conducted. To confirm known limits of solvent-related contaminant plumes, eight wells were selected from areas where moderate (50-100 µg/L) to high (1,000 µg/L) contaminant concentrations were previously detected. In addition, four wells were selected from areas where low to non-detectable levels of contamination were previously identified.

The five shallow existing wells that were selected for VOC resampling are located in the following areas:

- Moderate concentration area (50 µg/L) on the east side of F Street in the vicinity of the former ponded water area (35EMW-03).
- Moderate concentration area (50 µg/L) north of building TC474 and east of the former above ground storage tank farm (35MW-19A).
- Moderate concentration area (50 -100 µg/L) in the vicinity of buildings TC473 and TC470 (35MW-32A and 35MW-35A).
- Low concentration area (1 µg/L) east of buildings TC473 and TC470 (35MW-36A).

The seven intermediate wells that were selected for VOC resampling are located in the following areas.

- High concentration area (1,000 µg/L) in the vicinity of buildings TC474, TC473 and TC470 and east of the former above ground storage tank farm (35MW-19B).
- High concentration (1,000 µg/L) area near the intersection of E and Fourth Streets the east side of F Street (35MW-10B).
- Moderate concentration (100 µg/L) in the central area of the halogenated hydrocarbon plume (35MW-14B and 35MW-30B).

- Low concentration (1 µg/L) area that extends southwest from 35MW-25 along the edge of buildings TC341 to Fourth Street and south between buildings G531 and G534 to Fifth Street (MW-09B and MW-37B).

- Low concentration area east of building TC473 (35MW-36B).

Detailed well construction and installation information is included in the final RI/FS Work Plan and SAP (Baker, 1993).

3.3.2 Deep Groundwater Wells

A single deep groundwater monitoring well will be installed through the confining layer in the northern AOC. One (or more) deep wells will be installed in the southern AOC if significant contamination is detected in the intermediate zone during groundwater screening activities. The objective of this activity is as follows:

- Determine if solvent-related contamination, has migrated through the confining layer into the Castle Hayne Aquifer.

Deep well 35GWD-07 will be installed in the northern AOC on the northeast side of Brinson Creek adjacent to an area of high solvent-related groundwater contamination located in the vicinity of existing wells 35EMW-07 and 35MW19A, B (see Figure 1).

One or more deep wells will be installed in the southern AOC if contamination is detected in the intermediate zone temporary monitoring wells. For planning purposes one deep well (35GWD-06) was proposed in the southern AOC based on the results of the Phase I RI conducted by Baker in 1994. During this investigation five deep groundwater monitoring wells were installed. Three of these were installed directly through areas where significant levels of VOC contamination were detected in the intermediate and shallow zones. No VOC contaminants were detected in any of the five monitoring wells at levels above regulatory standards.

Detailed well construction information and well installation procedures are provided in the Final RI/FS and SAP (Baker, 1993).

3.3.3 Groundwater Sampling and Analysis

Samples collected from all 14 proposed permanent monitoring wells (35MW-39A, B through 35 MW-43A, B, 35GWD-06 and 35GWD-07) and the twelve existing monitoring wells (35EMW-03, 35MW-19A, -32A, -35A, -36A, -19B, -10B, -14B, -30B, -09B, -37B, and -36B) will be analyzed for TCL VOCs and MTBE.

Groundwater sample designations for existing permanent monitoring wells and new monitoring wells are included in Tables 5 and 6, respectively.

All samples will be packed and shipped to Weston Environmental Metrics for analysis. Raw data should be provided by the laboratory within 28 days.

3.3.4 Water Level Measurements

During the SGI a minimum of two rounds of static water levels will be collected from all existing and newly installed permanent monitoring wells.

5.2 Monitoring Well Installation and Well Development

Permanent shallow and deep wells and temporary shallow wells will be installed under this SGI. Temporary monitoring well installation and well development procedures not discussed in the original Baker FSAP will be presented in this section.

5.2.1 Temporary Well Installation

Temporary well construction should follow the procedures outlined for the installation of permanent wells outlined in Section 5.2 Well Installation and Development of the Baker FSAP with the following exceptions:

Temporary well clusters will be installed in the northern and southern AOCs. The construction of these clusters is somewhat unique and is based on the goals of the sampling activity. The objective of the sampling effort in the northern AOC was to provide a detailed profile of solvent-related and BTEX groundwater contamination in a well defined area. As such, clusters installed in the north will consist of a shallow well (5-10 feet bgs) screened across the water table, an intermediate well (35-40 feet bgs) seated in the confining layer and screened across the lower portion of the surficial aquifer, and a semi-shallow well (15-20 feet bgs) screened between the shallow and the intermediate wells. All of these wells will be constructed with five feet of screen. Splits spoons will be continuously collected to depth during the advancement of the intermediate well boring.

In the Southern AOC the objective was to define the horizontal extent of solvent-related contamination in the upper and lower portion of the surficial aquifer over a broad area and duplicate existing permanent well cluster construction. As such clusters will consist of a shallow well (15-20 bgs) screened across the water table with a 10 foot screen and an intermediate well (40-45 feet bgs) seated in the confining layer with a five foot screen. If the confining layer is at a depth of less than 15 feet bgs and the aquifer thickness is less than 10 feet thick, only one intermediate well will be installed. Splits spoons will be collected continuously to the water table and at 5 foot intervals thereafter to depth during the advancement of the intermediate well boring.

All temporary wells will be constructed with 1-inch diameter (ID) schedule 40 PVC casing and No. 10 slot (0.01-inch) screens.

- Temporary wells will be installed in borehole advanced by a 3 1/4-inch I.D. auger or equivalent. The well will be installed through the auger with a 2 inch-diameter well sock. As the augers are removed the borehole will be allowed to collapse around the well. If collapse is not complete No. 1 silica and will be placed in the borehole to approximately two feet above the screen. No grout seal or grout will be used unless a well is not sampled on the day it is installed.

- Development of the temporary wells is not required. However, the same volume of water introduced into the borehole during construction to prevent heaving sands must be removed prior to purging and sampling.

- Temporary wells will be removed manually and any remaining open boreholes will be backfilled with bentonite.

5.2.2 Well Development

All permanent shallow and intermediate groundwater monitoring wells will be developed using a centrifugal pump and check valve or inertial pumping system (Wattera). All deep wells will be developed with the Wattera system. As the well is opened HNU readings will be taken. In addition well depths and water levels will be measured and well volumes calculated. The check valve is secured to the end of a length of flex hose that is inserted into the well and is secured to a pump to the bottom of the well. All flex hose will be decontaminated with a damp paper towel prior to any insertion into the well. The flex hose may be secured with radiator clamps. If used radiator clamps should be wrapped with wells sock to limit any scoring of the inside of the well. The pump may then be manually primed by thrusting the flex hose up and down in the well. The discharge nozzle should be equipped with a valve to control flow. The valve and accelerator should be adjusted to establish constant flow. Once started the pump should run for 10 to 15 minutes to pump out any stagnant water. The flex hose should then be removed and a surge block secured to the flex hose. To flush accumulated sediment out of the sand pack the well should be surged along the entire length of the screen in approximately two foot intervals. Surging should be performed for approximately 20 minutes. After surging is completed the check valve should be reinserted into the well and the pump restarted. Pumping should continue until PH, temperature, and conductivity readings have stabilized (three successive readings varying no more than 10 percent) and turbidity is less than 10 NTUs. Total pumping time should not exceed 3 hours.

5.3 Groundwater Sample Collection

To reduce or eliminate sediments in groundwater samples and greatly reduce the possibility of cross contamination between sampling points, a peristaltic pump will be used to collect ground water samples from all permanent groundwater monitoring wells. A peristaltic pump can provide a maximum lift of approximately 25 feet. Although there are deep and intermediate wells that will be sampled the static water level is only six to eight feet below ground surface. Typically, Baker peristaltic pumps do not have power sources and must be run off of a vehicle battery.

Prior to collecting a sample, a minimum of three to five well volumes should be removed. A conductivity, pH, temperature, and turbidity readings will be taken from each well volume. Purging may be concluded and a sample collected when three to five well volumes have been removed, and three successive readings of conductivity, pH, and temperature vary no more than 10 percent.

5.8 Surveying

Survey data will be provided for roads, major building foundations, tree lines and monitoring well locations (temporary and permanent) in the AOCs not surveyed under the previous RI or RAC Design for Site 35 Groundwater (CTO-0323). Survey points will include a latitude coordinate, longitude coordinate and an elevation expressed in feet of mean sea level. The vertical accuracy will be within .1 feet and horizontal accuracy within .1 feet, and horizontal will be within .1 feet. In addition all points will be referenced to the North Carolina State Plain Coordinate System (NCSPCS). A sufficient number of points will be established to tie new survey data with previous surveys conducted at Site 35.

5.9 Handling of Site Investigation Generated Waste

5.9.3 Designation of Potentially Hazardous and Nonhazardous IDW

5.9.3.1 Drill Cuttings

All drill cuttings will be containerized in a roll-off box pending analytical results that determine whether or not the material is hazardous or non-hazardous. Only non-hazardous cuttings will be spread out on the ground.

5.9.3.2 Monitoring Well Development and Purge Water

All development or purge water generated by the SGI will be containerized in a 5,000-gallon tanker or 1,000-gallon polyethylene storage tanks.

5.9.3.3 Decontamination Fluids

All equipment and personal decontamination fluids generated by the SGI will be containerized in a 55 gallon drum.

5.9.8 Disposal of Contaminated Materials

A single composite of drill cuttings will be collected from the roll-off box and analyzed in accordance with TCLP and RCRA Hazardous Waste Characteristics, in order to assess disposal options.

A single sample will be collected from the 5,000-gallon tanker or 1,000-gallon polyethylene tanks used to store liquid IDW during the SGI. The sample will be analyzed for TCL volatiles, semivolatiles, pesticides and PCBs, and inorganics. Based on the analytical results and the prior approval of LANTDIV and MCB Camp Lejeune, liquid IDW will be transported to an off-base facility for treatment and disposal, transported to the Hadnot Point Industrial Area Groundwater Treatment Plants for treatment and disposal, or discharged on site.

Sample designations for IDW samples are presented on Table 8.

Baker appreciates the continued opportunity to serve the Navy. if you have any question please do not hesitate to contact Mr. Matthew Bartman at (412) 269-2053 or me at (412) 269-2063.

Sincerely,

BAKER ENVIRONMENTAL, INC.

Daniel L. Bonk

Daniel L. Bonk, P.E.
Project Manager

DLB/lq

cc: Mr. Neal Paul, MCB Camp Lejeune
Ms. Gena Townsend, USEPA
Mr. Patrick Watters, NC DEHNR
Mr. Jim Dunn, OHM
Ms. Lee Anne Rapp, P.E., Code 18312 (w/o attachments)
Ms. Beth Collier, Code 02115 (w/o attachments)

TABLE 1

SUPPLEMENTAL GROUNDWATER INVESTIGATION FOR OU NO. 10 (SITE 35)
CAMP GEIGER AREA FUEL FARM
GROUNDWATER SAMPLING IDENTIFICATION NUMBERS FOR TEMPORARY WELLS IN NORTHERN AREA OF CONCERN
CONTRACT TASK ORDER 0232

	ANALYSIS REQUESTED		COMMENTS	
TYPE/LOCATION	SAMPLE ID	NORTHERN[2] AOC CONTAMINANTS	TURN AROUND	Lab[3]
TEMPORARY WELLS (PROPOSED)[1] NORTHERN AOC	35-TW16A-04	X	24 hour	Microseeps
	35-TW16B-04	X	24 hour	Microseeps
	35-TW16C-04	X	24 hour	Microseeps
	35-TW17A-04	X	24 hour	Microseeps
	35-TW17B-04	X	24 hour	Microseeps
	35-TW17C-04	X	24 hour	Microseeps
	35-TW18A-04	X	24 hour	Microseeps
	35-TW18B-04	X	24 hour	Microseeps
	35-TW18C-04	X	24 hour	Microseeps
	35-TW19A-04	X	24 hour	Microseeps
	35-TW19B-04	X	24 hour	Microseeps
	35-TW19C-04	X	24 hour	Microseeps
	35-TW20A-04	X	24 hour	Microseeps
	35-TW20B-04	X	24 hour	Microseeps
	35-TW20C-04	X	24 hour	Microseeps
	35-TW21A-04	X	24 hour	Microseeps
	35-TW21B-04	X	24 hour	Microseeps
	35-TW21C-04	X	24 hour	Microseeps
	35-TW22A-04	X	24 hour	Microseeps
	35-TW22B-04	X	24 hour	Microseeps
	35-TW22C-04	X	24 hour	Microseeps
	35-TW23A-04	X	24 hour	Microseeps
	35-TW23B-04	X	24 hour	Microseeps
	35-TW23C-04	X	24 hour	Microseeps
	35-TW24A-04	X	24 hour	Microseeps
	35-TW24B-04	X	24 hour	Microseeps
	35-TW24C-04	X	24 hour	Microseeps
	35-TW25A-04	X	24 hour	Microseeps
	35-TW25B-04	X	24 hour	Microseeps
	35-TW25C-04	X	24 hour	Microseeps
	35-TW26A-04	X	24 hour	Microseeps
	35-TW26B-04	X	24 hour	Microseeps
	35-TW27A-04	X	24 hour	Microseeps
	35-TW27B-04	X	24 hour	Microseeps
TOTAL ANALYSES		34		

Notes:

(1) Temporary well sampling is a screening tool. No duplicates or MS/MSD will be collected and no trip blanks will be sent.

(2) The following analyses will be performed on groundwater samples collected from the northern AOC: benzene, toluene, trichloroethene, cis-1,2-dichloroethene, trans-1,2,-dichloroethene, ethylbenzene, methyltertiary butyl ether and xylenes. These analyses will be performed using modified EPA methods 8010A/8020A.

(3) Microseeps Inc. from Pittsburgh, PA is providing on-site lab services.

TABLE 2

SUPPLEMENTAL GROUNDWATER INVESTIGATION FOR OU NO. 10 (SITE 35)
CAMP GEIGER AREA FUEL FARM
GROUNDWATER SAMPLING IDENTIFICATION NUMBERS FOR TEMPORARY WELLS
IN SOUTHERN AREA OF CONCERN
CONTRACT TASK ORDER 0232

TYPE/LOCATION	ANALYSIS REQUESTED		COMMENTS	
	SAMPLE ID	SOUTHERN[2] AOC CONTAMINANTS	TURN AROUND	Lab[3]
TEMPORARY WELLS (PROPOSED)[1] SOUTHERN AOC	35-TW01A-04	X	24 hour	Microseeps
	35-TW01B-04	X	24 hour	Microseeps
	35-TW02A-04	X	24 hour	Microseeps
	35-TW02B-04	X	24 hour	Microseeps
	35-TW03A-04	X	24 hour	Microseeps
	35-TW03B-04	X	24 hour	Microseeps
	35-TW04A-04	X	24 hour	Microseeps
	35-TW04B-04	X	24 hour	Microseeps
	35-TW05A-04	X	24 hour	Microseeps
	35-TW05B-04	X	24 hour	Microseeps
	35-TW06A-04	X	24 hour	Microseeps
	35-TW06B-04	X	24 hour	Microseeps
	35-TW07A-04	X	24 hour	Microseeps
	35-TW07B-04	X	24 hour	Microseeps
	35-TW08A-04	X	24 hour	Microseeps
	35-TW08B-04	X	24 hour	Microseeps
	35-TW09A-04	X	24 hour	Microseeps
	35-TW09B-04	X	24 hour	Microseeps
	35-TW10A-04	X	24 hour	Microseeps
	35-TW10B-04	X	24 hour	Microseeps
	35-TW11A-04	X	24 hour	Microseeps
	35-TW11B-04	X	24 hour	Microseeps
	35-TW12A-04	X	24 hour	Microseeps
	35-TW12B-04	X	24 hour	Microseeps
	35-TW13A-04	X	24 hour	Microseeps
	35-TW13B-04	X	24 hour	Microseeps
	35-TW14A-04	X	24 hour	Microseeps
	35-TW14B-04	X	24 hour	Microseeps
	35-TW15A-04	X	24 hour	Microseeps
	35-TW15B-04	X	24 hour	Microseeps
TOTAL ANALYSES		30		

Notes:

(1) Temporary well sampling is a screening tool. No duplicates or MS/MSDs will be collected and no trip blanks will be sent.

(2) The following analyses will be performed on groundwater samples collected from the southern AOC: trichloroethene, cis-1,2-dichloroethene, and trans-1,2,-dichloroethene. These analyses will be performed using modified EPA methods 8010A.

(3) Microseeps Inc. from Pittsburgh, PA is providing on-site lab services.

TABLE 3

SUPPLEMENTAL GROUNDWATER INVESTIGATION FOR OU NO. 10 (SITE 35)
CAMP GEIGER AREA FUEL FARM
SOIL SAMPLING IDENTIFICATION NUMBERS FOR TEMPORARY WELL BORINGS
IN SOUTHERN AREA OF CONCERN
CONTRACT TASK ORDER 0232

TYPE/LOCATION	ANALYSIS REQUESTED		COMMENTS	
	SAMPLE ID[1]	SOUTHERN AOC CONTAMINANTS[2]	TURN AROUND	LAB
TEMPORARY WELL SOIL BORINGS (PROPOSED) SOUTHERN AOC	35-TW01B-XX	X	24 hr	Microseeps
	35-TW02B-XX	X	24 hr	Microseeps
	35-TW03B-XX	X	24 hr	Microseeps
	35-TW04B-XX	X	24 hr	Microseeps
	35-TW05B-XX	X	24 hr	Microseeps
	35-TW06B-XX	X	24 hr	Microseeps
	35-TW07B-XX	X	24 hr	Microseeps
	35-TW08B-XX	X	24 hr	Microseeps
	35-TW09B-XX	X	24 hr	Microseeps
	35-TW10B-XX	X	24 hr	Microseeps
	35-TW11B-XX	X	24 hr	Microseeps
	35-TW12B-XX	X	24 hr	Microseeps
	35-TW13B-XX	X	24 hr	Microseeps
	35-TW14B-XX	X	24 hr	Microseeps
	35-TW15B-XX	X	24 hr	Microseeps
	35-TW26B-XX	X	24 hr	Microseeps
	35-TW27B-XX	X	24 hr	Microseeps
TOTAL ANALYSES		15		

Notes:

(1) The XX in the sample ID indicates the interval where the soil sample was collected. The interval will be based on site conditions.

(2) The following analyses will be performed on soil samples collected from the southern AOC: trichloroethene, cis-1,2,-dichloroethene, trans-1,2,-dichloroethene. These analyses will be performed using modified EPA methods 8010A.

TABLE 4

SUPPLEMENTAL GROUNDWATER INVESTIGATION FOR OU NO. 10 (SITE 35)
CAMP GEIGER AREA FUEL FARM
SOIL SAMPLING IDENTIFICATION NUMBERS FOR PERMANENT WELL BORINGS
CONTRACT TASK ORDER 0232

	ANALYSIS REQUESTED		QA/QC		COMMENTS	
TYPE/LOCATION	SAMPLE ID[1]	TCL VOA[2]	DUPLICATE [3]	MS/MSD	TURN AROUND	LAB[4]
PERMANENT WELL BORINGS SOUTHERN AOC	35-MW39B-XX	X			28 day	Weston
	35-MW40B-XX	X			28 day	Weston
	35-MW41B-XX	X			28 day	Weston
	35-MW42B-XX	X			28 day	Weston
	35-MW43B-XX	X			28 day	Weston
	35-MW43B-XXD	X			28 day	Weston
PERMANENT WELL BORING NORTHERN AOC	35-MW44B-XX	X	X	X	28 day	Weston
TOTAL ANALYSES		7	1	1		

Notes:

(1) The XX in the sample ID indicates the interval where the soil sample will be collected. This interval will be based on site conditions.
(2) Level IV data quality will be provided by the lab. However, a Level III data package will be delivered.
(3) Duplicates have been arbitrarily assigned and can be changed.
(4) Weston Environmental Metrics.

TABLE 5

SUPPLEMENTAL GROUNDWATER INVESTIGATION FOR OU NO. 10 (SITE 35)
CAMP GEIGER AREA FUEL FARM
GROUNDWATER SAMPLING IDENTIFICATION NUMBERS FOR RESAMPLING OF EXISTING PERMANENT WELLS
CONTRACT TASK ORDER 0232

TYPE/LOCATION	ANALYSIS REQUESTED			QA/QC		COMMENTS	
	SAMPLE ID	TCL VOA[1]	MTBE[2]	DUPLICATE[3]	MS/MSD	TURN AROUND	LAB[4]
PERMANENT WELLS (EXISTING)	35-EMW03-04	X	X			28 day	Weston
	35-MW09B-04	X	X			28 day	Weston
	35-MW10B-04	X	X			28 day	Weston
	35-MW10B-04D	X	X	X		28 day	Weston
	35-MW14B-04	X	X			28 day	Weston
	35-MW19A-04	X	X			28 day	Weston
	35-MW19B-04	X	X			28 day	Weston
	35-MW19B-04D	X	X	X	X	28 day	Weston
	35-MW30B-04	X	X			28 day	Weston
	35-MW32A-04	X	X			28 day	Weston
	35-MW35A-04	X	X			28 day	Weston
	35-MW36A-04	X	X			28 day	Weston
	35-MW36B-04	X	X			28 day	Weston
	35-MW37B-04	X	X			28 day	Weston
TOTAL ANALYSES		14	14	2	1		

Notes:

(1) Level IV data quality will be provided by the Laboratory. However, a Level III data package will be delivered.
(2) MTBE = Methyl Tertiary Butyl Ether
(3) Duplicates have been arbitrarily assigned and can be changed.
(4) Weston Environmental Metrics.

TABLE 6

SUPPLEMENTAL GROUNDWATER INVESTIGATION FOR OU NO. 10 (SITE 35)
CAMP GEIGER AREA FUEL FARM
GROUNDWATER SAMPLING IDENTIFICATION NUMBERS FOR SGI PERMANENT WELLS
CONTRACT TASK ORDER 0232

	ANALYSIS REQUESTED			QA/QC		COMMENTS	
TYPE/LOCATION	SAMPLE ID	TCL VOA(1)	MTBE(2)	DUPLICATE(3)	MS/MSD	TURN AROUND	LAB(4)
SOUTHERN STUDY AOC	35-MW39A-04	X	X			28 day	Weston
	35-MW39B-04	X	X			28 day	Weston
	35-MW39B-04D	X	X	X	X	28 day	Weston
	35-MW40A-04	X	X			28 day	Weston
	35-MW40B-04	X	X			28 day	Weston
	35-MW41A-04	X	X			28 day	Weston
	35-MW41B-04	X	X			28 day	Weston
	35-MW42A-04	X	X			28 day	Weston
	35-MW42B-04	X	X			28 day	Weston
	35-MW43A-04	X	X			28 day	Weston
	35-MW43B-04	X	X			28 day	Weston
	35-MW43B-04D	X	X	X		28 day	Weston
	35-GWD06-04	X	X			28 day	Weston
NORTHERN STUDY AREA	35-MW44A-04	X	X			28 day	Weston
	35-MW44B-04	X	X			28 day	Weston
	35-GWD07-04	X	X			28 day	Weston
TOTAL ANALYSES		16	16	2	1		

Notes:

(1) Level IV data quality will be provided by the lab. However, a Level III data package will be delivered.
(2) MTBE - Methyl Tertiary Butyl Ether
(3) Duplicates have been arbitrarily assigned and can be changed.
(4) Weston Environmental Metrics.

TABLE 7

SUPPLEMENTAL GROUNDWATER INVESTIGATION FOR OU NO. 10 (SITE 35)
CAMP GEIGER AREA FUEL FARM
BAKER PROJECT DELIVERABLES
CONTRACT TASK ORDER 0232

Project Deliverable	Due Date
SGI Meeting	August 8, 1996
Draft SGI Report	September 12, 1996
Draft Final SGI Report	November 11, 1996
Final SGI Report	January 3, 1997
Draft FS/PRAP	November 11, 1996
Draft Final FS/PRAP	January 8, 1997
Final FS/PRAP	February 28, 1997
Draft ROD	January 8, 1997
Draft Final ROD	February 28, 1997
Final ROD	April 20, 1997

TABLE 8

SUPPLEMENTAL GROUNDWATER INVESTIGATION FOR OU NO. 10 (SITE 35)
CAMP GEIGER AREA FUEL FARM
IDW SAMPLE IDENTIFICATION NUMBERS
CONTRACT TASK ORDER 0232

SOILS

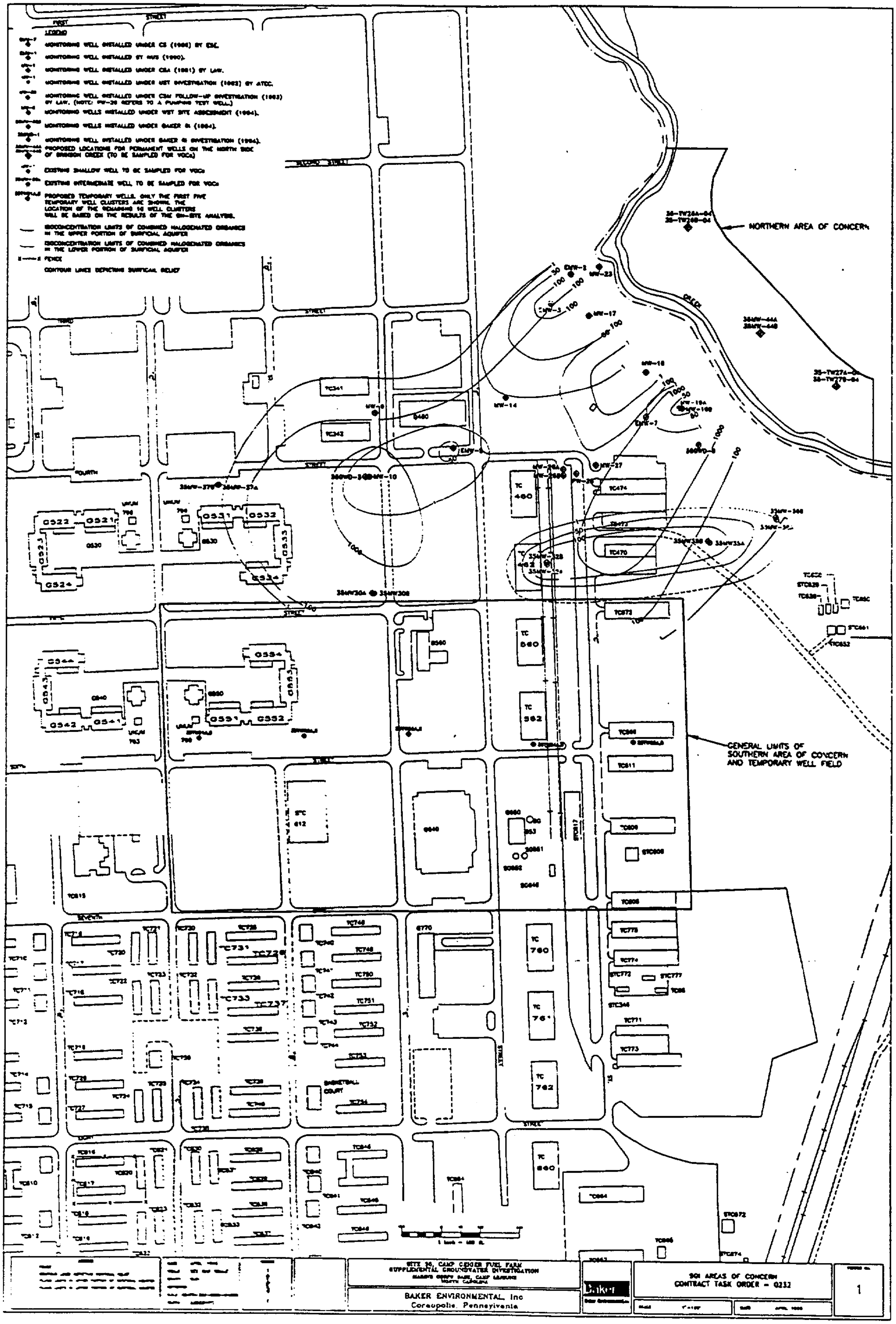
	ANALYSIS REQUESTED						COMMENTS	
TYPE/LOCATION	SAMPLE ID	RCRA Characteristics	TCLP VOA	TCLP SVOAs	TCLP Pest/Hebicides	TCLP Metals (2)	TURN AROUND	LAB
	35-IDW-ROB	X	X	X	X	X	14 day	Weston
TOTAL ANALYSES		1	1	1	1	1		

LIQUID

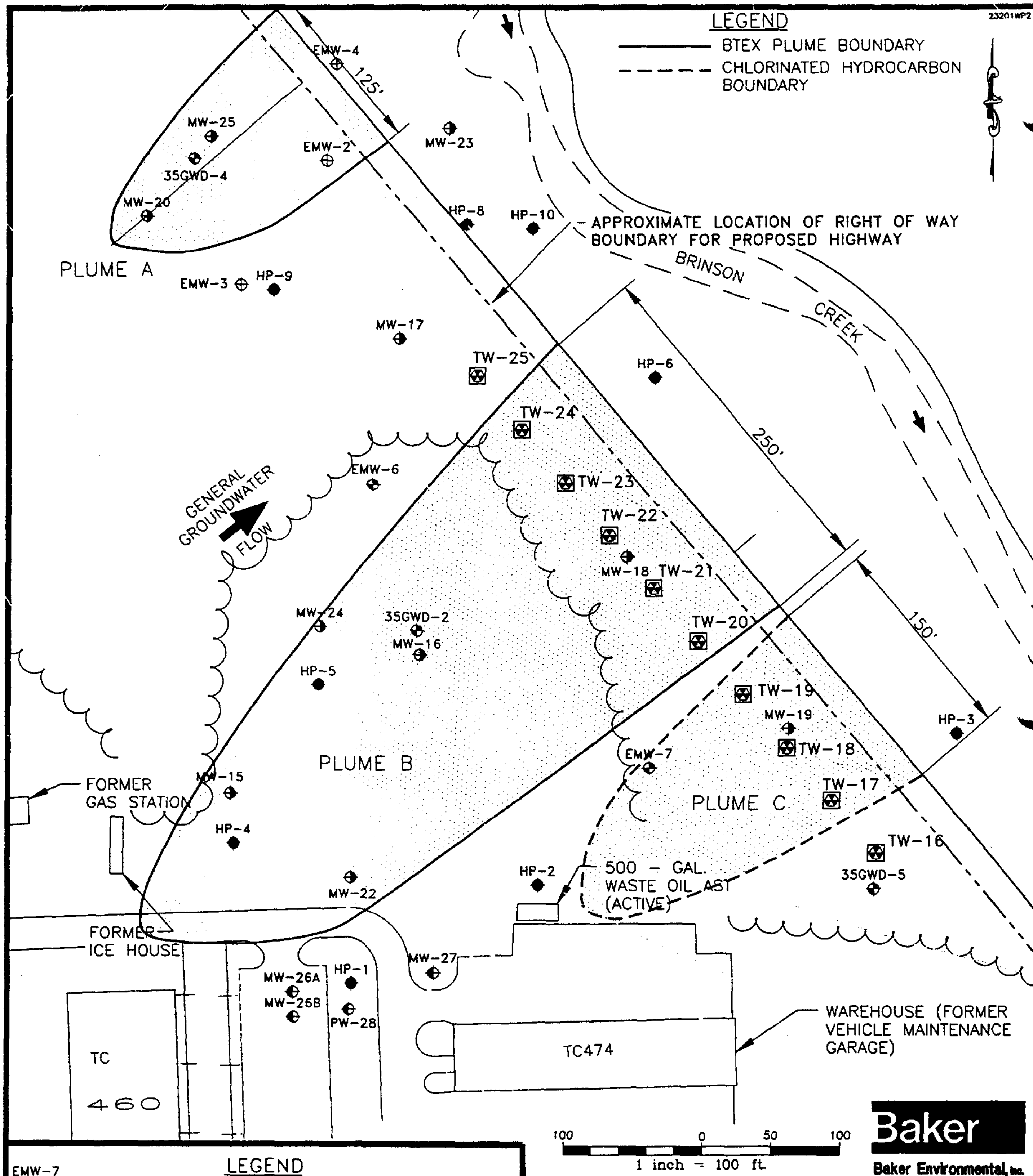
	ANALYSIS REQUESTED						COMMENTS	
TYPE/LOCATION	SAMPLE ID	TSS/TDS	TCL VOA	TCL SVOAs	TCL Pest/PCBs	TAL Metals	TURN AROUND	LAB
	35-IDW-TNK	X	X	X	X	X	14 day	Weston
TOTAL ANALYSES		1	1	1	1	1		

Notes:

(1) RCRA Hazard Characteristics



LEGEND
NORTHERN AREA OF CONCERN
GENERAL LIMITS OF SOUTHERN AREA OF CONCERN AND TEMPORARY WELL FIELD
CREEK
FIRST STREET
SECOND STREET
THIRD STREET
FOURTH STREET
SEVENTH
1 inch = 100 ft.
SITE 35, CAMP GEIGER FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA
BAKER ENVIRONMENTAL, Inc
Coraopolis, Pennsylvania
Baker
901 AREAS OF CONCERN
CONTRACT TASK ORDER – 0232
1



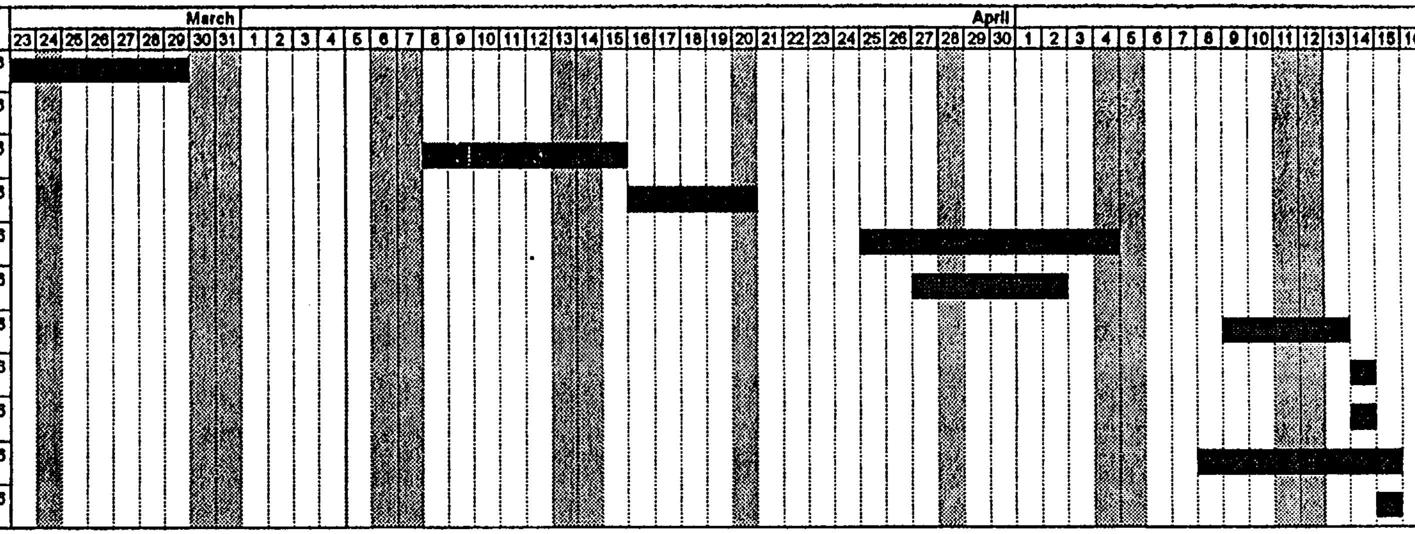
LEGEND

- EMW-7 — MONITORING WELL INSTALLED UNDER CS (1986) BY ESE.
- EMW-1 — MONITORING WELL INSTALLED BY NUS (1990).
- MW-1 — MONITORING WELL INSTALLED UNDER CSA (1991) BY LAW.
- MW-26 — MONITORING WELL INSTALLED UNDER CSM FOLLOW-UP INVESTIGATION (1993) BY LAW. (NOTE: PW-28 REFERS TO A PUMPING TEST WELL.)
- HP-18 — HYDROPUNCH SAMPLING POINT UNDER CSA (1991) BY LAW
- PROPOSED TEMPORARY WELL CLUSTER

FIGURE 2
SGI NORTHERN AOC
MONITORING WELL CLUSTERS
SITE 35, CAMP GEIGER FUEL FARM
SGI CTO-0232
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

FIGURE 3
PROPOSED SCHEDULE FOR SGI FIELD WORK
SITE 35 (OPERABLE UNIT 10), MCB, CAMP LEJEUNE

Task Name	Dur.	Start	Finish
MOBILIZATION	6d	3/23/96	3/29/96
TEMPORARY WELL INSTALLATION	0d	3/23/96	3/23/96
SAOC	8ed	4/8/96	4/16/96
NAOC	5ed	4/16/96	4/21/96
PERMANENT WELL INSTALLATION	10ed	4/25/96	5/5/96
WELL DEVELOPMENT	6ed	4/27/96	5/3/96
PERMANENT WELL SAMPLING	5ed	5/9/96	5/14/96
SLUG TEST	1ed	5/14/96	5/15/96
IDW SAMPLING	1ed	5/14/96	5/15/96
SITE SURVEY	8ed	5/8/96	5/16/96
DEMOBILIZATION	1d	5/15/96	5/15/96



APPENDIX L
QA/QC SAMPLE SUMMARIES

APPENDIX L.1
ROUND THREE, GROUNDWATER SAMPLING

QA/QC SUMMARY
TRIP BLANK (SUMMER 1995)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

LOCATION	35-TB01-02
LAB ID	95-7597-13
DATE SAMPLED	07/21/95
VOLATILES (ug/L)	
Chloromethane	10 U
Bromomethane	10 U
Vinyl Chloride	10 U
Chloroethane	10 U
Methylene Chloride	10 U
Acetone	10 U
Carbon Disulfide	10 U
1,1-Dichloroethene	10 U
1,1-Dichloroethane	10 U
1,2-Dichloroethene (total)	10 U
Chloroform	2 J
1,2-Dichloroethane	10 U
2-Butanone	10 U
1,1,1-Trichloroethane	10 U
Carbon Tetrachloride	10 U
Bromodichloromethane	10 U
1,2-Dichloropropane	10 U
cis-1,3-Dichloropropene	10 U
Trichloroethene	10 U
Dibromochloromethane	10 U
1,1,2-Trichloroethane	10 U
Benzene	2 J
trans-1,3-Dichloropropene	10 U
Bromoform	10 U
4-Methyl-2-Pentanone	10 U
2-Hexanone	10 U
Tetrachloroethene	10 U
1,1,2,2-Tetrachloroethane	10 U
Toluene	10 U
Chlorobenzene	10 U
Ethylbenzene	10 U
Styrene	10 U
Xylene (total)	10 U

QA/QC SUMMARY
EQUIPMENT RINSATES (SUMMER 1995)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

LOCATION	35-ER01-02	35-ER01-02m	35-ER03-02m	35-ER05-02	35-ER05-02m	35-ER07-02m
LAB ID	D95-7537-3	D95-7537-3	D95-7537-9	D95-7537-4	D95-7537-4	95-7597-10
DATE SAMPLED	8/10/95	08/11/95	08/09/95	8/10/95	08/11/95	08/13/95
METALS (ug/L)						
Aluminum	27.1	NA	35.5	36.3	NA	42.9 J
Antimony	20 U	NA	20 U	20 U	NA	20 U
Arsenic	2 U	NA	2 U	2 U	NA	1.4 U
Barium	20 U	NA	20 U	20 U	NA	20 U
Beryllium	1 U	NA	1 U	1 U	NA	1 U
Cadmium	2 U	NA	2 U	2 U	NA	2 U
Calcium	500 U	NA	500 U	500 U	NA	500 U
Chromium	2 U	NA	2 U	2 U	NA	2 U
Cobalt	2 U	NA	2 U	2 U	NA	2 U
Copper	5 U	NA	5 U	5 U	NA	5 U
Iron	20 U	NA	20 U	20 U	NA	20 U
Lead	1 U	NA	1 U	1 U	NA	1 UJ
Magnesium	50.6 U	NA	50 U	50 U	NA	50 U
Manganese	2 U	NA	2 U	2 U	NA	2 U
Mercury	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	10 U	NA	10 U	10 U	NA	10 U
Potassium	200 U	NA	200 U	10 U	NA	200 U
Selenium	2.5 UJ	NA	2.5 U	2.5 U	NA	2.5 UJ
Silver	2 U	NA	2 U	2 U	NA	2 U
Sodium	791	NA	1000	705	NA	854 J
Thallium	0.7 U	NA	0.7	0.7	NA	9.9 U
Vanadium	2 U	NA	2 U	2 U	NA	2 U
Zinc	7.8	7.8	6.1	6.8	6.8	15.1 U

QA/QC SUMMARY
EQUIPMENT RINSATES (SUMMER 1995)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

LOCATION LAB ID DATE SAMPLED	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
METALS (ug/L)						
Aluminum	NA	NA	27.1	42.9 J	35-ER07-02m	4/4
Antimony	20 U	20 U	ND	ND		0/4
Arsenic	1.4 U	2 U	ND	ND		0/4
Barium	20 U	20 U	ND	ND		0/4
Beryllium	1 U	1 U	ND	ND		0/4
Cadmium	2 U	2 U	ND	ND		0/4
Calcium	500 U	500 U	ND	ND		0/4
Chromium	2 U	2 U	ND	ND		0/4
Cobalt	2 U	2 U	ND	ND		0/4
Copper	5 U	5 U	ND	ND		0/4
Iron	20 U	20 U	ND	ND		0/4
Lead	1 U	1 U	ND	ND		0/4
Magnesium	50 U	50.6 U	ND	ND		0/4
Manganese	2 U	2 U	ND	ND		0/4
Mercury	0.2 U	0.2 U	ND	ND		0/6
Nickel	10 U	10 U	ND	ND		0/4
Potassium	10 U	200 U	ND	ND		0/4
Selenium	2.5 UJ	2.5 UJ	ND	ND		0/4
Silver	2 U	2 U	ND	ND		0/4
Sodium	NA	NA	705	1000	35-ER03-02m	4/4
Thallium	0.7 U	9.9 U	0.7	0.7	35-ER05-02	2/4
Vanadium	2 U	2 U	ND	ND		0/4
Zinc	15.1 U	15.1 U	6.1	7.8	35-ER01-02m	5/6

QA/QC SUMMARY
EQUIPMENT RINSATE - TPH (SUMMER 1995)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

LOCATION	35-ER01-02m
LAB ID	D95-7537-3
DATE SAMPLED	08/11/95
Total Petroleum Hydrocarbon 5030/8015M ug/L	
Gasoline	50 U
Total Petroleum Hydrocarbon 8015M mg/L	
Diesel	0.6 U

QA/QC SUMMARY
FIELD BLANK (SUMMER 1995)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

LOCATION	35-FB01-02m	
LAB ID	95-7597-12	
DATE SAMPLED	08/14/95	
METALS (ug/L)		
Aluminum	20.3	J
Antimony	20	U
Arsenic	1.4	U
Barium	20	U
Beryllium	1	U
Cadmium	2	U
Calcium	500	U
Chromium	2	U
Cobalt	2	U
Copper	5	U
Iron	20	U
Lead	1	UJ
Magnesium	50	U
Manganese	2	U
Mercury	0.2	U
Nickel	10	U
Potassium	200	U
Selenium	2.5	UJ
Silver	2	U
Sodium	509	J
Thallium	9.9	U
Vanadium	2	U
Zinc	5	U

GROUNDWATER - DUPLICATE SUMMARY
INORGANICS (SUMMER 1995)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

LOCATION	35-MW16S-02	35-MW16S-02D	35-MW19S-02	35-MW19S-02D
LAB ID	95-7537-11	95-7537-12	D95-7537-6	D95-7537-7
DATE SAMPLED	08/10/95	08/10/95	08/11/95	08/11/95
ANALYTES (ug/L)				
Aluminum	20 U	20 U	282	205
Antimony	20 U	20 U	20 U	20 U
Arsenic	10.3	11.1	2 U	2 U
Barium	32.2 J	31.3 J	20 U	20 U
Beryllium	1 U	1 U	1 U	1 U
Cadmium	2 U	2 U	2 U	2 U
Calcium	124000	121000	35600	34500
Chromium	2 U	2 U	2 U	2 U
Cobalt	16 J	16.9 J	4.4 J	4.1 J
Copper	5 U	5 U	5 U	5 U
Iron	40400	42200	266	215
Lead	8.9	2.9 J	1 U	1 U
Magnesium	4580 J	4540 J	1880 J	1770 J
Manganese	141	139	102	98.1
Mercury	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	10 U	10 U	10 U	10 U
Potassium	793 J	728 J	2650 J	2600 J
Selenium	2.5 UJ	2.5 U	2.5 U	2.5 U
Silver	10.9	2 U	2 U	2 U
Sodium	4350 J	4520 J	11300	11200
Thallium	0.9 J	1.1 J	0.7 U	1.3 J
Vanadium	2 U	2 U	2 U	2 U
Zinc	11.5 J	5 U	9.9 J	11.7 J

SEDIMENTS - DUPLICATE SUMMARY
INORGANICS (SUMMER 1995)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

LOCATION	35-SD07-06-02	35-SD07-06D-02	36-SD07-06-02	36-SD07-06D-02
LAB ID	D95-7354-1	D95-7354-2	D95-7350-5	D95-7350-6
DATE SAMPLED	08/08/95	08/08/95	08/07/95	08/07/95
METALS (mg/kg)				
Mercury	0.19 U	0.17 U	0.34 U	0.34 U
Zinc	72.6	61.7	65.8	94.5

APPENDIX L.2
ROUND FOUR, GROUNDWATER SAMPLING

QA/QC SUMMARY
TRIP BLANKS (SPRING 1996)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	35-TB01-04	35-TB02-35	35-TB03-04	35-TB04-04	35-TB06-04	35-TB07-04
METHOD	VOA1.8	VOA1.8	VOA1.8	VOA1.8	VOA1.8	VOA1.8
DATE SAMPLED	04/25/96	04/26/96	04/27/96	04/29/96	05/01/96	05/03/96
VOLATILES (ug/L)						
TRICHLOROETHENE	10 U	10 U	10 U	10 U	10 U	3 J

QA/QC SUMMARY
TRIP BLANKS (SPRING 1996)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - *CTO 0232*
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	35-TB08-04	35-TBO5-04
METHOD	VOA1.8	VOA1.8
DATE SAMPLED	08/04/96	04/27/96
VOLATILES (ug/L)		
TRICHLOROETHENE	10 U	10 U

QA/QC SUMMARY
TRIP BLANKS (SPRING 1996)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID METHOD DATE SAMPLED	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION	AVERAGE OF POSITIVE DETECTIONS	MEDIAN OF POSITIVE DETECTIONS
VOLATILES (ug/L)								
TRICHLOROETHENE	10 U	10 U	3 J	3 J	35-TB07-04	1/8	3.00	3.00

QA/QC SUMMARY
EQUIPMENT RINSATES (SPRING 1996)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	35-ERW01-04	35-ERW03-04	35-ERW05-04	35-ERW07-04	35-ERW09-04	35-ERW10-04
METHOD	VOA1.8	VOA1.8	VOA1.8	VOA1.8	VOA1.8	VOA1.8
DATE SAMPLED	04/25/96	04/27/96	04/29/96	05/01/96	05/03/96	08/05/96
VOLATILES (ug/L)						
CHLOROMETHANE	10 U	10 U	10 U	10 U	10 U	10 U
BROMOMETHANE	10 U	10 U	10 U	10 U	10 U	10 U
VINYL CHLORIDE	10 U	10 U	10 U	10 U	10 U	10 U
CHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
METHYLENE CHLORIDE	10 U	10 U	10 U	10 U	10 U	10 U
ACETONE	10 U	10 U	10 U	10 U	10 U	10 U
CARBON DISULFIDE	10 U	10 U	10 U	10 U	10 U	10 U
1,1-DICHLOROETHENE	10 U	10 U	10 U	10 U	10 U	10 U
1,1-DICHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROETHENE (TOTAL)	10 U	10 U	10 U	10 U	10 U	10 U
CHLOROFORM	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
2-BUTANONE	10 U	10 U	10 U	10 U	10 U	10 U
1,1,1-TRICHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
CARBON TETRACHLORIDE	10 U	10 U	10 U	10 U	10 U	10 U
BROMODICHLOROMETHANE	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROPROPANE	10 U	10 U	10 U	10 U	10 U	10 U
CIS-1,3-DICHLOROPROPENE	10 U	10 U	10 U	10 U	10 U	10 U
TRICHLOROETHENE	10 U	10 U	10 U	10 U	10 U	10 U
DIBROMOCHLOROMETHANE	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2-TRICHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
BENZENE	10 U	18	10 U	10 U	10 U	10 U
TRANS-1,3-DICHLOROPROPENE	10 U	10 U	10 U	10 U	10 U	10 U
BROMOFORM	10 U	10 U	10 U	10 U	10 U	10 U
4-METHYL-2-PENTANONE	10 U	10 U	10 U	10 U	10 U	10 U
2-HEXANONE	10 U	10 U	10 U	10 U	10 U	10 U
TETRACHLOROETHENE	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2,2-TETRACHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
TOLUENE	10 U	10 U	10 U	10 U	10 U	10 U
CHLOROBENZENE	10 U	10 U	10 U	10 U	10 U	10 U
ETHYLBENZENE	10 U	10 U	10 U	10 U	10 U	10 U
STYRENE	10 U	10 U	10 U	10 U	10 U	10 U
XYLENE (TOTAL)	10 U	10 U	10 U	10 U	10 U	10 U
METHYL-TERT-BUTYL ETHER	5 U	5 U	5 U	5 U	5 U	NA

QA/QC SUMMARY
EQUIPMENT RINSATES (SPRING 1996)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID METHOD DATE SAMPLED	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION	AVERAGE OF POSITIVE DETECTIONS	MEDIAN OF POSITIVE DETECTIONS
VOLATILES (ug/L)								
CHLOROMETHANE	10 U	10 U	ND	ND		0/6	NA	NA
BROMOMETHANE	10 U	10 U	ND	ND		0/6	NA	NA
VINYL CHLORIDE	10 U	10 U	ND	ND		0/6	NA	NA
CHLOROETHANE	10 U	10 U	ND	ND		0/6	NA	NA
METHYLENE CHLORIDE	10 U	10 U	ND	ND		0/6	NA	NA
ACETONE	10 U	10 U	ND	ND		0/6	NA	NA
CARBON DISULFIDE	10 U	10 U	ND	ND		0/6	NA	NA
1,1-DICHLOROETHENE	10 U	10 U	ND	ND		0/6	NA	NA
1,1-DICHLOROETHANE	10 U	10 U	ND	ND		0/6	NA	NA
1,2-DICHLOROETHENE (TOTAL)	10 U	10 U	ND	ND		0/6	NA	NA
CHLOROFORM	10 U	10 U	ND	ND		0/6	NA	NA
1,2-DICHLOROETHANE	10 U	10 U	ND	ND		0/6	NA	NA
2-BUTANONE	10 U	10 U	ND	ND		0/6	NA	NA
1,1,1-TRICHLOROETHANE	10 U	10 U	ND	ND		0/6	NA	NA
CARBON TETRACHLORIDE	10 U	10 U	ND	ND		0/6	NA	NA
BROMODICHLOROMETHANE	10 U	10 U	ND	ND		0/6	NA	NA
1,2-DICHLOROPROPANE	10 U	10 U	ND	ND		0/6	NA	NA
CIS-1,3-DICHLOROPROPENE	10 U	10 U	ND	ND		0/6	NA	NA
TRICHLOROETHENE	10 U	10 U	ND	ND		0/6	NA	NA
DIBROMOCHLOROMETHANE	10 U	10 U	ND	ND		0/6	NA	NA
1,1,2-TRICHLOROETHANE	10 U	10 U	ND	ND		0/6	NA	NA
BENZENE	10 U	10 U	18	18	35-ERW03-04	1/6	18.00	18.00
TRANS-1,3-DICHLOROPROPENE	10 U	10 U	ND	ND		0/6	NA	NA
BROMOFORM	10 U	10 U	ND	ND		0/6	NA	NA
4-METHYL-2-PENTANONE	10 U	10 U	ND	ND		0/6	NA	NA
2-HEXANONE	10 U	10 U	ND	ND		0/6	NA	NA
TETRACHLOROETHENE	10 U	10 U	ND	ND		0/6	NA	NA
1,1,2,2-TETRACHLOROETHANE	10 U	10 U	ND	ND		0/6	NA	NA
TOLUENE	10 U	10 U	ND	ND		0/6	NA	NA
CHLOROBENZENE	10 U	10 U	ND	ND		0/6	NA	NA
ETHYLBENZENE	10 U	10 U	ND	ND		0/6	NA	NA
STYRENE	10 U	10 U	ND	ND		0/6	NA	NA
XYLENE (TOTAL)	10 U	10 U	ND	ND		0/6	NA	NA
METHYL-TERT-BUTYL ETHER	5 U	5 U	ND	ND		0/5	NA	NA

QA/QC SUMMARY
FIELD BLANK (SPRING 1996)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	35-FB-04
METHOD	VOA1.8
DATE SAMPLED	08/03/96
VOLATILES (ug/L)	
CHLOROMETHANE	10 U
BROMOMETHANE	10 U
VINYL CHLORIDE	10 U
CHLOROETHANE	10 U
METHYLENE CHLORIDE	10 U
ACETONE	10 U
CARBON DISULFIDE	10 U
1,1-DICHLOROETHENE	10 U
1,1-DICHLOROETHANE	10 U
1,2-DICHLOROETHENE (TOTAL)	10 U
CHLOROFORM	10 U
1,2-DICHLOROETHANE	10 U
2-BUTANONE	10 U
1,1,1-TRICHLOROETHANE	10 U
CARBON TETRACHLORIDE	10 U
BROMODICHLOROMETHANE	5 J
1,2-DICHLOROPROPANE	10 U
CIS-1,3-DICHLOROPROPENE	10 U
TRICHLOROETHENE	10 U
DIBROMOCHLOROMETHANE	8 J
1,1,2-TRICHLOROETHANE	10 U
BENZENE	10 U
TRANS-1,3-DICHLOROPROPENE	10 U
BROMOFORM	10 U
4-METHYL-2-PENTANONE	10 U
2-HEXANONE	10 U
TETRACHLOROETHENE	10 U
1,1,2,2-TETRACHLOROETHANE	10 U
TOLUENE	10 U
CHLOROBENZENE	10 U
ETHYLBENZENE	10 U
STYRENE	10 U
XYLENE (TOTAL)	10 U

GROUNDWATER - DUPLICATE SUMMARY
ORGANICS (SPRING 1996)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	35-MW10D-04D	35-MW19D-04D	35-MW42B-04D	35-MW60B-04D
METHOD	VOA1.8	VOA1.8	VOA1.8	VOA1.8
DATE SAMPLED	04/27/96	04/27/96	05/03/96	08/04/96
VOLATILES (ug/L)				
CHLOROMETHANE	10 U	10 U	10 U	10 U
BROMOMETHANE	10 U	10 U	10 U	10 U
VINYL CHLORIDE	10 U	10 U	10 U	10 U
CHLOROETHANE	10 U	10 U	10 U	10 U
METHYLENE CHLORIDE	10 U	10 U	10 U	10 U
ACETONE	10 U	10 U	10 U	10 U
CARBON DISULFIDE	10 U	10 U	10 U	10 U
1,1-DICHLOROETHENE	6 J	10 U	10 U	10 U
1,1-DICHLOROETHANE	10 U	10 U	10 U	10 U
1,2-DICHLOROETHENE (TOTAL)	960	370	62	10 U
CHLOROFORM	10 U	10 U	10 U	10 U
1,2-DICHLOROETHANE	10 U	10 U	10 U	10 U
2-BUTANONE	10 U	10 U	10 U	10 U
1,1,1-TRICHLOROETHANE	10 U	10 U	10 U	10 U
CARBON TETRACHLORIDE	10 U	10 U	10 U	10 U
BROMODICHLOROMETHANE	10 U	10 U	10 U	10 U
1,2-DICHLOROPROPANE	10 U	10 U	10 U	10 U
CIS-1,3-DICHLOROPROPENE	10 U	10 U	10 U	10 U
TRICHLOROETHENE	630	320	110	10 U
DIBROMOCHLOROMETHANE	10 U	10 U	10 U	10 U
1,1,2-TRICHLOROETHANE	10 U	10 U	10 U	10 U
BENZENE	10 U	10 U	10 U	10 U
TRANS-1,3-DICHLOROPROPENE	10 U	10 U	10 U	10 U
BROMOFORM	10 U	10 U	10 U	10 U
4-METHYL-2-PENTANONE	10 U	10 U	10 U	10 U
2-HEXANONE	10 U	10 U	10 U	10 U
TETRACHLOROETHENE	10 U	10 U	10 U	10 U
1,1,2,2-TETRACHLOROETHANE	10 U	10 U	10 U	10 U
TOLUENE	2 J	10 U	10 U	10 U
CHLOROBENZENE	10 U	10 U	10 U	10 U
ETHYLBENZENE	10 U	10 U	10 U	10 U
STYRENE	10 U	10 U	10 U	10 U
XYLENE (TOTAL)	10 U	10 U	10 U	10 U
METHYL-TERT-BUTYL ETHER	5 U	5 U	5 U	NA

APPENDIX M
BASE BACKGROUND DATA

DRAFT

EVALUATION OF METALS IN GROUNDWATER

MARINE CORPS BASE, CAMP LEJEUNE, NORTH CAROLINA

CONTRACT TASK ORDER 0177

JUNE 3, 1994

Prepared for:

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES
ENGINEERING COMMAND
Norfolk, Virginia

Under the:

LANTDIV CLEAN Program
Contract N62470-89-D-4814

Prepared by:

BAKER ENVIRONMENTAL, INC.
Coraopolis, Pennsylvania

TABLE OF CONTENTS

1.0 INTRODUCTION

Numerous groundwater investigations have been conducted at Marine Corps Base (MCB), Camp Lejeune under the Department of the Navy (DON) Installation Restoration Program (IRP). These studies have identified elevated levels of total metals in shallow groundwater at almost every site. The degree of contamination, based on dissolved metals analysis of groundwater samples, is limited. It is believed that the presence of elevated metals are not always related to past disposal activities for several reasons, which is the basis of this study.

Currently, Records of Decision (ROD) are being prepared for Operable Units No. 1 (Sites 21, 24, and 78) and No. 5 (Site 2). Both RODs are proposing to not remediate shallow groundwater which contains elevated levels of total metals above State groundwater standards (i.e., North Carolina Water Quality Standards) and/or Federal drinking water standards (i.e., Maximum Contaminant Levels). Specifically, remediation of shallow groundwater due to elevated total metals is not cost effective, or practical, due to the following: (1) the shallow aquifer is not used for potable supply; (2) the source of metals in groundwater cannot be correlated with soil data or previous disposal practices; (3) the extent of shallow groundwater contamination (based on total metals analysis) is widespread and in many cases undefinable, since there are no apparent contaminant plumes or patterns associated with the metals; and (4) deep groundwater, which is the source of potable water, is not significantly contaminated with metals above the standards.

2.0 STUDY OBJECTIVES

The DON/Marine Corps initiated a study on inorganics in groundwater throughout MCB Camp Lejeune to assess whether total metals in groundwater are related to disposal practices or to other factors. The overall goal of this study is to provide information that would be used in consideration of not remediating shallow groundwater at Operable Units No. 1 and No. 5, and possibly other operable units where total metals are elevated without cause. The following study objectives were identified:

(1) Determine whether the elevated total metals detected in the shallow aquifer are related to past disposal practices, well construction factors, sampling techniques, or suspended particulates in the samples;

(2) Determine whether total metals in shallow groundwater are elevated throughout the region or MCB Camp Lejeune;

(3) Determine whether there is a correlation between elevated total metals in groundwater and metals in soil; and

(4) Determine whether the concentrations of total metals (i.e., low versus high) is related to shallow and deep aquifer characteristics.

3.0 SCOPE OF WORK

Groundwater and soil data from a total of 21 sites were compiled as part of the overall study. Three of the 21 sites are located outside the boundary of the base. These sites include the ABC Cleaners Superfund Site, located along Route 24 in Jacksonville, and two sites located along Highway 17 (Off-site Properties No. 1 and No. 2). The two sites along Route 17 were investigated by the DON/Marine Corps as part of a real estate survey. The other 18 sites are located throughout various portions of MCB Camp Lejeune (see Figure 1).

Information from studies conducted by Baker and other consultants were obtained to evaluate metal concentrations in groundwater. The study focused on 14 metals of potential concern to human health and the environment. Some of the information was collected under the IR Program whereas other information was obtained during other investigations (e.g., ABC Cleaners RI/FS). The following data tables were then prepared to determine why total metals are generally elevated in shallow groundwater.

Table 1 - Total Metal Concentrations in Shallow Groundwater by Site

Table 2 - Summary of Repeat Sampling of Shallow Wells (Sites 2 and 78)

Table 3 - Dissolved Metal Concentrations in Shallow Groundwater by Site

Table 4 - Summary of Total Metal Concentrations in Upgradient Wells

Table 5 - Comparison of Subsurface Metal Concentrations in Uncontaminated and Contaminated Wells

Table 6 - Total Metal Concentrations in Deep Groundwater by Site

Table 7 - Summary of Field Parameters in Shallow Monitoring Wells, Deep Monitoring Wells, and Supply Wells

The tables are presented at the end of this report.

4.0 DATA ANALYSIS

The following discussion represents an analysis of the information contained in each of the previously mentioned tables.

Table 1 (Total Metal Concentrations in Shallow Groundwater)

All of the sites had at least one (and in most cases several) metal which exceeded either State water quality standards or Federal drinking water standards. The most frequently detected metals included chromium, lead, and manganese, which were detected at almost every site above drinking water standards. Other frequently detected metals which exceeded drinking water standards included arsenic, beryllium, cadmium, and nickel.

An analysis of the data from Table 1 indicates that elevated total metals are present in shallow groundwater at every site, including the three sites which are located off base. The two sites which did not exhibit significant contamination include the ABC Cleaners site (only chromium exceeded the standards) and Site 48 (only manganese exceeded the standards).

Total metals detected in shallow groundwater at Site 2 exceeded State and/or Federal standards in seven of the 11 shallow monitoring wells. Manganese was the most frequently detected metal (7/11). Lead (3/11), chromium (2/11), and cadmium (1/11) were also detected above the standards,, but less frequently (see Figure 2).

With the exception of Wells 78GW03 and 78GW19, total metals were detected at Site 78 (Hadnot Point Industrial Area) above Federal MCLs or NCWQS in every shallow well (see Figure 3). The extent of elevated total metals in groundwater is widespread, encompassing approximately one square mile (or approximately 660 acres) in total area. The distribution and concentration of total metals in shallow groundwater makes it virtually impossible to identify or illustrate contaminant plumes (see Figure 3).

An analysis of the total metals results indicates the following pattern. Samples exhibiting elevated levels of lead, chromium, or other contaminants of concern, also exhibited elevated levels of other metals such as aluminum, antimony, iron, and zinc. Samples which did not exhibit elevated levels of lead, chromium, or manganese also did not exhibit elevated levels of other metals. This pattern indicates that the elevated total metals are not limited to one or two contaminants, which would be the case if a lead or chromium plume in the groundwater truly existed. In other words, if a site is impacted by a particular metal due to disposal activities (say chromium for example), then other metals such as aluminum, lead, or zinc should not be consistently elevated as in the case of samples collected from the shallow aquifer at MCB Camp Lejeune. This point is depicted in the data summary tables provided in Appendix A for Sites 2 and 78. These tables were taken from the Remedial Investigation Reports for Operable Units No. 1 and No. 5. As an example, note that sample numbers 78-MW08, 78-MW10, 78-MW11, and 78-MW12 all had elevated levels of total metals when compared to samples 78-MW09-2 and 78-MW09-3. It is clear that most of the metal concentrations in a particular sample follow a consistent pattern throughout.

Table 2 (Comparison of Repeat Sampling of Shallow Wells

Five wells from Sites 2 and 78 were randomly chosen to evaluate total metals concentrations between sampling rounds. The comparison was limited to only chromium, lead, and manganese since these contaminants were frequently detected throughout MCB Camp Lejeune. In several cases, metal concentrations were significantly different between the sampling rounds. If the shallow aquifer was impacted due to former disposal activities, a contaminant plume would be present and concentrations would not significantly deviate. The deviation in metal concentrations may indicate that sampling results are biased due to suspended particulates in the samples.

Table 3 (Dissolved Metal Concentration in Shallow Groundwater by Site)

The data base for Table 3 was limited to 12 sites since many of the previous investigations (i.e., prior to Navy CLEAN) did not analyze for dissolved metals. Nevertheless, an analysis of the 12 sites revealed that elevated levels of dissolved metals in groundwater is limited. Manganese was the most frequently detected metal above drinking water standards (10 of 12 sites exhibited elevated levels). Lead was detected at only one site (Site 21) above drinking water standards. Chromium was also detected at only one site (Site 78) above drinking water standards. No other metal was detected above the standards.

Literature searches have indicated that manganese is a naturally occurring metal in North Carolina. Therefore, the presence of manganese may not be attributable to site-related activities (Greenhorne & O'Mara, 1992).

An analysis of the data from Table 3 clearly shows a significant reduction in metal concentrations when compared to Table 1 (total metals in shallow groundwater). One possible reason for this reduction is that suspended solids or particles are not being introduced into the analysis of the sample due to filtering. A second possibility is that the metals are not significantly present in a dissolved state in shallow groundwater due to the species of metals under site conditions. It should be noted that calcium and sodium did not exhibit such a pattern since the salts of these metals are more soluble in water. For example, the concentrations of total calcium and total sodium versus dissolved calcium and dissolved sodium are similar and are not affected by the removal of the particulates during filtering. The fact that these salts do not exhibit the pattern that the other metals show supports the possibility that total metal concentrations are influenced by particulates in the sample.

Table 4 (Total Metals in Upgradient Shallow Wells)

The data base for Table 4 consists of groundwater results from 14 upgradient shallow monitoring wells (i.e., one well per site). These wells were installed to determine baseline groundwater quality to which on-site groundwater conditions could be compared. In some cases, the upgradient wells were located in areas where other base activities may have influenced groundwater quality.

The analysis of this data shows that manganese was the most frequently detected metal above Federal or State standards in upgradient shallow wells. Manganese was detected in 7 of the 14 upgradient wells above drinking water standards. Chromium and lead were also frequently detected above drinking water standards in upgradient (background) wells. These contaminants were detected in 6 of the 14 upgradient wells. At Site 2, samples collected from an upgradient well (2GW9) exhibited elevated levels of chromium (83µ/l), lead (27.2µ/l) and manganese (747µ/l). At Site 78, samples collected from upgradient wells 96W4 and 78GW26 did not exhibit elevated levels of total metals. The concentration range for metals detected above NC WQS and/of Federal MCLs in upgradient wells is provided below:

- beryllium (ND-46.5 µ/l)
- cadmium (ND-10 µ/l)
- chromium (ND-198 µ/l)
- lead (ND-78.8 µ/l)
- manganese (ND-747 µ/l)
- mercury (ND-1.6J µ/l)

Based on the above range representing upgradient wells, none of the on-site wells at Site 2 exhibited total metals above the maximum background concentrations. However, at Site 78, lead and chromium were detected above the maximum background in several on-site wells.

An analysis of the data from Table 4 indicates that shallow groundwater upgradient of some sites contains total metals above drinking water standards. A comparison of Table 4 data against Table 1 data indicates that shallow groundwater samples from upgradient wells are less contaminated than samples collected from on-site monitoring wells. However, it should be noted that the data base for Table 4 consists of only 14 wells whereas the data base for Table 1 consists of over 130 wells. Therefore, to assume that upgradient groundwater quality is better than on-site groundwater quality may not be justified due to the different data bases.

<u>Table 5 (Comparison of Subsurface Metal Concentrations in Uncontaminated and Contaminated Wells)</u>

The purpose of this table is to determine whether metal concentrations in soils correlate with the elevated levels of metals in shallow groundwater.

To evaluate this, metals in subsurface soils, representing an area of groundwater contamination, were compared to metals in subsurface soil in areas which did not exhibit groundwater contamination. If the elevated total metals in shallow groundwater are present due to former disposal activities, subsurface metals in soil representing an area of groundwater contamination would be expected to be elevated or higher than metals in subsurface soil representing a non-contaminated area. This evaluation assumes that the well exhibiting elevated total metals is within a source area and that the soil sample is representative of soil impacted by metal contamination.

As shown on Table 5, there is no clear pattern or correlation which indicates that elevated total metals are due to soil contamination. Note that in many cases, the concentration of metals which represent "non-contaminated" areas are greater than the metals which represent "contaminated" areas. Also note that the metals in subsurface soil are within or close to background subsurface metal concentrations. Therefore, this supports the possibility that in many cases at MCB Camp Lejeune, the elevated total metals in shallow groundwater cannot be attributable to a source or to past disposal practices.

Table 6 (Total Metals in Deep Monitoring Wells)

Table 6 presents total metal concentrations in deep groundwater for each site. The data base is limited to only 8 sites. Metal concentrations in supply wells were also included for comparison purposes.

As shown on Table 6, total metals in deep groundwater are below drinking water standards with a few exceptions. Arsenic and cadmium were detected above the standards in one deep monitoring well at Site 78 (see Figure 4). Manganese was detected in deep groundwater at three sites and a few of the supply wells. Lead was detected in one supply well at 16 µ/l, which is slightly above the drinking water standard of 15 µ/l.

Elevated total metals are not widespread in deep groundwater for two possible reasons. First, most metals are not very mobile in the environment. Second, deep groundwater samples may not have significant amounts of suspended particulates due to different geologic conditions. Soils in the deeper aquifer are more compacted and consist primarily of calcareous sands, clays, and limestone fragments. Soils in the shallow aquifer are loosely compacted and consist primarily of fine-grained sands, silts, and clays. This classification may support the possibility that suspended solids are collected during sampling, thereby influencing the analysis for total metals.

Table 7 (Summary of Field Parameters in Shallow, Deep, and Supply Wells)

Table 7 provides a range of pH and specific conductivity values representative of shallow and deep groundwater. In general, lower pH values were noted more often in shallow wells than in deep wells (including the supply wells). This condition may influence the leachability and speciation of metals in groundwater.

Deep groundwater usually exhibited higher specific conductivity values. High specific conductivity values are representative of high dissolved conditions. The fact that deep groundwater generally exhibited higher specific conductivity values indicates that most of the metals, if present, are in a dissolved state. The high specific conductivity values could also indicate less suspended particulates due to the geologic conditions of the deep aquifer. The lower specific conductivity values observed in shallow wells indicates that the metals in the shallow aquifer are not in a dissolved state. This also supports the possibility that suspended particulates in the shallow aquifer are influencing the analysis of total metals.

5.0 ANALYSIS OF THE STUDY OBJECTIVES

Each of the objectives identified for this study are analyzed below based on the information collected.

Objective No. 1 (Determine whether the elevated total metals in the shallow aquifer are related to past disposal practices, well construction factors, sampling techniques, or suspended particulates in the samples)

Based on the analysis of information provided in Tables 1 through 7 and Appendix A, it appears that suspended particulates in groundwater samples could influence the concentration of total metals in groundwater. Well construction factors and sampling techniques are probably not a significant factor since the data base is representative of data obtained by Baker, ESE (Site 28 and 30), Roy F. Weston (ABC Cleaners), and Halliburton NUS (Site 7). No particular pattern was noted between sites which Baker obtained the samples versus sites in which other consultants obtained the data. Sampling methods were also considered. For Sites 63 and 65 for example, samples were collected with a bailer. At Sites 2 and 78, samples were collected with a low flow pump. All four sites exhibited elevated levels of total metals in groundwater samples. In addition, due to the fact that deep groundwater quality is not significantly impacted with metals indicates that well construction or sampling techniques are probably not factors related to elevated total metals in groundwater.

With respect to past disposal practices, Table 5 clearly shows that soil concentrations do not correlate with elevated total metals in groundwater. Based on this analysis, and on many of the sites previously investigated, the source of total metals in groundwater cannot be attributable to soil contamination or disposal practices in many cases. This is based on both the history of the site as well as the analytical soil results. In some cases, total metals were detected at elevated levels even when the site history did not correlate with the contaminants found. For example, Sites 2 and 21 have a history of pesticide storage and handling, and there are no known disposal areas (i.e., buried debris) within the site boundary. Nevertheless, both of these sites exhibited several metals above drinking water standards that would not be expected to be present at high concentrations based on the historical use of the site. These metals included lead, chromium, beryllium, cadmium, and manganese.

Objective No. 2 (Determine whether total metals in shallow groundwater are elevated throughout the region or MCB Camp Lejeune)

Based on groundwater data obtained from both upgradient wells and off base wells, total metals were detected above drinking water standards in shallow groundwater in areas that would not be influenced by former disposal activities at the sites. Given that some of the upgradient wells are contaminated, it is apparent that total metals in shallow groundwater are elevated in certain areas of the base outside of the influence of site-related disposal activities. However, it is unknown whether the shallow aquifer upgradient of the sites is contaminated due to other base-related activities or whether the levels in groundwater samples are also elevated due to the influence of suspended fines in the samples.

Objective No. 3 (Determine whether there is a correlation between elevated total metals in groundwater and metals in soil)

An evaluation of the data presented in Table 5 shows that metals in soil samples collected in areas of groundwater contamination are not elevated when compared to metals in soil samples collected in areas that did not exhibit groundwater contamination. This supports the possibility that in many cases, elevated levels of total metals in shallow groundwater are not related to the disposal history at the site. As previously mentioned, sites which did not exhibit soil contamination (when compared to background soil levels) or did not have a history of disposal indicative of metals contamination still exhibited elevated levels of total metals in groundwater. Since there is no apparent correlation between metals in soil and total metals in groundwater, then the possibility exists that the elevated total metals in groundwater are biased high due to suspended particulates.

Objective No. 4 (Determine whether the concentrations of total metals in groundwater is related to shallow and deep aquifer characteristics)

There is some evidence that the geologic conditions of the shallow and deep aquifers influence the amount of total metals detected in groundwater samples. The fact that the deep aquifer generally exhibited higher specific conductivity values indicates that there is more dissolved constituents in the deep aquifer when compared to the shallow aquifer. This was evident when comparing Table 1 (total metals in shallow groundwater) to Table 6 (total metals in deep groundwater). Table 6 did not indicate significant levels of total metals in deep groundwater throughout MCB Camp Lejeune.

The geologic conditions of the shallow aquifer would tend to result in samples that may contain suspended particulates. The suspended particulates could influence the total metals concentrations in the samples.

6.0 CONCLUSIONS

1. Elevated levels of total metals in the shallow aquifer are probably influenced to some degree by the geologic conditions of the site.

2. There is no correlation between metal levels in soil and total metals in groundwater. Therefore, elevated total metals in groundwater cannot be attributable to soil contamination of past disposal practices.

3. Elevated levels of total metals in the shallow aquifer may be biased high due to suspended particulates in the samples.

4. Dissolved metals in groundwater were generally below Federal MCLs and NC WQS and therefore, do not present a significant problem at MCB Camp Lejeune.

5. Total and dissolved metal concentrations in the Castle Hayne aquifer were generally below drinking water standards and therefore, do not present a significant problem at MCB Camp Lejeune.

6. The presence of manganese in shallow and deep groundwater may be due to naturally occurring geologic conditions.

7.0 RECOMMENDATIONS

1. Remediation of total metals in the shallow aquifer at Operable Units 1 and 5 is not recommended based on the following:

   - Elevated metals in groundwater at both operable units does not appear to be related to soil contamination or past disposal practices;
   - The distribution of total metals in groundwater is not characteristic of a plume that would be present due to a source of contamination;
   - Remediation of total metals would not be practical from an engineering or cost standpoint; and
   - Currently, there is no human or environmental exposure to shallow groundwater.

2. Additional background wells should be installed at all sites in order to provide a baseline for comparing on-site groundwater quality.

Tables

TABLE 1
TOTAL METALS BY SITE
SHALLOW MONITORING WELLS
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Number / Units	NCWQS ug/L	FEDERAL MCL ug/L	Site 1 ug/L	Site 2 ug/L	Site 6 ug/L	Site 7 ug/L	Site 9 ug/L	Site 21 ug/L	Site 24 ug/L	Site 28 ug/L	Site 30 ug/L	Site 41 ug/L	Site 43 ug/L	Site 44 ug/L
Arsenic	50	50	7.2 - 57.4	2.2 - 23.6	ND - 23.3	ND - 43.4J	ND	ND - 101	ND - 116J	5.4 - 13J	6.4 - 12J	2.4 - 36.3	ND - 23.4	ND - 570
Barium	2000	2000	335 - 833	46 - 1420	ND - 1020	427 - 641	ND - 1060	ND - 647	ND - 1120	78.8 - 576	60.1 - 396	55.2 - 999	220 - 745	315 - 3180
Beryllium	NE	4	2.7 J - 43.4	1 - 3	ND - 7.5	ND - 10.3J	ND	ND - 8	ND - 19	ND - 1.2J	ND - 2.4	0.80 - 42.8	1.3 - 4.2	1.4 - 36.6
Cadmium	5	5	ND - 12.9	7	ND	ND	ND	ND	ND - 12	3.3J - 17.3J	ND - 10.7J	3.2 - 110	ND - 6.9	ND - 32
Calcium	NA	NA	8850 - 726000	5710 - 450000	5430 - 64900	5050 - 51300	16100 - 90700	6130J - 63000J	ND - 151000	20200 - 160000	1730 - 11900	8750 - 828000	10300 - 91900	2430 - 191000
Chromium	50	100	172 - 627	11 - 117	ND - 201	47.8 - 220	ND - 214	ND - 348J	19 - 316	9.0J - 140	42.8 - 106J	10.5 - 244	161 - 249	126 - 895
Copper	1000	1300	44.6 - 117	3 - 23	ND - 175	17.7 - 36.4	ND - 39.7	ND - 84	ND - 52	18.8J - 75.4	15.8 - 42.5	16.3 - 1030	64.2 - 104	28.6 - 313
Lead	15	15	40.8J - 176J	2.7 - 44.8	ND - 200	23 - 37.3	ND - 127	ND - 2000J	5.1 - 89	20.3J - 234J	7.7J - 115J	4.8 - 9340	16.5 - 28.8	15.8 - 508
Manganese	50	50 (1)	125 - 1720	21 - 190	ND - 362	56.9 - 220	ND - 91.3	59 - 276J	29 - 518	82.2 - 304	78.5 - 578	56.6 - 2110	72.6 - 297	88 - 1730
Mercury	1.1	2	ND - 1.2J	ND	ND - .46	0.2 - 0.36	ND - 1.4	ND - 2.4J	ND - 3.2	ND - 1.4J	0.88J - 0.9J	0.13 - 0.92	ND - 0.24	ND - 1.1
Nickel	100	100	28.5 - 426	ND	ND - 41.9	ND	ND	ND - 123	ND - 140	ND - 59.8	17.1J - 52.6J	28.8 - 137	20.5 - 143	21.9 - 486
Sodium	NA	NA	9090 - 19000	ND - 103000	1110 - 68700	7040 - 156000	1390 - 4170	7950 - 15700	5230 - 19200	9480 - 74700	5320 - 8100	2080 - 40200	9160 - 22100	4060 - 12600
Vanadium	NE	NE	214 - 640	9 - 184	ND - 330	37.8 - 423	ND - 175	ND - 419	ND - 408	6.1 - 164	57 - 101	20.4 - 244	122 - 233	184 - 739
Zinc	2100	5000 (1)	ND - 1110	6 - 146	ND - 1620	83.6 - 133	ND - 118	27J - 487J	20 - 650	ND	79.2 - 104	25.7 - 5180	19 J - 661J	87.3 - 2800J

Site Number / Units	Site 48 ug/L	Site 63 ug/L	Site 65 ug/L	Site 69 ug/L	Site 78 ug/L	Site 82 ug/L	ABC Cleaners ug/L	Offsite Property #1 ug/L	Offsite Property #2 ug/L
Arsenic	ND	ND - 23.4	ND - 308	2.9 - 29.6	ND - 405J	ND - 67.8	ND - 12	10.3 - 160	ND
Barium	18 - 51.3	56.1 - 5410	105 - 638	46.5 - 850	ND - 1250	ND - 340	33 - 220	ND - 468	ND
Beryllium	ND	ND - 3.1	ND	1.3 - 10.6	ND - 19	ND	NA	ND - 8.5	ND
Cadmium	2.2 - 3.3	ND	ND	2.4 - 11.4	ND - 21	ND	NA	ND	ND
Calcium	30600 - 115000	2830 - 24300	33300 - 181000	2010 - 38700	ND - 642000	6580 - 60800	790 - 16000	ND - 22800	ND - 5200
Chromium	5.8 - 17.5	4.4 - 134	50.1 - 364	15.1 - 159	ND - 858J	ND - 174	ND - 57	52.8 - 636	ND - 94
Copper	3.1 - 13.5	10.7 - 126	28.2 - 127	16.2 - 70.8	ND - 699	ND - 29.3	ND - 89	ND - 140	ND
Lead	ND	4.3 J - 369	19.1 - 132	7.8 - 188	ND - 360J	ND - 89	ND - 10	12.3 - 345	6.3 - 62.3
Manganese	38.1 - 585	50.3 - 1020	56.2 - 474	13.0 - 912	26 - 714	26.9 - 283	4 - 44	56 - 973	ND - 60.1
Mercury	0.04 - 0.09	ND - 0.20	ND - 0.29	0.10 - 0.94	ND - 1.5	ND - 0.66	NA	ND	ND
Nickel	ND	19.8 - 54.2	19.4 - 84.3	13.6 - 99.8	ND - 234	ND - 34.6	ND - 77	40.2 - 380	ND
Sodium	3750 - 8760	3150 - 7100	3850 - 11700	4790 - 41300	ND - 42500	5670 - 36500	5800 - 33000	ND - 9390	ND - 7630
Vanadium	3.4 - 12.8	7.9 - 163	59.8 - 433	17.3 - 210	ND - 1700	ND - 256	ND - 45	70 - 739	ND - 64.7
Zinc	ND - 30.3	58.5J - 1110J	148J - 406J	36.2 - 12100	6J - 967J	ND - 204	14 - 220	ND - 736	ND - 40.8

NOTES:
J - Value is estimated.
JB - Value is estimated below the CRDL, but greater than the IDL.
NE - Not established.
NA - Not analyzed.
ND - Not detected.
NCWQS - North Carolina Water Quality Standard
MCL - Maximum Contaminant Level
(1) - Secondary MCL

TABLE 2
COMPARISON OF REPEAT SAMPLING OF SHALLOW WELLS
MCB, CAMP LEJEUNE, NORTH CAROLINA

Well	2GW01		2GW03		2GW06		2GW08		2GW09	
Date	5/1993	3/1994	5/1993	3/1994	5/1993	3/1994	5/1993	3/1994	5/1993	3/1994
Chromium	18	ND	11	ND	15	ND	ND	ND	25	83
Lead	15.5 J	ND	3.5 J	ND	6.7 J	ND	ND	3.4	27.2 J	23.6
Manganese	55	47	21	ND	79	140	53	415	290	747

Well	78GW05		78GW08		78GW15		78GW16		78GW19	
Date	1/1991	4/1994	1/1991	4/1994	1/1991	4/1994	1/1991	4/1994	1/1991	4/1994
Chromium	ND	17 J	91.8	491 J	21.4	215 J	209	353 J	13.8	ND
Lead	13.6	13.1 J	54.1	131 J	16.6	53	100	224	31.7	8.3
Manganese	162	161 J	46.5	213 J	18.3	115	98.3	150	79	26

NOTES:
J - Value is estimated.
ND - Not detected.

TABLE 3
DISSOLVED METALS BY SITE
SHALLOW MONITORING WELLS
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Number Units	NCWQS ug/L	FEDERAL MCL ug/L	Site 1 ug/L	Site 2 ug/L	Site 6 ug/L	Site 7 ug/L	Site 9 ug/L	Site 21 ug/L	Site 24 ug/L	Site 28 ug/L	Site 30 ug/L	Site 41 ug/L	Site 43 ug/L	Site 44 ug/L
Arsenic	50	50	NA	2.2 - 7.1	ND	NA	ND	ND - 10.6	ND - 16.3	NA	NA	2.2 - 4.7	NA	NA
Barium	2000	2000	NA	25 - 149	ND	NA	ND	ND	ND	NA	NA	12.4 - 451	NA	NA
Beryllium	NE	4	NA	1	ND	NA	ND	ND	ND	NA	NA	0.80 - 3.2	NA	NA
Cadmium	5	5	NA	ND	ND	NA	ND	ND - 5	ND	NA	NA	3.2 - 4.2	NA	NA
Calcium	NA	NA	NA	5800 - 441000	6230 - 57400	NA	15800 - 82400	35900	ND - 113000	NA	NA	4710 - 138000	NA	NA
Chromium	50	100	NA	10	ND	NA	ND	ND	ND	NA	NA	8.3 - 9.6	NA	NA
Copper	1000	1300	NA	2 - 9	ND	NA	ND	ND	ND	NA	NA	16.3 - 23.9	NA	NA
Lead	15	15	NA	2.1	ND	NA	ND	ND - 94	ND	NA	NA	1.0	NA	NA
Manganese	50	50 (1)	NA	17 - 129	ND - 92.7	NA	ND	40 - 134	ND - 320	NA	NA	7.1 - 521	NA	NA
Mercury	1.1	2	NA	ND	ND	NA	ND	ND	ND - 0.5	NA	NA	0.13 - 0.20	NA	NA
Nickel	100	100	NA	ND	ND	NA	ND	ND	ND - 57	NA	NA	28.8 - 31.2	NA	NA
Sodium	NA	NA	NA	ND - 103000	1420 - 70500	NA	1280 - 3860	16200	ND - 183000	NA	NA	2500 - 34200	NA	NA
Vanadium	NE	NE	NA	43	ND	NA	ND	ND	ND	NA	NA	20.4	NA	NA
Zinc	2100	5000 (1)	NA	8 - 35	ND - 350	NA	ND	6B - 50	ND - 437	NA	NA	10.6 - 125	NA	NA

Site Number Units	Site 48 ug/L	Site 63 ug/L	Site 65 ug/L	Site 69 ug/L	Site 78 ug/L	Site 82 ug/L	ABC Cleaners ug/L	Offsite Property #1 ug/L	Offsite Property #2 ug/L
Arsenic	ND	NA	NA	2.9	ND - 21.6	ND	NA	ND - 18.8	ND
Barium	16.8 - 27.6	NA	NA	13.7 - 35.8	ND	ND	NA	ND	ND
Beryllium	ND	NA	NA	1.3	ND	ND	NA	ND	ND
Cadmium	ND - 3.1	NA	NA	2.4	ND	ND	NA	ND	ND
Calcium	72600 - 80700	NA	NA	764 - 10600	ND - 296000	15200 - 58500	NA	ND - 7710	ND
Chromium	ND	NA	NA	7.2	ND - 59	ND	NA	ND - 30.0	ND
Copper	2.6 - 7.6	NA	NA	16.2	ND - 121	ND	NA	ND - 10.7	ND
Lead	ND	NA	NA	1	ND - 17.2	ND	NA	ND - 15.8	ND
Manganese	39.7 - 539	NA	NA	8.5 - 139	ND - 152	21 - 127	NA	ND - 63.8	ND - 21.3
Mercury	0.05 - 0.09	NA	NA	0.1	ND - 0.6	ND	NA	ND	ND
Nickel	ND	NA	NA	13.6	ND	ND	NA	ND	ND
Sodium	6430 - 8920	NA	NA	5170 - 41100	ND - 42200	5980 - 36000	NA	ND - 9540	ND - 6750
Vanadium	ND	NA	NA	16.6	ND	ND	NA	ND	ND
Zinc	ND	NA	NA	7.0 - 7670	ND - 58	ND - 119	NA	ND - 468	ND - 222

NOTES:
J - Value is estimated.
JB - Value is estimated below the CRDL, but greater than the IDL.
NE - Not established.
NA - Not analyzed.
ND - Not detected.
NCWQS - North Carolina Water Quality Standard
MCL - Maximum Contaminant Level
(1) - Secondary MCL

TABLE 4
SUMMARY OF TOTAL METALS IN UPGRADIENT WELLS
SHALLOW MONITORING WELLS
MCB, CAMP LEJEUNE, NORTH CAROLINA

			Upgradient of Site 1	Upgradient of Site 2	Upgradient of Site 6	Upgradient of Site 7	Upgradient of Site 9	Upgradient of Sites 21 and 78	Upgradient of Site 24	Upgradient of Site 28	Upgradient of Site 30	Upgradient of Site 41	Upgradient of Site 43	Upgradient of Site 44
Well Number	NCWQS	FEDERAL MCL	1GW06	2GW09	6BP6S	7GW03	9GW48	78GW26	24GW07	28GW04		41GW05		
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L		ug/L		
Arsenic	50	50	17.8 J	12.9	ND	ND	ND	ND	3.7 J	7.4 J	No Upgradient Well Sites	13.1	No Upgradient Well Sites	No Upgradient Well Sites
Barium	2000	2000	348	328	257	428	71.3	ND	ND	576		55.7		
Beryllium	NE	4	3.2 J	3	ND	ND	ND	ND	ND	9.3 J		1.6		
Cadmium	5	5	ND	ND	ND	ND	ND	not reported	ND	3.3 J		10		
Chromium	50	100	193	75	198	124	ND	13	37	122		54.4		
Copper	1000	1300	64.8	25	35.6	36.4	ND	ND	ND	20.7 J		27		
Lead	15	15	78.8 J	27.2	64.4	30.3 J	ND	9	11.4	22.4 J		23.7		
Manganese	50	50 (1)	202	747	84.5	56.9 J	ND	ND	39	206		203		
Mercury	1.1	2	1.6 J	ND	ND	0.36	ND	ND	ND	ND		0.16		
Nickel	100	100	51.6	ND	ND	ND	ND	ND	ND	39.8		38		
Vanadium	NE	NE	214	86	209	152	ND	149	64	85.3		38.1		
Zinc	2100	5000 (1)	ND	103	36.6	86.4 J	ND	68.1	41	ND		173		

	Upgradient of Site 48	Upgradient of Site 63	Upgradient of Site 65	Upgradient of Site 69	Upgradient of Site 78	Upgradient of Site 82	Upgradient of ABC Cleaners	Upgradient of Offsite Property #1	Upgradient of Offsite Property #2
Well Number	48GW1			69GW07	9GW04	6MW38	MW-S01		
Units	ug/L			ug/L	ug/L	ug/L	ug/L		
Arsenic	ND	No Upgradient Well Sites	No Upgradient Well Sites	2.9	ND	ND	ND	No Upgradient Well Sites	No Upgradient Well Sites
Barium	29.4 J			46.5	ND	ND	35		
Beryllium	ND			1.3	ND	ND	NA		
Cadmium	2.5 J			2.4	ND	ND	NA		
Chromium	ND			15.8	ND	ND	ND		
Copper	ND			16.2	ND	ND	ND		
Lead	ND			7.8	ND	ND	3		
Manganese	70.6			13	ND	ND	10		
Mercury	ND			0.1	ND	ND	NA		
Nickel	ND			13.6	ND	ND	ND		
Vanadium	3.4 J			17.3	ND	ND	9		
Zinc	ND			36.2	ND	ND	23		

NOTES:
J - Value is estimated.
JB - Value is estimated below the CRDL, but greater than the IDL.
NE - Not established.
NA - Not analyzed.
ND - Not detected.
NCWQS - North Carolina Water Quality Standard
MCL - Maximum Contaminant Level
(1) - Secondary MCL

TABLE 5
COMPARISON OF INORGANIC SUBSURFACE SOIL CONCENTRATIONS IN "CLEAN" AND "CONTAMINATED" WELLS
MCB, CAMP LEJEUNE, NORTH CAROLINA

	Camp Lejeune Background Subsurface Soil Data	Site 1		Site 2		Site 6		Site 7		Site 9		Site 21	
		"Clean"	"Contaminated"	"Clean"	"Contaminated"	"Clean"	"Contaminated"	"Clean"	"Contaminated"	"Clean"	"Contaminated"	"Clean"	"Contaminated"
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Well Number		--	--	2GW07	2GW09	6GW18	6GW15	7GW03	7GW02	9GW5	9GW1	21GW03	21GW02
Soil Sample Number		--	--	2-GW07-01	2 - GW09-02	6-GW18-0303	6-GW15-03	GW03-002	GW02-7595	9-GW5-03	9-SB35-03	21-GW03	-21-GW02
ic	0.03 - 0.47	NA	NA	1.7 J	ND	ND	ND	1.5	ND	ND	ND	ND	0.55 J
m	2 - 11	NA	NA	12.5 J	ND	ND	ND	6.6	71	ND	ND	ND	4.4 J
lium	0.03 - 0.23	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ium	0.17 - 1.2	NA	NA	ND	ND	ND	ND	1.3	4.5	ND	ND	ND	ND
nium	2 - 9	NA	NA	10.9 J	4.6	ND	[illegible]	5.2	[illegible]	ND	[illegible]	15.2	[illegible]
er	0.47 - 2	NA	NA	0.97 J	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1 - 12	NA	NA	8 J	4.3	3.3 J	[illegible]	2.5	34.4	1.6	[illegible]	7.1	[illegible]
ganese	0.40 - 8	NA	NA	4.3 J	4.1	ND	1.8 B	3	[illegible]	ND	3.7 J	[illegible]	[illegible]
ury	0.01 - 0.11	NA	NA	0.3 J	ND	ND	ND	10.13	0.48	ND	ND	ND	ND
el	0.70 - 5.0	NA	NA	ND	ND	ND	ND	3.4	11.8	ND	ND	ND	ND
dium	0.75 - 13	NA	NA	13.8 J	ND	ND	2.9 B	5.5	4.5	ND	ND	15.5	4.4 J
	0.40 - 12	NA	NA	ND	ND	ND	ND	1.3	ND	ND	6.1 J	5.7	3 J

NOTES:
Shaded area indicates inorganic which exceeded a MCL and/or NCWQS in groundwater sample.
J - Value is estimated.
JB - Value is estimated below the CRDL, but greater than the IDL.
NA - No available wells to compare OR compound was not analyzed.
ND - Not detected.
NCWQS - North Carolina Water Quality Standard
MCL - Maximum Contaminant Level
(1) - Secondary MCL

TABLE 5
COMPARISON OF INORGANIC SUBSURFACE SOIL CONCENTRATIONS IN "CLEAN" AND "CONTAMINATED" WELLS
MCB, CAMP LEJEUNE, NORTH CAROLINA

	Site 24		Site 28		Site 30		Site 41		Site 43		Site 44	
	"Clean"	"Contaminated"	"Clean"	"Contaminated"	"Clean"	"Contaminated"	"Clean"	"Contaminated"	"Clean"	"Contaminated"	"Clean"	"Contaminated"
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Well Number	24GW10	24GW02	--	--	--	--	41GW04	41-GW11	43GW01	43GW02	44GW02	44GW01
Soil Sample Number	24-GW10	24-BDA-SB09	--	--	--	--	41-GW04-DW	41-GW11-01	43-GW01-00	43-GW02-00	44-GW02-035	--
Arsenic	ND	ND	NA	NA	NA	NA	0.51	1.6	ND	ND	ND	1.7
Barium	ND	ND	NA	NA	NA	NA	9.4	22.6	ND	ND	ND	[illegible]
Beryllium	ND	ND	NA	NA	NA	NA	0.18	0.18	ND	ND	ND	ND
Cadmium	ND	ND	NA	NA	NA	NA	0.73	[illegible]	8.3	ND	ND	ND
Chromium	11.2	[illegible]	NA	NA	NA	NA	3.6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Copper	ND	ND	NA	NA	NA	NA	3.7	[illegible]	3.4	ND	6.2 J	23.4 J
Lead	4.6 J	[illegible]	NA	NA	NA	NA	4.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Manganese	4.7	[illegible]	NA	NA	NA	NA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mercury	ND	ND	NA	NA	NA	NA	0.06	0.31	ND	ND	ND	[illegible]
Nickel	ND	ND	NA	NA	NA	NA	6.6	[illegible]	7.6	[illegible]	3.1	[illegible]
Vanadium	18.4	10	NA	NA	NA	NA	6.8	9.3	7.2	5.8	5	14.7
Zinc	ND	7.8	NA	NA	NA	NA	7.7	[illegible]	20.1	3	3.2	[illegible]

NOTES:
Shaded area indicates inorganic which exceeded a MCL and/or NCWQS in groundwater sample.
J - Value is estimated.
JB - Value is estimated below the CRDL, but greater than the IDL.
NA - No available wells to compare OR compound was not analyzed.
ND - Not detected.
NCWQS - North Carolina Water Quality Standard
MCL - Maximum Contaminant Level
(1) - Secondary MCL

TABLE 5
COMPARISON OF INORGANIC SUBSURFACE SOIL CONCENTRATIONS IN "CLEAN" AND "CONTAMINATED" WELLS
MCB, CAMP LEJEUNE, NORTH CAROLINA

	Site 48		Site 63		Site 65		Site 69		Site 78		Site 82	
	"Clean"	"Contaminated"	"Clean"	"Contaminated"	"Clean"	"Contaminated"	"Clean"	"Contaminated"	"Clean"	"Contaminated"	"Clean"	"Contaminated"
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Well Number	48-GW01	48-GW03	63MW03	63MW02	65MW03	65MW02	69-GW11	69-GW03	78GW34	78GW24-1	6-GW28	82MW3
Soil Sample Number	48-GW1A-01	48-C3-03	63-MW03-04	63-MW02-06	65-MW03-11	65-MW02-06	69-GW11-04	69-CSA-SB23-00	78-GW34	78-B903-SB03	6-GW28-09	6-GW27D-06
Arsenic	1.3	0.77 J	ND	ND	ND	15	0.68	0.63	ND	ND	0.31	15.9
Barium	21.1	15	ND	ND	3.4	6.8	5.6	3	ND	ND	ND	ND
Beryllium	0.2	0.19	ND	ND	ND	ND	0.3	0.28	ND	ND	ND	ND
Cadmium	1.4	1.8 J	ND	ND	NA	NA	0.56	0.52	ND	ND	ND	ND
Chromium	18.2	18.6	7.7	ND	39	[illegible]	6.8	17	18.5	[illegible]	2.6	[illegible]
Copper	3.5	3.8	ND	ND	1.5	3.1	3.8	3.5	3.4 B	ND	ND	ND
Lead	32.3	14.3	4.2	[illegible]	17	[illegible]	4.3	11	4.5 J	[illegible]	2.7	[illegible]
Manganese	[illegible]	7	4.9	[illegible]	3.5	6.9	4	12	[illegible]	ND	ND	ND
Mercury	ND	ND	ND	ND	NA	NA	0.06	0.05	ND	ND	ND	ND
Nickel	2.2	1.9 J	ND	ND	ND	ND	3.2	3	ND	ND	ND	ND
Vanadium	28.3	20.8 J	ND	ND	4.4	3	4.4	3.6	18.7	19.2	ND	ND
Zinc	ND	ND	ND	ND	2.7	5	3.2	[illegible]	7.9	ND	ND	ND

NOTES:
Shaded area indicates inorganic which exceeded a MCL and/or NCWQS in groundwater sample.
J - Value is estimated.
JB - Value is estimated below the CRDL, but greater than the IDL.
NA - No available wells to compare OR compound was not analyzed.
ND - Not detected.
NCWQS - North Carolina Water Quality Standard
MCL - Maximum Contaminant Level
(1) - Secondary MCL

TABLE 5
COMPARISON OF INORGANIC SUBSURFACE SOIL CONCENTRATIONS IN "CLEAN" AND "CONTAMINATED" WELLS
MCB, CAMP LEJEUNE, NORTH CAROLINA

	ABC Cleaners		Offsite Property #1		Offsite Property #2	
	"Clean"	"Contaminated"	"Clean"	"Contaminated"	"Clean"	"Contaminated"
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Well Number	--	--	--	--	--	--
Soil Sample Number	--	--	--	--	--	--
Arsenic	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA
Beryllium	NA	NA	NA	NA	NA	NA
Cadmium	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	NA	NA	NA	NA
Nickel	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	NA

NOTES:
Shaded area indicates inorganic which exceeded a MCL and/or NCWQS in groundwater sample.
J - Value is estimated.
JB - Value is estimated below the CRDL, but greater than the IDL.
NA - No available wells to compare OR compound was not analyzed.
ND - Not detected.
NCWQS - North Carolina Water Quality Standard
MCL - Maximum Contaminant Level
(1) - Secondary MCL

TABLE 6
TOTAL METALS BY SITE
DEEP MONITORING WELLS
MCB, CAMP LEJEUNE, NORTH CAROLINA

	Site 1	Site 2	Site 6	Site 7	Site 9	Site 21	Site 24	Site 28	Site 30	Site 41	Site 43	Site 44	Site 48	Site 63	Site 65	Site 69	Site 78	Site 82	ABC Cleaners	Base Supply Wells (1)
Arsenic	No Deep Wells	ND	ND	No Deep Wells	ND	No Deep Wells	No Deep Wells	No Deep Wells	No Deep Wells	2.2 - 9.6	No Deep Wells	No Deep Wells	No Deep Wells	No Deep Wells	No Deep Wells	2.2 - 3.5	2 - 118 J	ND	ND - 14	ND
Barium		1420	ND		ND					22.6 - 186						42.3 - 58.0	ND - 347	ND	4 - 36	ND
Beryllium		ND	ND		ND					3.2						0.80 - 0.89	ND	ND	NA	NA
Cadmium		ND	ND		ND					4.2 - 4.7						3.2	ND - 21	ND	NA	ND
Chromium		16	ND		ND					9.6 - 40.5						8.3 - 20.7	ND - 10	ND	ND - 32	ND
Copper		ND	ND		ND					23.9						16.3	ND	ND	ND - 41	ND - 130
Lead		ND	ND		ND					1.0 - 11.1						3.1 - 6.8	ND	ND	ND - 10	ND - 16
Manganese		ND	ND - 33.5		ND					16.9 - 101						53.7 - 114	ND - 391	ND - 21.6	ND - 45	10 - 120
Mercury		ND	ND		ND					0.15 - 0.17						0.16 - 0.17	ND - 0.3	ND	NA	ND
Nickel		ND	ND		ND					31.2						28.8	ND	ND	ND - 14	NA
Vanadium		ND	ND		ND					20.4 - 49.8						20.4	ND - 24 J	ND	ND - 15	NA
Zinc		ND	ND		ND					17.8 - 83.8						31.1 - 48.7	ND - 181 J	ND	58 - 390	ND - 120

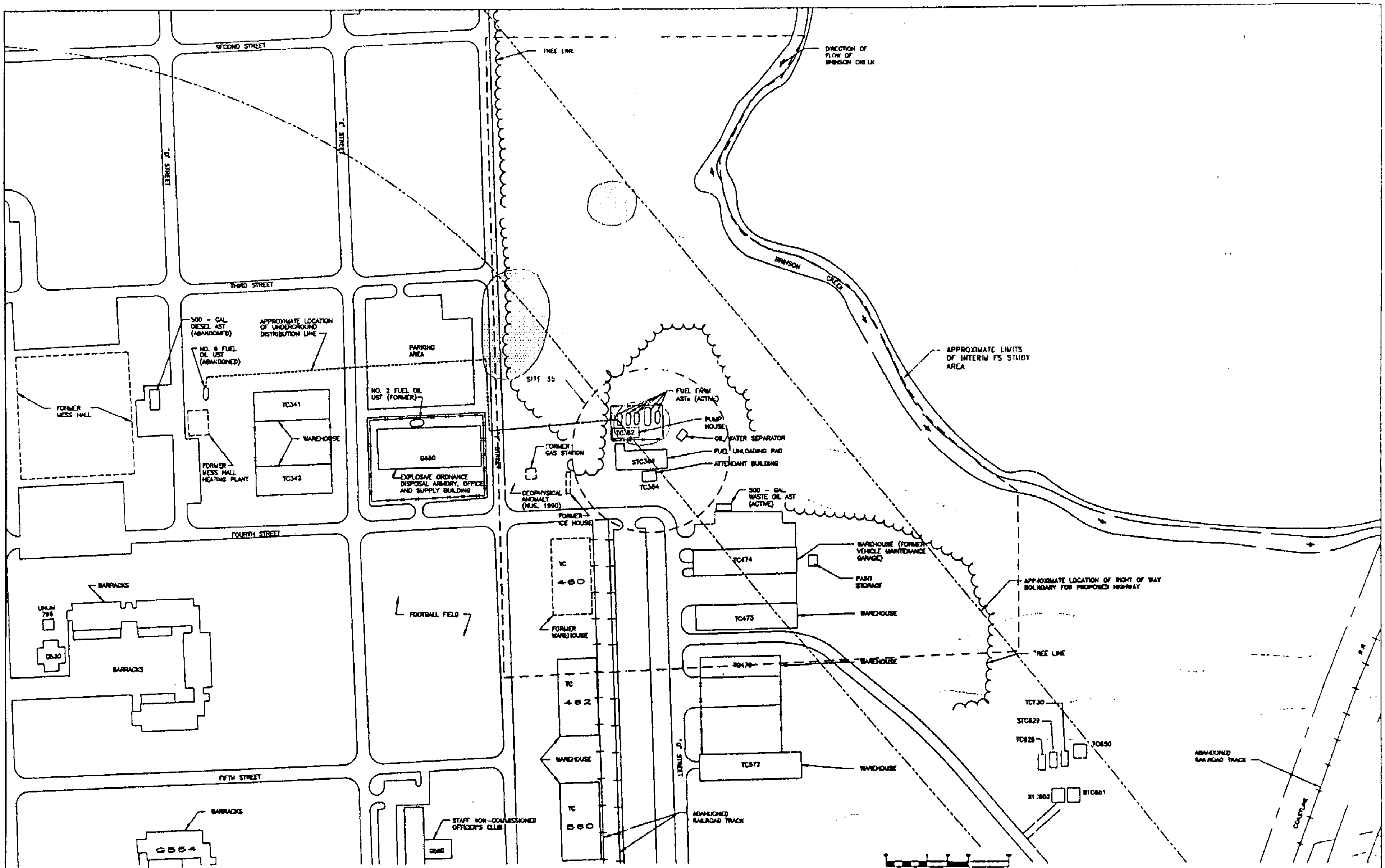
NOTES:
J - Value is estimated.
NA - Not analyzed.
ND - Not detected.
(1) - Range is based on 67 supply wells located throughout MCB, Camp Lejeune, NC.

TABLE 7
SUMMARY OF FIELD PARAMETERS IN
SHALLOW, DEEP, AND SUPPLY WELLS
MCB, CAMP LEJEUNE, NORTH CAROLINA

	Shallow Wells		Deep Wells		Supply Wells	
	Range (1)	Average Maximum	Range (2)	Average Maximum	Range (3)	Average Maximum
pH (standard units)	4.5 - 7.28	6.08	7.52 - 11.34	8.88	6.91 - 7.45	7.32
Specific Conductivity (micromhos/cm)	40 - 580	267	149 - 525	350	212 - 511	353

(1) - Based on data from 11 sites.
(2) - Based on data from 6 sites.
(3) - Based on data from 9 supply wells.

APPENDIX N
INTERIM RECORD OF DECISION FOR SURFICIAL GROUNDWATER



LEGEND

FENCE LINE

CONTOUR LINES DEPICTING SURFICIAL RELIEF

APPROXIMATE LOCATION OF THE UNDERGROUND DISTRIBUTION LINE

APPROXIMATE LOCATION OF RIGHT OF WAY BOUNDARY FOR PROPOSED HIGHWAY

APPROXIMATE LIMITS OF SOIL CONTAMINATION SUBJECT TO REMEDIATION UNDER INTERIM ROD CTO-0160 DATED AUGUST 31, 1994.

DATE	MAY 199[illegible]
SCALE	SEE BAR SCALE
DRAWN	REL
REVIEWED	JSC
B.O.#	62470-232-0000-07000
CADD#	232202PR

NORTH

INTERIM ROD FOR SURFICAL GROUNDWATER, CTO-0232
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

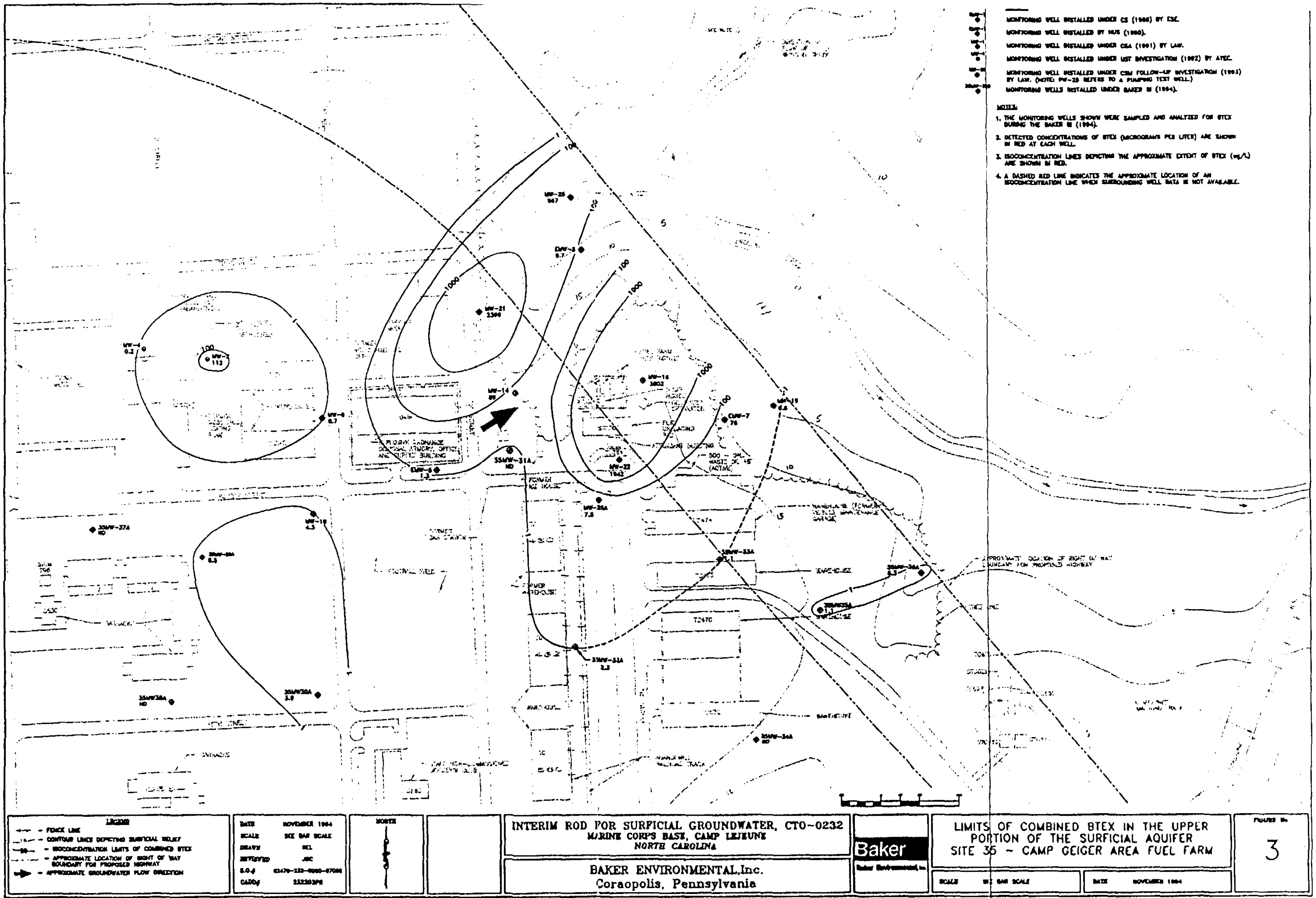
Baker
Baker Environmental, Inc.

SITE PLAN
SITE 35 - CAMP GEIGER AREA FUEL FARM
CONTRACT TASK ORDER - 0232

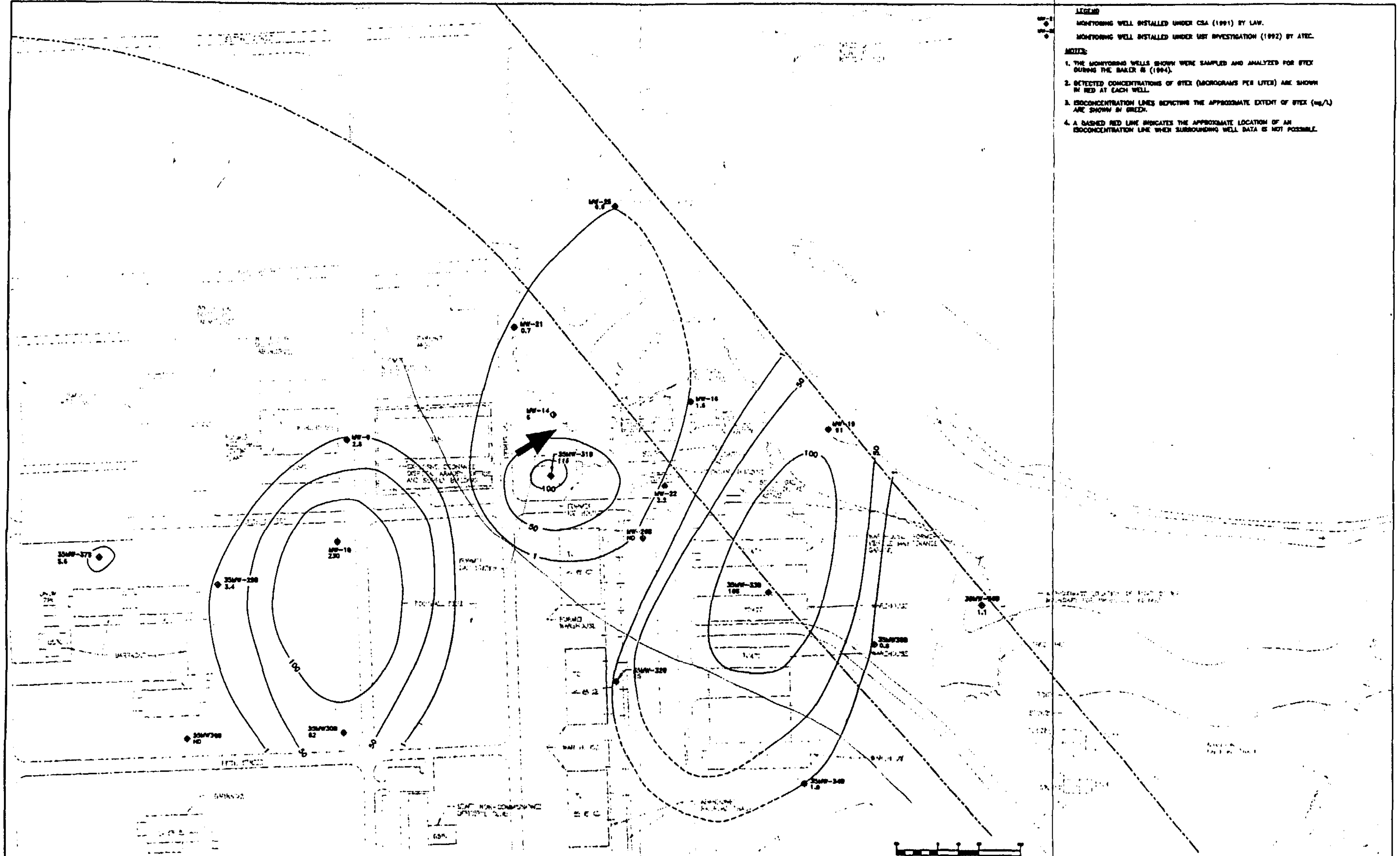
SCALE SEE BAR SCALE

DATE MAY 199[illegible]

FIGURE No.
2



MONITORING WELL INSTALLED UNDER CS (1986) BY ESE.
MONITORING WELL INSTALLED BY NUS (1990).
MONITORING WELL INSTALLED UNDER CSA (1991) BY LAW.
MONITORING WELL INSTALLED UNDER UST INVESTIGATION (1992) BY ATEC.
MONITORING WELL INSTALLED UNDER CSM FOLLOW-UP INVESTIGATION (1993) BY LAW. (NOTE: PW-2B REFERS TO A PUMPING TEST WELL.)
MONITORING WELLS INSTALLED UNDER BAKER III (1994).
NOTES:
1. THE MONITORING WELLS SHOWN WERE SAMPLED AND ANALYZED FOR BTEX DURING THE BAKER III (1994).
2. DETECTED CONCENTRATIONS OF BTEX (MICROGRAMS PER LITER) ARE SHOWN IN RED AT EACH WELL.
3. ISOCONCENTRATION LINES DEPICTING THE APPROXIMATE EXTENT OF BTEX (ug/L) ARE SHOWN IN RED.
4. A DASHED RED LINE INDICATES THE APPROXIMATE LOCATION OF AN ISOCONCENTRATION LINE WHEN SURROUNDING WELL DATA IS NOT AVAILABLE.
LEGEND
FENCE LINE
CONTOUR LINES DEPICTING SURFICIAL RELIEF
ISOCONCENTRATION LIMITS OF COMBINED BTEX
APPROXIMATE LOCATION OF RIGHT OF WAY BOUNDARY FOR PROPOSED HIGHWAY
APPROXIMATE GROUNDWATER FLOW DIRECTION
DATE NOVEMBER 1994
SCALE SEE BAR SCALE
DRAWN
REVISED
CADD# 232203PR
NORTH
INTERIM ROD FOR SURFICIAL GROUNDWATER, CTO-0232
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA
BAKER ENVIRONMENTAL,Inc.
Coraopolis, Pennsylvania
Baker
LIMITS OF COMBINED BTEX IN THE UPPER PORTION OF THE SURFICIAL AQUIFER
SITE 35 - CAMP GEIGER AREA FUEL FARM
FIGURE No.
3
SCALE SEE BAR SCALE
DATE NOVEMBER 1994



LEGEND

MW-21 ◆ MONITORING WELL INSTALLED UNDER CSA (1991) BY LAW.

MW-26 ◆ MONITORING WELL INSTALLED UNDER UST INVESTIGATION (1992) BY ATEC.

NOTES:

1. THE MONITORING WELLS SHOWN WERE SAMPLED AND ANALYZED FOR BTEX DURING THE BAKER RI (1994).
2. DETECTED CONCENTRATIONS OF BTEX (MICROGRAMS PER LITER) ARE SHOWN IN RED AT EACH WELL.
3. ISOCONCENTRATION LINES DEPICTING THE APPROXIMATE EXTENT OF BTEX (ug/L) ARE SHOWN IN GREEN.
4. A DASHED RED LINE INDICATES THE APPROXIMATE LOCATION OF AN ISOCONCENTRATION LINE WHEN SURROUNDING WELL DATA IS NOT POSSIBLE.

LEGEND

- FENCE LINE
- CONTOUR LINES DEPICTING SURFICIAL RELIEF
- 50 — ISOCONCENTRATION LIMITS OF COMBINED BTEX
- APPROXIMATE LOCATION OF RIGHT OF WAY BOUNDARY FOR PROPOSED HIGHWAY
- APPROXIMATE GROUNDWATER FLOW DIRECTION

DATE	DEC. 1994
SCALE	SEE BAR SCALE
DRAWN	REL
REVIEWED	JSC
S.O.#	62470-232-0000-07000
CADD#	232204PR

NORTH

INTERIM ROD FOR SURFICIAL GROUNDWATER, CTO-0232
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

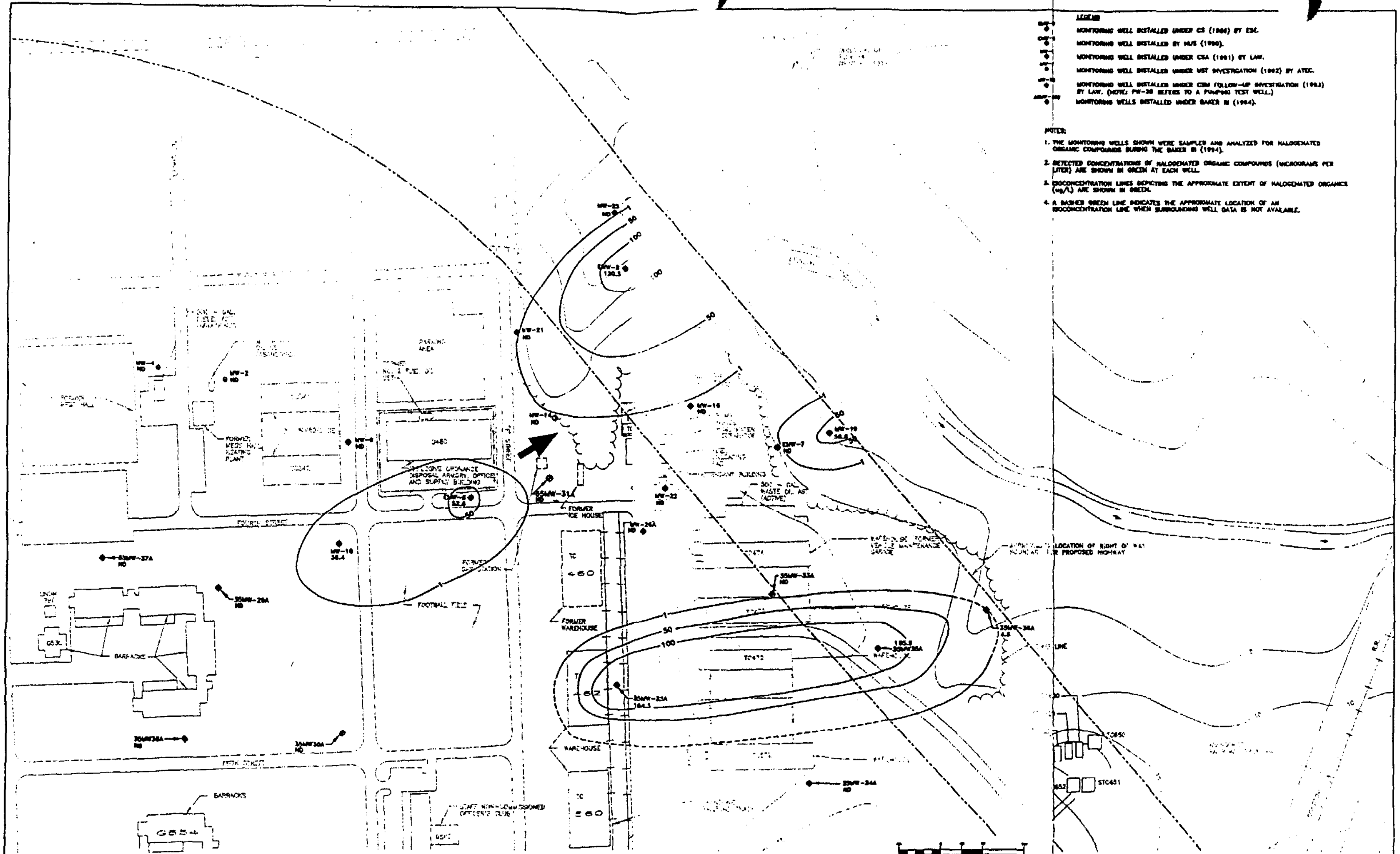
BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

LIMITS OF COMBINED BTEX IN THE
LOWER PORTION OF THE SURFICIAL AQUIFER
SITE 35 - CAMP GEIGER AREA FUEL FARM

SCALE	SEE BAR SCALE	DATE	DEC. 1994

FIGURE No.
4



LEGEND	
—·—·—	FENCE LINE
—15—	CONTOUR LINES DEPICTING SURFICIAL RELIEF
—50—	ISOCONCENTRATION LIMITS OF COMBINED HALOGENATED ORGANICS.
- - - - -	APPROXIMATE LOCATION OF RIGHT OF WAY BOUNDARY FOR PROPOSED HIGHWAY
➔	APPROXIMATE GROUNDWATER FLOW DIRECTION

DATE	DEC. 1994
SCALE	SEE BAR SCALE
DRAWN	BEL
REVIEWED	JBC
S.O.#	62470-232-0000-07000
CADD#	232003PR

NORTH

INTERIM ROD FOR SURFICIAL GROUNDWATER, CTO-0232
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

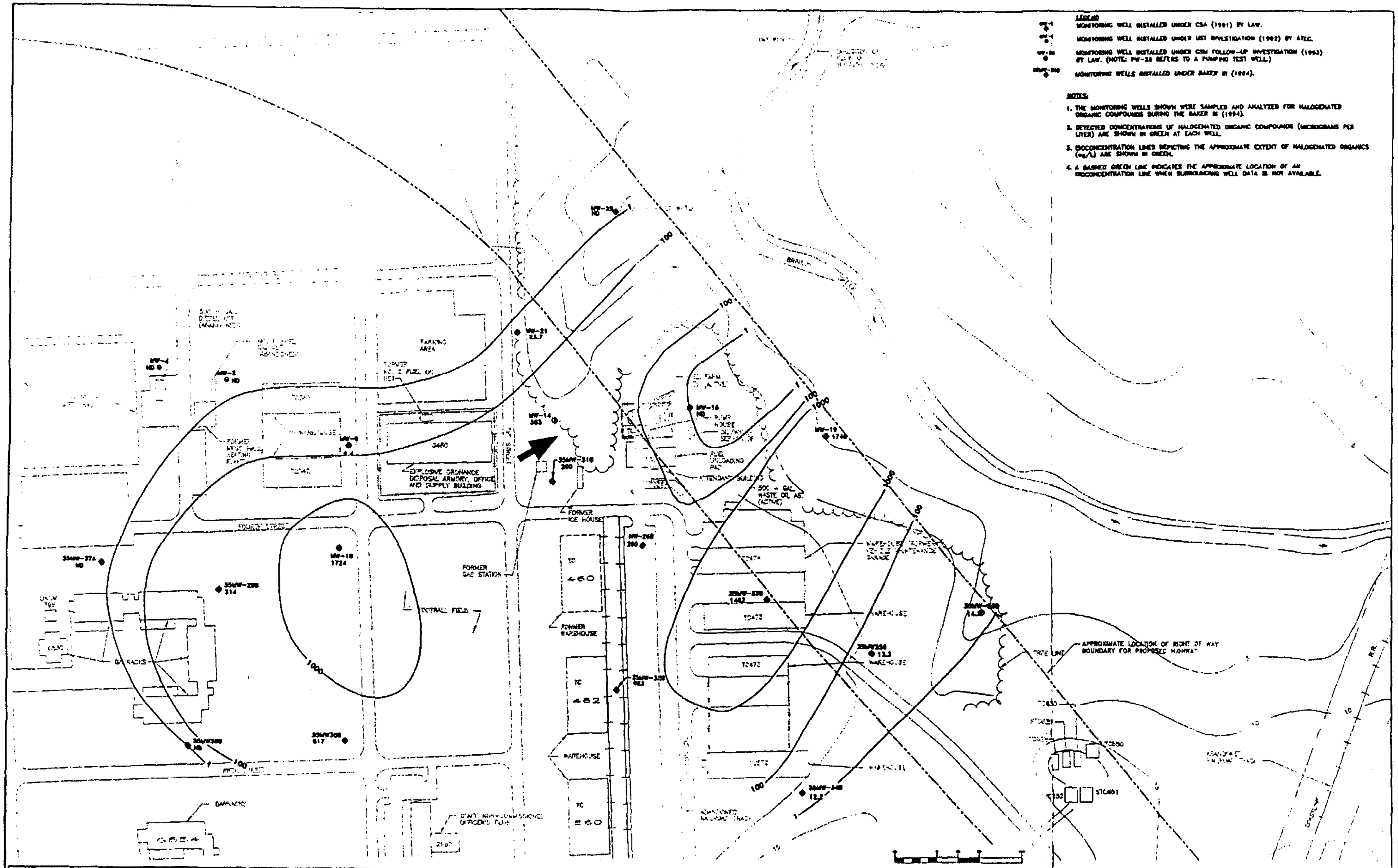
Baker
Baker Environmental, Inc.

LIMITS OF COMBINED HALOGENATED ORGANIC COMPOUNDS IN THE UPPER PORTION OF THE SURFICIAL AQUIFER
SITE 35 – CAMP GEIGER AREA FUEL FARM

SCALE SEE BAR SCALE

DATE DEC. 1994

FIGURE No. 5



LEGEND	
FENCE LINE	
CONTOUR LINES DEPICTING SURFICIAL RELIEF	
ISOCONCENTRATION LIMITS OF COMBINED HALOGENATED ORGANICS.	
APPROXIMATE LOCATION OF RIGHT OF WAY BOUNDARY FOR PROPOSED HIGHWAY	
APPROXIMATE GROUNDWATER FLOW DIRECTION	

DATE	DEC. 1994
SCALE	SEE BAR SCALE
DRAWN	REL
REVIEWED	JRC
S.O.#	62470-232-0000-07000
CADD#	23220GFR

NORTH

INTERIM ROD FOR SURFICIAL GROUNDWATER, CTO-0232
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

LIMITS OF COMBINED HALOGENATED ORGANIC COMPOUNDS IN THE LOWER PORTION OF THE SURFICIAL AQUIFER
SITE 35 - CAMP GEIGER AREA FUEL FARM

FIGURE No. 6

SCALE SEE BAR SCALE DATE DEC. 1994

APPENDIX O
FREQUENCY AND DETECTION SUMMARIES

APPENDIX O.1
ROUND THREE, GROUNDWATER SAMPLING

FREQUENCY OF DETECTION SUMMARY
GROUNDWATER
INORGANICS (SUMMER 1995)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

LOCATION	35-EMW03-02	35-EMW05-02	35-EMW07-02	35-GW05-02m	35-MW09D-02	35-MW09S-02
LAB ID	D95-7537-1	D95-7597-6	D95-7537-2	D95-7537-8	D95-7597-2	D95-7597-7
DATE SAMPLED	08/10/95	08/11/95	08/10/95	08/11/95	08/12/95	08/12/95
METALS (ug/L)						
Aluminum	96.5	93.2 J	20 U	25.9	26.2 J	198 J
Antimony	20 U	20 U	20 U	20 U	20 U	20 U
Arsenic	2 U	8.7 J	2 U	2 U	1.4 U	3.2 J
Barium	20 U	21.7 J	20 U	20 U	20.9 J	57.7 J
Beryllium	1 U	1 U	1 U	1 U	1 U	1 U
Cadmium	2 U	2 U	2 U	2 U	2 U	3.9 U
Calcium	89900	45100	105000	56900	104000	98600
Chromium	2 U	2 U	2 U	2 U	2 U	2 U
Cobalt	9 J	3.8 J	2.8 J	2 U	2 U	2 U
Copper	9.6 U	5 U	5 U	5 U	5 U	5 U
Iron	3350	20200	106	337	1650	162
Lead	1 UJ	12.1 J	1 UJ	1 U	1 UJ	1 UJ
Magnesium	2240 J	3610 J	3480 J	2280	2260 J	4110 J
Manganese	22.9	51.7	26.2	22.1	19.7	38.6
Mercury	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	10 U	10 U	10 U	10 U	10 U	10 U
Potassium	734 J	1160 J	2150 J	4400	844 J	3350 J
Selenium	2.5 UJ	2.5 UJ	2.5 U	2.5 U	2.5 UJ	3.4 J
Silver	2 U	2 U	2 U	2 U	2 U	2 U
Sodium	8120	9090	7940	31900	8740	29000
Thallium	0.7 U	9.9 U	0.7 U	1	9.9 U	9.9 U
Vanadium	2 U	2 U	2 U	2 U	2 U	5.5 J
Zinc	10.5 J	5 U	10.6 J	6.7	10.9 U	18.5 U

FREQUENCY OF DETECTION SUMMARY
GROUNDWATER
INORGANICS (SUMMER 1995)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

LOCATION	35-MW10D-02	35-MW10S-02	35-MW14D-02	35-MW14S-02	35-MW16D-02	35-MW16S-02
LAB ID	95-7537-15	95-7537-14	95-7537-17	95-7537-16	95-7537-13	95-7537-11
DATE SAMPLED	08/09/95	08/09/95	08/10/95	08/10/95	08/09/95	08/10/95
METALS (ug/L)						
Aluminum	20 U	303	28.6 J	20 U	20 U	20 U
Antimony	20 U	20 U	20 U	20 U	20 U	20 U
Arsenic	2 U	3.5 J	2 U	4.2 J	2 U	10.3
Barium	20 U	20 U	33.7 J	27.1 J	20 U	32.2 J
Beryllium	1 U	1 U	1 U	1 U	1 U	1 U
Cadmium	2 U	2 U	2 U	2 U	2 U	2 U
Calcium	122000	75000	119000	142000	96900	124000
Chromium	2 U	2 U	2 U	2 U	2 U	2 U
Cobalt	2 U	2 U	2 U	2.9 J	6.1 J	16 J
Copper	5 U	6.6 U	5 U	5 U	5 U	5 U
Iron	1490	152	1070	4490	2580	40400
Lead	1	1 U	15.4	1 U	1 U	8.9
Magnesium	2420	1800 J	2450 J	4520 J	3440 J	4580 J
Manganese	19	7.5 J	23.4	44.6	275	141
Mercury	0.2 U	0.2 U	2 U	0.2 U	0.2 U	0.2 U
Nickel	10 U	10 U	10 U	10 U	10 U	10 U
Potassium	811	860 J	1270 J	1460 J	970 J	793 J
Selenium	2.5 U	2.5 U	2.5 U	2.5 UJ	2.5 U	2.5 UJ
Silver	2 U	2 U	2 U	2 U	2 U	10.9
Sodium	8390	9970	9560	10400	8380	4350 J
Thallium	0.7 U	0.7 U	0.7 U	0.7 UJ	0.7 UJ	0.9 J
Vanadium	2 U	9.1 J	2 U	2 U	2 U	2 U
Zinc	13.8	6.5 J	29.5	22.5	12.9 J	11.5 J

FREQUENCY OF DETECTION SUMMARY
GROUNDWATER
INORGANICS (SUMMER 1995)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

LOCATION	35-MW19D-02	35-MW19S-02	35-MW22D-02	35-MW22S-02	35-MW29A-02	35-MW29B-02
LAB ID	D95-7537-5	D95-7537-6	D95-7597-8	D95-7597-9	D95-7597-4	D95-7597-5
DATE SAMPLED	08/11/95	08/11/95	08/13/95	08/13/95	08/12/95	08/12/95
METALS (ug/L)						
Aluminum	47.8 J	282	22.6 J	123 U	357	20 U
Antimony	20 U	20 U	20 U	20 J	20 U	20 U
Arsenic	2 U	2 U	1.4 U	7.1 J	13.3	1.4 U
Barium	20 U	20 U	24.7 J	32.5 U	81.7 J	20 U
Beryllium	1 U	1 U	1 U	1 U	1 U	1 U
Cadmium	2 U	2 U	2 U	2 U	2 U	2 U
Calcium	109000	35600	104000	133000	7460	93500
Chromium	2 U	2 U	2 U	2 U	2 U	2 U
Cobalt	2.2 J	4.4 J	2 U	5.6 J	3.3 J	2 U
Copper	5 U	5 U	5 U	5 U	5 U	5 U
Iron	113	266	1110	15700	9360	933
Lead	1 UJ	1 U	2.5 J	1 UJ	1 UJ	1.4 J
Magnesium	4990 J	1880 J	3020 J	3230 J	1550 J	1890 J
Manganese	36.7	102	41.2	63.5	29.2	17.1
Mercury	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	10 U	10 U	10 U	10 U	10 U	10 U
Potassium	3360 J	2650 J	1120 J	2320 J	2170 J	1110 J
Selenium	2.5 U	2.5 U	2.5 UJ	2.5 UJ	2.5 UJ	2.5 UJ
Silver	2 U	2 U	2 U	2 U	2 U	2 U
Sodium	10500	11300	7050	5080	14600	6460
Thallium	0.7 J	0.7 U	9.9 U	9.9 U	9.9 U	9.9 U
Vanadium	2 U	2 U	2 U	2 U	2 U	2 U
Zinc	10.4 J	9.9 J	5.9 U	5 U	17.4 U	11.6 U

FREQUENCY OF DETECTION SUMMARY
GROUNDWATER
INORGANICS (SUMMER 1995)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

LOCATION	35-MW33A-02		35-MW33D-02	
LAB ID	D95-7597-1		D95-7597-3	
DATE SAMPLED	08/12/95		08/12/95	
METALS (ug/L)				
Aluminum	520		20	U
Antimony	20	U	20	U
Arsenic	1.4	U	1.4	U
Barium	98.4	J	20	U
Beryllium	1	U	1	U
Cadmium	2	U	2	U
Calcium	6380		102000	
Chromium	2	U	2	U
Cobalt	2	U	2	U
Copper	5	U	5	U
Iron	58.4	J	648	
Lead	6	J	1.5	J
Magnesium	3620	J	2170	J
Manganese	8.8	J	20.1	
Mercury	0.2	U	0.2	U
Nickel	10	U	10	U
Potassium	1840	J	929	J
Selenium	2.6	J	2.5	UJ
Silver	2	U	2	U
Sodium	5370		7340	
Thallium	9.9	U	9.9	U
Vanadium	2	U	2	U
Zinc	7.6	U	24.3	U

FREQUENCY OF DETECTION SUMMARY
GROUNDWATER
INORGANICS (SUMMER 1995)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

LOCATION LAB ID DATE SAMPLED	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION	AVERAGE OF POSITIVE DETECTIONS	MEDIAN OF POSITIVE DETECTIONS
METALS (ug/L)								
Aluminum	20 U	123 U	22.6 J	520	35-MW33A-02	12/20	166.73	94.85
Antimony	20 U	20 U	20 J	20 J	35-MW22S-02	1/20	20.00	20.00
Arsenic	1.4 U	2 U	3.2 J	13.3	35-MW29A-02	7/20	7.19	7.10
Barium	20 U	32.5 U	20.9 J	98.4 J	35-MW33A-02	9/20	44.23	32.20
Beryllium	1 U	1 U	ND	ND		0/20	NA	NA
Cadmium	2 U	3.9 U	ND	ND		0/20	NA	NA
Calcium	NA	NA	6380	142000	35-MW14S-02	20/20	88467.00	100300.00
Chromium	2 U	2 U	ND	ND		0/20	NA	NA
Cobalt	2 U	2 U	2.2 J	16 J	35-MW16S-02	10/20	5.61	4.10
Copper	5 U	9.6 U	ND	ND		0/20	NA	NA
Iron	NA	NA	58.4 J	40400	35-MW16S-02	20/20	5208.77	1090.00
Lead	1 UJ	1 UJ	1	15.4	35-MW14D-02	8/20	6.10	4.25
Magnesium	NA	NA	1550 J	4990 J	35-MW19D-02	20/20	2977.00	2735.00
Manganese	NA	NA	7.5 J	275	35-MW16D-02	20/20	50.52	27.70
Mercury	0.2 U	2 U	ND	ND		0/20	NA	NA
Nickel	10 U	10 U	ND	ND		0/20	NA	NA
Potassium	NA	NA	734 J	4400	35-GW05-02m	20/20	1715.05	1215.00
Selenium	2.5 UJ	2.5 UJ	2.6 J	3.4 J	35-MW09S-02	2/20	3.00	3.00
Silver	2 U	2 U	10.9	10.9	35-MW16S-02	1/20	10.90	10.90
Sodium	NA	NA	4350 J	31900	35-GW05-02m	20/20	10677.00	8565.00
Thallium	0.7 U	9.9 U	0.7 J	1	35-GW05-02m	3/20	0.87	0.90
Vanadium	2 U	2 U	5.5 J	9.1 J	35-MW10S-02	2/20	7.30	7.30
Zinc	5 U	24.3 U	6.5 J	29.5	35-MW14D-02	11/20	13.16	10.60

APPENDIX O.2
ROUND FOUR, GROUNDWATER SAMPLING

FREQUENCY OF DETECTION SUMMARY
GROUNDWATER, SHALLOW & INTERMEDIATE WELLS
ORGANICS (SPRING 1996)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	35-EMW03-04	35-MW19S-04	35-MW32A-04	35-MW35A-04	35-MW36A-04	35-TW30A-04
METHOD	VOA1.8	VOA1.8	VOA1.8	VOA1.8	VOA1.8	VOA1.8
DATE SAMPLED	04/26/96	04/27/96	04/27/96	04/27/96	04/27/96	08/04/96
VOLATILES (ug/L)						
CHLOROMETHANE	10 U	10 U	10 U	10 U	10 U	10 U
BROMOMETHANE	10 U	10 U	10 U	10 U	10 U	10 U
VINYL CHLORIDE	10 U	10 U	10 U	10 U	10 U	10 U
CHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
METHYLENE CHLORIDE	10 U	10 U	10 U	10 U	10 U	10 U
ACETONE	10 U	10 U	10 U	10 U	10 U	10 U
CARBON DISULFIDE	10 U	10 U	10 U	10 U	10 U	10 U
1,1-DICHLOROETHENE	10 U	10 U	10 U	10 U	10 U	10 U
1,1-DICHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROETHENE (TOTAL)	3 J	16	10 U	5 J	10 U	10 U
CHLOROFORM	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
2-BUTANONE	10 U	10 U	10 U	10 U	10 U	10 U
1,1,1-TRICHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
CARBON TETRACHLORIDE	10 U	10 U	10 U	10 U	10 U	10 U
BROMODICHLOROMETHANE	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROPROPANE	10 U	10 U	10 U	10 U	10 U	10 U
CIS-1,3-DICHLOROPROPENE	10 U	10 U	10 U	10 U	10 U	10 U
TRICHLOROETHENE	10 U	12	10 U	25	10 U	10 U
DIBROMOCHLOROMETHANE	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2-TRICHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
BENZENE	3 J	10 U	10 U	10 U	10 U	10 U
TRANS-1,3-DICHLOROPROPENE	10 U	10 U	10 U	10 U	10 U	10 U
BROMOFORM	10 U	10 U	10 U	10 U	10 U	10 U
4-METHYL-2-PENTANONE	10 U	10 U	10 U	10 U	10 U	10 U
2-HEXANONE	10 U	10 U	10 U	10 U	10 U	10 U
TETRACHLOROETHENE	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2,2-TETRACHLOROETHANE	10 U	10 U	10 U	17 J	10 U	10 U
TOLUENE	10 U	10 U	10 U	10 U	10 U	10 U
CHLOROBENZENE	10 U	10 U	10 U	10 U	10 U	10 U
ETHYLBENZENE	10 U	10 U	10 U	10 U	10 U	10 U
STYRENE	10 U	10 U	10 U	10 U	10 U	10 U
XYLENE (TOTAL)	10 U	10 U	10 U	10 U	10 U	10 U
METHYL-TERT-BUTYL ETHER	5 U	5 U	5 U	5 U	5 U	NA

FREQUENCY OF DETECTION SUMMARY
GROUNDWATER, SHALLOW & INTERMEDIATE WELLS
ORGANICS (SPRING 1996)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	35-TW31A-04	35-MW09D-04	35-MW10D-04	35-MW14D-04	35-MW19D-04	35-MW30B-04
METHOD	VOA1.8	VOA1.8	VOA1.8	VOA1.8	VOA1.8	VOA1.8
DATE SAMPLED	08/04/96	04/27/96	04/27/96	04/27/96	04/27/96	04/27/96
VOLATILES (ug/L)						
CHLOROMETHANE	10 U	10 U	10 U	10 U	10 U	10 U
BROMOMETHANE	10 U	10 U	10 U	10 U	10 U	10 U
VINYL CHLORIDE	10 U	10 U	13	10 U	10 U	10 U
CHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
METHYLENE CHLORIDE	10 U	10 U	10 U	10 U	10 U	10 U
ACETONE	10 U	10 U	10 U	10 U	10 U	10 U
CARBON DISULFIDE	10 U	10 U	10 U	10 U	10 U	10 U
1,1-DICHLOROETHENE	10 U	10 U	6 J	10 U	10 U	10 U
1,1-DICHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROETHENE (TOTAL)	10 U	10 U	1200	160	360	620
CHLOROFORM	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
2-BUTANONE	10 U	10 U	10 U	10 U	10 U	10 U
1,1,1-TRICHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
CARBON TETRACHLORIDE	10 U	10 U	10 U	10 U	10 U	10 U
BROMODICHLOROMETHANE	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROPROPANE	10 U	10 U	10 U	10 U	10 U	10 U
CIS-1,3-DICHLOROPROPENE	10 U	10 U	10 U	10 U	10 U	10 U
TRICHLOROETHENE	10 U	10 U	740	71	320	270
DIBROMOCHLOROMETHANE	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2-TRICHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
BENZENE	10 U	10 U	10 U	3 J	10 U	2 J
TRANS-1,3-DICHLOROPROPENE	10 U	10 U	10 U	10 U	10 U	10 U
BROMOFORM	10 U	10 U	10 U	10 U	10 U	10 U
4-METHYL-2-PENTANONE	10 U	10 U	10 U	10 U	10 U	10 UJ
2-HEXANONE	10 U	10 U	10 U	10 U	10 U	10 UJ
TETRACHLOROETHENE	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2,2-TETRACHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
TOLUENE	10 U	10 U	2 J	10 U	10 U	10 U
CHLOROBENZENE	10 U	10 U	10 U	10 U	10 U	10 U
ETHYLBENZENE	10 U	10 U	10 U	10 U	10 U	10 U
STYRENE	10 U	10 U	10 U	10 U	10 U	10 U
XYLENE (TOTAL)	10 U	10 U	10 U	10 U	10 U	10 U
METHYL-TERT-BUTYL ETHER	NA	5 U	5 U	5 U	5 U	5 U

FREQUENCY OF DETECTION SUMMARY
GROUNDWATER, SHALLOW & INTERMEDIATE WELLS
ORGANICS (SPRING 1996)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	35-MW36B-04	35-MW37B-04	35-MW39B-04	35-MW40B-04	35-MW41B-04	35-MW42B-04
METHOD	VOA1.8	VOA1.8	VOA1.8	VOA1.8	VOA1.8	VOA1.8
DATE SAMPLED	04/27/96	04/28/96	05/02/96	05/01/96	05/01/96	05/03/96
VOLATILES (ug/L)						
CHLOROMETHANE	10 U	10 U	10 U	10 U	10 U	10 U
BROMOMETHANE	10 U	10 U	10 U	10 U	10 U	10 U
VINYL CHLORIDE	10 U	10 U	10 U	10 U	10 U	10 U
CHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
METHYLENE CHLORIDE	10 U	10 U	10 U	10 U	10 U	10 U
ACETONE	10 U	10 U	10 U	10 U	10 U	10 UJ
CARBON DISULFIDE	10 U	10 U	10 U	10 U	10 U	10 U
1,1-DICHLOROETHENE	4 J	10 U	10 U	10 U	10 U	10 U
1,1-DICHLOROETHANE	4 J	10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROETHENE (TOTAL)	10 U	10 U	12	180	10	48
CHLOROFORM	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
2-BUTANONE	10 U	10 U	10 U	10 U	10 U	10 U
1,1,1-TRICHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
CARBON TETRACHLORIDE	10 U	10 U	10 U	10 U	10 U	10 U
BROMODICHLOROMETHANE	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROPROPANE	10 U	10 U	10 U	10 U	10 U	10 U
CIS-1,3-DICHLOROPROPENE	10 U	10 U	10 U	10 U	10 U	10 U
TRICHLOROETHENE	10 U	10 U	10 U	16	10 U	83
DIBROMOCHLOROMETHANE	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2-TRICHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
BENZENE	10 U	10 U	4 J	10 U	10 U	10 U
TRANS-1,3-DICHLOROPROPENE	10 U	10 U	10 U	10 U	10 U	10 U
BROMOFORM	10 U	10 U	10 U	10 U	10 U	10 U
4-METHYL-2-PENTANONE	10 U	10 U	10 U	10 U	10 U	10 U
2-HEXANONE	10 U	10 U	10 U	10 U	10 U	10 U
TETRACHLOROETHENE	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2,2-TETRACHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
TOLUENE	10 U	4 J	10 U	10 U	10 U	10 U
CHLOROBENZENE	10 U	10 U	10 U	10 U	10 U	10 U
ETHYLBENZENE	10 U	10 U	10 U	10 U	10 U	10 U
STYRENE	10 U	10 U	10 U	10 U	10 U	10 U
XYLENE (TOTAL)	10 U	10 U	10 U	10 U	10 U	10 U
METHYL-TERT-BUTYL ETHER	5 U	5 U	5 U	5 U	5 U	5 U

FREQUENCY OF DETECTION SUMMARY
GROUNDWATER, SHALLOW & INTERMEDIATE WELLS
ORGANICS (SPRING 1996)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	35-MW43B-04	35-MW60A-04	35-MW60B-04	35-TW12B-04	35-TW13B-04	35-TW14B-04
METHOD	VOA1.8	VOA1.8	VOA1.8	VOA1.8	VOA1.8	VOA1.8
DATE SAMPLED	05/03/96	08/04/96	08/04/96	04/26/96	04/26/96	04/29/96
VOLATILES (ug/L)						
CHLOROMETHANE	10 U	10 U	10 U	10 U	10 U	10 U
BROMOMETHANE	10 U	10 U	10 U	10 U	10 U	10 U
VINYL CHLORIDE	10 U	10 U	10 U	10 U	10 U	10 U
CHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
METHYLENE CHLORIDE	10 U	10 U	10 U	10 U	10 U	10 U
ACETONE	10 U	10 U	10 U	10 U	10 U	10 U
CARBON DISULFIDE	10 U	10 U	10 U	10 U	10 U	10 U
1,1-DICHLOROETHENE	10 U	10 U	10 U	10 U	10 U	10 U
1,1-DICHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROETHENE (TOTAL)	30	10 U	10 U	51	10 U	14
CHLOROFORM	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
2-BUTANONE	10 U	10 U	10 U	10 U	10 U	10 U
1,1,1-TRICHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
CARBON TETRACHLORIDE	10 U	10 U	10 U	10 U	10 U	10 U
BROMODICHLOROMETHANE	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROPROPANE	10 U	10 U	10 U	10 U	10 U	10 U
CIS-1,3-DICHLOROPROPENE	10 U	10 U	10 U	10 U	10 U	10 U
TRICHLOROETHENE	12 U	10 U	10 U	93	10 U	10 U
DIBROMOCHLOROMETHANE	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2-TRICHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
BENZENE	10 U	10 U	10 U	10 U	10 U	10 U
TRANS-1,3-DICHLOROPROPENE	10 U	10 U	10 U	10 U	10 U	10 U
BROMOFORM	10 U	10 U	10 U	10 U	10 U	10 U
4-METHYL-2-PENTANONE	10 U	10 U	10 U	10 U	10 U	10 U
2-HEXANONE	10 U	10 U	10 U	10 U	10 U	10 U
TETRACHLOROETHENE	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2,2-TETRACHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
TOLUENE	10 U	10 U	10 U	10 U	10 U	10 U
CHLOROBENZENE	10 U	10 U	10 U	10 U	10 U	10 U
ETHYLBENZENE	10 U	10 U	10 U	10 U	10 U	10 U
STYRENE	10 U	10 U	10 U	10 U	10 U	10 U
XYLENE (TOTAL)	10 U	10 U	10 U	10 U	10 U	10 U
METHYL-TERT-BUTYL ETHER	5 U	NA	NA	5 U	5 U	5 U

FREQUENCY OF DETECTION SUMMARY
GROUNDWATER, SHALLOW & INTERMEDIATE WELLS
ORGANICS (SPRING 1996)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	35-TW15B-04	35-TW27B-04	35-TW28B-04	35-TW29B-04	35-TW30B-04	35-TW31B-04
METHOD	VOA1.8	VOA1.8	VOA1.8	VOA1.8	VOA1.8	VOA1.8
DATE SAMPLED	04/30/96	04/25/96	04/29/96	04/30/96	08/04/96	08/04/96
VOLATILES (ug/L)						
CHLOROMETHANE	10 U	10 UJ	10 U	10 U	10 U	10 U
BROMOMETHANE	10 U	10 UJ	10 U	10 U	10 U	10 U
VINYL CHLORIDE	10 U	10 UJ	10 U	10 U	10 U	10 U
CHLOROETHANE	10 U	10 UJ	10 U	10 U	10 U	10 U
METHYLENE CHLORIDE	10 U	10 UJ	10 U	10 U	10 U	10 U
ACETONE	10 U	66 J	10 U	10 U	10 U	10 U
CARBON DISULFIDE	10 U	10 UJ	10 U	10 U	10 U	10 U
1,1-DICHLOROETHENE	10 U	10 UJ	4 J	10 U	10 U	10 U
1,1-DICHLOROETHANE	10 U	10 UJ	3 J	10 U	10 U	10 U
1,2-DICHLOROETHENE (TOTAL)	13	260 J	2 J	28	10 U	10 U
CHLOROFORM	10 U	10 UJ	10 U	10 U	10 U	10 U
1,2-DICHLOROETHANE	10 U	10 UJ	10 U	10 U	10 U	10 U
2-BUTANONE	10 U	10 UJ	10 U	10 U	10 U	10 U
1,1,1-TRICHLOROETHANE	10 U	10 UJ	10 U	10 U	10 U	10 U
CARBON TETRACHLORIDE	10 U	10 UJ	10 U	10 U	10 U	10 U
BROMODICHLOROMETHANE	10 U	10 UJ	10 U	10 U	10 U	10 U
1,2-DICHLOROPROPANE	10 U	10 UJ	10 U	10 U	10 U	10 U
CIS-1,3-DICHLOROPROPENE	10 U	10 UJ	10 U	10 U	10 U	10 U
TRICHLOROETHENE	4 J	41 J	10 U	220	10 U	10 U
DIBROMOCHLOROMETHANE	10 U	10 UJ	10 U	10 U	10 U	10 U
1,1,2-TRICHLOROETHANE	10 U	10 UJ	10 U	10 U	10 U	10 U
BENZENE	10 U	10 UJ	10 U	10 U	10 U	10 U
TRANS-1,3-DICHLOROPROPENE	10 U	10 UJ	10 U	10 U	10 U	10 U
BROMOFORM	10 U	10 UJ	10 U	10 U	10 U	10 U
4-METHYL-2-PENTANONE	10 U	10 UJ	10 U	10 U	10 U	10 U
2-HEXANONE	10 U	10 UJ	10 U	10 U	10 U	10 U
TETRACHLOROETHENE	10 U	10 UJ	10 U	2 J	10 U	10 U
1,1,2,2-TETRACHLOROETHANE	10 U	10 UJ	10 U	23	10 U	10 U
TOLUENE	10 U	10 UJ	10 U	10 U	10 U	10 U
CHLOROBENZENE	10 U	10 UJ	10 U	10 U	10 U	10 U
ETHYLBENZENE	10 U	10 UJ	10 U	10 U	10 U	10 U
STYRENE	10 U	10 UJ	10 U	10 U	10 U	10 U
XYLENE (TOTAL)	10 U	10 UJ	10 U	10 U	10 U	10 U
METHYL-TERT-BUTYL ETHER	5 U	5 UJ	5 U	5 U	NA	NA

FREQUENCY OF DETECTION SUMMARY
GROUNDWATER, SHALLOW & INTERMEDIATE WELLS
ORGANICS (SPRING 1996)
SITE 35, CAMP GEIGER AREA FUEL FARM
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 0232
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID METHOD DATE SAMPLED	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION	AVERAGE OF POSITIVE DETECTIONS	MEDIAN OF POSITIVE DETECTIONS
VOLATILES (ug/L)								
CHLOROMETHANE	10 U	10 U	ND	ND		0/30	NA	NA
BROMOMETHANE	10 U	10 U	ND	ND		0/30	NA	NA
VINYL CHLORIDE	10 U	10 U	13	13	35-MW10D-04	1/30	13.00	13.00
CHLOROETHANE	10 U	10 U	ND	ND		0/30	NA	NA
METHYLENE CHLORIDE	10 U	10 U	ND	ND		0/30	NA	NA
ACETONE	10 U	10 U	66 J	66 J	35-TW27B-04	1/30	66.00	66.00
CARBON DISULFIDE	10 U	10 U	ND	ND		0/30	NA	NA
1,1-DICHLOROETHENE	10 U	10 U	4 J	6 J	35-MW10D-04	3/30	4.67	4.00
1,1-DICHLOROETHANE	10 U	10 U	3 J	4 J	35-MW36B-04	2/30	3.50	3.50
1,2-DICHLOROETHENE (TOTAL)	10 U	10 U	2 J	1200	35-MW10D-04	18/30	167.33	29.00
CHLOROFORM	10 U	10 U	ND	ND		0/30	NA	NA
1,2-DICHLOROETHANE	10 U	10 U	ND	ND		0/30	NA	NA
2-BUTANONE	10 U	10 U	ND	ND		0/30	NA	NA
1,1,1-TRICHLOROETHANE	10 U	10 U	ND	ND		0/30	NA	NA
CARBON TETRACHLORIDE	10 U	10 U	ND	ND		0/30	NA	NA
BROMODICHLOROMETHANE	10 U	10 U	ND	ND		0/30	NA	NA
1,2-DICHLOROPROPANE	10 U	10 U	ND	ND		0/30	NA	NA
CIS-1,3-DICHLOROPROPENE	10 U	10 U	ND	ND		0/30	NA	NA
TRICHLOROETHENE	10 U	12 U	4 J	740	35-MW10D-04	12/30	157.92	77.00
DIBROMOCHLOROMETHANE	10 U	10 U	ND	ND		0/30	NA	NA
1,1,2-TRICHLOROETHANE	10 U	10 U	ND	ND		0/30	NA	NA
BENZENE	10 U	10 U	2 J	4 J	35-MW39B-04	4/30	3.00	3.00
TRANS-1,3-DICHLOROPROPENE	10 U	10 U	ND	ND		0/30	NA	NA
BROMOFORM	10 U	10 U	ND	ND		0/30	NA	NA
4-METHYL-2-PENTANONE	10 U	10 U	ND	ND		0/30	NA	NA
2-HEXANONE	10 U	10 U	ND	ND		0/30	NA	NA
TETRACHLOROETHENE	10 U	10 U	2 J	2 J	35-TW29B-04	1/30	2.00	2.00
1,1,2,2-TETRACHLOROETHANE	10 U	10 U	17 J	23	35-TW29B-04	2/30	20.00	20.00
TOLUENE	10 U	10 U	2 J	4 J	35-MW37B-04	2/30	3.00	3.00
CHLOROBENZENE	10 U	10 U	ND	ND		0/30	NA	NA
ETHYLBENZENE	10 U	10 U	ND	ND		0/30	NA	NA
STYRENE	10 U	10 U	ND	ND		0/30	NA	NA
XYLENE (TOTAL)	10 U	10 U	ND	ND		0/30	NA	NA
METHYL-TERT-BUTYL ETHER	5 U	5 U	ND	ND		0/24	NA	NA

APPENDIX O.3
ROUND THREE, PERCENT SOLIDS

SITE 35, CAMP GEIGER AREA FUEL FARM
TOTAL DISSOLVED SOLIDS/SUSPENDED SOLIDS RESULTS
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 232
MCB CAMP LEJEUNE, NORTH CAROLINA

LOCATION	35-EMW03-02	35-EMW05-02	35-EMW07-02	35-GW05-02m	35-MW09D-02	35-MW09S-02
LAB ID	D95-7537-1	D95-7597-6	D95-7537-2	D95-7537-8	D95-7597-2	D95-7597-7
DATE SAMPLED	08/10/95	08/11/95	08/10/95	08/11/95	08/12/95	08/12/95
Total Dissolved Solids (mg/L)	288	173	335	290	290	432
Total Suspended Solids (mg/L)	10 U	10 U	10 U	10 U	10 U	24

SITE 35, CAMP GEIGER AREA FUEL FARM
TOTAL DISSOLVED SOLIDS/SUSPENDED SOLIDS RESULTS
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 232
MCB CAMP LEJEUNE, NORTH CAROLINA

LOCATION	35-MW10D-02	35-MW10S-02	35-MW14D-02	35-MW14S-02	35-MW16D-02	35-MW16S-02
LAB ID	95-7537-15	95-7537-14	95-7537-17	95-7537-16	95-7537-13	95-7537-11
DATE SAMPLED	08/09/95	08/09/95	08/10/95	08/10/95	08/09/95	08/10/95
Total Dissolved Solids (mg/L)	367	244	369	434	309	386
Total Suspended Solids (mg/L)	10 U	10 U	10 U	10 U	10 U	60

SITE 35, CAMP GEIGER AREA FUEL FARM
TOTAL DISSOLVED SOLIDS/SUSPENDED SOLIDS RESULTS
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 232
MCB CAMP LEJEUNE, NORTH CAROLINA

LOCATION	35-MW16S-02D	35-MW19D-02	35-MW19S-02	35-MW19S-02D	35-MW22D-02	35-MW22S-02
LAB ID	95-7537-12	D95-7537-5	D95-7537-6	D95-7537-7	D95-7597-8	D95-7597-9
DATE SAMPLED	08/10/95	08/11/95	08/11/95	08/11/95	08/13/95	08/13/95
Total Dissolved Solids (mg/L)	344	385	168	202	310	432
Total Suspended Solids (mg/L)	63	10 U	10 U	10 U	10 U	16

SITE 35, CAMP GEIGER AREA FUEL FARM
TOTAL DISSOLVED SOLIDS/SUSPENDED SOLIDS RESULTS
SUPPLEMENTAL GROUNDWATER INVESTIGATION - CTO 232
MCB CAMP LEJEUNE, NORTH CAROLINA

LOCATION	35-MW29A-02	35-MW29B-02	35-MW33A-02	35-MW33D-02
LAB ID	D95-7597-4	D95-7597-5	D95-7597-1	D95-7597-3
DATE SAMPLED	08/12/95	08/12/95	08/12/95	08/12/95
Total Dissolved Solids (mg/L)	91	257	45	283
Total Suspended Solids (mg/L)	10 U	10 U	10 U	10 U