DOWNTOWN CASPER PCE INVESTIGATION
CASPER, WYOMING

EXECUTIVE SUMMARY

In September and October 1994, Huntingdon Engineering & Environmental, Inc., under the direction of the Wyoming Department of Environmental Quality (WDEQ), conducted an investigation to describe the extent and degree of contamination due to volatile organic compounds, including tetrachloroethene (PCE), trichloroethene (TCE), 1,1,1-trichloroethane (1,1,1-TCA), benzene, ethylbenzene, toluene and xylenes, in the subsurface in the downtown Casper area. The area of investigation is approximately bounded on the east by McKinley Street, on the west by Poplar Street and the North Platte River, on the south by Collins Drive and East Yellowstone Highway and on the north by U.S. I-25. During this investigation, field operations generally proceeded from east to west across the study area. Invasive actions such as soil and groundwater sampling were confined to public property in order to minimize any impact on private property owners. All field activities were halted at Poplar Street due to the combined factors of budget and time constraints, large blocks of private property limiting sample density and, to a lesser extent, inclement weather.

Contamination of the soil vapor and shallow groundwater in the area by these compounds had been documented by earlier studies, but the extent and degree of the contamination had not been established precisely.

The scope of work for this investigation included using a Geoprobe sampler and portable field analytical equipment to collect and analyze samples of groundwater and soil vapor for either PCE, TCE and 1,1,1-TCA or benzene, ethylbenzene, toluene and xylenes (BETX) in the field to establish the horizontal extent of the affected area; submitting samples of groundwater to the Wyoming Department of Environmental Quality laboratory (WDEQ) for volatile organic compounds (VOCs) analysis; and preparing a report that describes the methods used for the investigation, presents the data developed during the investigation, describes the geologic and hydrogeologic conditions present in the study area and provides conclusions regarding the degree and extent of contamination by VOCs.

The land surface in the area is relatively flat. The area is underlain by approximately 35 to 40 feet of floodplain alluvium (sand and gravel) deposited by the North Platte River. The alluvium rests on the Cody Shale. A water table aquifer is present in the alluvium below depths of 6 to 24 feet throughout the study area. Groundwater flows generally to the north and northeast.

During this investigation, PCE and a related compound, trichloroethene (TCE), were found in the groundwater in four separate parts of the study area. The concentrations of PCE and TCE ranged from non-detectable to 613 micrograms per liter (μg/L) and non-detectable to 98 μg/L, respectively. The maximum contaminant level established by the U.S. Environmental Protection Agency for drinking water is 5 μg/L for each compound.

As a group, the BETX compounds were found in the groundwater in four separate parts of the study area. The concentrations of benzene, ethylbenzene, toluene and xylenes ranged from non-detectable to 9,043 μg/L, non-detectable to 9,214 μg/L, non-detectable to 2,219 μg/L and non-detectable to 6,969 μg/L, respectively. The maximum contaminant levels for benzene, ethylbenzene, toluene and xylenes are 5 μg/L, 700 μg/L, 1,000 μg/L and, 10,000 μg/L, respectively.

PCE and TCE were found in soil vapor in areas generally coinciding with the areas with PCE and TCE contaminated groundwater. Field-screening for vapor-phase benzene, ethylbenzene, toluene and xylenes did not detect any of these constituents in any of the soil vapor samples.

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1.0 INTRODUCTION

1.1 Objective

The objective of this project was to determine the extent and degree of contamination by volatile organic compounds, including tetrachloroethene (also called perchloroethylene, tetrachloroethylene, or PCE), trichloroethene (TCE), 1,1,1-trichloroethane (1,1,1-TCA), benzene, ethylbenzene, toluene and xylenes in portions of the downtown Casper area (Figure 1-1). PCE, TCE and 1,1,1-TCA are common solvents used in dry cleaning, vehicle maintenance, and other commercial and manufacturing operations. Benzene, toluene, ethylbenzene and xylenes are compounds of motor fuels such as gasoline. Contamination of the soil vapor and shallow groundwater in the area had been documented by several studies conducted previously. During the previous investigations, environmental media in the area were sampled at various times, in various locations and with a variety of methods. The present investigation was intended to provide a single set of data which was current, collected in a consistent manner and covered areas in downtown Casper which were known or suspected to be affected by volatile organic compounds, including PCE, TCE, 1,1,1-TCA, benzene, ethylbenzene, toluene and xylenes. During this investigation, field operations generally proceeded from east to west across the study area. Invasive actions such as soil and groundwater sampling were confined to public property in order to minimize any impact on private property owners. All field activities were halted at Poplar Street due to the combined factors of budget and time constraints, large blocks of private property limiting sample density and, to a lesser extent, inclement weather.

1.2 Scope of Work

The scope of work of this investigation included:

- Collecting and analyzing samples of groundwater and soil vapor for PCE, TCE, 1,1,1-TCA, benzene, ethylbenzene, toluene and xylenes, using a Geoprobe sampler and portable field analytical equipment, to establish the horizontal extent of the affected area and guide further field investigation,

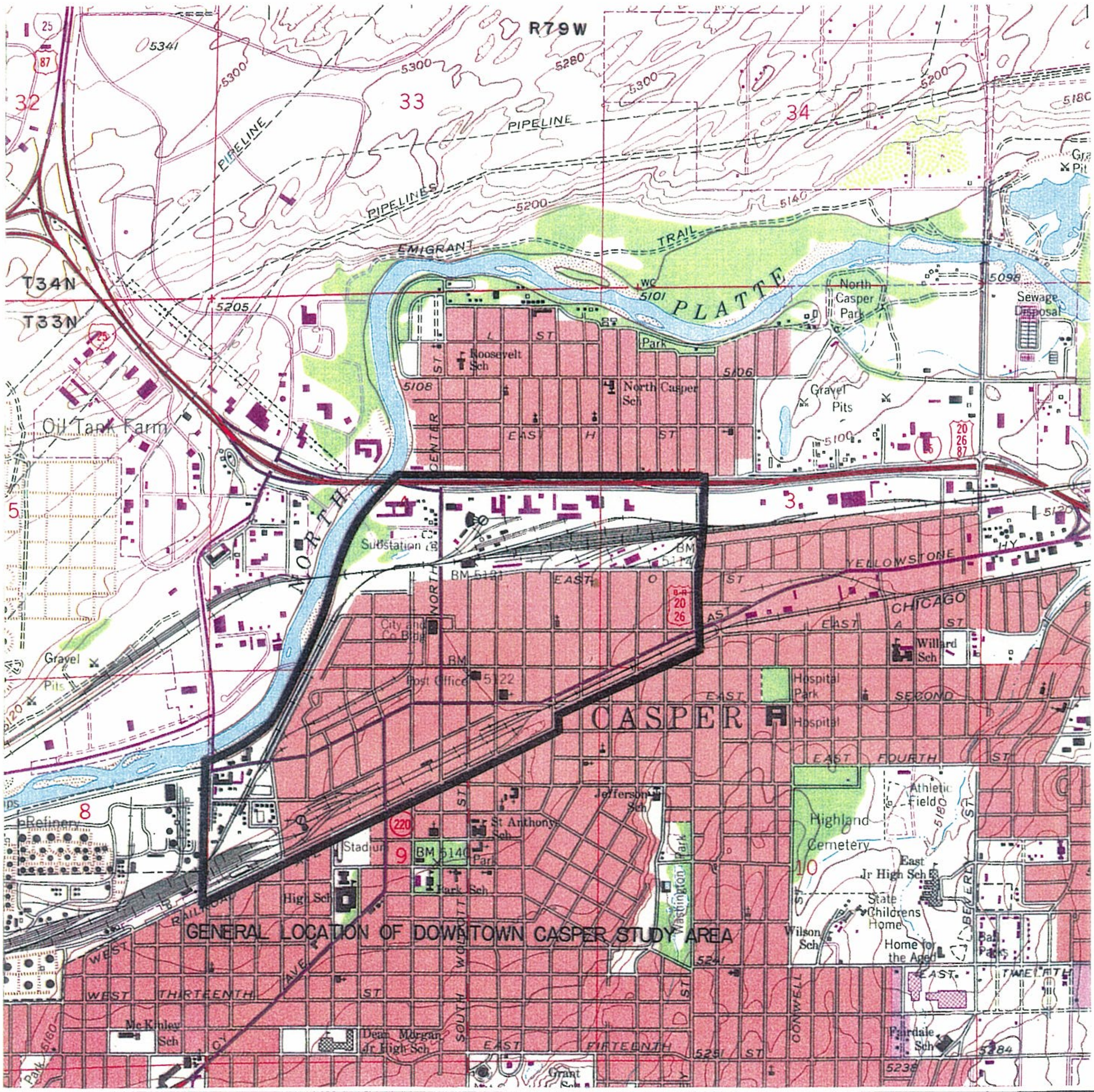
- Collecting samples of groundwater from each of the Geoprobe locations for laboratory analysis,

- Analyzing the groundwater samples for volatile organic compounds including PCE, TCE, 1,1,1-TCA, benzene, ethylbenzene, toluene and xylenes, and

- Preparing a report that describes the methods used for the investigation, presents the data developed during the investigation, describes the geologic and hydrogeologic conditions present in the study area and provides conclusions regarding the degree and extent of contamination by volatile organic compounds, including PCE, TCE, 1,1,1-TCA, benzene, ethylbenzene, toluene and xylenes.

Downtown Casper
PCE Investigation
Portions of Section 3, 4 and 9
T33N R79W
Casper, Wyoming

0 1000 2000
SCALE IN FEET



94-4455	Huntingdon	VICINITY MAP	Figure 1-1

This investigation was conducted by Huntingdon Engineering & Environmental, Inc. (Huntingdon) under the direction of the Wyoming Department of Environmental Quality (WDEQ), in general accordance with a contract executed September 16, 1994 between the WDEQ and Huntingdon.

2.0 BACKGROUND INFORMATION

2.1 Location, Land Use, Topography, Drainage and Climate of the Study Area

The study area is located in parts of the SW¼ of Section 3, the S½ of Section 4, and the N½ of Section 9, Township 33 North, Range 79 West (Figure 1-1). The area is bounded on the east by McKinley Street, on the west by Poplar Street and the North Platte River, on the south by Collins Drive, and on the north by U.S. I-25.

Land use in this area is primarily commercial and light industrial, with some residential. The residential areas are located primarily in the eastern third of the study area. The Amoco refinery site borders the western side of the study area, along Poplar Street.

The topography of the area of investigation is relatively flat, with a very slight slope toward the North Platte River. The area drains to the river, either by direct overland runoff or via the City of Casper storm sewer system.

The climate of the Natrona County area is arid, except in the mountainous areas at altitudes above 6,000 feet (Crist and Lowry, 1972). The average annual precipitation at Casper is about 12 inches. The mean annual temperature is approximately 46°F (Crist and Lowry, 1972).

2.2 Regional Overview of Geology and Hydrogeology

The City of Casper is located on the eastern flank of the Casper Arch, with the Powder River Basin to the north and east, the Laramie Range to the south, and the Wind River Basin and Rattlesnake Hills to the northwest and west, respectively (Crist and Lowry, 1972). The Downtown Casper study area is underlain by Quaternary-age unconsolidated floodplain deposits associated with the North Platte River. The floodplain deposits range from silt to sand, cobbles and boulders. Exploratory borings determined the thickness of the floodplain alluvium to be approximately 35 to 40 feet. The sands are very fine grained near the surface and become coarser grained with depth; the grains are subangular to subrounded. Gravel, cobbles and boulders are subrounded to rounded.

Bedrock beneath the alluvium is the Cody Shale, an upper Cretaceous, marine shale. It has been described by Gable and others (1987) as a soft, bentonitic, dark-gray shale with lenticular sandstones in the upper sections and thin bentonite layers throughout. The dip of the Cody Shale is slight and, in this area, generally to the northeast (Crist and Lowry, 1972).

The hydrology of the area of investigation is most directly influenced by the drainage and climate of the surrounding region. The North Platte River is the principal drainage system of Natrona County, flowing from west to east as part of the Missouri River drainage. Discharge rates of several reservoirs upstream from Casper control the river flow.

Groundwater is present in the alluvial deposits that underlie the study area at depths below approximately six to twenty-four feet. Groundwater levels in the alluvium are affected by runoff, the stage of the North Platte River, and waters from underlying bedrock aquifers (Crist and Lowry, 1972). Groundwater flow in the study area is generally north-northeast toward the North Platte River. Chemically, the dominant anion found in alluvial groundwater by Crist and Lowry (1972) was sulfate. In the same study, calcium magnesium hardness was less than 600 milligrams per liter (mg/L), and total dissolved solids less than 1500 mg/L. Selenium was present in alluvium groundwater at levels less than 1.1 mg/L (Crist and Lowry, 1972).

2.3 Previous Environmental Investigations

To date, at least eleven reports have been issued documenting environmental investigations conducted in the downtown Casper area. The purpose of this section is to summarize the scopes of work, results and conclusions of those investigations. The quality and validity of the data presented in the reports of these investigations were assessed for this study only in a cursory, qualitative manner; an exhaustive evaluation was beyond the project scope and was not deemed necessary. Copies of the reports discussed in this section are available at public information repositories in Casper or in WDEQ files. The reader should refer to the original reports for data quality assessment.

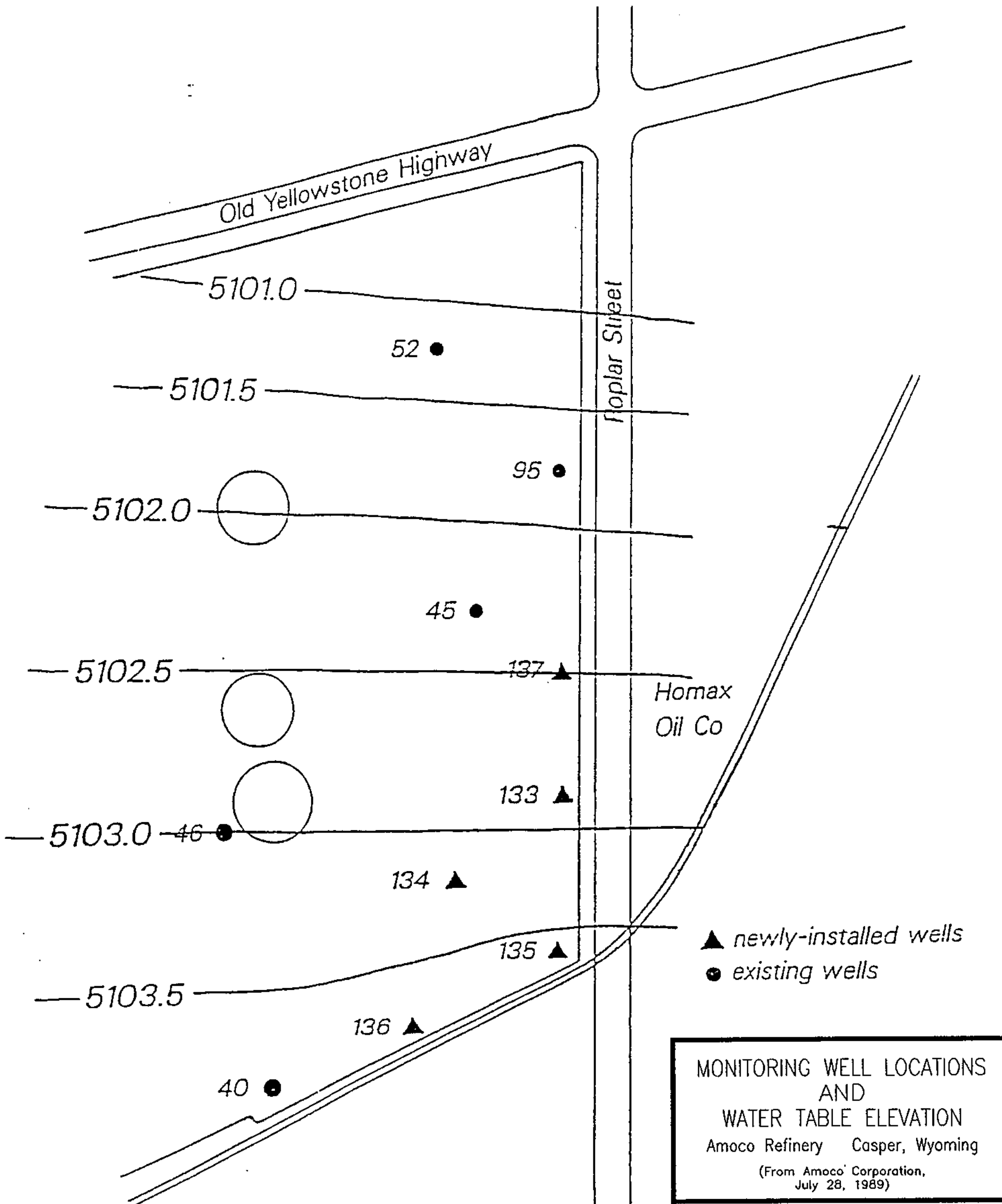
2.3.1 Amoco Oil Company. July 28, 1989. Subsurface Investigation of the Area of the Amoco Refinery Near the Homax Oil Company Facility.

During May 1989, personnel from Amoco Oil Company conducted an investigation to determine if operations at their Casper, Wyoming refinery could be contributing to subsurface hydrocarbon contamination at the Homax Oil Company site located east of the refinery. The investigation included drilling and collecting soil samples from five soil borings, installing five monitoring wells, collecting and analyzing groundwater samples from 11 monitoring wells and collecting and analyzing liquid hydrocarbon samples from 6 monitoring wells. The locations of the monitoring wells are shown on Figure 2-1.

Analysis of the liquid hydrocarbon samples indicated that the composition of the hydrocarbon samples from Amoco monitoring wells 41, 133 and 137 differs significantly from hydrocarbon samples collected previously from wells located farther west in the refinery. Based on those analytical results and the fact that the direction of groundwater flow in May 1989 was to the north, it was concluded that the source of the alleged contamination at the Homax site is not the refinery.

2.3.2 Chen-Northern, Inc. December 18, 1989. Preliminary Environmental Study, Hensley Battery & Electrical Supply Property, 613 West Yellowstone Highway, Casper, Wyoming.

During November 1989 personnel from Chen-Northern, Inc. conducted a subsurface investigation to provide data which could be used to describe the extent of the hydrocarbon contamination identified during the removal of eleven underground storage tanks (USTs) from



MONITORING WELL LOCATIONS
AND
WATER TABLE ELEVATION

Amoco Refinery Casper, Wyoming

(From Amoco Corporation, July 28, 1989)

Huntingdon

94-4455

Figure 2-1

the site. The investigation consisted of drilling three soil borings and installing and sampling three monitoring wells. The locations of the monitoring wells are shown on Figure 2-2. The results of the groundwater analyses are presented in Table 2-1.

Groundwater samples were collected from each well and analyzed for benzene, ethylbenzene, toluene, xylenes and total petroleum hydrocarbons. The results of the analyses found one or more of the analyzed constituents to be present in the groundwater samples from two of the wells, MW-2 and MW-3. No conclusions were presented in the report.

2.3.3 Delta Environmental Consultants, Inc. August 9, 1989. Subsurface Investigation, Homax Oil Sales, Inc., 605 South Poplar, Casper, Wyoming.

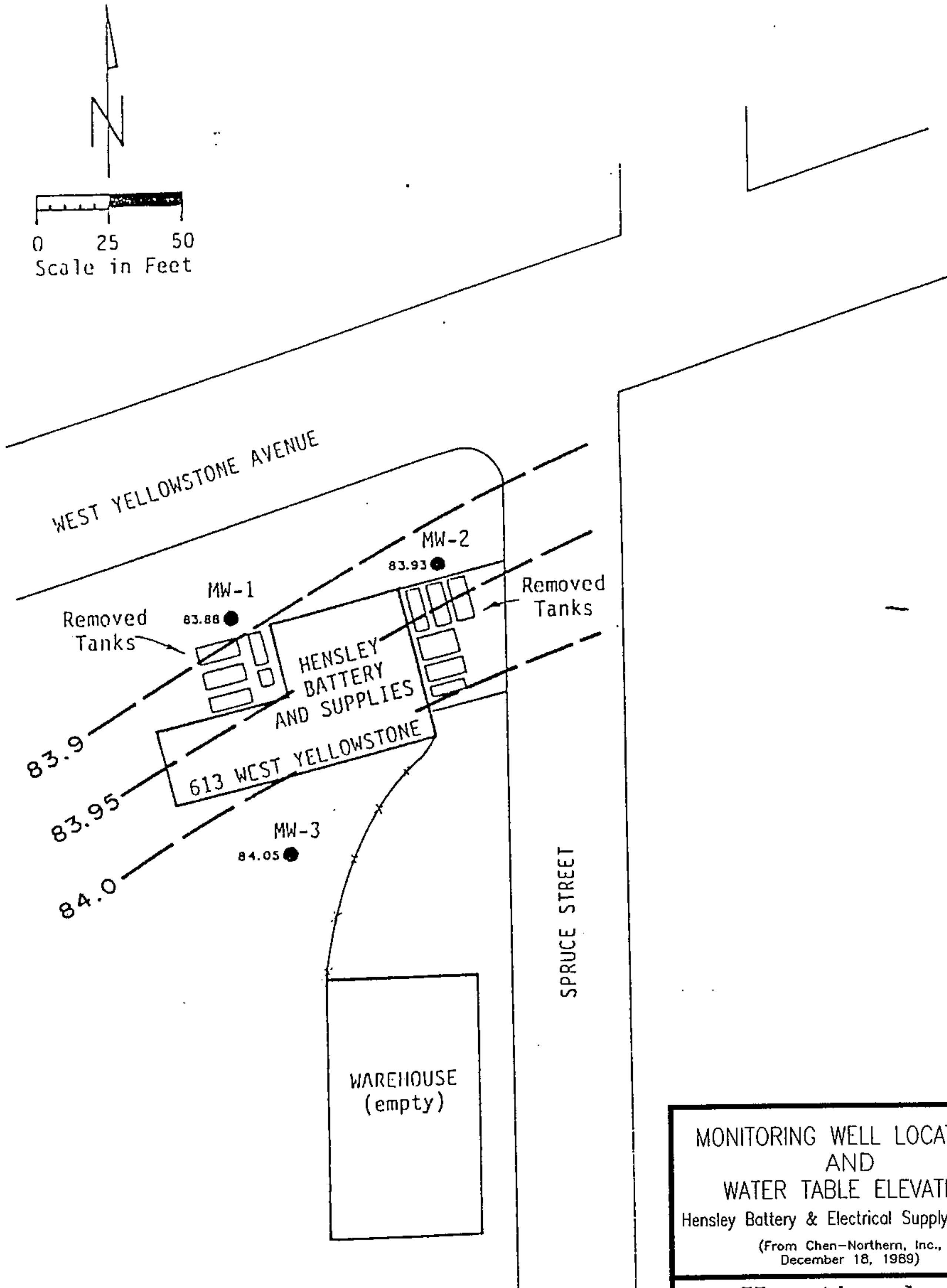
During June and July of 1989, personnel from Delta Environmental Consultants, Inc., at the request of Homax Oil Sales, Inc., conducted an investigation to determine the extent of possible petroleum contamination of the soil and groundwater at the Homax Oil Sales, Inc. - Poplar Site located at 605 South Poplar Street in Casper. The investigation was done in response to the discovery of petroleum hydrocarbon contamination during the removal of two USTs from the site in September 1988. The investigation consisted of drilling and sampling 6 soil borings and installing and sampling 6 monitoring wells (MW-1 through MW-6). The locations of the monitoring wells are shown on Figure 2-3. Analytical results are presented in Table 2-2.

Based on the results of this investigation, Delta Environmental Consultants concluded that significant levels of hydrocarbon contamination were present in every monitoring well and that the contamination was a combination of gasoline and diesel. They also concluded that essentially all of the contamination found at the site migrated there from the Amoco Refinery which is located west of the site.

2.3.4 Chen-Northern, Inc. October 22, 1990. Phase II Environmental Assessment At The Baroid Property Located At 1030 West Collins Drive, Casper, Wyoming.

Between September 10, 1990 and October 10,1990 personnel from Chen-Northern, Inc., at the request of Baroid Drilling Fluids, Inc. conducted a Phase II Site Assessment at the Baroid property located at 1030 West Collins Drive in Casper. The purpose of the assessment was to evaluate the groundwater quality and groundwater gradient and the probability of an off-site contamination source or sources. The assessment consisted of drilling and sampling six soil borings and installing and sampling three monitoring wells. The locations of the monitoring wells are shown on Figure 2-4. Analytical results are presented in Table 2-3.

Analysis of the soil and groundwater samples found high concentrations of petroleum contamination in the subsurface beneath the Baroid site. The report concludes that while some of the contamination may have originated from two underground storage tanks which previously occupied the site and from sumps within the building, the majority of the contamination is related to past railroad operations and refining activities located north and west of the site.



MONITORING WELL LOCATIONS AND WATER TABLE ELEVATION

Hensley Battery & Electrical Supply Property

(From Chen-Northern, Inc., December 18, 1989)

Huntingdon

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Figure 2-2

Table 2-1

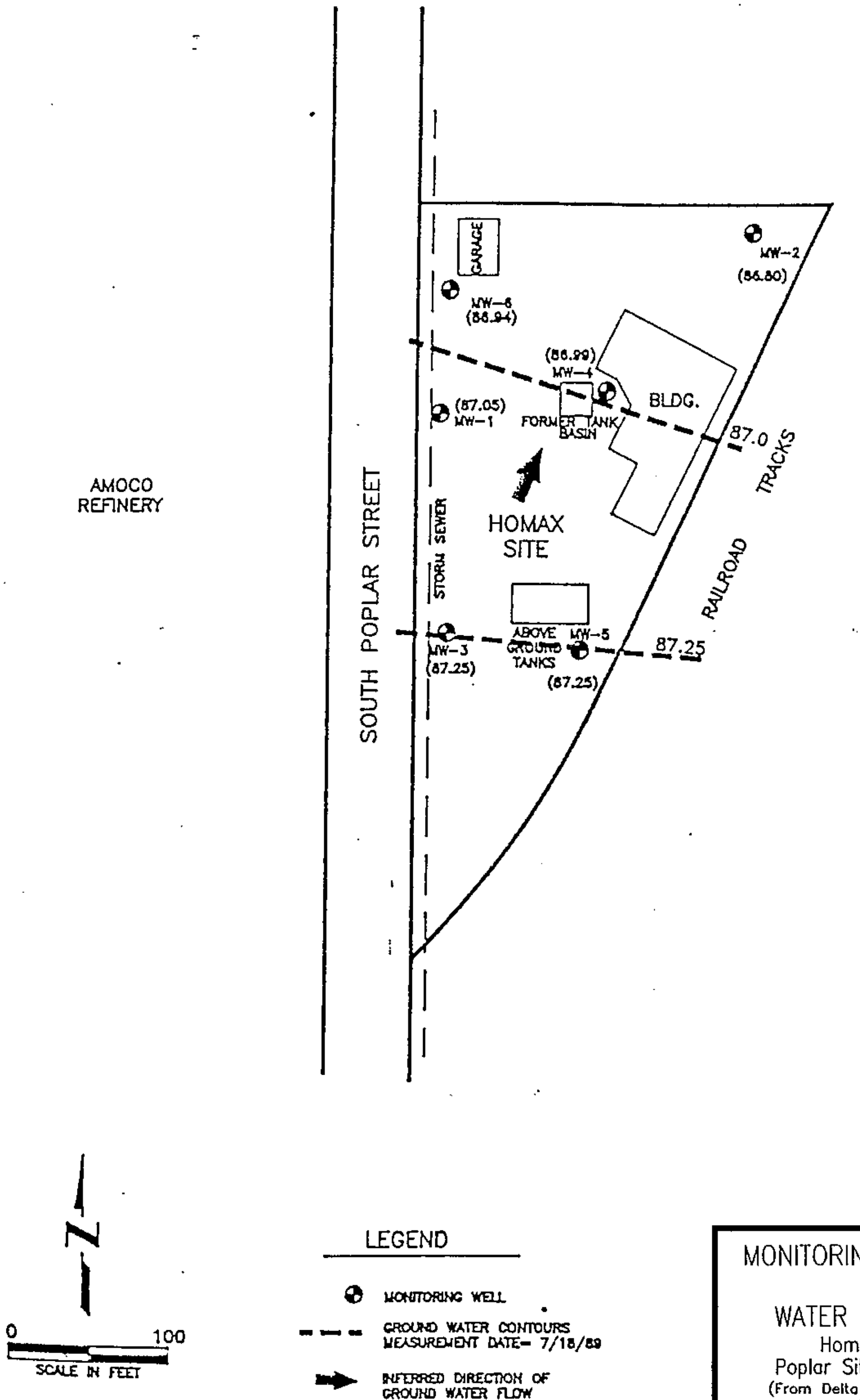
Summary of Analytical Results
Hensley Battery & Electrical Supply Project
613 West Yellowstone Highway
Casper, Wyoming

Well No.	Date Sampled	Benzene (μg/L)	Ethylbenzene (μg/L)	Toluene (μg/L)	Xylenes (μg/L)	Total Petroleum Hydrocarbons (mg/L)
MW-1	11-17-89	ND	ND	ND	ND	ND
MW-2	11-17-89	1,600	1,438	640	9,361	16.0
MW-3	11-17-89	15	ND	12	29	ND

"ND" indicates compound was not detected above detection level of 5 ppb BETX and 0.5 ppm TPH

Note: All values are in μg/L or mg/L. In dilute aqueous solution, μg/L and mg/L are equivalent to parts per billion (ppb) and parts per million (ppm), respectively.

Data from Chen-Northern, Inc.; December 18, 1989



MONITORING WELL LOCATIONS AND WATER TABLE ELEVATION

Homax Oil Sales, Inc.

Poplar Site Casper, Wyoming

(From Delta Environmental Consultants, August 9, 1989)

Huntingdon

Consulting Engineers Environmental Scientists

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Figure 2-3

Table 2-2
Summary of Analytical Results
Homax Oil Sales Inc. - Poplar Site
605 South Poplar
Casper, Wyoming

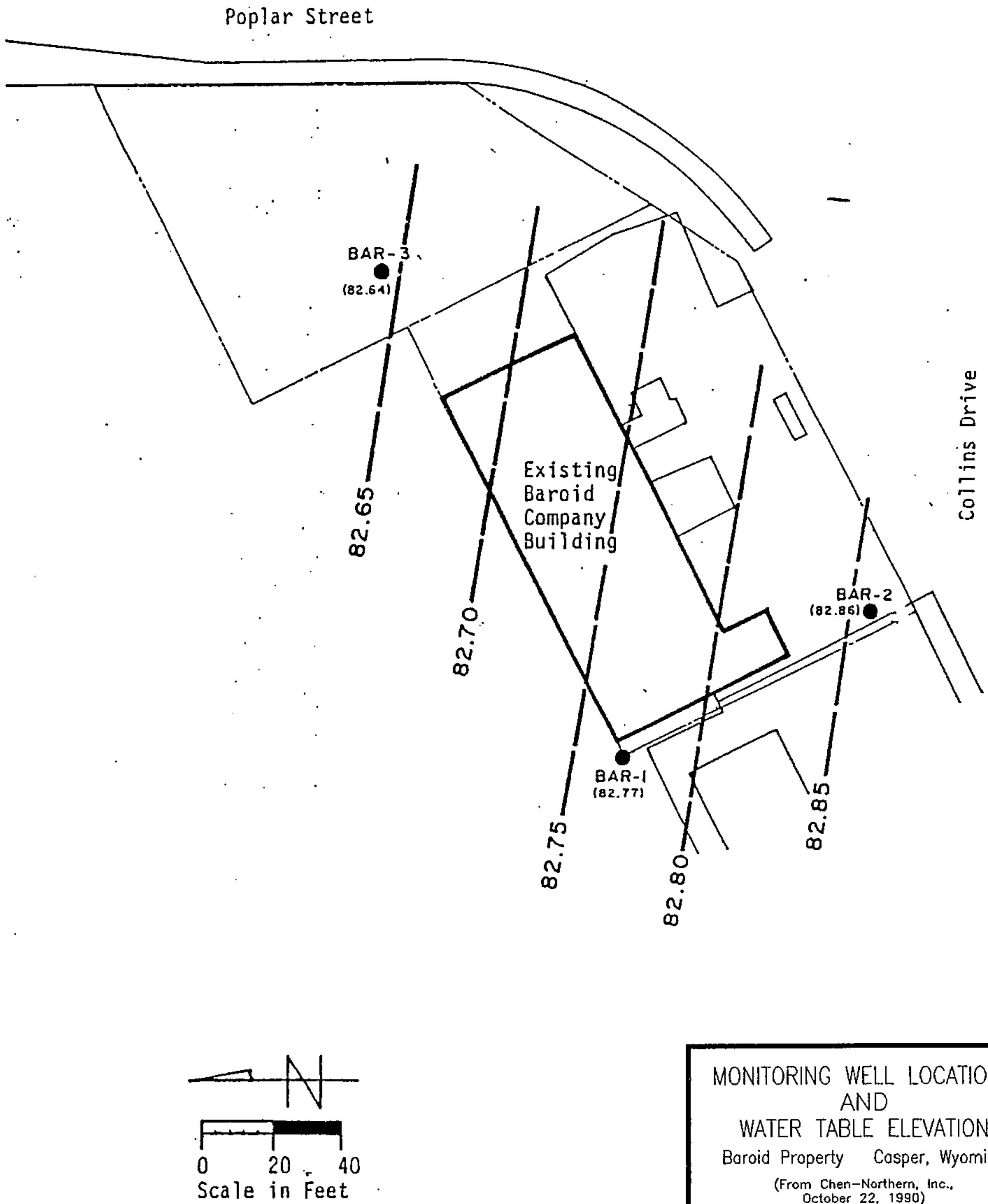
Parameter	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7*	DIS-B**
Benzene	12.10	4.02	10.10	4.17	7.09	9.47	9.78	ND
Toluene	25.70	0.375	15.30	0.783	0.514	12.50	15.20	ND
Ethyl-benzene	5.02	4.08	3.90	2.03	3.13	4.46	4.52	ND
Total Xylenes	25.10	19.0	21.10	8.82	20.80	21:40	19.90	ND
TPH	229	120	232	72	159	207	219	ND
Lead	ND	ND	ND	NA	NA	NA	NA	ND
Arsenic	ND	ND	ND	NA	NA	NA	NA	ND
Barium	0.37	0.42	0.39	NA	NA	NA	NA	ND
Cadmium	ND	ND	ND	NA	NA	NA	NA	ND
Chromium	ND	ND	ND	NA	NA	NA	NA	ND
Selenium	ND	ND	ND	NA	NA	NA	NA	ND
Mercury	ND	ND	ND	NA	NA	NA	NA	ND
Silver	ND	ND	ND	NA	NA	NA	NA	ND

Note: These are groundwater samples collected on June 30, 1989

Note: All concentrations are in mg/l

ND Not Detected
NA Not Analyzed
* MW-7 is a duplicate of sample MW-3
** DIS-B is a bailer blank

Data from Delta Environmental Consultants; August 9, 1989



MONITORING WELL LOCATIONS
AND
WATER TABLE ELEVATION
Baroid Property Casper, Wyoming
(From Chen-Northern, Inc., October 22, 1990)

Huntingdon

94-4455

Figure 2-4

Table 2-3
Summary of Analytical Results
Baroid Property
1030 West Collins Drive
Casper, Wyoming

Water Sampled September 13, 1990							
Date Sampled	Sample Number	Sample Depth (ft)	Concentration of Volatile Hydrocarbon Compounds				Total Petroleum Hydrocarbons (mg/L)
			Benzene (μg/L)	Ethylbenzene (μg/L)	Toluene (μg/L)	Xylenes (μg/L)	
9/13/90	BAR-1	15.12	140	2,200	80	11,000	100
9/13/90	BAR-2	14.89	35	1,200	15	340	110
9/13/90	BAR-3	17.51	640	2,600	67	9,000	100

Soil Sampled September 10, 1990			
Date Sampled	Sample Number	Sample Depth (ft)	Total Petroleum Hydrocarbons (mg/kg)
09/10/90 10/10/90	BAR-1	14.0 5.0	940 <0.5
09/10/90 10/10/90	BAR-2	14.0 5.0	1,300 <0.05
09/10/90 10/10/90	BAR-3	14.0 5.0	190 <0.5

Note: Data from Chen-Northern, Inc., October 22, 1990

2.3.5 Hart Crowser, Inc. February 12, 1991. Subsurface Exploration and Testing. Glacier Park Company Property, Property Sequence No. 3476, Casper, Wyoming.

During the months of May through August 1990, Glacier Park Company retained Hart Crowser, Inc. to conduct an investigation to determine if activities conducted by Burlington Northern Railroad had caused significant subsurface impact to their property. The property in question consists of two parcels, one located north and the other south of the Burlington Northern mainline between North Center Street and North McKinley Street. The combined area is bounded approximately by I-25 on the north and by East "C" Street on the south. The investigation was performed in response to a limited Site Investigation conducted by ENERLOG/TIS, Inc. and a Phase I Preliminary Environmental Assessment conducted by Hart Crowser, Inc. which identified historical practices by Burlington Northern that might have impacted soil and groundwater quality. The subsurface investigation was restricted to the Burlington Northern rail yards between Center and McKinley Streets.

The investigation consisted of conducting a geophysical survey, drilling and sampling eleven soil borings and installing and sampling nine monitoring wells (HC-1 through HC-9; Figure 2-5), excavating and sampling nine test pits, obtaining two composite surface soil samples, advancing and sampling three hand-auger borings, and collecting one sample of sludge and seven samples of suspected asbestos-containing material.

Based on the results of this investigation, Hart Crowser concluded that petroleum hydrocarbons had significantly impacted soil and groundwater at both of the parcels. The extent of free petroleum product is shown on Figure 2-6; the extent of soil and groundwater contamination by petroleum hydrocarbons is approximately coincident with the area containing free product. In addition, chlorinated volatile organic compounds were detected in the groundwater beneath the study area. PCE was the primary compound detected, and was detected at concentrations that ranged from 10 μg/L to 300 μg/L. No PCE was detected in the soils in the study area. The areas of PCE occurrence in the study area indicated that other potential source areas south of the parcels, rather than activities at the subject site, were most likely responsible for the presence of the PCE.

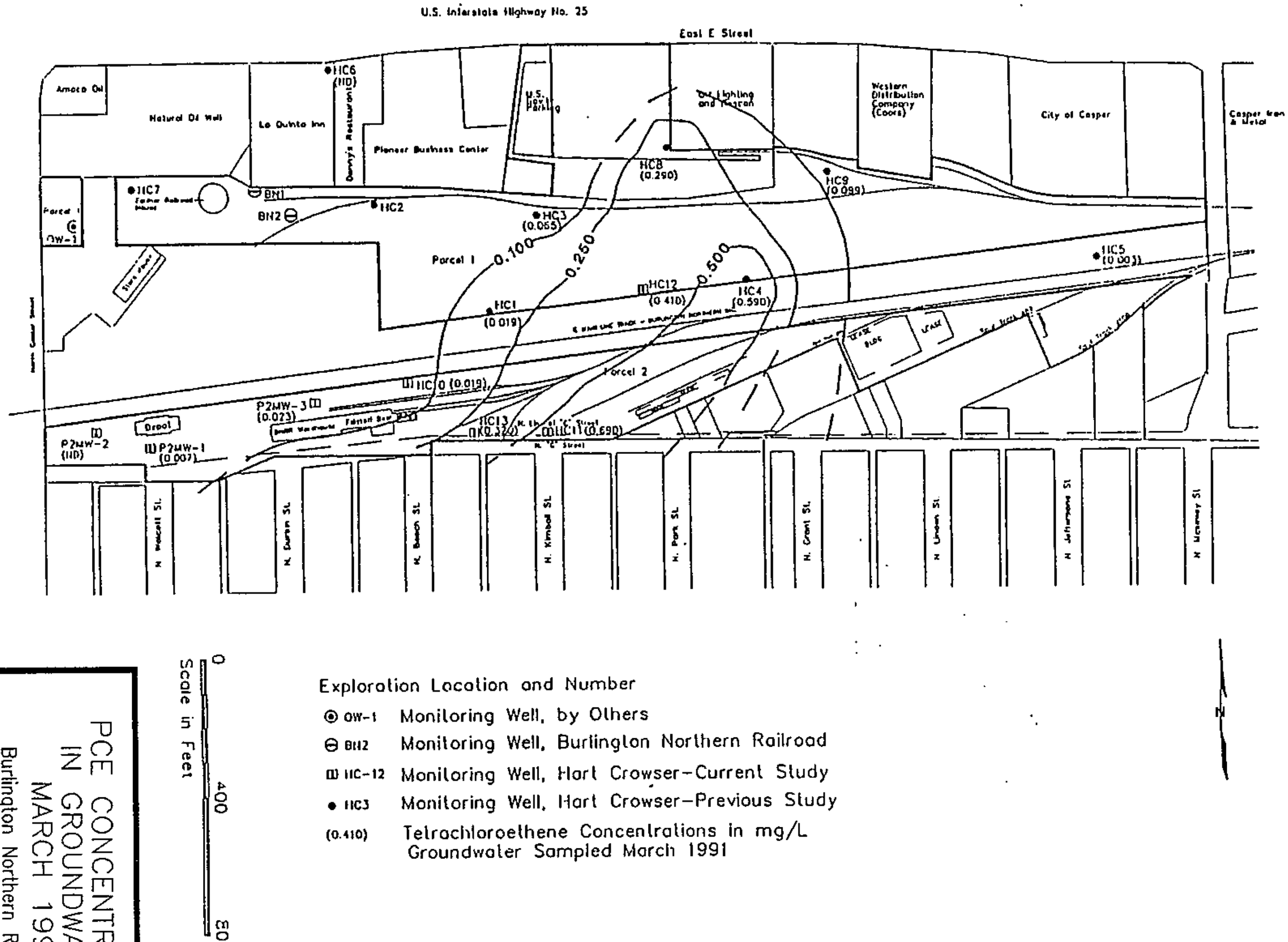
2.3.6 Hart Crowser, Inc. May 15, 1991. Additional Site Assessment, Glacier Park Company Property, Property Sequence No. 3476, Parcels 1 and 2, Casper, Wyoming.

In response to the results of the investigation submitted on February 12, 1991, Hart Crowser, Inc. conducted an additional investigation for the Glacier Park Company to further define the nature and extent of the chlorinated volatile organic compounds detected previously and to determine whether the presence of these compounds resulted from activities within the subject site.

The investigation consisted of installing and sampling seven monitoring wells (HC-10 through HC-13, and P2MW-1 through P2MW-3), excavating and sampling three test pits, sampling the wells installed previously, and conducting an off-site reconnaissance and review of available historical information to identify potential off-site sources of the chlorinated volatile organic compounds. Sampling was limited to the rail yard area.

Tetrachloroethene Concentration in Groundwater

March 1991 Groundwater Sampling



Exploration Location and Number

- ⊙ OW-1 Monitoring Well, by Others
- ⊖ BN2 Monitoring Well, Burlington Northern Railroad
- ◫ HC-12 Monitoring Well, Hart Crowser-Current Study
- • HC3 Monitoring Well, Hart Crowser-Previous Study
- (0.410) Tetrachloroethene Concentrations in mg/L Groundwater Sampled March 1991

PCE CONCENTRATION IN GROUNDWATER MARCH 1991

Burlington Northern Railyard

(From Hart Crowser, May 15, 1991)

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Consulting Engineers Environmental Scientists

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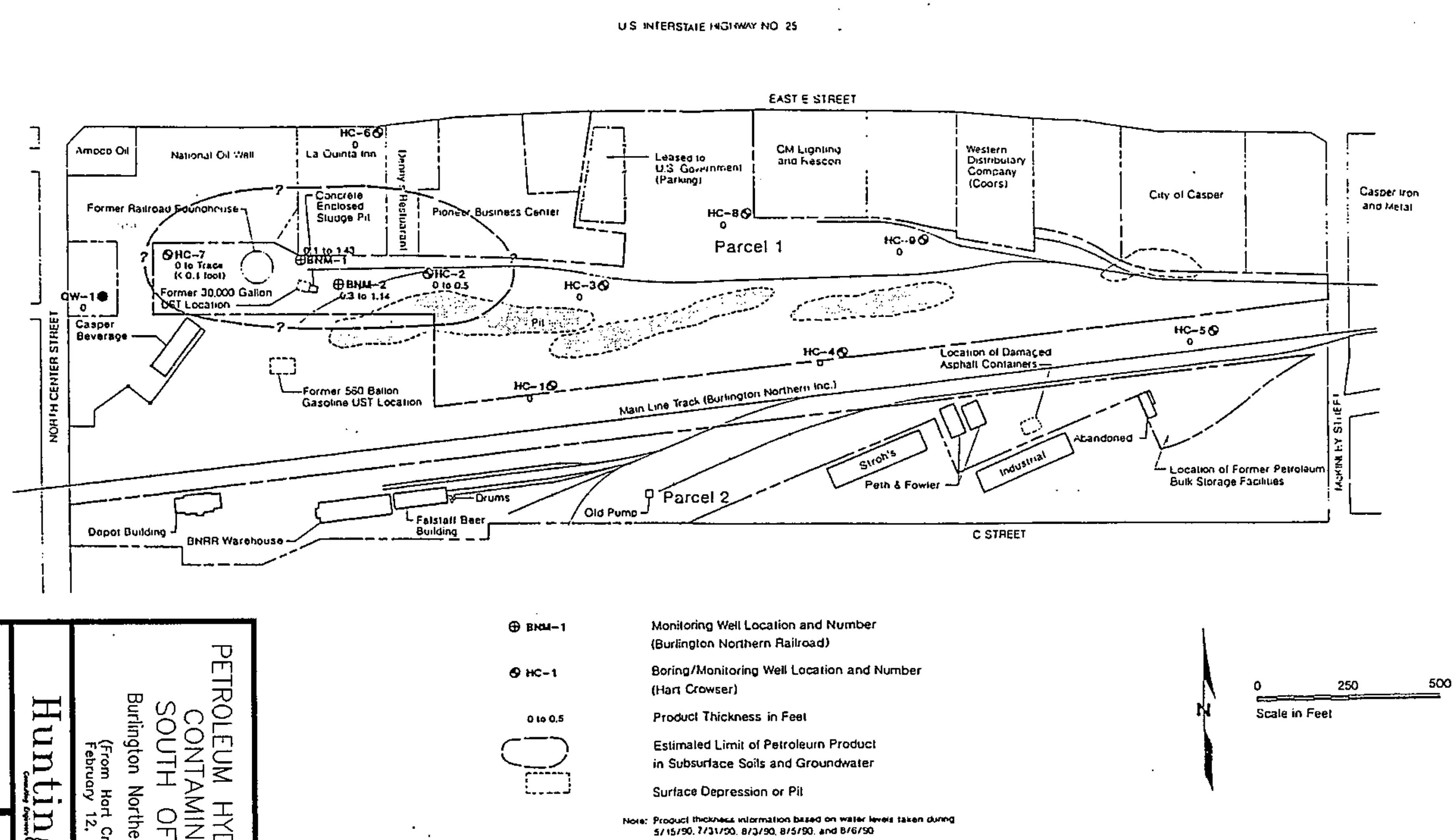
Figure 2-5

Approximate Extent of Free (Floating) Product Map



PETROLEUM HYDROCARBON CONTAMINATION SOUTH OF I-25

Burlington Northern Railyard

(From Hart Crowser, February 12, 1991)

Huntingdon
Consulting Engineers Environmental Scientists

94-4455

Figure 2-6

This investigation showed that PCE was the major contaminant detected, that PCE was present in the groundwater at concentrations ranging from 3 μg/L to 690 μg/L, and that the source of the PCE was located to the south (up-gradient) of the subject site. The distribution of PCE in the groundwater as determined by this investigation is shown on Figure 2-5. Seventeen potential sources of PCE contamination south and southwest of the study area were identified during the investigation (Table 2-4). Hart Crowser concluded that the three most likely potential sources were the former industrial laundry (Steiner Corp., Casper Troy Laundry, and Casper Linen Co., at various times) that operated at 330 North Durbin Street from 1948 to 1985, the Fischer Body Shop that has operated continuously at 223 North Durbin Street since the 1950s, and the Acme Fuel Company that operated at 400 East A Street during the 1970s. They also concluded that additional soil and groundwater investigation south of the Burlington Northern rail yard area would be required to further evaluate the PCE source.

2.3.7 Lockheed Engineering and Sciences Company. October 1991. Aerial Photographic Analysis of North Casper Groundwater Contamination Study Area.

Lockheed Engineering and Sciences Company, under contract to the US EPA, conducted analysis of aerial photographs of the north part of Casper taken between 1944 and 1991 to locate possible sources of groundwater contamination by chlorinated organic compounds. The analysis documented visible waste disposal activities and physical conditions that pose potential environmental hazards. Photographs taken in 1944, 1947, 1960, 1971, 1978, 1982, 1988 and 1991 were examined. The report documents the presence and evolution of numerous potential sources of contamination. The potential sources most significant in terms of their nature, size and location relative to the contamination identified in the north Casper area include: the railroad yard and associated facilities including a locomotive maintenance facility and lagoon in the area now between I-25 and C Street west of McKinley Street, a fuel/oil distributorship at the southeast end of the railroad yard, the former City Garage, the building housing the former Norge Village Dry Cleaning facility, commercial businesses (many storing unidentified 55-gallon drums) that were built in and around the railroad yard, an open dump on the south side of the North Platte River between Beech and Durbin Streets, and a landfill along the west side of McKinley Street between the railroad yard and I-25. Lockheed Engineering and Sciences Company provided a narrative description of each of the photographs, identifying potential sources of contamination, but did not make any conclusions regarding the contribution or lack of contribution of any of the identified facilities to the groundwater contamination by chlorinated organic compounds.

2.3.8 Scientific Geochemical Services. January, 1992. Preliminary Environmental Site Assessment & Soil Vapor Probe Contamination Study - Wilson Addition Project, Casper, Wyoming.

During December 1992 personnel from Scientific Geochemical Services conducted a soil vapor survey at the Wilson Addition located at the northeast corner of the intersection of South Poplar Street and west Yellowstone Highway. The purpose of the investigation was to identify the presence or absence of potentially hazardous accumulations of hydrocarbons in the subsurface soils and groundwater at the site. The soil vapor survey consisted of collecting 27 soil vapor samples and analyzing the samples for light (methane, ethane, propane, iso- and normal butane,

Table 2-4
Historic and Current Potential Sources of Tetrachloroethene
(After Hart Crowser, 1991b)

Business Name	Address	Current Operating Status	Dates of Operation Noted in Review
Kay Cee's Budget Office Furniture (formerly Steiner Corp., Casper Troy Laundry Co., Casper Lien Co.)	330 North Durbin Street	P	1960s, 1970s
Eisman Chemical Co.	838 East C Street	P	1989
1-Hour Martinizing	946 East 2nd Street	P	1989
Midwest Cleaners & Laundry	638 East 2nd Street	P	1960s
Rick's Rod Shop - Auto Repair	709 East C Street	P	1989
Fischer Body Shop	223 North Durbin Street	P	1970s
Allen's Import Car Care	548 East A Street	P	1989
United Glass and Paint	235 North Kimball Street	P	1989
Auto Detail Shop	214 North Beech Street	O	1989
Baily Chemical Company	437 East A Street	?	1980?
Wright's Paint and Body Shop	315 North Grant Street	P	1960s
Energy Laboratories, Inc.	254 North Center Street	P	1989
Auto Hospital	304 North Grant Street	P	1960s
Northwest Iron & Metal Co.	331 North Park Street	O	1960s
Jack's Union 76 Service Station	400 East A Street	O	1970s
Acme Fuel Company	466 East C Street	O	1970s
Casper Dry Cleaners	120 East 5th Street	P	

P = presently operating
O = out of operation
? = unable to find listing in current phone directory

ethylene, and propylene) as well as heavy (benzene, toluene, ethylbenzene and xylenes) hydrocarbon vapors. Sample locations and sample results are presented in Table 2-5 and shown on Figures 2-7, 2-8 and 2-9.

The results of the survey identified two separate plumes of hydrocarbon contamination in the subsurface at the site. The report concludes the a portion of the identified contamination may be due to historical activities which took place at the site, but that all or a portion of the contamination originated at the Amoco refinery.

2.3.9 Scientific Geochemical Services. February, 1992. Amendment to Preliminary Environmental Site Assessment & Soil Vapor Probe Contamination Study - Wilson Addition Project, Casper, Wyoming.

On January 29, 1992, personnel from Scientific Geochemical Services conducted additional investigative activities at the Wilson Addition located at the northeast corner of the intersection of South Poplar Street and West Yellowstone Highway. The purpose of this additional investigation was provide data which could be used to better delineate the areal extent of the vadose zone contamination identified previously. The additional investigative activities consisted of collecting and analyzing eleven soil vapor samples. Sample locations and sample results are presented in Table 2-6 and shown on Figures 2-10, 2-11 and 2-12.

Based on data compiled for this assessment, Scientific Geotechnical Services concluded that the subsurface contamination at the Wilson Addition was probably due to leakage from a heretofore unknown buried tank or above ground system that discharged product into the subsurface, and also to migration of contamination on to the site from an off-site source.

2.3.10 Engineering-Science, Inc. August 1992. Results of Site Investigation at the Casper Yard, Casper, Wyoming.

Engineering-Science, Inc. conducted an investigation for Burlington Northern Railroad during July 1991 at the Burlington Northern Railroad mainline property located between North Center Street and North McKinley Street. The investigation was conducted to further define the extent of soil and groundwater impacted by petroleum hydrocarbon at the subject site and to obtain data to evaluate potential remedial alternatives for the site.

The investigation consisted of conducting a soil vapor survey, a biological respiration test, an aquifer test, drilling and sampling 12 soil borings, and installing and sampling 13 monitoring wells (Figure 2-13).

Based on the results of this investigation, Engineering-Science, Inc. concluded that petroleum hydrocarbon contamination existed in a four-foot vertical interval from 15 to 19 feet below ground surface in the vicinity of the former diesel fueling track, former 30,000-gallon UST, and former diesel fuel unloading rack/fuel pipeline. PCE was detected in groundwater from only one of the wells (CY-MW10 near the west side of the area), at a concentration of 11 μg/L. They reported transmissivity values between 105,600 gallons per day per foot (gpd/ft) and 194,526 gpd/ft, and storativity values between 2.37×10^{-3} and 7.7×10^{-5} from the pumped well

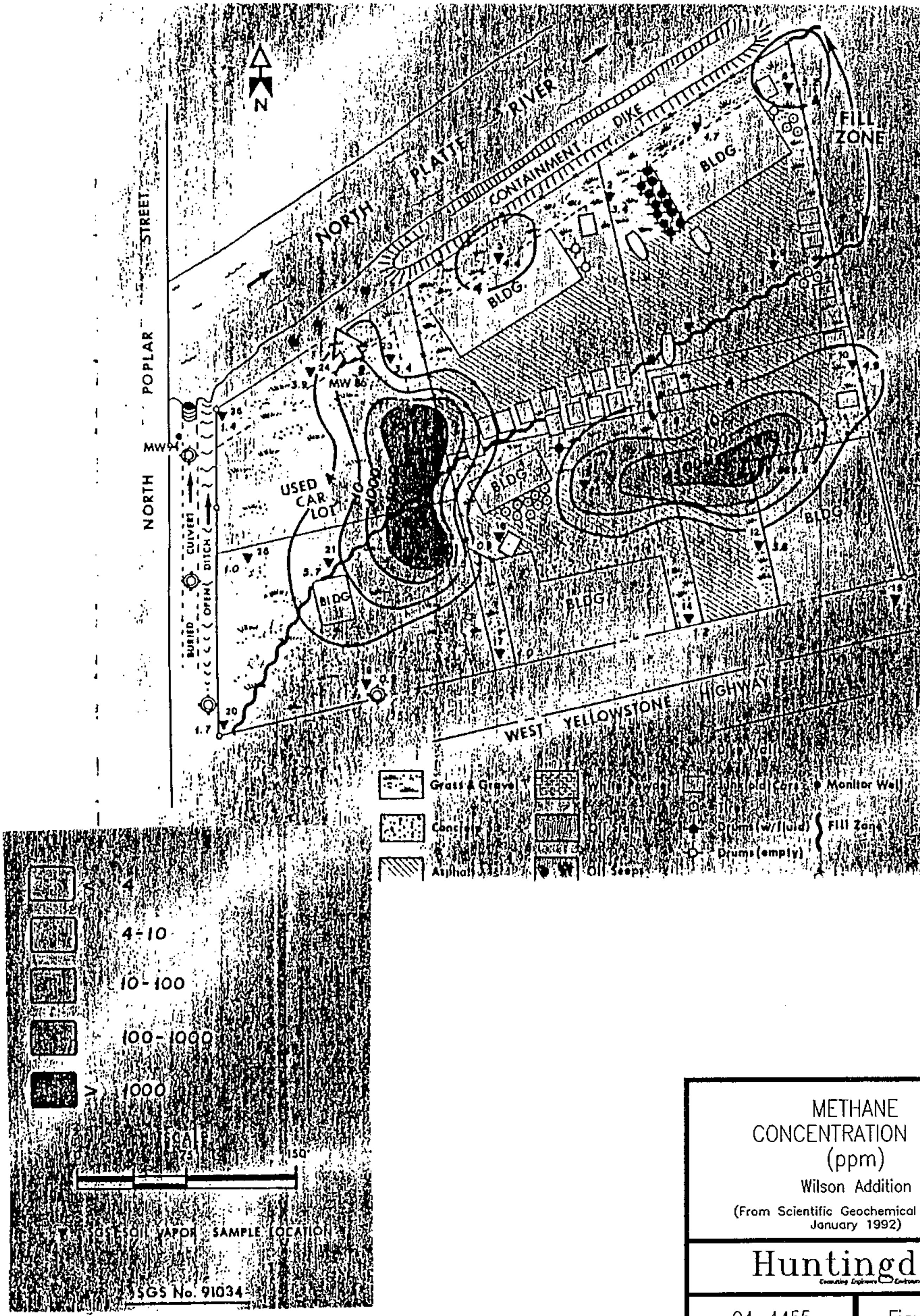
Table 2-5
Summary of Analytical Results
Wilson Addition
Casper, Wyoming

Sample No.	Methane (ppm)	Ethane (ppm)	Propane (ppm)	1-Butane (ppm)	N-Butane (ppm)	C5-BZ (ppm)	BZ-TL (ppm)	TL-XYL (ppm)	XYL+ (ppm)	C5+ (ppm)	TOTALS (ppm)
01 BLK	1.6	0.01	0.01	0.07	0.01	0.1	0.0	0.0	0.0	0.1	1.8
01 SPL	1.7	0.06	0.03	0.05	0.00	0.1	0.0	0.0	0.0	0.1	2.0
02 SPL	3.4	0.17	0.07	0.06	0.02	0.0	0.0	0.0	0.0	0.0	4.0
03 SPL	4.4	0.40	0.14	0.07	0.02	0.1	0.0	0.0	0.0	0.1	5.9
04 SPL	1.7	0.18	0.06	0.05	0.03	0.1	0.0	0.0	0.0	0.1	2.4
05 SPL	1.9	0.19	0.11	0.08	0.04	0.3	0.0	0.0	0.0	0.3	2.8
06 SPL	5.2	0.37	0.14	0.06	0.04	0.2	0.0	0.0	0.0	0.2	6.3
07 SPL	4.2	0.29	0.09	0.05	0.04	0.1	0.2	0.0	0.0	0.3	5.2
08 SPL	4.6	0.39	0.15	0.04	0.04	0.2	0.0	0.0	0.0	0.2	6.2
09 SPL	1.4	0.04	0.02	0.07	0.03	0.1	0.0	0.0	0.0	0.1	1.7
10 BLK	1.6	0.01	0.01	0.04	0.02	0.0	0.0	0.0	0.0	0.0	1.6
10 SPL	4.9	0.20	0.07	0.05	0.06	0.1	0.0	0.0	0.0	0.1	5.7
11 BLK	1.9	0.01	0.01	0.06	0.01	0.1	0.0	0.0	0.0	0.1	2.0
11 SPL	39889.4	5.47	0.49	0.23	0.21	15.6	72.5	24.4	0.0	112.6	40009.2
12 SPL	3.6	0.27	0.10	0.07	0.02	0.1	0.3	0.0	0.0	0.4	4.9
13 SPL	25.0	0.05	0.06	0.16	0.05	0.0	0.0	0.0	0.0	0.0	25.3
14 SPL	1.2	0.09	0.05	0.07	0.01	0.3	0.0	0.0	0.0	0.3	1.9
15 SPL	1.2	0.08	0.03	0.05	0.02	0.2	0.0	0.0	0.0	0.2	1.6
16 SPL	0.9	0.04	0.02	0.09	0.01	0.1	0.0	0.0	0.0	0.1	1.3

Table 2-5 (continued)
Summary of Analytical Results
Wilson Addition
Casper, Wyoming

Sample No.	Methane (ppm)	Ethane (ppm)	Propane (ppm)	1-Butane (ppm)	N-Butane (ppm)	C5-BZ (ppm)	BZ-TL (ppm)	TL-XYL (ppm)	XYL+ (ppm)	C5+ (ppm)	TOTALS (ppm)
17 SPL	1.0	0.09	0.03	0.07	0.01	0.2	0.3	0.0	0.0	0.5	1.8
18 SPL	2263.5	0.15	0.07	0.08	0.13	14.8	31.0	17.4	0.0	63.2	2327.2
19 SPL	0.9	0.07	0.03	0.07	0.01	0.0	0.0	0.0	0.0	0.0	1.2
20 SPL	1.7	0.05	0.02	0.05	0.01	0.0	0.0	0.0	0.0	0.0	1.9
21 SPL	5.7	0.53	0.21	0.09	0.03	0.2	0.0	0.0	0.0	0.2	8.0
22 SPL	3029.7	1.63	0.68	0.16	0.11	1.5	2.7	0.6	0.0	4.8	3038.9
23 SPL	3.4	0.21	0.08	0.05	0.02	0.0	0.0	0.0	0.0	0.0	4.3
24 SPL	3.9	0.41	0.16	0.05	0.04	0.0	0.0	0.0	0.0	0.0	5.4
25 SPL	1.4	0.09	0.04	0.06	0.02	0.0	0.0	0.0	0.0	0.0	1.7
26 SPL	1.0	0.06	0.02	0.08	0.01	0.0	0.6	0.0	0.0	0.6	1.8
MW AIR	2482.4	0.18	0.03	0.08	0.03	25.8	53.2	46.5	7.3	132.8	2615.5

Data from Scientific Geochemical Services; January, 1992

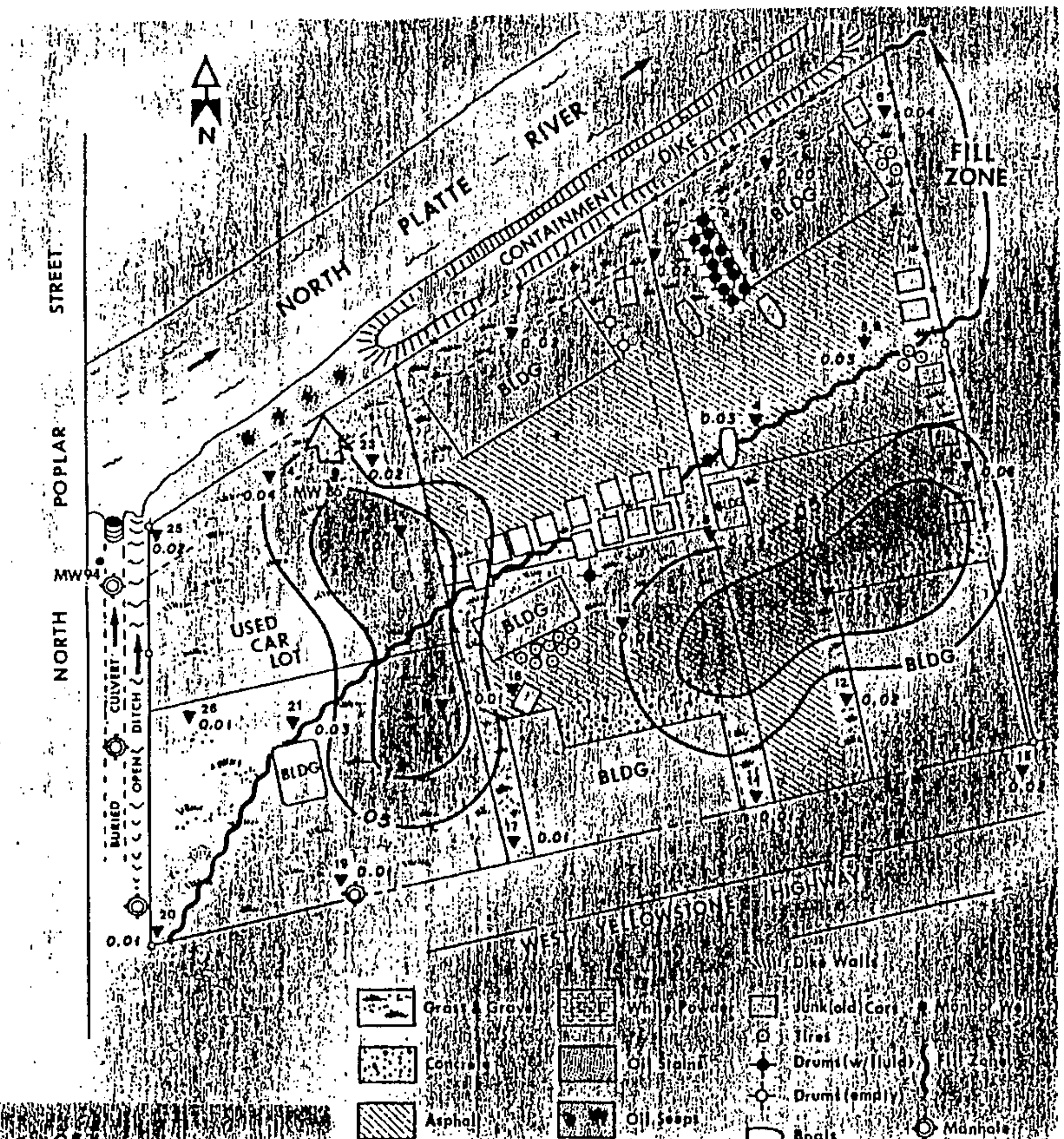


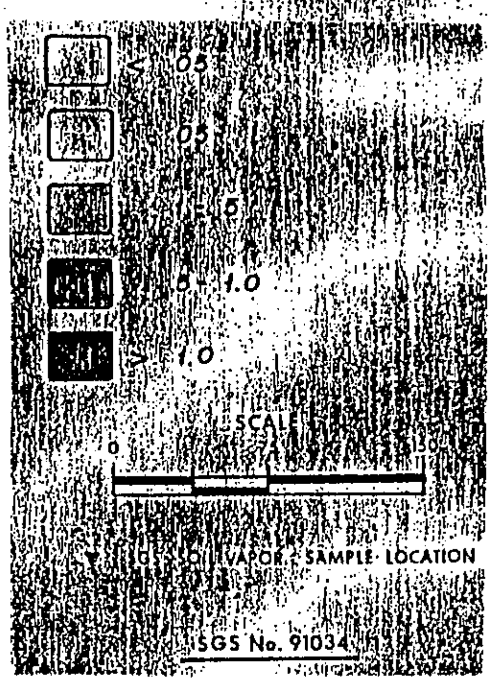
METHANE
CONCENTRATION MAP
(ppm)
Wilson Addition

(From Scientific Geochemical Services, January 1992)

Huntingdon
Consulting Engineers Environmental Scientists

94-4455	Figure 2-7





N-BUTANE
CONCENTRATION MAP
(ppm)

Wilson Addition

(From Scientific Geochemical Services, January 1992)

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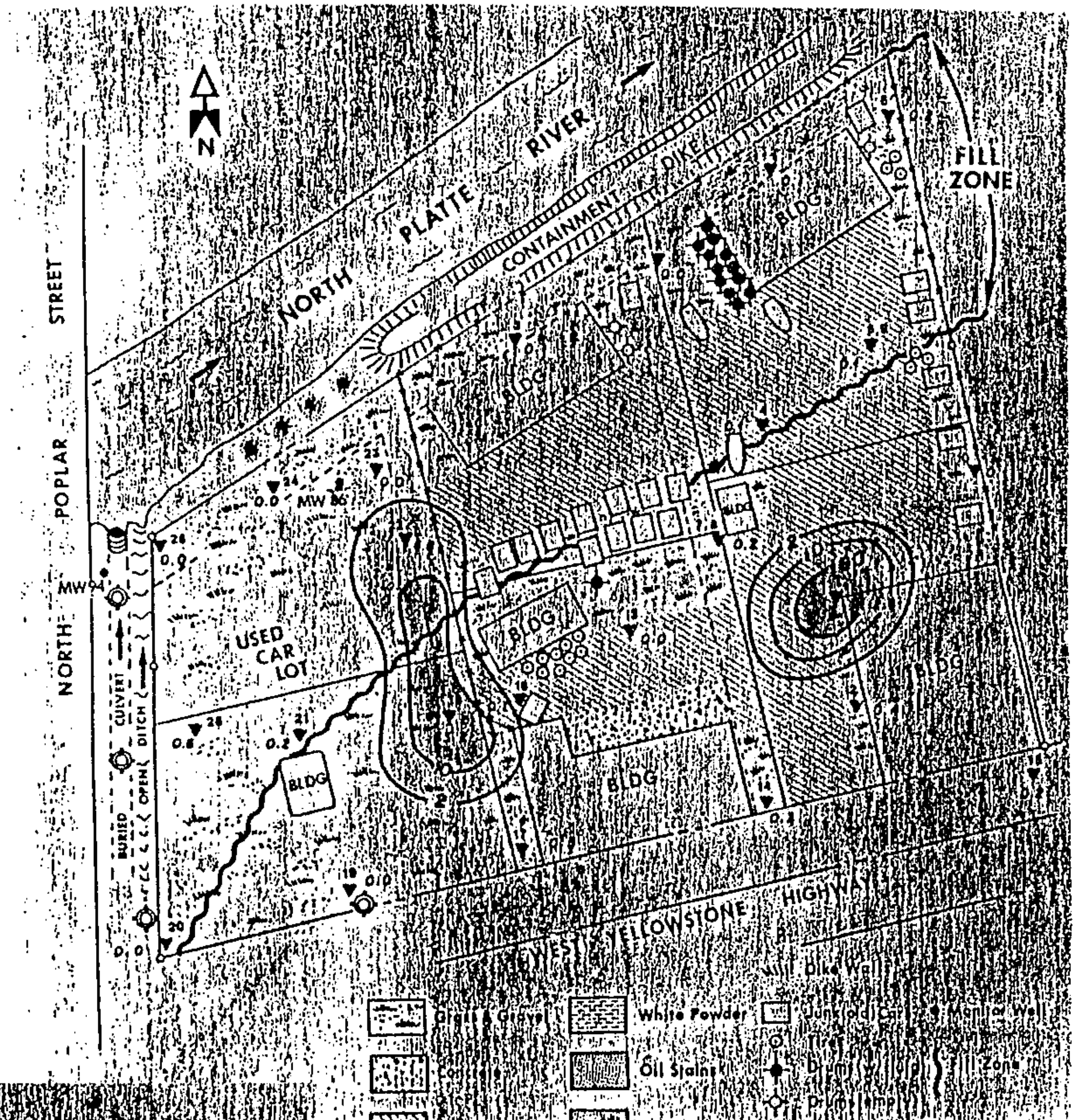
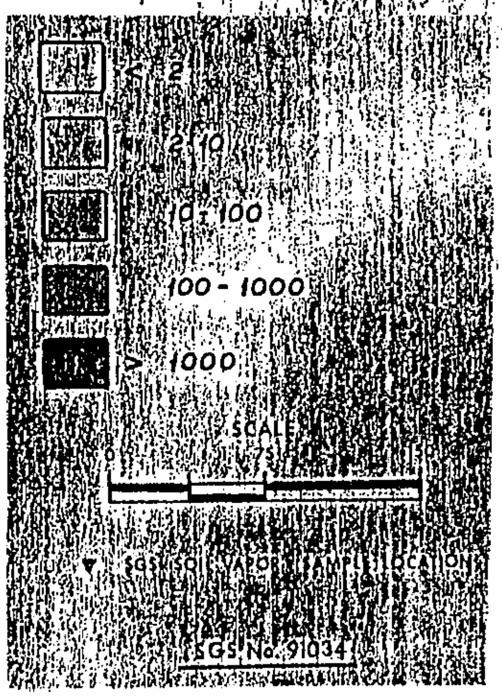
94-4455

Figure 2-8





C5+
CONCENTRATION MAP
(ppm)
Wilson Addition

(From Scientific Geochemical Services, January 1992)

Huntingdon

Consulting Engineers Environmental Scientists

94–4455

Figure 2–9

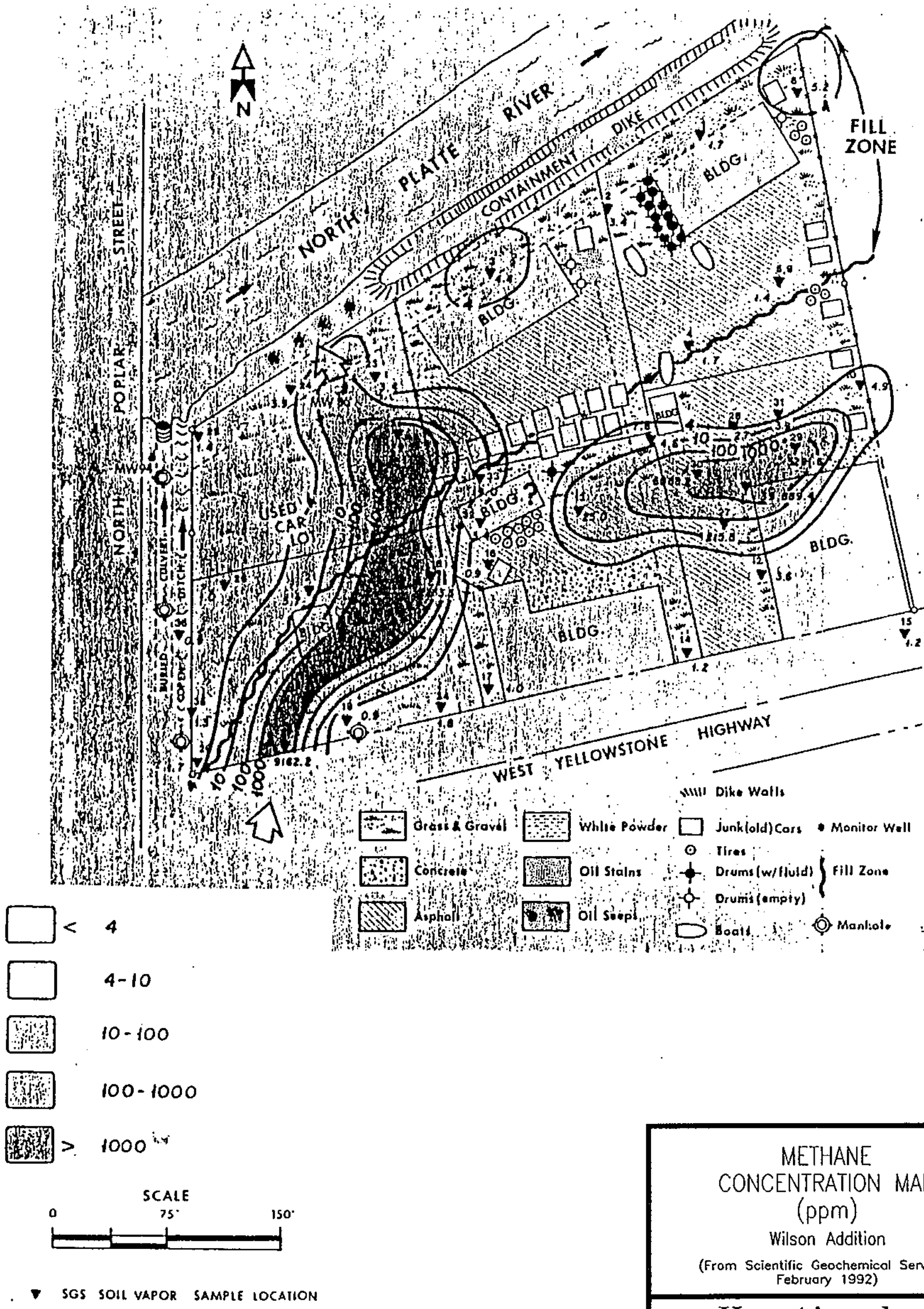
Table 2-6
Summary of Analytical Results
Wilson Addition
Casper, Wyoming

Sample No.	Methane (ppm)	Ethane (ppm)	Propane (ppm)	1-Butane (ppm)	N-Butane (ppm)	C5-BZ (ppm)	BZ-TL (ppm)	TL-XYL (ppm)	XYL* (ppm)	C5+ (ppm)	Totals (ppm)
01 BLK	1.6	0.01	0.01	0.07	0.01	0.1	0.0	0.0	0.0	0.1	1.8
01 SPL	1.7	0.06	0.03	0.05	0.00	0.1	0.0	0.0	0.0	0.1	2.0
02 SPL	3.4	0.17	0.07	0.06	0.02	0.0	0.0	0.0	0.0	0.0	4.0
03 SPL	4.4	0.40	0.14	0.07	0.02	0.1	0.0	0.0	0.0	0.1	5.9
04 SPL	1.7	0.18	0.06	0.05	0.03	0.1	0.0	0.0	0.0	0.1	2.4
05 SPL	1.9	0.19	0.11	0.08	0.04	0.3	0.0	0.0	0.0	0.3	2.8
06 SPL	5.2	0.37	0.14	0.06	0.04	0.2	0.0	0.0	0.0	0.2	6.3
07 SPL	4.2	0.29	0.09	0.05	0.04	0.1	0.2	0.0	0.0	0.3	5.2
08 SPL	4.6	0.39	0.15	0.04	0.04	0.2	0.0	0.0	0.0	0.2	6.2
09 SPL	1.4	0.04	0.02	0.07	0.03	0.1	0.0	0.0	0.0	0.1	1.7
10 BLK	1.6	0.01	0.01	0.04	0.02	0.0	0.0	0.0	0.0	0.0	1.6
10 SPL	4.9	0.20	0.07	0.05	0.06	0.1	0.0	0.0	0.0	0.1	5.7
11 BLK	1.9	0.01	0.01	0.06	0.01	0.1	0.0	0.0	0.0	0.1	2.0
11 SPL	39889.4	5.47	0.49	0.23	0.21	15.6	72.5	24.4	0.0	112.6	40009.2
12 SPL	3.6	0.27	0.10	0.07	0.02	0.1	0.3	0.0	0.0	0.4	4.9
13 SPL	25.0	0.05	0.06	0.16	0.05	0.0	0.0	0.0	0.0	0.0	25.3
14 SPL	1.2	0.09	0.05	0.07	0.01	0.3	0.0	0.0	0.0	0.3	1.9
15 SPL	1.2	0.08	0.03	0.05	0.02	0.2	0.0	0.0	0.0	0.2	1.6
16 SPL	0.9	0.04	0.02	0.09	0.01	0.1	0.0	0.0	0.0	0.1	1.3
17 SPL	1.0	0.09	0.03	0.07	0.01	0.2	0.3	0.0	0.0	0.5	1.8
18 SPL	2263.5	0.15	0.07	0.08	0.13	14.8	31.0	17.4	0.0	63.2	2327.2
19 SPL	0.9	0.07	0.03	0.07	0.01	0.0	0.0	0.0	0.0	0.0	1.2

Table 2-6 (continued)
Summary of Analytical Results
Wilson Addition
Casper, Wyoming

Sample No.	Methane (ppm)	Ethane (ppm)	Propane (ppm)	1-Butane (ppm)	N-Butane (ppm)	C5-BZ (ppm)	BZ-TL (ppm)	TL-XYL (ppm)	XYL* (ppm)	C5+ (ppm)	Totals (ppm)
20 SPL	1.7	0.05	0.02	0.05	0.01	0.0	0.0	0.0	0.0	0.0	1.9
21 SPL	5.7	0.53	0.21	0.09	0.03	0.2	0.0	0.0	0.0	0.2	8.0
22 SPL	3029.7	1.63	0.68	0.16	0.11	1.5	2.7	0.6	0.0	4.8	3038.9
23 SPL	3.4	0.21	0.08	0.05	0.02	0.0	0.0	0.0	0.0	0.0	4.3
24 SPL	3.9	0.41	0.16	0.05	0.04	0.0	0.0	0.0	0.0	0.0	5.4
25 SPL	1.4	0.09	0.04	0.06	0.02	0.0	0.0	0.0	0.0	0.0	1.7
26 SPL	1.0	0.06	0.02	0.08	0.01	0.0	0.6	0.0	0.0	0.6	1.8
MW AIR	2482.4	0.18	0.03	0.08	0.03	25.8	53.2	46.5	7.3	132.8	2615.5
27 SMP	215.5	0.28	0.06	0.08	0.05	1.4	0.8	1.5	0.2	3.8	220.1
28 BLK	2.3	0.02	0.01	0.16	0.03	0.4	0.0	0.0	0.0	0.4	2.9
28 SMP	2.7	0.05	0.02	0.12	0.02	0.3	0.0	1.2	0.2	1.7	4.7
29 SMP	3291.6	0.61	0.23	0.19	0.13	0.6	5.6	2.8	0.2	9.2	3302.1
30 SMP	6088.2	0.95	0.26	0.23	0.13	3.3	18.0	4.9	0.0	26.3	6116.2
31 SMP	3.9	0.02	0.02	0.10	0.02	0.0	0.0	0.0	0.0	0.0	4.1
32 SMP	3.4	0.36	0.12	0.09	0.08	0.0	0.0	0.0	0.0	0.0	5.1
33 SMP	19.0	1.69	0.64	0.18	0.49	0.1	0.0	0.0	0.0	0.1	26.3
34 SMP	1.8	0.07	0.04	0.15	0.04	0.0	0.0	0.0	0.0	0.0	2.2
35 SMP	1.3	0.05	0.02	0.10	0.05	0.0	0.0	0.0	0.0	0.0	1.6
36 SMP	0.9	0.03	0.02	0.11	0.02	0.0	0.0	0.0	0.0	0.0	1.1
37 SMP	9162.2	0.32	0.32	0.42	1.61	99.7	185.9	83.0	2.2	370.8	9535.8

Note: Data from Scientific Geotechnical Services, February 1992.



METHANE CONCENTRATION MAP (ppm)

Wilson Addition

(From Scientific Geochemical Services, February 1992)

Huntingdon

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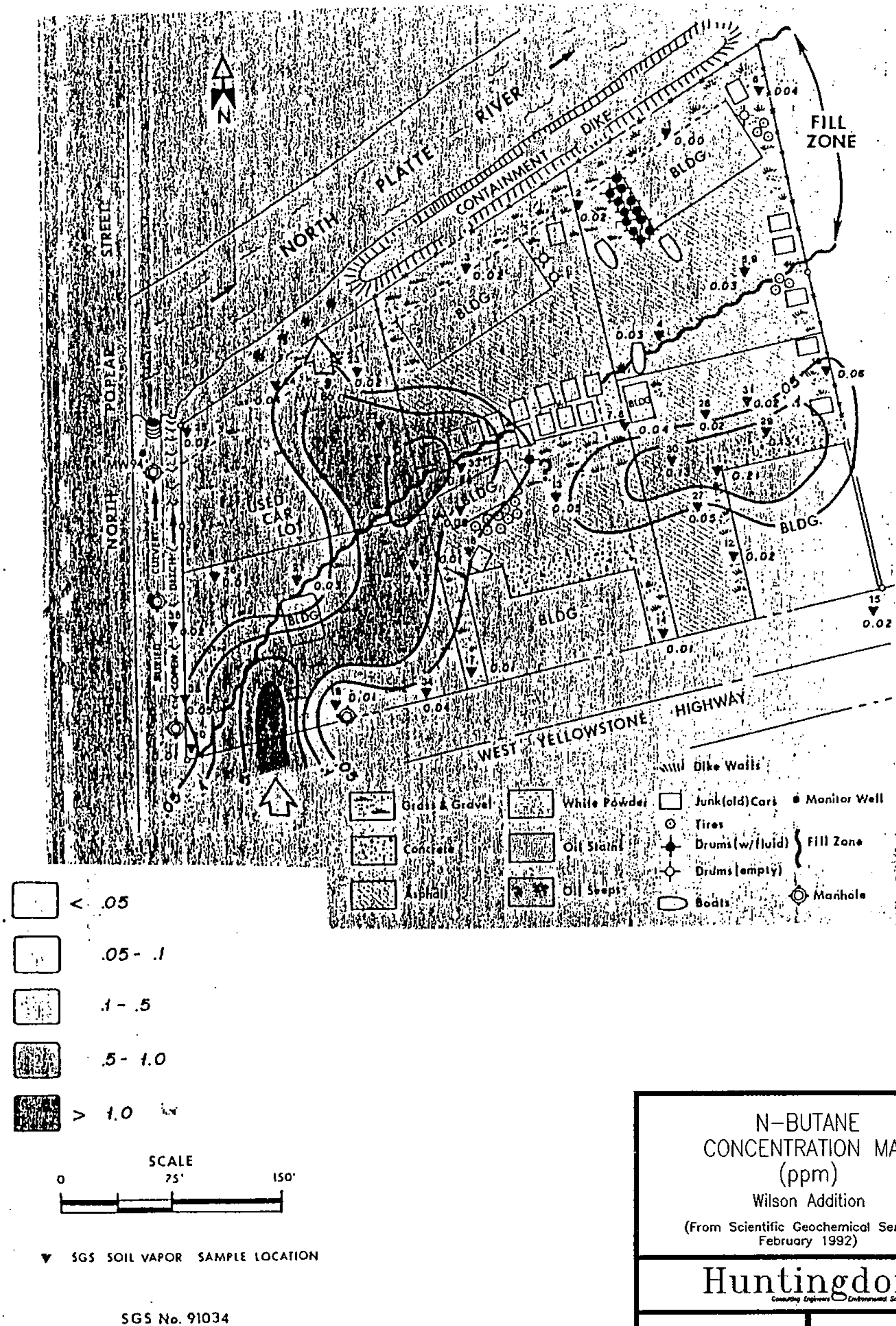
94–4455	Figure 2–10



N–BUTANE
CONCENTRATION MAP
(ppm)
Wilson Addition

(From Scientific Geochemical Services, February 1992)

Huntingdon

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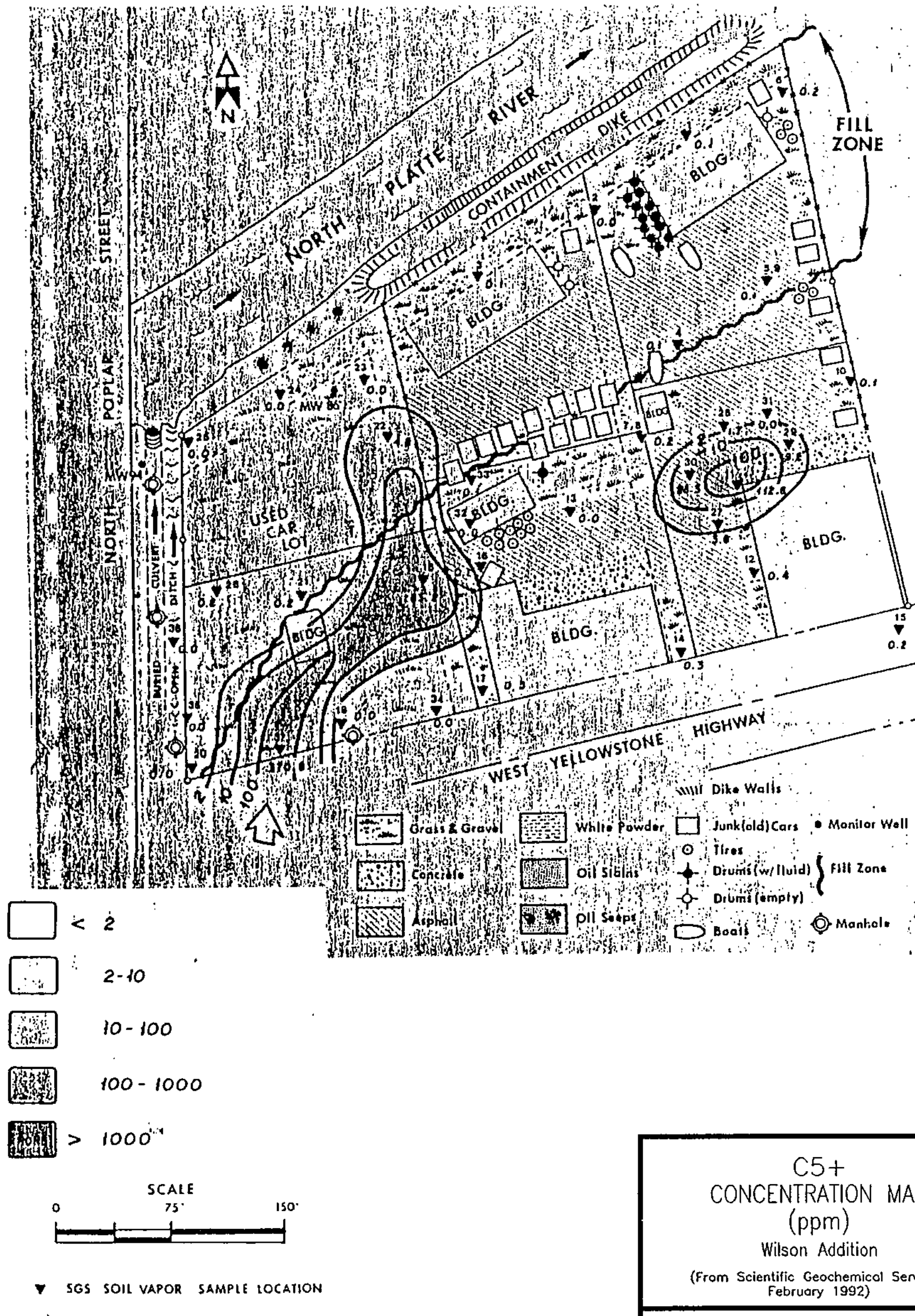
94–4455

Figure 2–11



SGS No. 91034

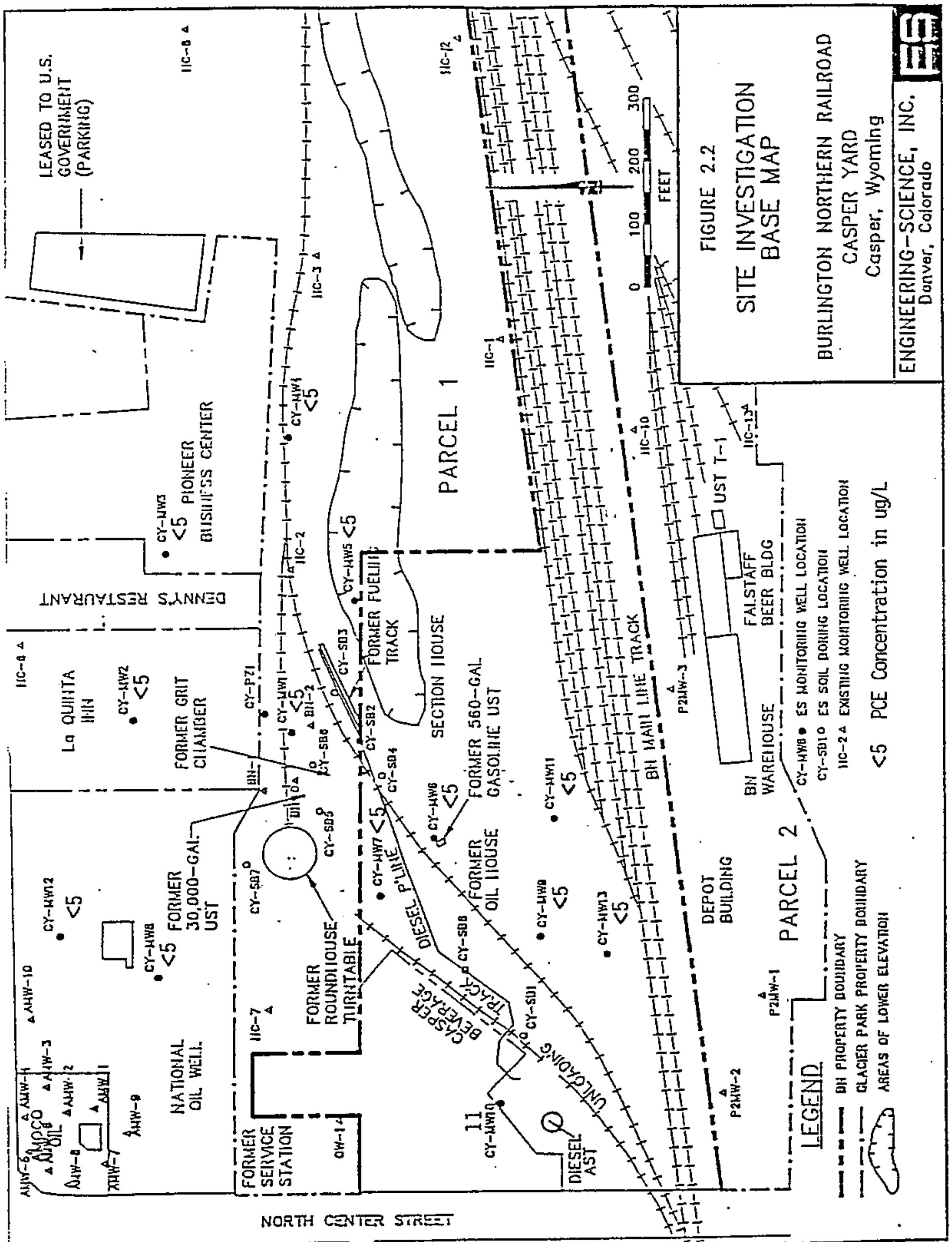
C5+
CONCENTRATION MAP
(ppm)
Wilson Addition

(From Scientific Geochemical Services, February 1992)

Huntingdon

94-4455

Figure 2-12



PCE CONCENTRATIONS IN GROUNDWATER

Burlington Northern Railyard

(From Engineering-Science, Inc., 1992)

Huntingdon

94-4455

Figure 2-13

and three observation wells used for the alluvial aquifer test. A hydraulic conductivity value of 6,117 gpd/ft^2 was reported for one observation well. Engineering-Science, Inc. concluded that the main area of focus for the investigation was farther to the west of the PCE plume detected previously.

2.3.11 Armand Morris & Associates. September 14, 1992. Report of Investigations - Joe Shickich Property, Casper, Wyoming.

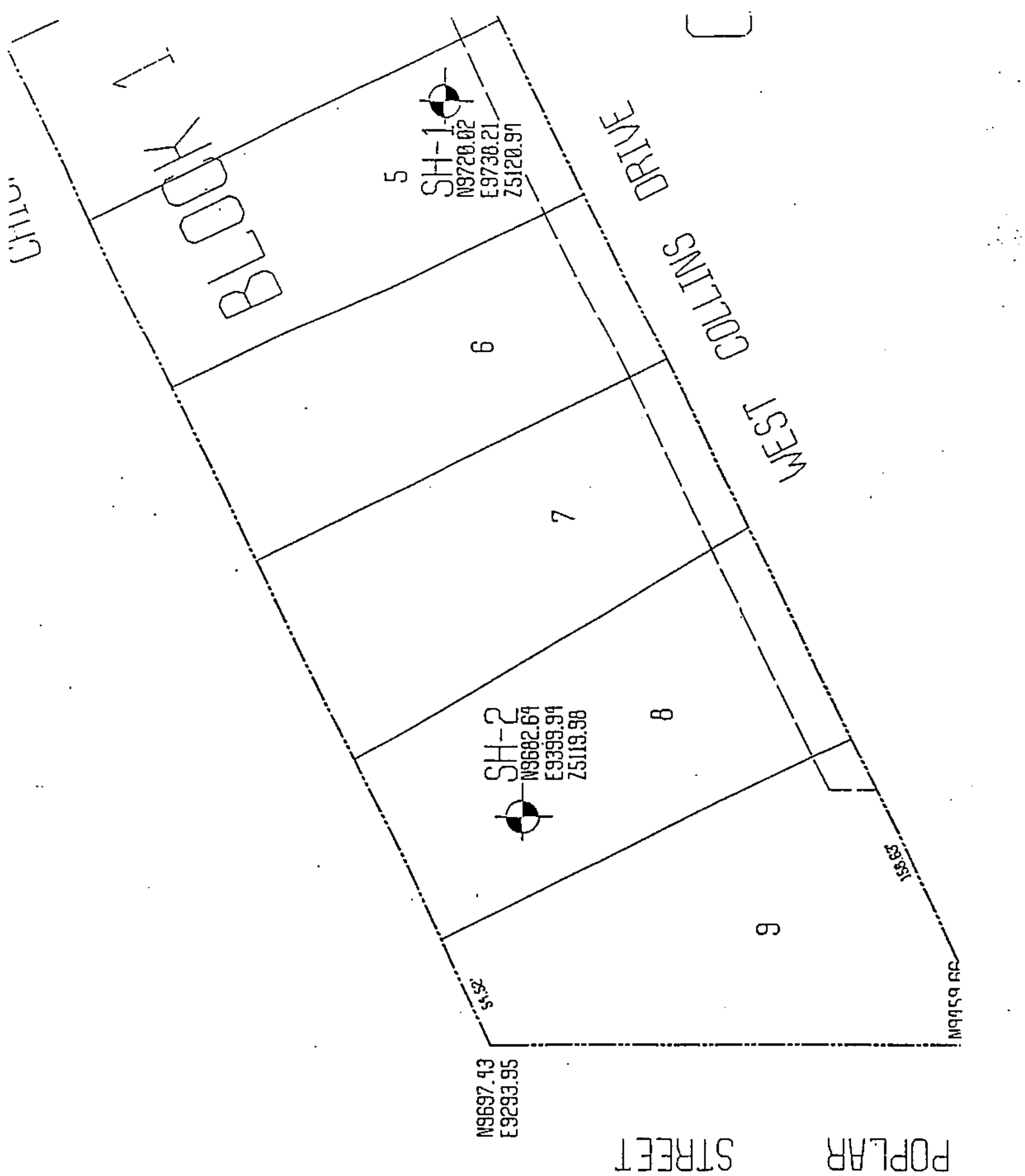
On August 23, 1992 personnel from Armand Morris & Associates, at the request of the D.I.R.T. Land Trust, conducted a subsurface investigation at property owned by the land trust and located at the northeast corner of Poplar Street and Collins Avenue in Casper. The purpose of this investigation was to determine if groundwater or soil contamination was present on the property. The investigation involved drilling and sampling two soil borings and installing and sampling two monitoring wells (SH-1 and SH-2). Well locations are shown on Figure 2-14. A summary of the analytical results is presented in Table 2-7. Analysis of the groundwater samples found several volatile organic compounds to be present in the sample from monitoring well SH-2.

2.3.12 Summary of Amoco Casper Refinery Annual Reports to the WDEQ, 1988 to 1993.

In accordance with a February 2, 1989 request from the Wyoming Department of Environmental Quality (WDEQ), Amoco Oil Company prepares an annual report documenting activities conducted at their Casper, Wyoming refinery related to the soil and groundwater contamination known to be present at the refinery site. Topics addressed in the annual reports include groundwater gradient and product thickness as determined from the gauging of refinery monitoring wells, subsurface data obtained from newly installed monitoring wells, storage tank and transfer line testing, recovery well pumping rates and product recovery rates, recovery system downtime, extent of contaminant plumes and API separator testing.

Annual reports submitted between 1988 and 1993 document the following:

- Groundwater flow in the alluvial aquifer underlying the refinery is to the east and northeast.
- Petroleum product is present on the water table beneath the majority of the refinery site. Product thicknesses in excess of three feet occur beneath the west side of the refinery site.
- Between 1981 and 1993, approximately 183,756 barrels of product have been recovered by the refinery recovery systems.



MONITORING WELL
LOCATION
MAP

Joe Shickich Property

(From Armand Morris & Associates, September 14, 1992)

Huntingdon

94-4455

Figure 2-14

Table 2-7
Summary of Well Completions and Analytical Results
Joe Shickich Property

Well No.	SH-1	SH-2	NC-1
Date Drilled	8/21/92	8/21/92	12/09/89
Date Sampled	8/23/92	8/23/92	12/17/89
Latitude	42°50′36″	42°50′37″	
Longitude	106°20′12″	106°20′14″	
Collar Elevation, ft.	5120.94	5119.98	5116.46
Depth, ft.	23.00	23.00	20.00
Water Depth, ft.	16.23	15.38	13.50
Water Elevation, ft.	5104.56	5104.71	5102.96
Screened Interval, ft.	10-20	10-20	9.7-19.7
Benzene, μg/L	<0.50	219	<0.50
sec-butylbenzene, μg/L	<0.50	141	NA
Ethylbenzene, μg/L	<0.50	3181	<0.50
Isopropylbenzene, μg/L	<0.50	454	NA
4-Isopropylbenzene, μg/L	<0.50	93	NA
Napthalene, μg/L	<0.50	998	NA
Propylbenzene, μg/L	<0.50	1282	NA
Toluene, μg/L	<0.50	<0.50	<0.50
1,2,4-Trimethylbenzene, μg/L	<0.50	5140	NA
1,3,5-Trimethylbenzene, μg/L	<0.50	712	NA
m+p Xylene, μg/L	<0.50	5654	<0.50
8015 (GRO), mg/L	0.096	66.1	NA
418.1 (TPH), mg/L	NA	NA	0.60

NA No Analysis

Data from Armand Morris and Associates, September 14, 1992

2.3.13 **URS Consultants, Incorporated. August 19,1994. Preliminary Assessment, Casper Downtown Plume, Natrona County, Wyoming.**

At the request of the United States Environmental Protection Agency, URS Consultants, Inc. prepared a preliminary assessment of the Casper Downtown Plume. The objectives of this assessment were to:

- Determine contaminant characteristics and quantify potential waste sources;
- Report on the adequacy of the containment of waste sources;
- Assess the potential for contaminant migration;
- Identify target populations; and
- Determine the potential site impacts to public health and the environment.

The report concludes that:

- A chlorinated hydrocarbon-contaminated groundwater plume is located in northern Casper;
- PCE is the substance of primary concern because it was detected at higher concentrations than any other chlorinated hydrocarbon detected;
- The most probable routes of contaminant migration are along groundwater and surface water pathways; and
- A specific source of the Casper Downtown Plume is not known at this time, however, potential sources located up-gradient of the plume include a former industrial laundry, a former fuel company and a currently operating autobody shop.

3.0 INVESTIGATION PROCEDURES

To accomplish the project objectives, a variety of equipment and sampling procedures were used. The following sections provide a description of the equipment used and a discussion of field and laboratory procedures. A more detailed narrative on field and laboratory procedures is presented in the standard operating procedures (SOPs)included in Appendix C.

3.1 Geoprobe Exploration

As part of the investigation, samples of soil vapor and groundwater were collected using a Model 8-M Geoprobe sampling assembly equipped with 1-inch diameter hollow steel rods. The testing locations were laid out in a grid pattern. The initial spacing between sampling locations was approximately 300 feet east-west by 350 feet north-south. The grid spacing was modified as necessary to accommodate physical structures, such as roads and alleys, buildings and utilities. In areas where contamination was identified, the grid spacing was tightened to provide more detail.

Collection of soil vapor samples involved driving the hollow steel rods, with a retractable point assembly attached to the lead rod, to approximately nine feet below the ground surface. Once at the desired depth, the rods were raised approximately six inches to allow the point to retract. A gas sampling cap was then placed on the above-ground end of the rods, a vacuum hose was connected to the cap and a vacuum was applied. Prior to collecting a sample, the ambient air was evacuated from the rods and vacuum tubing. A soil vapor sample was collected into a syringe inserted into the tubing. The procedure is detailed in the Geoprobe Operation and Sample Collection SOP in Appendix C.

Collection of groundwater samples involved driving the hollow steel rods, with a short (6 inches), mill-slotted rod in the lead rod position, to a depth approximately 18 feet below the ground surface. Once at the desired depth, new or decontaminated polyethylene tubing was inserted into the hollow rods and a peristaltic pump was used to obtain the groundwater sample.

Depending on the depth to the water table at each sample location, the groundwater samples may have been collected from near the water table or from up to 10 feet below the water table. In all cases, the sampled interval was short. At some locations, light non-aqueous phase liquids (LNAPLs) such as gasoline could have been present on the water table or LNAPL components may have dissolved into the groundwater in the uppermost part of the aquifer. If the sampling probe was driven below the contaminated uppermost part of the aquifer, a sample of uncontaminated groundwater may have been obtained. This scenario could result in underestimation of the extent of LNAPL-related contamination. No attempt was made to characterize any vertical stratification of the water quality.

Samples obtained with the geoprobe sampling assembly were analyzed in the field using a Photovac 10S70 portable gas chromatograph equipped with photo-ionization detector, isothermal capillary GC column oven, encapsulated capillary column and data analysis software. Each soil vapor sample and groundwater sample was analyzed for either PCE, TCE and 1,1,1-TCA or benzene, toluene, ethylbenzene and xylenes. These compounds were selected because they had been detected in environmental samples analyzed during previous investigations conducted within the study area. Analytical procedures are detailed in the Portable Gas Chromatograph Operation SOP in Appendix C. The detection limits for the field analyses were approximately 1 part per billion (ppb) for soil vapor samples and 1 $\mu g/L$ for groundwater samples. A second groundwater sample was collected from each sampling location and submitted to the WDEQ laboratory in Cheyenne, Wyoming for analysis for volatile organic compounds (VOCs) by EPA Method 502.2

3.1.1 Geoprobe Sampling

Prior to collecting a sample of groundwater from the hollow geoprobe rod, the depth to groundwater was measured using an electronic water-level probe, and a minimum of three rod volumes of water were removed from the rod using a peristaltic pump and new or decontaminated polyethylene tubing. The purge water was pumped into a 5-gallon bucket to allow measurement of the water volume. The groundwater sample was carefully transferred into pre-cleaned glass sample containers (at least two 40-milliliter VOA vials), preserved with hydrochloric acid to a pH less than 2 standard units, checked to assure that no bubbles were in the sample containers, labelled, placed into coolers containing ice or "blue ice" refrigerant, and transported to the laboratory following chain-of custody procedures. SOPs describing Field Measurement of Ground Water Level, Groundwater Sampling, Field QC Samples, Sample Documentation, and Sample Packaging and Shipping are included in Appendix C.

3.2 Chemical Analysis

Groundwater samples submitted to the WDEQ laboratory were analyzed for volatile organic compounds using EPA Method 502.2. This analysis is used to detect and quantify concentrations of volatile organic compounds which include common solvents (such as PCE, TCE or 1,1,1-TCA) as well as compounds that are components of petroleum fuels (such as benzene in gasoline). Table 3-1 lists the compounds for which these methods are used. Total petroleum hydrocarbons (TPH) analyses were not conducted because the detection limits for the TPH analysis methods are much higher than most of the concentrations of fuel-related contaminants that were detected during earlier investigations. The analytical data were reviewed prior to release. Specific information on standard laboratory operating procedures, detection limits, and quality control measures is presented in "Methods for the Determination of Organic Compounds in Drinking Water" (USEPA, 1992a) and "Test Methods for Evaluating Solid Wastes" (USEPA, 1990). Quality control for this project is discussed below in Section 3.3.

3.3 Quality Assurance and Quality Control

Quality assurance (QA) and quality control (QC) procedures established in Huntingdon's Standard Operating Procedures (see Appendix C) or as otherwise agreed upon by Huntingdon and the WDEQ were used for this project. A separate and formal quality assurance project plan

Table 3.1
Volatile Organic Compounds Analyzed by EPA Method 502.2

EPA Method 502.2		
Benzene	1,2-Dichlorobenzene	Naphthalene
Bromobenzene	1,3-Dichlorobenzene	n-Propylbenzene
Bromochloromethane	1,4-Dichlorobenzene	Styrene
Bromodichloromethane	Dichlorodifluoromethane	1,1,1,2-Tetrachloroethane
Bromoform	1,1-Dichloroethane	1,1,2,2-Tetrachloroethane
Bromomethane	1,2-Dichloroethane	Tetrachloroethene
n-Butylbenzene	1,1-Dichloroethene	Toluene
sec-Butylbenzene	c-1,2-Dichloroethene	1,2,3-Trichlorobenzene
t-Butylbenzene	t-1,2-Dichloroethene	1,2,4-Trichlorobenzene
Carbon Tetrachloride	1,2-Dichloropropane	1,1,1-Trichloroethane
Chlorobenzene	1,3-Dichloropropane	1,1,2-Trichloroethane
Chloroethane	2,2-Dichloropropane	Trichloroethene
Chloroform	1,1-Dichloropropene	Trichlorofluoromethane
Chloromethane	c-1,3-Dichloropropene	1,2,3-Trichloropropane
2-Chlorotoluene	t-1,3-Dichloropropene	1,2,4-Trimethylbenzene
4-Chlorotoluene	Ethylbenzene	1,3,5-Trimethylbenzene
Dibromochloromethane	Hexachlorobutadiene	Vinyl Chloride
1,2-Dibromo-3-chloropropane	Isopropylbenzene	Total Xylenes
1,2-Dibromoethane	Isopropyltoluene	
Dibromomethane	Methylene chloride	

was not established for this project. This section generally describes the QA and QC procedures used; the reader is referred to Appendix C for further details.

Quality control for field activities including collection of soil vapor and groundwater samples with the Geoprobe equipment, analysis of soil vapor and groundwater samples, and handling of samples were conducted in accordance with appropriate SOPs. Deviations from the SOPs were made in some instances, as described below.

As a form of quality control, groundwater samples from each geoprobe location were analyzed both in the field and at the WDEQ laboratory in Cheyenne, Wyoming. Samples analyzed in the field were analyzed for either PCE, TCE and 1,1,1-TCA or BETX. Samples submitted to the laboratory were analyzed for volatile organic compounds, including PCE, TCE, 1,1,1-TCA and BETX, using EPA Method 502.2. In most cases the results from the laboratory and the field analyses were similar. In cases where significant differences were observed, these differences may be due to one or more of the following causes.

One possible cause for the difference may be due to the additional handling and storage of lab samples prior to their being analyzed. Samples analyzed in the field were analyzed immediately after their collection, whereas samples submitted to the laboratory were transferred to the appropriate bottles and stored prior to being shipped to the laboratory. This additional handling and storage of the samples may have allowed loss of the volatile compounds by volatilization or degradation prior to laboratory analysis. Sample handling included placing the samples into coolers containing ice or "blue ice" refrigerant immediately upon collection and labeling. Temperatures above 4°C can allow loss of organic compounds by degradation and volatilization and result in analyses reporting lower concentrations than originally existed in the samples. Sample documentation included field forms for the samples, combined chain-of-custody/sample analysis request forms, and custody seals on either the cooler, the sample bottles or both. The coolers were sealed for transport in all cases by the sampler, and in no case did the lab note evidence of tampering with the cooler transport seals. On that basis, we feel that the integrity of the samples was not compromised.

Another possible cause for the differences may be due to unaccounted for laboratory dilution of samples. In cases where samples contain relatively high contaminant levels it is a common practice for laboratories to dilute the samples to facilitate analysis. The actual concentration of a compound in the sample must then be calculated using the results obtained from the analysis of the diluted sample and the dilution ratio. In several cases where differences occur between the field results and laboratory results, the field results are approximately five or ten times (common dilution ratios) higher than the laboratory results. This suggests that the results reported by the laboratory may be uncorrected results obtained from the analysis of diluted samples.

4.0 INVESTIGATION RESULTS

4.1 Geology

In general, the study area is underlain by alluvial deposits which rest unconformably on bedrock consisting of the Steele Shale member of the Cretaceous Cody Shale (Figure 4-1). The fluvial terrace deposits are composed of unindurated to partly-indurated, bedded deposits of silt, sand, gravel and boulders (Howard-Donley Associates, Inc., 1980).

The Steele Shale member of the Cretaceous Cody Shale consists of dark-gray, soft, marine shale containing thin beds of limestone and numerous white bentonite beds (Howard-Donley Associates, Inc., 1980).

4.2 Groundwater Occurrence and Flow

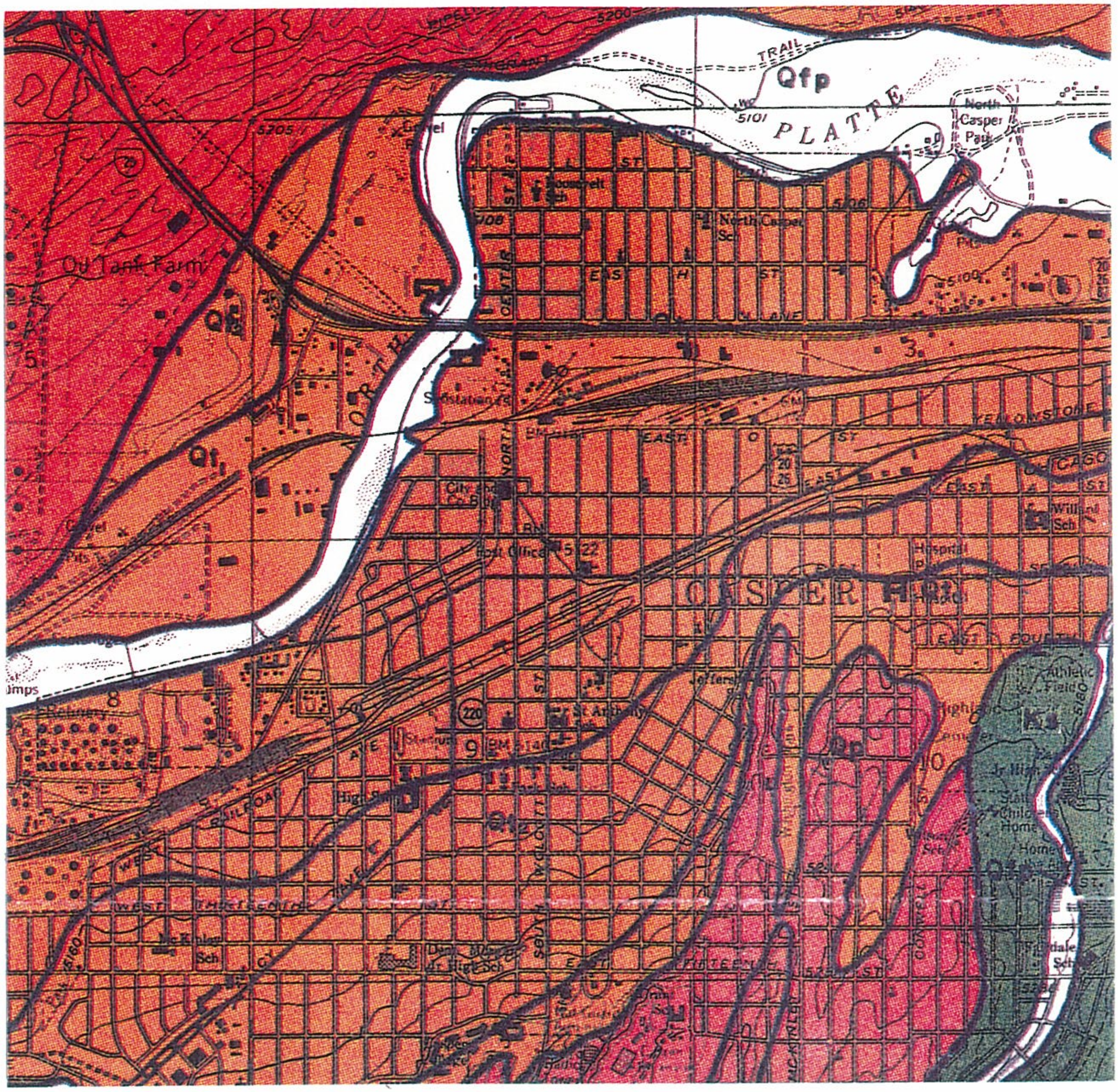
4.2.1 Groundwater Occurrence

Throughout the study area, groundwater was encountered within the permeable alluvial sand and gravel that overlies the Cody Shale. The Cody Shale is much less permeable than the alluvium and forms the lower boundary of the alluvial aquifer. Within the alluvial aquifer, groundwater is present under unconfined (water table) conditions and is first encountered at depths ranging from approximately 6 to 24 feet below the ground surface, depending on location (Table 4-1).

4.2.2 Groundwater Flow

A groundwater elevation map constructed from depth-to-groundwater data collected between September 24, 1994 and October 5, 1994 is presented as Figure 4-2. Several anomalous groundwater elevation "highs" and "lows" are present which obscure the regional groundwater flow direction. Most of, if not all of, the anomalous groundwater "highs" and "lows" are believed to be the result of the groundwater not reaching an equilibrium level within the geoprobe rod prior to measurement of the depth to groundwater at each geoprobe point (Section 3.1). A generalized water table elevation map (Figure 4-3) was constructed using a data set which was edited to remove the data points which caused the anomalous groundwater elevation "highs" and "lows". The resulting generalized groundwater elevation map indicates that groundwater flow is to the north and northeast under a gradient of between 1.3×10^{-3} and 6.6×10^{-3}. This groundwater flow pattern is consistent with the flow direction observed during previous investigations.

As previously noted in Section 2.3.10, Engineering-Science, Inc. (1992) reported a hydraulic conductivity of 6117 gpd/ft^2 (820 ft/day) for the alluvial aquifer at the Burlington Northern railyards. Using this reported hydraulic conductivity and the gradient determined during this study, and assuming a porosity typical of shallow alluvial sand and gravel aquifers, an average range of horizontal groundwater velocity can be calculated using Darcy's Law:



LITHOLOGIC DESCRIPTIONS

Qfp Flood Plain Deposits (Holocene)
Unindurated gravel and sand. Area subject to 100 and 500 year floods.

Qc Colluvium (Holocene and Pleistocene)
Gravity deposit of unsorted, unindurated to partly-indurated, locally derived detritus that has moved only short distances and not as a coherent mass.

Qt Fluvial Terrace Deposit (Holocene and Pleistocene)
Unindurated to partly-indurated, bedded deposit of silt, sand, gravel and boulders. Subscript number (e.g., Qt_3) refers to terrace level.

Kc Cody Shale (Upper Cretaceous)
Ks - Steele Shale - Dark-gray, soft, marine shale containing thin beds of gray limestone and numerous, white bentonite beds.

0 1/2 1
SCALE IN MILES
(APPROXIMATE)

BEDROCK AND SURFICIAL
GEOLOGIC MAP

COMPILED BY
HOWARD—DONLEY ASSOCIATES INC.
Consulting Engineers and Geologists
Redwood City, Calif.; Boise and Moscow, Idaho
235 North Wolcott Ave., Suite 4 Casper, Wyoming

Huntingdon
Consulting Engineers Environmental Scientists

94-4455	Figure 4-1

Table 4-1
Geoprobe Sampling Locations and Water Level Data
Downtown Casper PCE Investigation

Well Number	Measuring Point Elevation (ft MSL)	Depth to Groundwater (ft)	Groundwater Elevation (ft MSL)	Location in Wyoming State Plane Coordinate System (ft)	
				East	North
A-2	5114.65	14.80	5,099.85	1584829.23	1186572.75
A-3	5111.77	14.80	5,096.97	1584378.33	1186463.98
A-3.5	5107.53	10.50	5,097.03	1584205.39	1186796.81
A-4	5111.99	14.80	5,097.19	1583997.27	1186462.31
A-4.5	5112.32	14.80	5,097.52	1583797.29	1186582.37
A-5	5113.58	16.05	5,097.53	1583616.45	1186441.48
A-5.5	5113.68	15.90	5,097.78	1583412.88	1186624.98
A-6	5115.91	12.60	5,103.31	1583239.01	1186393.30
A-6.5	5114.76	15.80	5,098.96	1583034.75	1186820.96
A-7	5118.93	18.60	5,100.33	1582852.52	1186414.32
B-1	5105.21	9.30	5,095.91	1585128.80	1186950.55
B-2	5103.63	7.80	5,095.83	1584825.48	1186943.98
B-3	5106.23	9.60	5,096.63	1584372.37	1186838.29
B-3.5	5104.93	8.30	5,096.63	1584200.13	1187029.73
B-4	5109.42	12.45	5,096.97	1583991.20	1186921.54
B-5	5112.62	15.45	5,097.17	1583619.89	1186941.97
B-5.5	5112.38	15.00	5,097.38	1583407.06	1186837.15
B-6	5114.06	12.90	5,101.16	1583233.16	1186873.09
B-6.5	5114.31	16.00	5,098.31	1583034.76	1186924.08
C-1	5104.31	7.05	5,097.26	1585126.72	1187300.33
C-2	5102.15	6.40	5,095.75	1584823.70	1187293.72
C-3	5103.09	7.05	5,096.04	1584365.68	1187270.47
C-3.5	5102.58	6.45	5,096.13	1584198.82	1187273.87
C-4	5107.67	11.30	5,096.37	1583984.87	1187291.01
C-5	5109.77	12.75	5,097.02	1583598.09	1187243.75
C-5.5	5110.45	12.20	5,098.25	1583402.87	1187209.85
C-6	5111.41	12.05	5,099.36	1583226.61	1187209.10
C-6.5	5112.94	15.20	5,097.74	1583024.59	1187154.37

Table 4-1 (continued)
Geoprobe Sampling Location and Water Level Data
Downtown Casper PCE Investigation

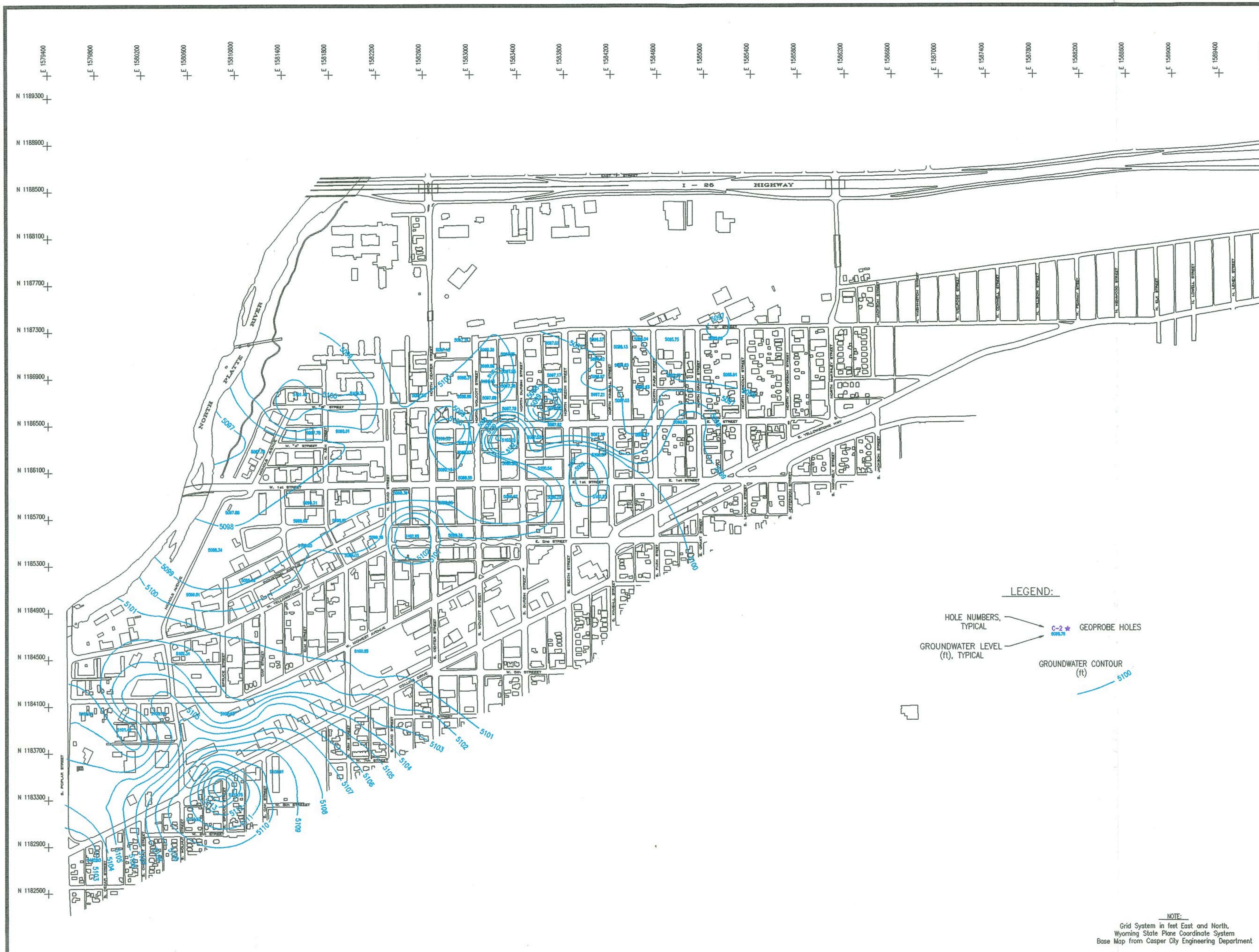
Well Number	Measuring Point Elevation (ft MSL)	Depth to Groundwater (ft)	Groundwater Elevation (ft MSL)	Location in Wyoming State Plane Coordinate System (ft)	
				East	North
C-7	5116.15	19.00	5,097.15	1582802.58	1187054.94
D-4	5114.41	11.60	5,102.81	1584004.72	1185942.45
D-5	5116.09	17.80	5,098.29	1583625.25	1185930.45
D-6	5117.96	19.29	5,098.67	1583244.67	1185924.53
AA-4	5110.33	13.12	5,097.21	1583993.75	1186764.43
AA-5	5114.02	13.20	5,100.82	1583625.67	1186654.26
AA-6	5114.68	16.80	5,097.88	1583235.23	1186657.81
BB-4	5108.72	10.10	5,098.62	1583989.38	1187073.84
BB-5.5	5111.35	13.40	5,097.95	1583402.16	1186981.94
BB-6	5112.13	12.25	5,099.88	1583231.19	1187026.95
DD-4	5113.17	12.60	5,100.57	1583993.88	1186268.20
DD-5	5115.34	14.80	5,100.54	1583618.05	1186230.21
DD-6	5117.78	19.50	5,098.28	1583235.48	1186199.28
AAA-5	5113.32	15.10	5,098.22	1583623.91	1186813.79
929-1	5115.81	18.25	5,097.56	1583030.91	1186445.82
929-2	5116.87	18.80	5,098.07	1583031.97	1186266.21
929-3	5117.75	19.20	5,098.55	1583035.80	1186067.95
929-4	5119.93	20.80	5,099.13	1582873.44	1186187.33
929-5	5119.86	21.00	5,098.86	1582862.49	1185939.62
929-6	5121.64	21.90	5,099.74	1582869.92	1185658.32
930-1	5122.19	23.80	5,098.39	1582501.13	1185922.31
930-2	5122.95	20.00	5,102.95	1582501.45	1185663.04
930-3	5111.38	12.20	5,099.18	1582213.59	1185644.31
930-4	5110.13	11.10	5,099.03	1581905.15	1185491.12
930-5	5108.97	10.30	5,098.67	1581726.74	1185656.75
930-6	5108.61	10.30	5,098.31	1581630.65	1185940.35
930-7	5108.56	9.90	5,098.66	1581586.54	1185635.99
930-8	5110.23	10.20	5,100.03	1581666.43	1185398.13

Table 4-1 (continued)
Geoprobe Sampling Location and Water Level Data
Downtown Casper PCE Investigation

Well Number	Measuring Point Elevation (ft MSL)	Depth to Groundwater (ft)	Groundwater Elevation (ft MSL)	Location in Wyoming State Plane Coordinate System (ft)	
				East	North
1003-1	5111.75	14.20	5,097.55	1582463.97	1186764.62
1003-2	5108.11	7.80	5,100.31	1582001.16	1186682.94
1003-3	5107.75	6.30	5,101.45	1581554.70	1186678.86
1003-4	5108.28	10.50	5,097.78	1581564.01	1186353.50
1003-5	5107.91	9.90	5,098.01	1581944.30	1186359.76
1004-1	5111.49	14.30	5,097.19	1581130.45	1186371.60
1004-2	5110.88	13.00	5,097.88	1580868.03	1185824.40
1004-3	5110.64	12.30	5,098.34	1580719.34	1185518.26
1004-4	5110.81	11.80	5,099.01	1580538.43	1185142.82
1004-5	5109.36	10.20	5,099.16	1581238.20	1185188.85
1004-6	5113.54	11.20	5,102.34	1580439.68	1184573.57
1004-7	5115.11	12.30	5,102.81	1579717.36	1184134.93
1004-8	5114.56	8.80	5,105.76	1580323.02	1184135.90
1005-1	5116.03	13.10	5,102.93	1579704.09	1182872.10
1005-2	5123.13	12.20	5,110.93	1580550.53	1183233.41
1005-3	5125.65	9.90	5,115.75	1580890.97	1183429.54
1005-4	5124.11	14.20	5,109.91	1581226.03	1183597.85
1005-5	5120.25	--		1581942.43	1183943.74
1005-6	5114.48	13.00	5,101.48	1580135.42	1183813.19
1005-7	5117.93	15.90	5,102.03	1580923.04	1184133.11
1005-8	5120.12	--		1581278.40	1184264.84
1005-9	5120.45	--		1581593.30	1184415.08
1005-10	5120.05	19.20	5,100.85	1581901.40	1184570.66

-- indicates groundwater not encountered.

Water level data was collected between 09-24-94 and 10-05-94.

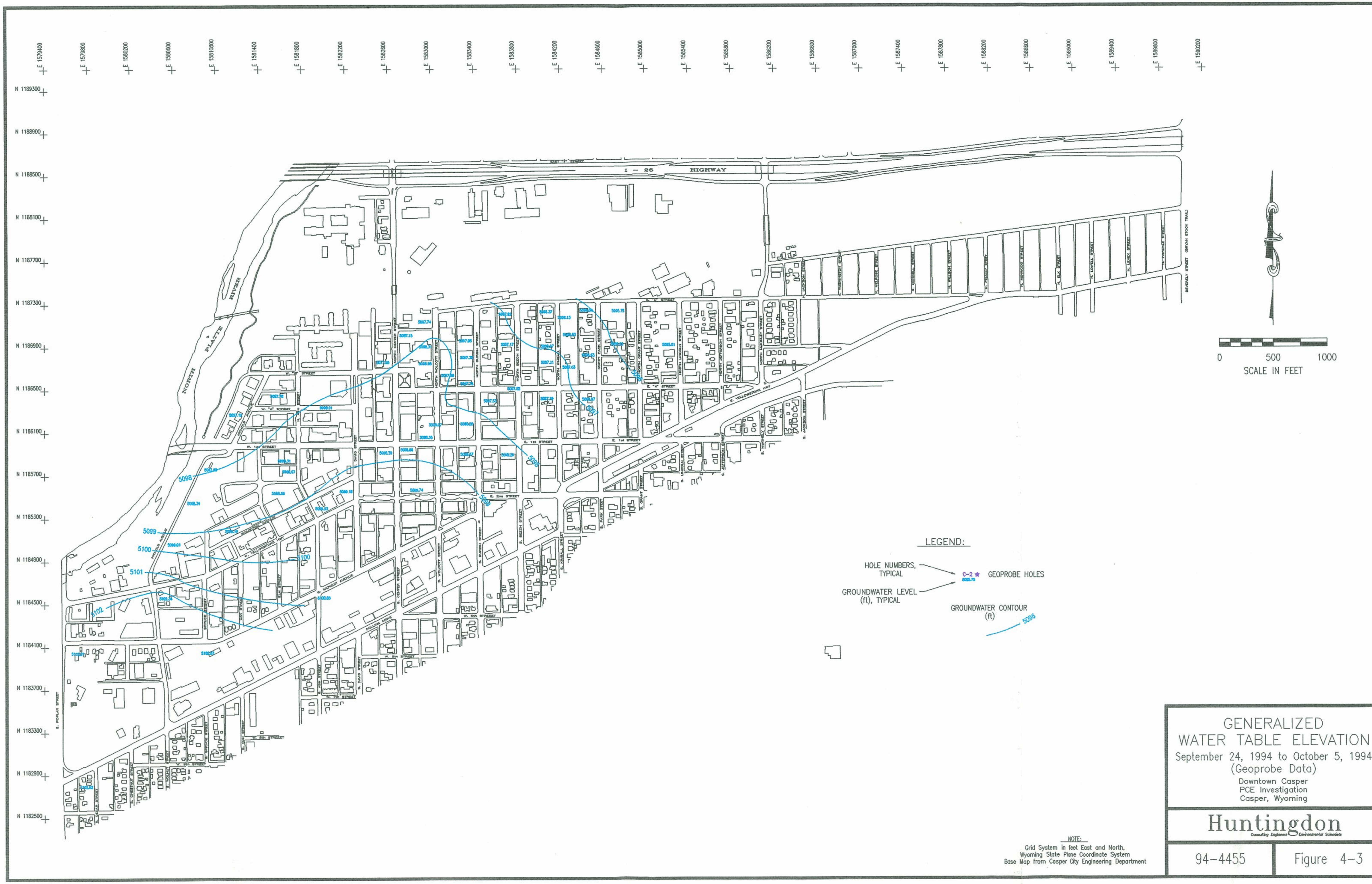


WATER TABLE ELEVATION
September 24, 1994 to October 5, 1994
(Geoprobe Data)
Downtown Casper
PCE Investigation
Casper, Wyoming

Huntingdon
Consulting Engineers Environmental Scientists

94-4455

Figure 4-2



NORTH PLATTE RIVER
I - 25 HIGHWAY
0 500 1000
SCALE IN FEET
LEGEND:
HOLE NUMBERS, TYPICAL
C-2
GEOPROBE HOLES
GROUNDWATER LEVEL (ft), TYPICAL
GROUNDWATER CONTOUR (ft)
5096
5098
5099
5100
5101
5102
NOTE:
Grid System in feet East and North,
Wyoming State Plane Coordinate System
Base Map from Casper City Engineering Department
GENERALIZED
WATER TABLE ELEVATION
September 24, 1994 to October 5, 1994
(Geoprobe Data)
Downtown Casper
PCE Investigation
Casper, Wyoming
Huntingdon
94-4455
Figure 4-3

$$V = K(dh/dl)/\theta$$

where:
- V = average horizontal groundwater velocity,
- K = hydraulic conductivity (820 ft/day)
- dh/dl = groundwater gradient 1.3×10^{-3} to 6.6×10^{-3} and
- θ = porosity, typical value for a sand/gravel is 0.35 (Freeze and Cherry, 1979).

The average horizontal groundwater velocity calculated using this equation is 3.0 to 15.5 feet per day.

4.3 Soil Vapor Contamination

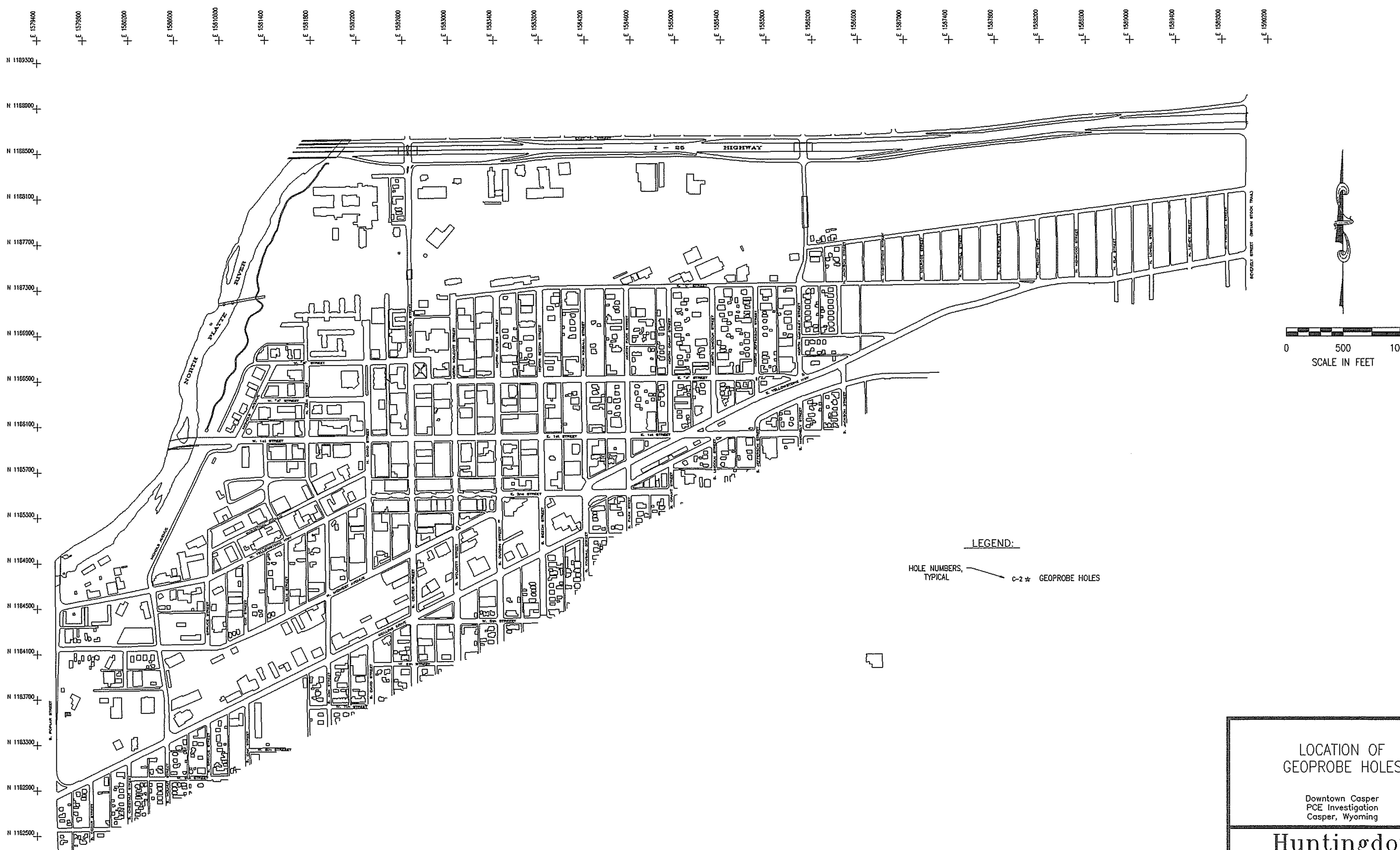
During the investigation, samples of soil vapor were collected at 79 locations from a depth of approximately 9 feet below the ground surface using a Model 8-M Geoprobe sampling assembly. Each sample was analyzed in the field for either PCE, TCE and 1,1,1-TCA or benzene, ethylbenzene, toluene and xylenes using a Photovac 10S70 portable gas chromatograph. The geoprobe sample locations are shown on Figure 4-4. The soil vapor data are included in Appendix A and are summarized in Table 4-2. The detection limit for the soil vapor analyses was approximately 1 ppb. Quantification of concentrations below 5 ppb is not always precise, and concentrations in this range are referred to as "trace" in Table 4-2 and on Figures 4-5 and 4-6. Below 1 ppb, concentrations are referred to as "non-detectable."

4.3.1 Type, Degree and Extent of Soil Vapor Contamination

4.3.1.1 PCE and TCE in Soil Vapor

The concentrations of PCE and TCE in the soil vapor samples ranged from non-detectable to 425,630 ppb and from non-detectable to 38,080 ppb, respectively. 1,1,1-TCA was not detected at concentrations exceeding 5 ppb (trace) at any of the sample locations. TCE is a degradation product of PCE, and TCE also is a byproduct of the manufacture of PCE. Both of these compounds have been detected in environmental samples analyzed during previous investigations of the study area, and both commonly occur together. The distribution of vapor-phase PCE and TCE in the subsurface of the study area is shown on Figures 4-5 and 4-6.

Based on the soil vapor data collected during this investigation, two vapor-phase PCE plumes, an east plume and a west plume, appear to be present in the subsurface beneath the study area (Figure 4-5). The east vapor-phase PCE plume is approximately 1,000 feet wide by more than 1,800 feet long and extends in a southwest to northeast direction from near the intersection of South Durbin Street and East First Street to beyond the north boundary of the study area. The highest concentrations of PCE within the east plume were found at geoprobe sample points A-5.5, C-5.5 and C-6, where the concentrations of PCE in the soil vapor samples were 113,400 ppb, 425,630 ppb and 134,370 ppb, respectively.



NOTE:
Grid System in feet East and North,
Wyoming State Plane Coordinate System
Base Map from Casper City Engineering Department

LOCATION OF
GEOPROBE HOLES

Downtown Casper
PCE Investigation
Casper, Wyoming

Huntingdon
Consulting Engineers Environmental Scientists

94-4455

Figure 4-4

Table 4-2
Summary of Geoprobe Soil Vapor Survey Data
Downtown Casper PCE Investigation

Sample Information		Field Screening Results (parts per billion)		
Probe Location	Date Collected	111-TCA	TCE	PCE
A-2	09/28/94	ND	ND	ND
A-3	09/25/94	ND	ND	ND
A-3.5	09/28/94	ND	ND	ND
A-4	09/25/94	ND	ND	ND
A-4.5	09/28/94	ND	ND	96
A-5	09/24/94	ND	ND	ND
A-5.5	09/28/94	ND	302	113,400
A-6	09/25/94	ND	501	10,720
A-6.5	09/27/94	ND	ND	ND
A-7	09/25/94	ND	ND	ND
B-1	09/28/94	ND	ND	ND
B-2	09/24/94	ND	ND	ND
B-3	09/24/94	ND	ND	ND
B-3.5	09/28/94	ND	ND	TR
B-4	09/24/94	ND	ND	133
B-5	09/24/94	ND	ND	777
B-5.5	09/28/94	ND	ND	89
B-6	09/25/94	ND	ND	ND
B-6.5	09/27/94	ND	ND	ND
C-1	09/24/94	ND	ND	ND
C-2	09/24/94	ND	ND	ND
C-3	09/24/94	ND	ND	ND
C-3.5	09/28/94	ND	TR	49,170
C-4	09/24/94	ND	ND	67,600
C-5	09/24/94	ND	ND	20,194
C-5.5	09/27/94	ND	ND	425,630

Table 4-2 (continued)
Summary of Geoprobe Soil Vapor Survey Data
Downtown Casper PCE Investigation

Sample Information		Field Screening Results (parts per billion)		
Probe Location	Date Collected	111-TCA	TCE	PCE
C-6	09/25/94	ND	ND	134,370
C-6.5	09/27/94	ND	ND	ND
C-7	09/25/94	ND	ND	ND
D-4	09/25/94	ND	ND	ND
D-5	09/25/94	ND	ND	ND
D-6	09/24/94	ND	ND	ND
AA-4	09/28/94	ND	ND	ND
AA-5	09/27/94	ND	ND	5,440
AA-6	09/27/94	ND	ND	5,200
BB-4	09/28/94	ND	ND	41,940
BB-5.5	09/27/94	ND	ND	3,260
BB-6	09/27/94	ND	38,080	>100,000
DD-4	09/28/94	ND	ND	ND
DD-5	09/27/94	ND	ND	11,030
DD-6	09/27/94	ND	413	44,270
AAA-5	09/27/94	ND	TR	57,480
0929-01	09/29/94	ND	ND	ND
0929-02	09/29/94	ND	ND	ND
0929-03	09/29/94	ND	ND	ND
0929-04	09/29/94	ND	ND	ND
0929-05	09/29/94	ND	ND	ND
0929-06	09/29/94	ND	ND	ND
1003-03	10/03/94	ND	ND	62
1003-04	10/03/94	ND	ND	43,500

Table 4-2 (continued)
Summary of Geoprobe Soil Vapor Survey Data
Downtown Casper PCE Investigation

Sample Information		Field Screening Results (parts per billion)			
Probe Location	Date Collected	Benzene	Toluene	Ethylbenzene	Xylenes
0930-01	09/30/94	ND	ND	ND	ND
0930-02	09/30/94	ND	ND	ND	ND
0930-03	09/30/94	ND	ND	ND	ND
0930-04	09/30/94	ND	ND	ND	ND
0930-05	09/30/94	ND	ND	ND	ND
0930-06	09/30/94	ND	ND	ND	ND
0930-07	09/30/94	ND	ND	ND	ND
0930-08	09/30/94	FP	FP	FP	FP
1003-01	10/03/94	ND	ND	ND	ND
1003-02	10/03/94	ND	ND	ND	ND
1003-05	10/03/94	ND	ND	ND	ND
1004-01	10/04/94	ND	ND	ND	ND
1004-02	10/04/94	ND	ND	ND	ND
1004-03	10/04/94	NS	NS	NS	NS
1004-04	10/04/94	ND	ND	ND	ND
1004-05	10/04/94	ND	ND	ND	ND
1004-06	10/04/94	ND	ND	ND	ND
1004-07	10/04/94	ND	ND	ND	ND
1004-08	10/04/94	ND	ND	ND	ND
1005-01	10/05/94	ND	ND	ND	ND
1005-02	10/05/94	ND	ND	ND	ND
1005-03	10/05/94	ND	ND	ND	ND
1005-04	10/05/94	ND	ND	ND	ND
1005-05	10/05/94	ND	ND	ND	ND
1005-06	10/05/94	ND	ND	ND	ND
1005-07	10/05/94	ND	ND	ND	ND
1005-08	10/05/94	ND	ND	ND	ND

Table 4-2 (continued)
Summary of Geoprobe Soil Vapor Survey Data
Downtown Casper PCE Investigation

Sample Information		Field Screening Results (parts per billion)			
Probe Location	Date Collected	Benzene	Toluene	Ethylbenzene	Xylenes
1005-09	10/05/94	ND	ND	ND	ND
1005-10	10/05/94	ND	ND	ND	ND

ND = Not Detected
TR = Trace
NS = No Sample Collected
FP = Free Product in Sample (not quantifiable)

NOTE:
Grid System in feet East and North,
Wyoming State Plane Coordinate System
Base Map from Casper City Engineering Department

CONCENTRATION OF PCE IN SOIL VAPOR (ppb)
(GEOPROBE RESULTS)

Downtown Casper
PCE Investigation
Casper, Wyoming

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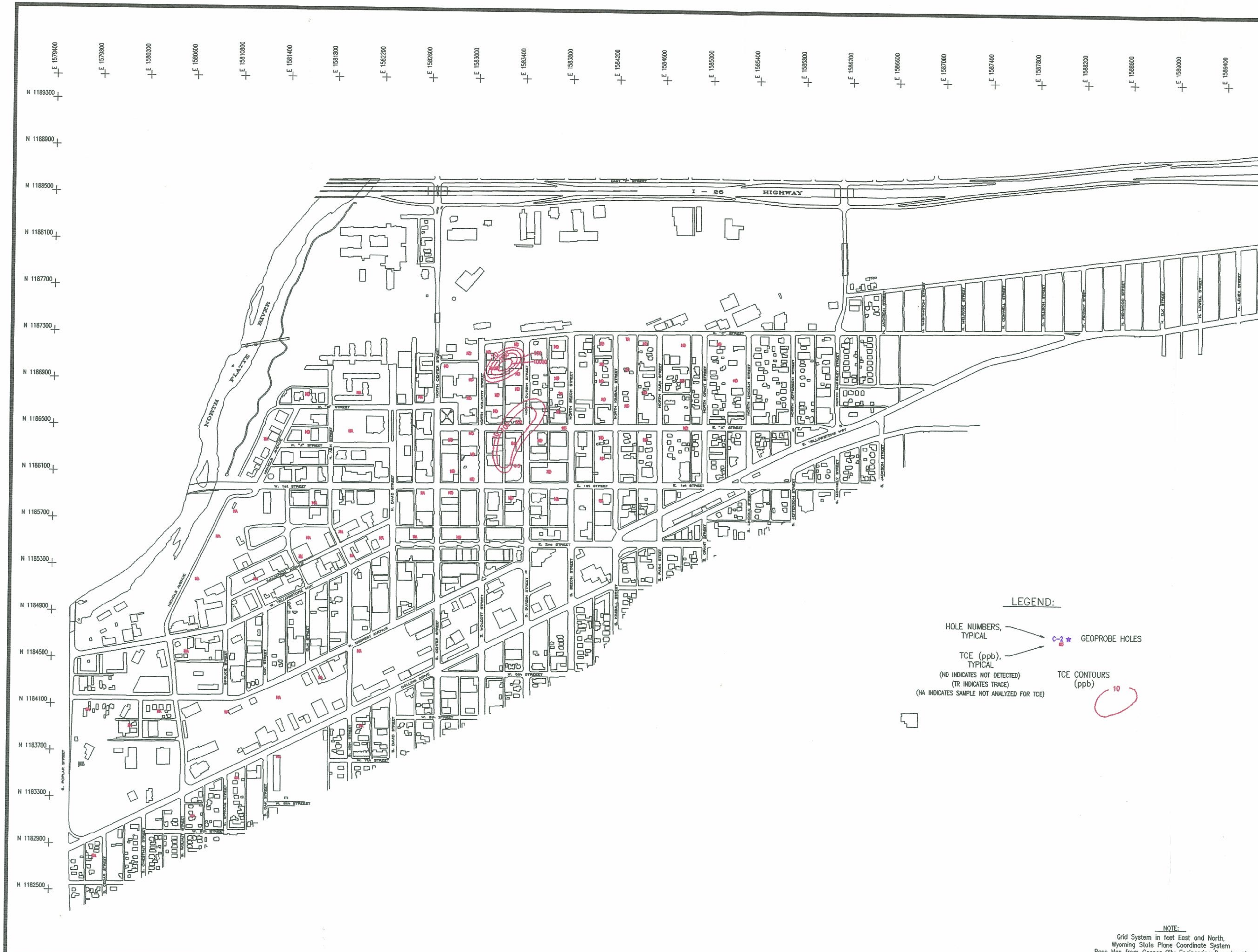
Figure 4-5



CONCENTRATION OF TCE IN SOIL VAPOR (ppb)

(GEOPROBE RESULTS)

Downtown Casper
PCE Investigation
Casper, Wyoming

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Figure 4-6

The west vapor-phase PCE plume is located in the area approximately bounded by West A Street, West B Street, North Ash Street and Nichols Avenue. It is approximately 260 feet wide by 500 feet long. The highest concentrations of PCE within the west plume was found at geoprobe sample point 1003-4, where the concentration of PCE in the soil vapor sample was 43,500 ppb.

Based on the soil vapor data collected during this investigation, two vapor-phase TCE plumes, a north plume and a south plume, appear to be present in the subsurface beneath the study area (Figure 4-6). The highest concentration of TCE within the north plume was found at geoprobe point BB-6 and was 38,080 ppb. The locations of both vapor-phase TCE plumes coincide with the up-gradient parts of the east vapor-phase PCE plume.

4.3.1.2 Benzene, Ethylbenzene, Toluene and Xylenes in Soil Vapor

Field screening for vapor-phase benzene, ethylbenzene, toluene and xylenes (BETX) did not detect benzene, ethylbenzene, toluene or xylenes in any of the soil gas samples screened for the BETX compounds (Table 4-2).

4.4 Groundwater Contamination

During the investigation, samples of groundwater were collected from 67 geoprobe locations using a Model 8-M Geoprobe sampling assembly. Each groundwater sample was analyzed in the field for either PCE, TCE and 1,1,1-TCA or BETX using a Photovac 10S70 portable gas chromatograph. The field analysis methods are described in the SOP for Portable Gas Chromatograph Operation (Appendix C). In addition, a second groundwater sample was collected from each of the geoprobe locations and submitted to the WDEQ laboratory in Cheyenne, Wyoming to be analyzed for volatile organic compounds by EPA Method 502.2. Analytical data for groundwater samples are included in Appendices A and B and are summarized in Tables 4-3 and 4-4. In some instances, multiple samples were collected at different times from approximately the same sampling locations and submitted for laboratory analysis (C-5.5, AA-5, BB-6, DD-6 and AAA-5). For interpretation purposes only the highest contaminant concentrations were used. The following discussion of the type, degree and extent of the groundwater contamination is based on the results generated by the laboratory.

4.4.1 Degree and Extent of Groundwater Contamination by Chlorinated Compounds

Results of the laboratory analyses found only two chlorinated compounds, PCE and TCE, at levels exceeding their respective quantitation limits. Chlorinated ethenes such as PCE and TCE are prevalent groundwater contaminants due to their widespread use as cleaning solvents. PCE and TCE are closely related in that TCE is an intermediate in the formulation of PCE. The two compounds often occur together as groundwater contaminants due to the fact that TCE is also a degradation product of PCE. While the occurrence of TCE in the groundwater beneath the study area lies within the area where the groundwater contains PCE, the degree and extent of each compound will be discussed separately since each compound has been assigned a maximum contaminant level (MCL) by the United States Environmental Protection Agency (EPA). In the

Table 4-3
Summary of Geoprobe Groundwater Data
Downtown Casper PCE Investigation

Sample Information		Field Screening Results (parts per billion)		
Probe Location	Date Collected	111-TCA	TCE	PCE
A-2	09/28/94	NS	NS	NS
A-3	09/25/94	NS	NS	NS
A-3.5	09/28/94	ND	ND	ND
A-4	09/25/94	ND	ND	ND
A-4.5	09/28/94	ND	ND	47
A-5	09/24/94	ND	ND	77
A-5.5	09/28/94	ND	TR	155
A-6	09/25/94	ND	ND	TR
A-6.5	09/27/94	ND	ND	ND
A-7	09/25/94	ND	ND	ND
B-1	09/28/94	NS	NS	NS
B-2	09/24/94	ND	ND	ND
B-3	09/24/94	ND	ND	ND
B-3.5	09/28/94	ND	ND	TR
B-4	09/24/94	ND	ND	39
B-5	09/24/94	ND	ND	42
B-5.5	09/28/94	ND	ND	ND
B-6	09/25/94	FP	FP	FP
B-6.5	09/27/94	ND	ND	ND
C-1	09/24/94	ND	ND	TR
C-2	09/24/94	ND	ND	ND
C-3	09/24/94	ND	ND	ND
C-3.5	09/28/94	ND	TR	683
C-4	09/24/94	ND	ND	177
C-5	09/24/94	ND	ND	57
C-5.5	09/27/94	ND	ND	1009

Table 4-3 (continued)
Summary of Geoprobe Groundwater Data
Downtown Casper PCE Investigation

Sample Information		Field Screening Results (parts per billion)		
Probe Location	Date Collected	111-TCA	TCE	PCE
C-6	09/25/94	ND	ND	72
C-6.5	09/27/94	ND	ND	ND
C-7	09/25/94	ND	ND	ND
D-4	09/25/94	ND	ND	ND
D-5	09/25/94	ND	ND	ND
D-6	09/24/94	ND	ND	ND
AA-4	09/28/94	ND	TR	69
AA-5	09/27/94	ND	ND	ND
AA-6	09/27/94	ND	ND	ND
BB-4	09/28/94	ND	TR	278
BB-5.5	09/27/94	ND	ND	TR
BB-6	09/27/94	ND	ND	1,174
DD-4	09/28/94	ND	ND	TR
DD-5	09/27/94	ND	ND	ND
DD-6	09/27/94	ND	23	27
AAA-5	09/27/94	ND	40	425
0929-01	09/29/94	ND	ND	ND
0929-02	09/29/94	ND	ND	ND
0929-03	09/29/94	ND	ND	18
0929-04	09/29/94	ND	ND	ND
0929-05	09/29/94	ND	ND	ND
0929-06	09/29/94	ND	ND	ND
1003-03	10/03/94	ND	ND	692
1003-04	10/03/94	ND	ND	3050

Table 4-3 (continued)
Summary of Geoprobe Groundwater Data
Downtown Casper PCE Investigation

Sample Information		Field Screening Results (parts per billion)			
Probe Location	Date Collected	Benzene	Toluene	Ethylbenzene	Xylenes
0930-01	09/30/94	16	ND	*	*
0930-02	09/30/94	ND	ND	ND	ND
0930-03	09/30/94	FP	FP	FP	FP
0930-04	09/30/94	FP	FP	FP	FP
0930-05	09/30/94	25	ND	ND	ND
0930-06	09/30/94	ND	ND	ND	ND
0930-07	09/30/94	ND	ND	ND	ND
0930-08	09/30/94	FP	FP	FP	FP
1003-01	10/03/94	ND	ND	ND	ND
1003-02	10/03/94	ND	ND	ND	ND
1003-03	10/03/94	ND	ND	ND	ND
1003-04	10/03/94	ND	ND	ND	ND
1003-05	10/03/94	ND	ND	ND	ND
1004-01	10/04/94	ND	ND	ND	ND
1004-02	10/04/94	ND	ND	ND	ND
1004-03	10/04/94	176	166	*	133
1004-04	10/04/94	32	16	ND	ND
1004-05	10/04/94	ND	ND	ND	ND
1004-06	10/04/94	ND	ND	ND	ND
1004-07	10/04/94	FP	FP	FP	FP
1004-08	10/04/94	18	ND	*	51
1005-01	10/05/94	26	ND	*	>1000
1005-02	10/05/94	NS	NS	NS	NS
1005-03	10/05/94	NS	NS	NS	NS
1005-04	10/05/94	NS	NS	NS	NS
1005-05	10/05/94	NS	NS	NS	NS

Table 4-3 (continued)
Summary of Geoprobe Groundwater Data
Downtown Casper PCE Investigation

Sample Information		Field Screening Results (parts per billion)			
Probe Location	Date Collected	Benzene	Toluene	Ethylbenzene	Xylenes
1005-06	10/05/94	TR	ND	*	15
1005-07	10/05/94	TR	ND	*	22
1005-08	10/05/94	ND	ND	ND	ND
1005-09	10/05/94	ND	ND	ND	ND
1005-10	10/05/94	TR	ND	*	30

ND = Not Detected
TR = Trace
NS = No Sample Collected
FP = Free Product in Sample (not quantifiable)
* = Ethylbenzene and/or Xylene not discernable due to interference.

Table 4-4
Concentrations of Compounds Detected In Groundwater Samples Collected in September and October 1994 From Geoprobe Holes and Monitoring Wells
Downtown Casper PCE Investigation

Well Number or Geoprobe Location	Tetrachloro-ethene (μg/L)	Trichloro-ethene (μg/L)	Benzene (μg/L)	Ethylbenzene (μg/L)	Toluene (μg/L)	Xylenes (μg/L)
A-2	NS	NS	NS	NS	NS	NS
A-3	NS	NS	NS	NS	NS	NS
A-3.5	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
A-4	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
A-4.5	22.8	<1.0	<0.5	<0.5	<0.5	<0.5
A-5	64.0	<1.0	<0.5	<0.5	<0.5	<0.5
A-5.5	16.4	<1.0	<0.5	<0.5	<0.5	<0.5
A-6	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
A-6.5	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
A-7	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
B-1	NS	NS	NS	NS	NS	NS
B-2	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
B-3	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
B-3.5	4.7	<1.0	<0.5	<0.5	<0.5	<0.5
B-4	71.4	<1.0	<0.5	<0.5	<0.5	<0.5
B-5	31.4	<1.0	<0.5	<0.5	<0.5	<0.5
B-5.5	0.7	<1.0	<0.5	<0.5	<0.5	<0.5
B-6	126	10.5	<50	495	<0.5	5066
B-6.5	60.0	3.0	<0.5	<0.5	<0.5	<0.5
C-1	1.2	<1.0	<0.5	<0.5	<0.5	<0.5
C-2	1.4	<1.0	<0.5	<0.5	<0.5	<0.5
C-3	2.5	<1.0	<0.5	<0.5	<0.5	<0.5
C-3.5	613	<1.0	<0.5	<0.5	<0.5	<0.5
C-4	173.5	2.6	<0.5	<0.5	<0.5	<0.5
C-5	45.0	<1.0	<0.5	<0.5	<0.5	<0.5
C-5.5	220	6.1	<0.5	<0.5	<0.5	<0.5
C-5.5	1.0	<1.0	<0.5	<0.5	<0.5	<0.5
C-6	145.0	1.2	<0.5	<0.5	<0.5	<0.5
C-6.5	127.6	<1.0	<0.5	<0.5	<0.5	<0.5
C-7	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
D-4	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
D-5	1.2	<1.0	<0.5	<0.5	<0.5	<0.5
D-6	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5

Table 4-4 (continued)
Concentrations of Compounds Detected In Groundwater Samples Collected in May and June 1994 From Geoprobe Holes and Monitoring Wells
North Casper PCE Investigation

Well Number or Geoprobe Location	Tetrachloro-ethene (μg/L)	Trichloro-ethene (μg/L)	Benzene (μg/L)	Ethylbenzene (μg/L)	Toluene (μg/L)	Xylenes (μg/L)
AA-4	43.7	<1.0	<0.5	<0.5	<0.5	<0.5
AA-5	270.0	45.0	<0.5	<0.5	<0.5	<0.5
AA-5	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
AA-6	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
BB-4	313	<1.0	<0.5	<0.5	<0.5	<0.5
BB-5.5	2.7	<1.0	<0.5	<0.5	<0.5	<0.5
BB-6	200	<1.0	<0.5	<0.5	<0.5	<0.5
BB-6	201	<1.0	<0.5	<0.5	<0.5	<0.5
BB-6	200	<1.0	<0.5	<0.5	<0.5	<0.5
DD-4	1.1	<1.0	<0.5	<0.5	<0.5	<0.5
DD-5	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
DD-6	<1.0	3.0	<0.5	<0.5	<0.5	<0.5
DD-6	16.4	7.0	<0.5	<0.5	<0.5	<0.5
AAA-5	17.3	28.0	<0.5	<0.5	<0.5	<0.5
AAA-5	197	30.2	<0.5	<0.5	<0.5	<0.5
929-1	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
929-2	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
929-3	23.1	<1.0	<0.5	<0.5	<0.5	<0.5
929-4	1.3	<1.0	<0.5	<0.5	<0.5	<0.5
929-5	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
929-6	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
930-1	<1.0	<1.0	1.7	10.5	<0.5	173
930-2	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
930-3	145	98.0	<50	9214	187	445
930-4	<1.0	<1.0	52	3258	<50	6700
930-5	4.6	1.1	<0.5	29	<0.5	58.3
930-6	<1.0	<1.0	<0.5	19.2	<0.5	37.4
930-7	<1.0	<1.0	<0.5	14.8	<0.5	37.4
930-8	<1.0	<1.0	9043	746	2219	6276
1003-1	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
1003-2	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
1003-3	9.9	<1.0	<0.5	<0.5	<0.5	<0.5

Table 4-4 (continued)
Concentrations of Compounds Detected In Groundwater Samples Collected in May and June 1994 From Geoprobe Holes and Monitoring Wells
North Casper PCE Investigation

Well Number or Geoprobe Location	Tetrachloro-ethene (μg/L)	Trichloro-ethene (μg/L)	Benzene (μg/L)	Ethylbenzene (μg/L)	Toluene (μg/L)	Xylenes (μg/L)
1003-4	27.2	<1.0	<0.5	<0.5	<0.5	<0.5
1003-5	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
1004-1	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
1004-2	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
1004-3	23.2	19.2	<0.5	65	12.8	49.8
1004-4	21.9	<1.0	0.7	23.2	11.1	15.8
1004-5	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
1004-6	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
1004-7	<1.0	<1.0	2019	1877	14.3	6969
1004-8	<1.0	<1.0	23.5	53.1	1.7	133
1005-1	<1.0	<1.0	1.2	14.0	<0.5	51.3
1005-2	NS	NS	NS	NS	NS	NS
1005-3	NS	NS	NS	NS	NS	NS
1005-4	NS	NS	NS	NS	NS	NS
1005-5	NS	NS	NS	NS	NS	NS
1005-6	<1.0	<1.0	<0.5	13.7	<0.5	57.3
1005-7	<1.0	<1.0	<0.5	8.0	<0.5	41.5
1005-8	NS	NS	NS	NS	NS	NS
1005-9	NS	NS	NS	NS	NS	NS
1005-10	<1.0	<1.0	<0.5	11.9	<0.5	53.8
1005-10	<1.0	<1.0	<0.5	25.6	<0.5	10.8
R1	12.2	<1.0	<0.5	<0.5	<0.5	<0.5
R1	11.8	<1.0	<0.5	<0.5	<0.5	<0.5
IM-5 (MW-5)	7.7	<1.0	<0.5	<0.5	<0.5	<0.5
IM-5 (MW-5)	8.1	<1.0	<0.5	<0.5	<0.5	<0.5
IM-6 (MW-6)	13.6	<1.0	<0.5	<0.5	<0.5	<0.5
IM-6 (MW-6)	13.4	<1.0	<0.5	<0.5	<0.5	<0.5
IM-4 (MW-4)	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
IM-4 (MW-4)	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5

NS - No sample collected

following discussion each contaminant plume is assigned a number, with the plume numbers increasing as one moves west across the study area.

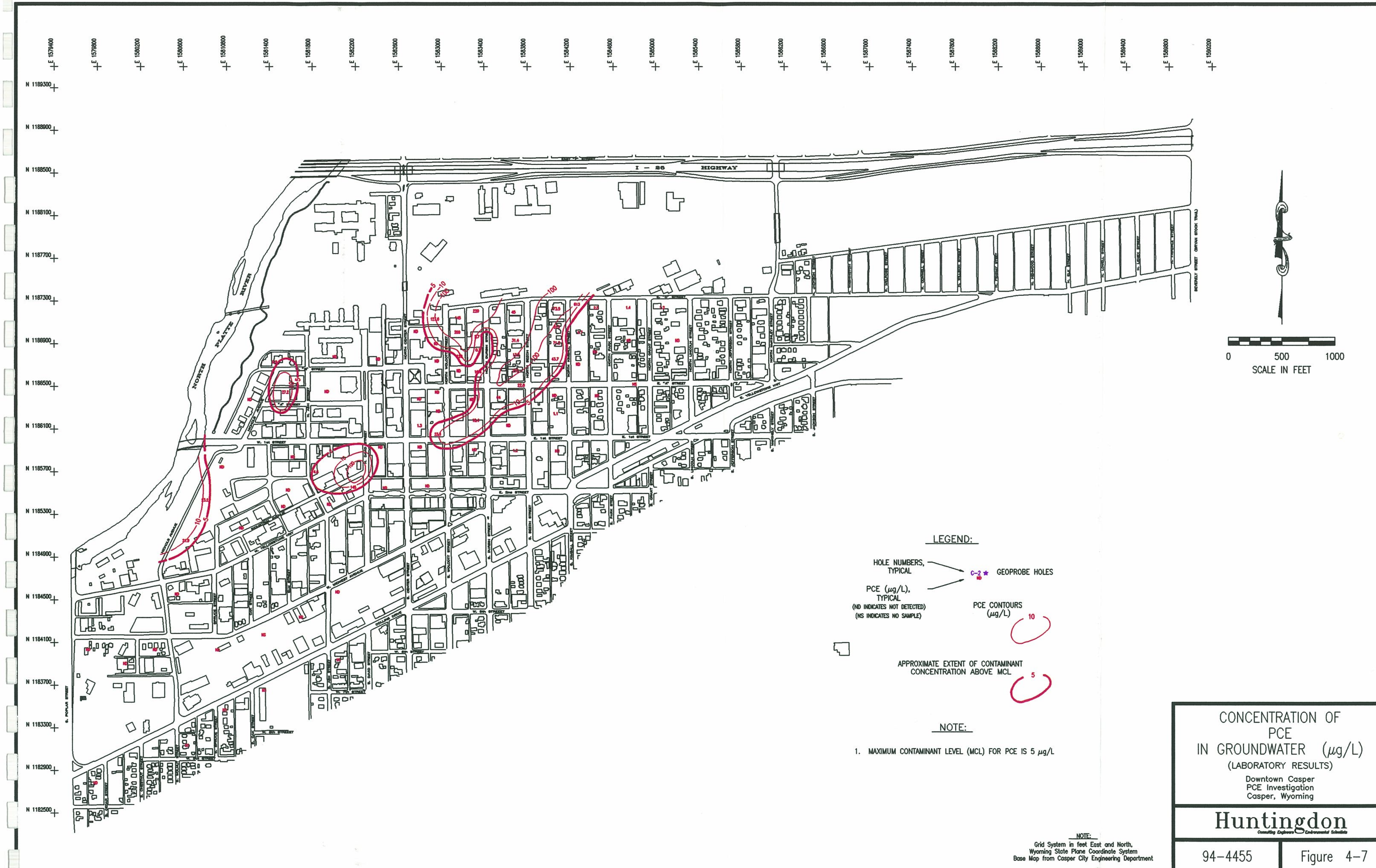
4.4.1.1 PCE in Groundwater

The reported concentrations of PCE in the groundwater samples ranged from non-detectable to 613 micrograms per liter (µg/L). Concentrations less than the detection limits are referred to as non-detectable. For laboratory analyses the detection limit was generally 1 µg/L.

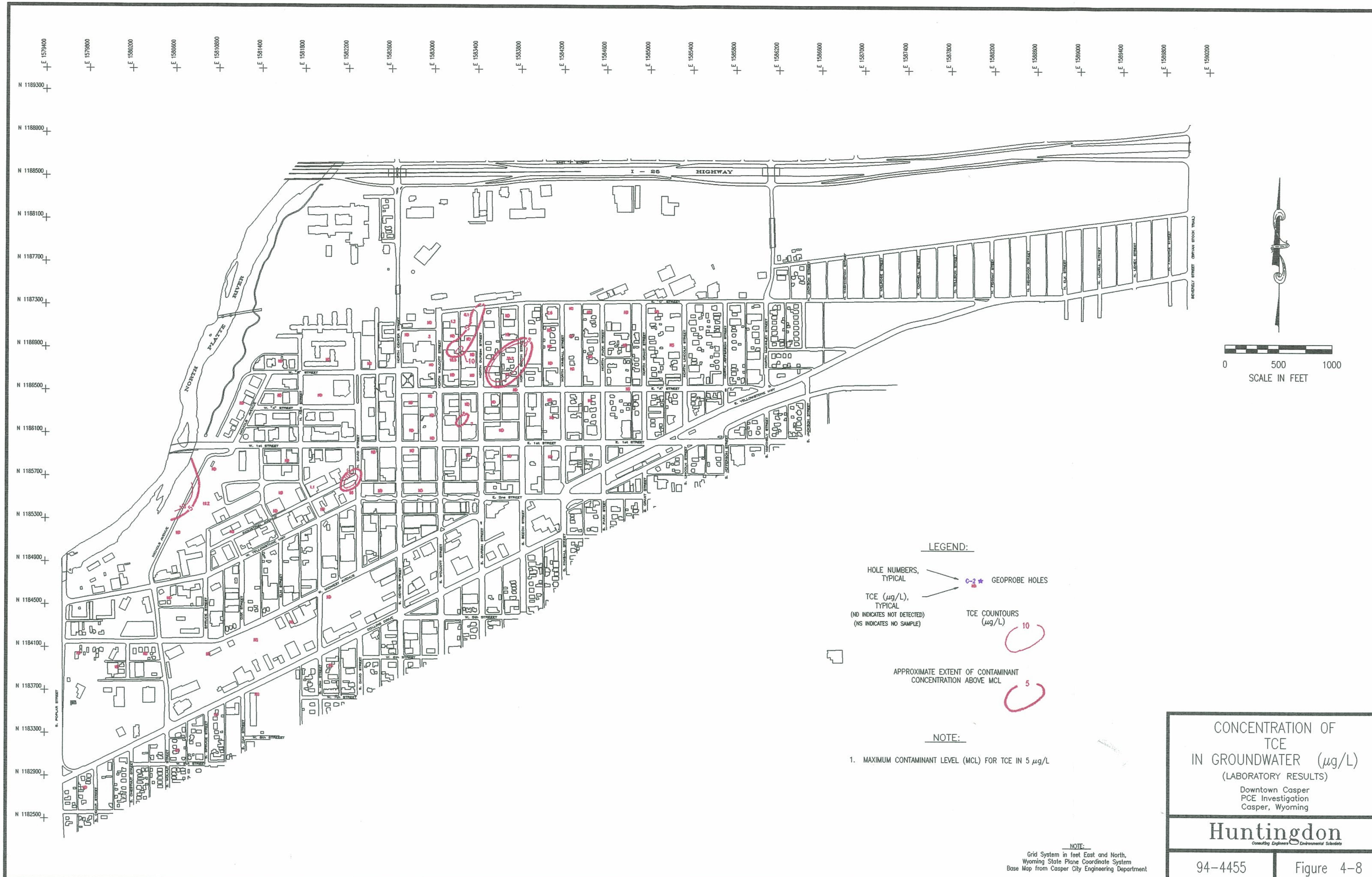
PCE-impacted groundwater was found in four plumes as shown on Figure 4-7. All four plumes contain groundwater with PCE concentrations exceeding the 5 µg/L drinking water MCL for PCE. PCE Plume #1 is approximately 1,400 feet wide by at least 1,800 feet long and extends northeast from near the intersection of South Wolcott Street and East 1st Street to beyond the northern boundary of the study area. The highest concentrations of PCE within plume #1 were found in the groundwater samples collected from geoprobe locations AA-5 (270 µg/L), C3.5 (613 µg/L) and C-5.5 (220 µg/L). Extension of PCE plume #1 to the northeast (the direction of groundwater flow) links it directly to the up-gradient end of the eastern PCE plume identified during Huntingdon's investigation of the north Casper area during May and June of 1994 (Huntingdon, 1994). PCE plume #2 is approximately 280 feet wide by 520 feet long and extends from East "A" Street between North Ash Street and Nichols Avenue to a point north of East "B" Street. The highest concentration of PCE within plume #2 was found at geoprobe sample point 1003-4, where the concentration was 27.2 µg/L. PCE plume #3 is approximately 160 feet wide by 240 feet long and is centered near the intersection of Industrial Avenue and North David Street. The highest concentration of PCE within plume #3 was found at geoprobe sample point 930-3, where the concentration was 145 µg/L. PCE plume #4 is located in the vicinity of Nichols Avenue, between West Yellowstone Highway and West 1st Street. Insufficient data are available to describe the exact size, shape and orientation of this plume. The highest concentration of PCE within plume #4 was found at geoprobe sample point 1004-3, where the concentration was 23.2 µg/L.

4.4.1.2 TCE in Groundwater

The TCE-impacted groundwater occurs in five plumes as shown on Figure 4-8. All five plumes contain groundwater with TCE concentrations exceeding the 5 µg/L drinking water MCL for TCE. All five plumes are coincident with parts of the PCE plumes discussed above. TCE plume #1 is approximately 350 feet wide by 640 feet long and extends northeast from near the intersection of North Durbin Street and East "A" Street to just northeast of North Beech Street between East "A" Street and East "C" Street. The highest concentration of TCE within this plume was found at geoprobe sample point AA-5, where the concentration was 45 µg/L. TCE plume #2 is approximately 140 feet wide by 600 feet long and extends northeast from North Wolcott Street between East "A" Street and East "C" Street to near the intersection of North Durbin Street and East "C" Street. The highest concentration of TCE within this plume, 10.5 µg/L, was found at geoprobe sample point B-6. TCE plume #3 is approximately 130 feet wide by 240 feet long and is elongated in a southwest to northeast direction. Plume #3 is bounded by East 1st Street on the south, by East "A" Street on the north, by South Durbin Street on the east and by South Wolcott Street on the west. The highest concentration of TCE within



LEGEND:
HOLE NUMBERS, TYPICAL
C-2 GEOPROBE HOLES
PCE (µg/L), TYPICAL
(ND INDICATES NOT DETECTED)
(NS INDICATES NO SAMPLE)
PCE CONTOURS (µg/L)
APPROXIMATE EXTENT OF CONTAMINANT CONCENTRATION ABOVE MCL
NOTE:
1. MAXIMUM CONTAMINANT LEVEL (MCL) FOR PCE IS 5 µg/L
0 500 1000
SCALE IN FEET
NORTH PLATTE RIVER
I - 25 HIGHWAY
NOTE:
Grid System in feet East and North,
Wyoming State Plane Coordinate System
Base Map from Casper City Engineering Department
CONCENTRATION OF PCE IN GROUNDWATER (µg/L)
(LABORATORY RESULTS)
Downtown Casper
PCE Investigation
Casper, Wyoming
Huntingdon
94-4455
Figure 4-7



CONCENTRATION OF TCE IN GROUNDWATER (μg/L)

(LABORATORY RESULTS)

Downtown Casper
PCE Investigation
Casper, Wyoming

Huntingdon
Consulting Engineers Environmental Scientists

94-4455

Figure 4-8

plume #3 was found at geoprobe sample point DD-6, where the concentration was 7 µg/L. TCE plume #4 is approximately 220 feet wide by 340 feet long and is centered near the intersection of Industrial Avenue and South David Street. The highest concentration of TCE within plume #4 was found at geoprobe sample point 930-3, where the concentration was 98 µg/L. TCE plume #5 is located in the vicinity of Nichols Avenue, between West Yellowstone Highway and West 1st Street. Insufficient data are available to describe the exact size, shape and orientation of this plume. The highest concentration of TCE within the fifth plume was found at geoprobe sample point 1004-3. At that location the concentration of TCE in the groundwater sample was 19.2 µg/L.

4.4.2 Degree and Extent of Groundwater Contamination by Petroleum Fuel Related Compounds

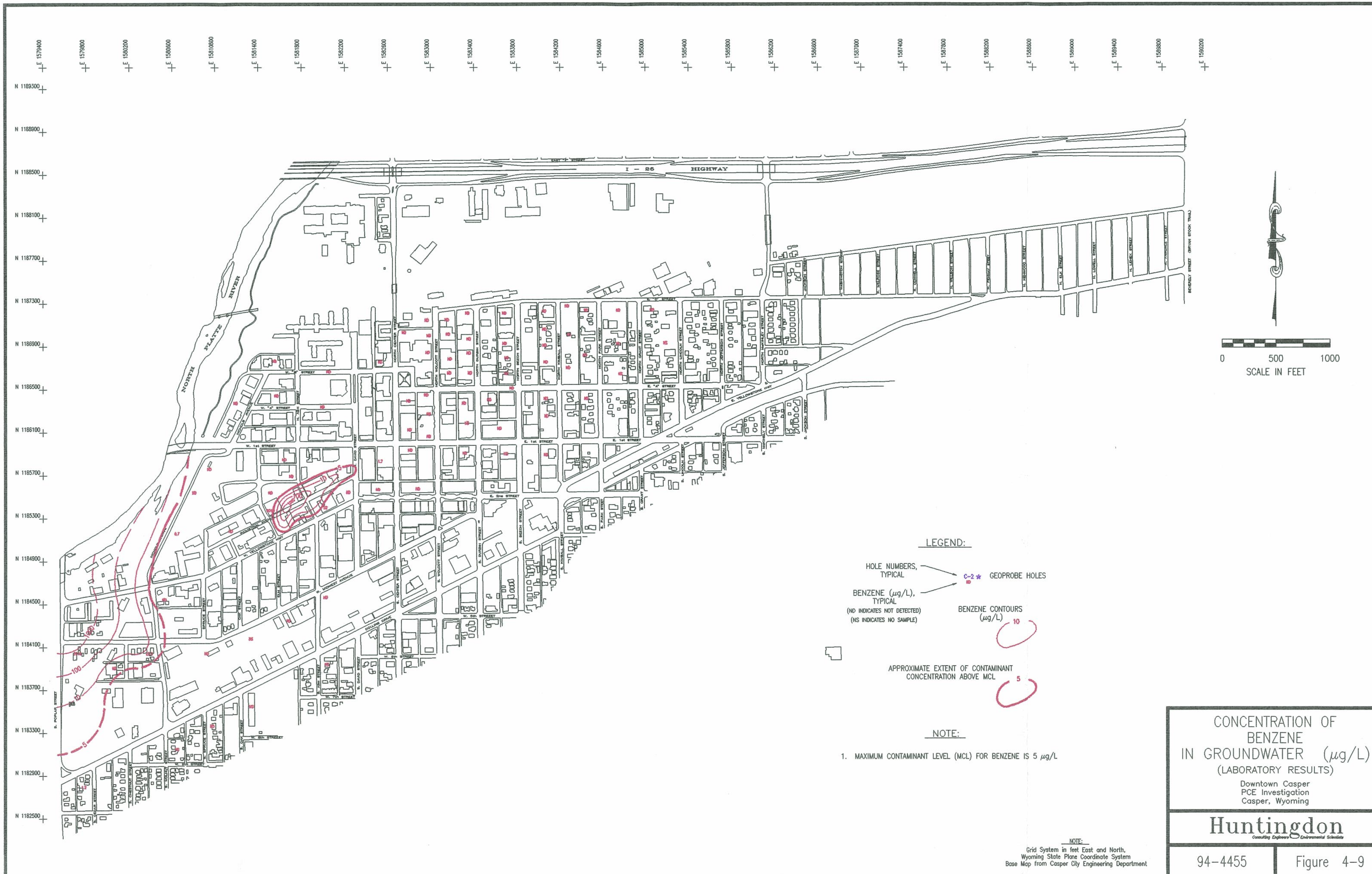
Results of the laboratory analyses found only four petroleum fuel-related compounds, benzene, ethylbenzene, toluene and xylenes, at levels exceeding their respective quantitation limits. Because each of these compounds is a component of petroleum fuels, it is common to find two or more of the compounds together in areas where petroleum fuels have impacted groundwater. Even though the occurrences of these compounds in the groundwater beneath the study area are generally coincident, the degree and extent of occurrence of each compound will be discussed separately since each compound has been assigned a MCL by the EPA. In the following discussion each contaminant plume is assigned a number, with the plume numbers increasing as one moves west across the study area.

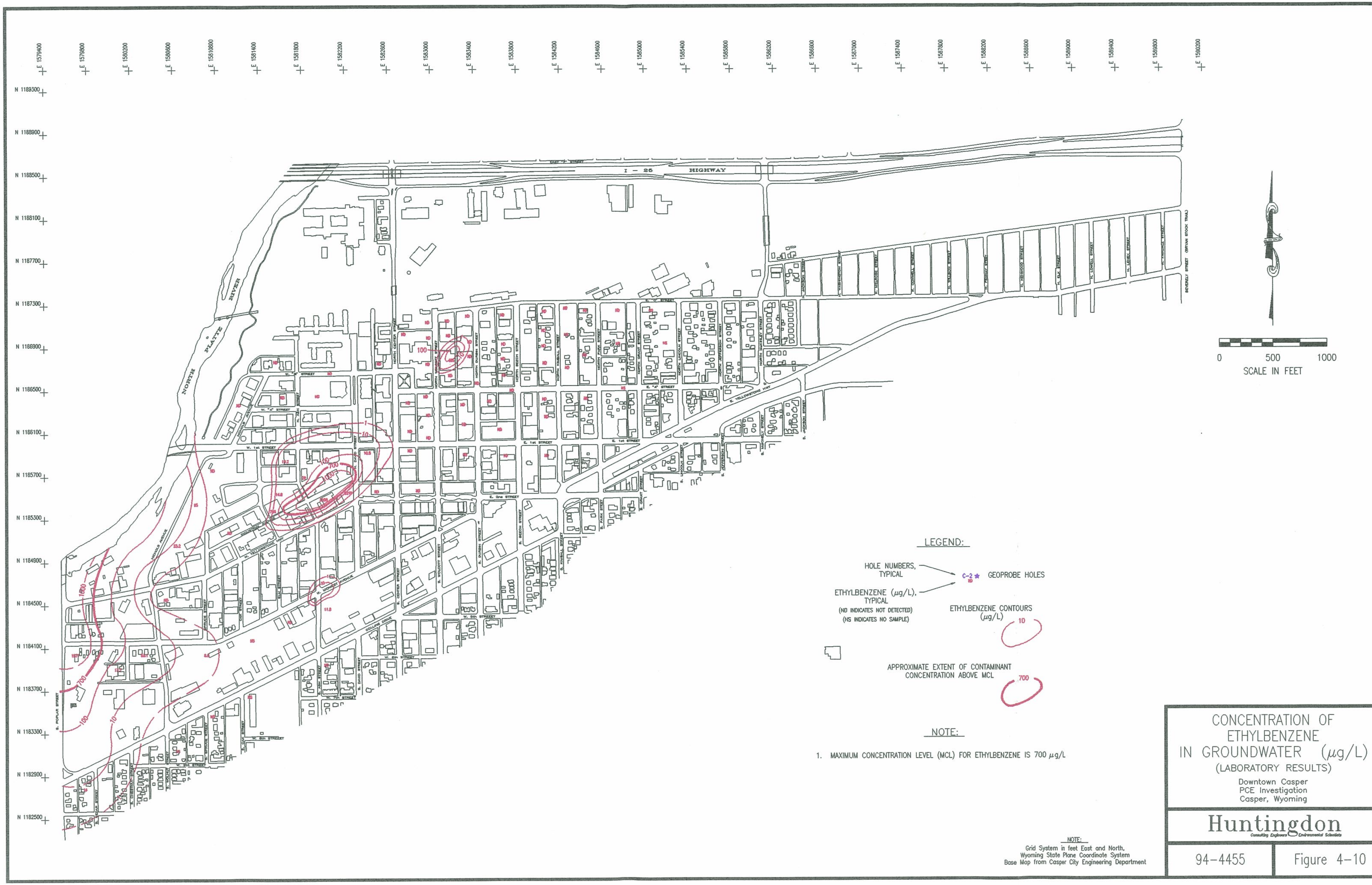
4.4.2.1 Benzene in Groundwater

Benzene-impacted groundwater occurs in two plumes as shown on Figure 4-9. Both plumes contain groundwater with benzene concentrations exceeding the 5 µg/L drinking water MCL for benzene. Benzene plume #1 is approximately 300 feet wide by 560 feet long and underlies an area bounded by West Yellowstone Highway on the south, by Cody Street and West 2nd Street on the north, by Elm Street on the west and by South David Street on the east. The highest concentration of benzene within plume #1 was found at geoprobe sample point 930-8, where the concentration was 9043 µg/L. Benzene plume #2 underlies an area approximately bounded by Nichols Avenue on the east, by Collins Drive on the south and by the North Platte River on the north. Insufficient data are available to describe the western extent of this plume. The highest known concentration of benzene within the second plume was found at geoprobe sample point 1004-7. At that location the concentration of benzene in the groundwater sample was 2019 µg/L.

4.4.2.2 Ethylbenzene in Groundwater

Ethylbenzene-impacted groundwater occurs in four plumes as shown on Figure 4-10. Ethylbenzene concentrations exceeding the 700 µg/L drinking water MCL for ethylbenzene occur in two of the four plumes (#2 and #4). Ethylbenzene plume #1 is approximately 220 feet wide by 400 feet long and underlies an area bounded by East "A" Street on the south, by East "C" Street on the north, by North Durbin Street on the east and by North Wolcott Street on the west. The highest concentration of ethylbenzene within plume #1 (495 µg/L) was found at geoprobe


I - 25 HIGHWAY
NORTH PLATTE RIVER
0 500 1000
SCALE IN FEET
LEGEND:
HOLE NUMBERS, TYPICAL
C-2 ★ GEOPROBE HOLES
BENZENE (μg/L), TYPICAL
(ND INDICATES NOT DETECTED)
(NS INDICATES NO SAMPLE)
BENZENE CONTOURS (μg/L)
10
APPROXIMATE EXTENT OF CONTAMINANT CONCENTRATION ABOVE MCL
5
NOTE:
1. MAXIMUM CONTAMINANT LEVEL (MCL) FOR BENZENE IS 5 μg/L
NOTE:
Grid System in feet East and North,
Wyoming State Plane Coordinate System
Base Map from Casper City Engineering Department
CONCENTRATION OF BENZENE IN GROUNDWATER (μg/L)
(LABORATORY RESULTS)
Downtown Casper
PCE Investigation
Casper, Wyoming
Huntingdon
Consulting Engineers Environmental Scientists
94-4455
Figure 4-9



I - 25 HIGHWAY
NORTH PLATTE RIVER
0 500 1000
SCALE IN FEET
LEGEND:
HOLE NUMBERS, TYPICAL
C-2 GEOPROBE HOLES
ETHYLBENZENE (μg/L), TYPICAL
(ND INDICATES NOT DETECTED)
(NS INDICATES NO SAMPLE)
ETHYLBENZENE CONTOURS (μg/L)
10
APPROXIMATE EXTENT OF CONTAMINANT CONCENTRATION ABOVE MCL
700
NOTE:
1. MAXIMUM CONCENTRATION LEVEL (MCL) FOR ETHYLBENZENE IS 700 μg/L
NOTE:
Grid System in feet East and North,
Wyoming State Plane Coordinate System
Base Map from Casper City Engineering Department
CONCENTRATION OF ETHYLBENZENE IN GROUNDWATER (μg/L)
(LABORATORY RESULTS)
Downtown Casper
PCE Investigation
Casper, Wyoming
Huntingdon
Consulting Engineers Environmental Scientists
94-4455
Figure 4-10

sample point B-6. Ethylbenzene plume #2 is approximately 800 feet wide by 1400 feet long and underlies an area approximately bounded by West Yellowstone Highway on the south, West "A" Street on the north, by South Center Street on the east and by Elm Street on the west. The highest concentration of ethylbenzene within plume #2 (3,258 μg/L) was found at geoprobe sample point 930-4. Ethylbenzene plume #3 is located near the intersection of West Midwest Street and South Ash Street. Insufficient data are available to describe the exact size, shape and orientation of this plume. The highest known concentration of ethylbenzene within the third plume (11.9 μg/L) was found at geoprobe sample point 1005-10. Ethylbenzene plume #4 underlies an area approximately bounded by Spruce Street on the east and by the North Platte River on the north. Insufficient data are available to describe the western and southern extent of this plume. The highest known concentration of ethylbenzene within the fourth plume (1,877 μg/L) was found at geoprobe sample point 1004-7.

4.4.2.3 Toluene in Groundwater

Toluene-impacted groundwater occurs in three plumes as shown on Figure 4-11. Toluene concentrations exceeding the 1,000 μg/L drinking water MCL for toluene occurs only in plume #2. Toluene plume #1 is located near the intersection of Industrial Avenue and South David Street. The highest concentration of toluene the first plume (187 μg/L) was found at geoprobe sample point 930-3. Toluene plume #2 is approximately 250 feet wide by 500 feet long and underlies an area bounded by West Yellowstone Highway on the south, Cody and West 2nd Streets on the north, by South Ash Street on the east and by South Elm Street on the west. The highest concentration of toluene within the second plume (2,219 μg/L) was found at geoprobe sample point 930-8. Toluene plume #3 underlies an area approximately bounded by Spruce Street on the east, by Wimborne Street on the south and by the North Platte River on the north. Insufficient data are available to describe the western extent of this plume. The highest known concentration of toluene within the third plume was found at geoprobe sample point 1004-7, where the concentration was 14.3 μg/L.

4.4.2.4 Xylenes in Groundwater

Xylene-impacted groundwater occurs in four plumes as shown on Figure 4-12. Xylenes were not found in any of the four plumes at concentrations exceeding the 10,000 μg/L drinking water MCL for xylenes. Xylene plume #1 is approximately bounded by East "C" Street on the north, by East "A" Street on the south, by North Durbin Street on the east and by North Wolcott Street on the east. The highest concentration of xylenes within the first plume was found at geoprobe sample point B-6, where the concentration was 5,066 μg/L. Xylene plume #2 is approximately bounded by West "A" Street on the north, by West Midwest Street on the south, by South Oak Street on the west and by South Center Street on the east. The highest concentration of xylenes within the second plume was found at geoprobe sample point 930-8, where the concentration was 6,276 μg/L. Xylene plume #3 is located near the intersection of West Midwest Street and South Ash Street. Insufficient data are available to describe the exact size, shape and orientation of this plume. The highest known concentration of xylenes within the third plume was found at geoprobe sample point 1005-10, where the concentration was 53.8 μg/L. Xylene plume #4 underlies an area approximately bounded by South Wolcott Street and Nichols Avenue on the east and by the North Platte River on the north. Insufficient data are available to describe the southern and western extent of this plume. The highest known concentration of xylenes within the fourth plume was found at geoprobe sample point 1004-7, where the concentration was 6,969 μg/L.

LEGEND:

HOLE NUMBERS, TYPICAL — C-2 ★ GEOPROBE HOLES

TOLUENE (μg/L), TYPICAL (ND INDICATES NOT DETECTED) (NS INDICATES NO SAMPLE)

TOLUENE CONTOURS (μg/L) — 10

APPROXIMATE EXTENT OF CONTAMINANT CONCENTRATION ABOVE MCL — 1000

NOTE:

1. MAXIMUM CONTAMINANT LEVEL (MCL) FOR TOLUENE IS 1,000 μg/L

NOTE:
Grid System in feet East and North,
Wyoming State Plane Coordinate System
Base Map from Casper City Engineering Department

CONCENTRATION OF TOLUENE IN GROUNDWATER (μg/L)
(LABORATORY RESULTS)

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Casper, Wyoming

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Figure 4-11

NOTE:
Grid System in feet East and North, Wyoming State Plane Coordinate System
Base Map from Casper City Engineering Department

CONCENTRATION OF XYLENE IN GROUNDWATER (µg/L)
(LABORATORY RESULTS)

Downtown Casper
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Figure 4-12

5.0 SUMMARY AND CONCLUSIONS

5.1 Summary

In September and October 1994, Huntingdon Engineering & Environmental, Inc., under the direction of the Wyoming Department of Environmental Quality (WDEQ), conducted an investigation to describe the extent and degree of contamination due to volatile organic compounds, including tetrachloroethene (PCE), trichloroethene (TCE), 1,1,1-TCA, benzene, ethylbenzene, toluene and xylenes, in the subsurface in the downtown Casper area. The area of investigation is approximately bounded on the east by McKinley Street, on the west by Poplar Street and the North Platte River, on the south by Collins Drive and East Yellowstone Highway and on the north by U.S. I-25.

During this investigation, field operations generally proceeded from east to west across the study area. Invasive actions such as soil and groundwater sampling were confined to public property in order to minimize any impact on private property owners. All field activities were halted at Poplar Street due to the combined factors of budget and time constraints, large blocks of private property limiting sample density and, to a lesser extent, inclement weather. During the past five years groundwater samples have been collected, on one or more occasions, at 148 different locations throughout North Casper and downtown Casper and analyzed for volatile organic compounds (Figure 5-1).

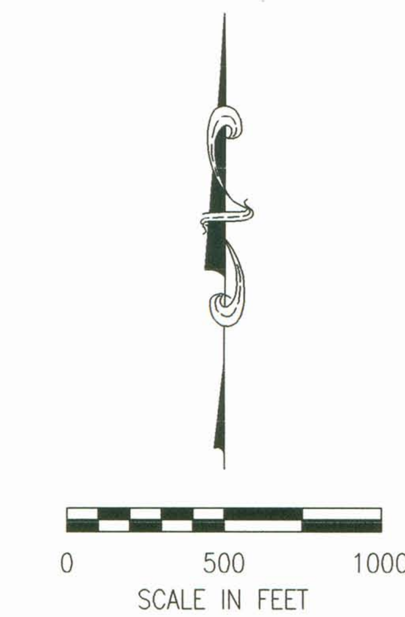
Chlorinated ethenes such as PCE and TCE are prevalent groundwater contaminants due to their widespread use as cleaning solvents. PCE and TCE are closely related in that TCE is an intermediate in the formulation of PCE. The two compounds often occur together as groundwater contaminants due to the fact that TCE is also a degradation product of PCE. BETX compounds are major components of gasoline and minor components of other petroleum fuels, and commonly contaminate soil and groundwater because of fuel spills and leaks.

Contamination of the soil vapor and shallow groundwater in the area by these compounds had been documented by earlier studies, but the extent and degree of the contamination had not been established precisely.

5.2 Conclusions

Based on the observations made and data generated during this investigation, the following conclusions are evident:

- The study area is underlain by fluvial terrace deposits which rest unconformably on bedrock consisting of the Steele Shale member of the Cretaceous Cody Shale. According to published data, the thickness of the fluvial deposits in this area is approximately 35 to 40 feet.



LEGEND:

HOLE NUMBERS, TYPICAL

- GEOPROBE HOLES (AUGUST 5,1994)
- 1003-2 GEOPROBE HOLES (DECEMBER 1994)
- NEW WELLS (AUGUST 1994)
- OLD WELLS
- DOMESTIC WELLS
- NEW BORINGS
- SYMBOLS FOR MONITORING WELLS, TYPICAL (COLOR VARIES IN REFERENCE TO PREVIOUS INVESTIGATION DATA BELOW; MULTIPLE SYMBOLS INDICATE LOCATION USED IN MORE THAN ONE INVESTIGATION)
- PUMP TEST WELLS, TYPICAL (COLOR VARIES IN REFERENCE TO PREVIOUS INVESTIGATION DATA BELOW)

- FROM WESTERN WATER CONSULTANTS, 1989
- FROM ECOLOGY AND ENVIRONMENT, MARCH 1990
- MODIFIED FROM ECOLOGY AND ENVIRONMENT, MARCH 1990
- FROM INBERG-MILLER ENGINEERS, APRIL 1990
- FROM HART CROWSER, MAY 15,1991
- FROM ECOLOGY AND ENVIRONMENT, MAY 22, 1991
- AFTER ENGINEERING - SCIENCE, INC., 1992
- HUNTINGDON, AUGUST 5, 1994
- HUNTINGDON, DECEMBER 1994

NOTE:

* VOC ANALYSIS BY EPA METHOD 501.2, 524.2 OR SIMILAR METHOD

NOTE:
Grid System in feet East and North, Wyoming State Plane Coordinate System
Base Map from Casper City Engineering Department

LOCATIONS AT WHICH GROUNDWATER SAMPLES WERE COLLECTED FOR VOLATILE ORGANIC COMPOUND* ANALYSIS

Downtown Casper
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Figure 5-1

- Groundwater is present under unconfined conditions within the alluvium at depths below 6 to 24 feet. Groundwater flow is to the north and northeast under a gradient of between 0.0013 and 0.0066. The average groundwater velocity is estimated to range from 3.0 to 15.5 feet per day.

- Soil vapor is impacted by PCE in two areas and by TCE in two areas. These areas coincide generally with areas of groundwater impacted by PCE and TCE. Concentrations of PCE and TCE as great as 425,630 and 501 ppb, respectively, were found in the soil vapor during this investigation. The horizontal extent of both vapor-phase TCE plumes fall within the horizontal extent of the east vapor phase PCE plume.

- Based on the available data, the east vapor-phase PCE plume of this investigation appears to be the up-gradient extension of the east vapor-phase PCE plume described in the North Casper PCE Investigation (Huntingdon Engineering & Environmental, Inc., 1994). The combined plume is approximately 6,500 feet long by 1,000 feet wide and extends northeast from near the intersection of South Wolcott Street and East 1st Street to the North Platte River (Figure 5-2).

- Based on the available data, neither of the vapor-phase TCE plumes of this investigation appears to be related to the vapor-phase TCE plume described in the North Casper PCE Investigation (Huntingdon Engineering & Environmental, Inc., 1994) (Figure 5-3).

- PCE-impacted groundwater with PCE concentrations exceeding the 5 µg/L MCL occurs in four plumes. PCE plume #1 is approximately 1,400 feet wide by more than 1,800 feet long and extends northeast from near the intersection of South Wolcott Street and East 1st Street to beyond the northern boundary of the study area. PCE plume #2 is approximately 280 feet wide by 520 feet long and extends north from East "A" Street between North Ash Street and Nichols Avenue to a point north of East "B" Street. PCE plume #3 is approximately 160 feet wide by 240 feet long and is centered near the intersection of Industrial Avenue and North David Street. PCE plume #4 is located in the vicinity of Nichols Avenue, between West Yellowstone Highway and West 1st Street. Insufficient data are available to describe the exact size, shape and orientation of this plume.

- Based on the available data, PCE plume #1 of this investigation appears to be the up-gradient extension of the east PCE plume described in the North Casper PCE Investigation (Huntingdon Engineering & Environmental, Inc., 1994). The combined plume is approximately 6,500 feet long by 1,200 feet wide and extends northeast from near the intersection of South Wolcott Street and East 1st Street to the North Platte River (Figure 5-4).

- TCE-impacted groundwater occurs in five plumes. Groundwater in each plume contains TCE at concentrations greater than the 5 µg/L MCL. TCE plume #1 is approximately 350 feet wide by 640 feet long and extends northeast from near the

NOTE:
Grid System in feet East and North,
Wyoming State Plane Coordinate System
Base Map from Casper City Engineering Department

CONCENTRATION OF PCE IN SOIL VAPOR (ppb)

(GEOPROBE RESULTS)

Downtown Casper
PCE Investigation
Casper, Wyoming

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Consulting Engineers · Environmental Scientists

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CONCENTRATION OF TCE IN SOIL VAPOR (ppb)
(GEOPROBE RESULTS)

Downtown Casper
PCE Investigation
Casper, Wyoming

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Figure 5-3

NORTH CASPER LEGEND:

HOLE NUMBERS, TYPICAL — GEOPROBE HOLES

PCE (µg/L), TYPICAL (ND INDICATES NOT DETECTED) — NEW WELLS (AUGUST 1994)

OLD WELLS

DOMESTIC WELLS

PCE CONTOURS (µg/L)

APPROXIMATE EXTENT OF CONTAMINANT CONCENTRATION ABOVE MCL

DOWNTOWN CASPER LEGEND:

HOLE NUMBERS, TYPICAL — C-2 GEOPROBE HOLES

PCE (µg/L), TYPICAL (ND INDICATES NOT DETECTED) (NS INDICATES NO SAMPLE)

PCE CONTOURS (µg/L)

APPROXIMATE EXTENT OF CONTAMINANT CONCENTRATION ABOVE MCL

NOTE:

1. MAXIMUM CONTAMINANT LEVEL (MCL) FOR PCE IS 5 µg/L

NOTE:
Grid System in feet East and North,
Wyoming State Plane Coordinate System
Base Map from Casper City Engineering Department

CONCENTRATION OF PCE IN GROUNDWATER (µg/L)
(GEOPROBE RESULTS)

Downtown Casper
PCE Investigation
Casper, Wyoming

Huntingdon
Consulting Engineers Environmental Scientists

94-4455 | Figure 5-4

intersection of North Durbin Street and East "A" Street to just northeast of North Beech Street between East "A" Street and East "C" Street. TCE plume #2 is approximately 140 feet wide by 600 feet long and extends northeast from North Wolcott Street between East "A" Street and East "C" Street to near the intersection of North Durbin Street and East "C" Street. TCE plume #3 is approximately 130 feet wide by 240 feet long and is bounded by East 1st Street on the south, by East "A" Street on the north, by South Durbin Street on the east and by South Wolcott Street on the west. TCE plume #4 is approximately 220 feet wide by 340 feet long and is centered near the intersection of Industrial Avenue and South David Street. TCE plume #5 is located in the vicinity of Nichols Avenue, between West Yellowstone Highway and West 1st Street. Insufficient data are available to describe the exact size, shape and orientation of this plume.

- Based on the available data, the plumes of TCE-impacted groundwater identified during this investigation are isolated from the plumes of TCE-impacted groundwater identified during the North Casper PCE investigation (Figure 5-5). TCE plumes #1, #2 and #3 of this investigation may be related to the east TCE plume described in the North Casper PCE Investigation (Huntingdon Engineering & Environmental, Inc. 1994) since TCE is a degradation product of PCE and all four TCE plumes occur within the limits of the PCE plume #1/east PCE plume.

- Inspection of Figures 4-7 and 4-8, shows that the occurrence of TCE in the groundwater beneath the study area is generally coincident with the areas where the higher concentrations of PCE occur in the groundwater. This, together with the fact that TCE is a degradation product of PCE, strongly suggests common sources for both of these compounds. Potential sources of PCE and TCE include any business or industry that might use or store products that consist solely of or contain these compounds. Such businesses and industries include wholesale and retail fuel distributors, automotive and small engine repair shops, analytical laboratories, commercial copiers and duplicators, dry cleaners, machine shops, sheet metal shops, photo finishers and metal plating facilities.

- Separate-phase PCE and TCE are not likely to be present in the subsurface in the area, based on the concentrations of PCE and TCE observed in groundwater samples collected during this investigation.

- Groundwater impacted by benzene, ethylbenzene, toluene and/or xylenes (BETX) occurs in four plumes. Each plume contains one or more of the BETX compounds at or above its respective MCL.

- The benzene-impacted groundwater occurs in two plumes. The first plume is approximately 300 feet wide by 560 feet long and underlies an area bounded by West Yellowstone Highway on the south, by Cody Street and West 2nd Street on the north, by Elm Street on the west and by South David Street on the east. The second benzene plume underlies an area approximately bounded by Nichols Avenue on the east, by Collins Drive on the south and by the North Platte River on the north. Insufficient data are available to describe the western extent of this plume.

NORTH CASPER LEGEND:

HOLE NUMBERS, TYPICAL — GEOPROBE HOLES

TCE (µg/L), TYPICAL (ND INDICATES NOT DETECTED) — NEW WELLS (AUGUST 1994)

OLD WELLS

DOMESTIC WELLS

TCE CONTOURS (µg/L)

APPROXIMATE EXTENT OF CONTAMINANT CONCENTRATION ABOVE MCL

DOWNTOWN CASPER LEGEND:

HOLE NUMBERS, TYPICAL — GEOPROBE HOLES

TCE (µg/L), TYPICAL (ND INDICATES NOT DETECTED) (NS INDICATES NO SAMPLE)

TCE COUNTOURS (µg/L)

APPROXIMATE EXTENT OF CONTAMINANT CONCENTRATION ABOVE MCL

NOTE:

1. MAXIMUM CONTAMINANT LEVEL (MCL) FOR TCE IN 5 µg/L

NOTE:
Grid System in feet East and North,
Wyoming State Plane Coordinate System
Base Map from Casper City Engineering Department

CONCENTRATION OF TCE IN GROUNDWATER (µg/L)
(GEOPROBE RESULTS)

Downtown Casper
PCE Investigation
Casper, Wyoming

Huntingdon
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94-4455

Figure 5-5

- Ethylbenzene-impacted groundwater occurs in four plumes. Ethylbenzene plume #1 is approximately 220 feet wide by 400 feet long and underlies an area bounded by East "A" Street on the south, by East "C" Street on the north, by North Durbin Street on the east and by North Wolcott Street on the west. Ethylbenzene plume #2 is approximately 800 feet wide by 1400 feet long and underlies an area approximately bounded by West Yellowstone Highway on the south, West "A" Street on the north, by South Center Street on the east and by Elm Street on the west. Ethylbenzene plume #3 is located near the intersection of West Midwest Street and South Ash Street. Insufficient data are available to describe the exact size, shape and orientation of this plume. Ethylbenzene plume #4 underlies an area approximately bounded by Spruce Street on the east and by the North Platte River on the north. Insufficient data are available to describe the western and southern extent of this plume.

- Toluene-impacted groundwater occurs in three plumes as shown on Figure 4-11. Toluene plume #1 is located in the vicinity of the intersection of Industrial Avenue and South David Street. Insufficient data is available to describe the exact size, shape and orientation of this plume. Toluene plume #2 is approximately 250 feet wide by 500 feet long and underlies an area bounded by West Yellowstone Highway on the south, Cody Street/West 2nd Street on the north, by South Ash Street on the east and by South Elm Street on the west. Toluene plume #3 underlies an area approximately bounded by Spruce Street on the east, by Wimborne Street on the south and by the North Platte River on the north. Insufficient data are available to describe the western extent of this plume.

- Xylene-impacted groundwater occurs in four plumes as shown on Figure 4-12. Xylene plume #1 is approximately bounded by East "C" Street on the north, by East "A" Street on the south, by North Durbin Street on the east and by North Wolcott Street on the east. Xylene plume #2 is approximately bounded by West "A" Street on the north, by West Midwest Street on the south, by South Oak Street on the west and by South Center Street on the east. Xylene plume #3 is located near the intersection of West Midwest Street and South Ash Street. Insufficient data is available to describe the exact size, shape and orientation of this plume. Xylene plume #4 underlies an area approximately bounded by South Wolcott Street and Nichols Avenue on the east and by the North Platte River on the north. Insufficient data are available to describe the southern and western extent of this plume.

- Separate-phase accumulations of petroleum fuels may be present at the water table in the study area, based on field observations and the results of the groundwater and soil vapor analyses.

- The occurrence of benzene, ethylbenzene, toluene and xylene in the groundwater beneath the study area is generally coincident. This, together with the fact that all four compounds are components of petroleum fuels, strongly suggests common sources for all four of these compounds. Potential sources of benzene, ethylbenzene, toluene and xylenes include any business or industry that might use or store products that consist solely of or contain these compounds. Such businesses and industries include wholesale and retail fuel distributors, automotive and small engine repair shops, analytical laboratories, machine shops and petroleum hydrocarbon refineries.

- No conclusions can be made with any certainty regarding the vertical distribution of PCE, TCE and BETX in the study area, because only the soil vapor above the water table and the groundwater in the uppermost part of the alluvial aquifer were sampled in this investigation.

- The distribution and migration of the contaminant plumes described in this report are apparently influenced only by groundwater flow and advective transport of the contaminants by the groundwater.

6.0 LIMITATIONS

Huntingdon has endeavored to meet what it believes is the applicable standard of care for the services performed and, in doing so, is obliged to advise the WDEQ of pertinent limitations.

The findings and opinions conveyed via this report are based upon information obtained at a particular date from a variety of sources enumerated herein, and which Huntingdon believes are reliable. Nonetheless, Huntingdon cannot and does not warrant the authenticity or reliability of the information sources it has relied upon.

This report represents Huntingdon's service to the WDEQ as of the report date. In that regard, the report constitutes Huntingdon's final document, and the text of the report may not be altered in any manner after final issuance of the same. Opinions relative to environmental conditions given in this report are based upon information derived from the most recent site reconnaissance date and from other activities described herein. The WDEQ is herewith advised that the conditions observed by Huntingdon are subject to change. Certain indicators of the presence of hazardous materials may have been latent or not present at the time of the most recent site reconnaissance and may have subsequently become observable. In similar manner, the research effort conducted for this project was limited. Accordingly, it is possible that Huntingdon's research, while fully appropriate for this project and in compliance with the scope of service, may not include other important information sources. Assuming such sources exist, their information could not have been considered in the formulation of our findings and conclusions.

This report is not a comprehensive site characterization or regulatory compliance audit and should not be construed as such. The opinions presented in this report are based upon findings derived from site reconnaissance, review of specified records and sources and subsurface investigations conducted by Huntingdon. Specifically, Huntingdon does not and cannot represent that the site contains no hazardous or toxic materials, products, or other latent conditions beyond that observed by Huntingdon during its site assessment. Further, the services herein shall in no way be construed, designed or intended to be relied upon as legal interpretation or advice.

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APPENDIX A

GEOPROBE DATA FOR GROUNDWATER AND SOIL VAPOR ANALYSIS

Photovac 10S70 Portable Gas Chromatograph
North Casper Soil–Gas and Groundwater Survey Results
Huntingdon Engineering & Environmental

Sample Information		Field Screenig Results (parts per billion)					
Probe	Date	Soil–Gas			Groundwater		
Location	Collected	111–TCA	TCE	PCE	111–TCA	TCE	PCE
D–6	09/24/94	nd	nd	nd	nd	nd	nd
A–5	09/24/94	nd	nd	nd	nd	nd	77
C–3	09/24/94	nd	nd	nd	nd	nd	nd
C–4	09/24/94	nd	nd	67600	nd	nd	177
C–2	09/24/94	nd	nd	nd	nd	nd	nd
C–1	09/24/94	nd	nd	nd	nd	nd	tr
B–2	09/24/94	nd	nd	nd	nd	nd	nd
B–3	09/24/94	nd	nd	nd	nd	nd	nd
B–4	09/24/94	nd	nd	133	nd	nd	39
B–5	09/24/94	nd	nd	777	nd	nd	42
C–5	09/24/94	nd	nd	20194	nd	nd	57
C–6	09/25/94	nd	nd	134370	nd	nd	72
B–6	09/25/94	nd	nd	nd	fp	fp	fp
A–6	09/25/94	nd	501	10720	nd	nd	tr
A–7	09/25/94	nd	nd	nd	nd	nd	nd
C–7	09/25/94	nd	nd	nd	nd	nd	nd
D–5	09/25/94	nd	nd	nd	nd	nd	nd
D–4	09/25/94	nd	nd	nd	nd	nd	nd
A–4	09/25/94	nd	nd	nd	nd	nd	nd
A–3	09/25/94	nd	nd	nd	ns	ns	ns
AA–6	09/27/94	nd	nd	5200	nd	nd	nd
BB–6	09/27/94	nd	38080	>100000	nd	nd	1174
DD–6	09/27/94	nd	413	44270	nd	23	27
DD–5	09/27/94	nd	nd	11030	nd	nd	nd
AA–5	09/27/94	nd	nd	5440	nd	nd	nd
AAA–5	09/27/94	nd	tr	57480	nd	40	425
C–6.5	09/27/94	nd	nd	nd	nd	nd	nd
B–6.5	09/27/94	nd	nd	nd	nd	nd	nd
A–6.5	09/27/94	nd	nd	nd	nd	nd	nd
C–5.5	09/27/94	nd	nd	425630	nd	nd	1009
BB–5.5	09/27/94	nd	nd	3260	nd	nd	tr
B–5.5	09/28/94	nd	nd	89	nd	nd	nd
A–5.5	09/28/94	nd	302	113400	nd	tr	155
A–4.5	09/28/94	nd	nd	96	nd	nd	47
BB–4	09/28/94	nd	nd	41940	nd	tr	278
AA–4	09/28/94	nd	nd	nd	nd	tr	69
DD–4	09/28/94	nd	nd	nd	nd	nd	tr
C–3.5	09/28/94	nd	tr	49710	nd	tr	683
B–3.5	09/28/94	nd	nd	tr	nd	nd	tr
A–3.5	09/28/94	nd	nd	nd	nd	nd	nd
A–2	09/28/94	nd	nd	nd	ns	ns	ns
B–1	09/28/94	nd	nd	nd	ns	ns	ns
0929–01	09/29/94	nd	nd	nd	nd	nd	nd
0929–02	09/29/94	nd	nd	nd	nd	nd	nd
0929–03	09/29/94	nd	nd	nd	nd	nd	18
0929–04	09/29/94	nd	nd	nd	nd	nd	nd
0929–05	09/29/94	nd	nd	nd	nd	nd	nd
0929–06	09/29/94	nd	nd	nd	nd	nd	nd

Sample Information		Field Screenig Results (parts per billion)							
Probe Location	Date Collected	Soil–Gas				Groundwater			
		B	T	E	X	B	T	E	X
0930–01	09/30/94	nd	nd	nd	nd	16	nd	*	8480
0930–02	09/30/94	nd	nd	nd	nd	nd	nd	nd	nd
0930–03	09/30/94	nd	nd	nd	nd	fp	fp	fp	fp
0930–04	09/30/94	nd	nd	nd	nd	fp	fp	fp	fp
0930–05	09/30/94	nd	nd	nd	nd	25	nd	nd	nd
0930–06	09/30/94	nd	nd	nd	nd	nd	nd	nd	nd
0930–07	09/30/94	nd	nd	nd	nd	nd	nd	nd	nd
0930–08	09/30/94	fp	fp	fp	fp	fp	fp	fp	fp
1003–01	10/03/94	nd	nd	nd	nd	nd	nd	nd	nd
1003–02	10/03/94	nd	nd	nd	nd	nd	nd	nd	nd
1003–03**	10/03/94		nd	nd	62		nd	nd	692
1003–04**	10/03/94		nd	nd	43500		nd	nd	3050
1003–05	10/03/94	nd	nd	nd	nd	nd	nd	nd	nd
1004–01	10/04/94	nd	nd	nd	nd	nd	nd	nd	nd
1004–02	10/04/94	nd	nd	nd	nd	nd	nd	nd	nd
1004–03	10/04/94	ns	ns	ns	ns	176	166	*	133
1004–04	10/04/94	nd	nd	nd	nd	32	16	nd	nd
1004–05	10/04/94	nd	nd	nd	nd	nd	nd	nd	nd
1004–06	10/04/94	nd	nd	nd	nd	nd	nd	nd	nd
1004–07	10/04/94	nd	nd	nd	nd	fp	fp	fp	fp
1004–08	10/04/94	nd	nd	nd	nd	18	nd	*	51
1005–01	10/05/94	nd	nd	nd	nd	26	nd	*	>1000
1005–02	10/05/94	nd	nd	nd	nd	ns	ns	ns	ns
1005–03	10/05/94	nd	nd	nd	nd	ns	ns	ns	ns
1005–04	10/05/94	nd	nd	nd	nd	ns	ns	ns	ns
1005–05	10/05/94	nd	nd	nd	nd	ns	ns	ns	ns
1005–06	10/05/94	nd	nd	nd	nd	tr	nd	*	15
1005–07	10/05/94	nd	nd	nd	nd	tr	nd	*	22
1005–08	10/05/94	nd	nd	nd	nd	nd	nd	nd	nd
1005–09	10/05/94	nd	nd	nd	nd	nd	nd	nd	nd
1005–10	10/05/94	nd	nd	nd	nd	tr	nd	*	30

nd = non–detect
tr = trace
ns = no sample collected
fp = free product in sample (not quantifiable)
* – Ethylbenzene and Xylene not discernable due to interference.
** – Approximate PCE concentrations. BTEX concentrations non–detect.

Photovac 10S70 Portable Gas Chromatograph
North Casper Soil–Gas and Groundwater Survey Results
Huntingdon Engineering & Environmental

Sample Information			Field Screenig Results (parts per billion)						
			Soil–Gas			Groundwater			
Grid Location	Probe Number	Date Collected	111–TCA	TCE	PCE	111–TCA	TCE	PCE	
D-6	2-1	9/24/94			~~[illegible]~~ nd	nd →			
A-5	2-2	↓	nd →					77.12	jb.
C-3	2-3		nd →			n.d. →			
C 4	2-4				~~57,60[illegible]~~			176.9	
C-2	2-5		nd →			nd →			EP
C-1	2-6		nd →					.27	EP
B-2	2-7		nd →			nd →			EP
B-3	2-8		nd →			nd →			EP
B-4	2-9		nd	nd	133 ppb			39.46	
B-5	2-10				776.7			41.96	
C-5	2-11	↓			20194			56.66	
C-6	2-12	9/25/94		134369	~~403,06~~			72.06	
B-6	2-13		nd →			UNKNOWN →			
4-6	2-14			5?1.1	~~321553~~	10718	.	.341	
A-7	2-15		nd →			nd →			
C-7	2-16		nd →			nd →			
D-5	2-17		nd →			nd →			
D-4	2-18		nd →			nd →			
A-4	2-19		nd →			nd →			
A-3	2-20		nd →			NO SAMPLE COLLECTED			
AA-6	2-21	9/27/94			5,200	nd →			
BB-6	2-22			38082	>500,000		nd.	1173.8	
DD-6	2-23			413 ~~>500000~~	44,271		22.7	26.8	
DD-5	2-24				11,029	nd →			
AA-5	2-25				5,437		6.73	86.06	
AAA-5	2-26			tr.	57,476		40.37	425.0	
C-6.5	2-27		nd →			nd →	~~[illegible]~~ nd	~~[illegible]~~ nd	
B-6.5	2-28		nd →			nd →			
A-6.5	2-29		nd →			nd →	~~2.5~~		
C-5.5	2-30				425,630			1,008.6	
BB-5.5	2-31				3,262			tr (.39)	
B-5.5	2-32	9/28/94			8815.0	nd →			
A-5.5	2-33			302	113398		2.322	155.32	
A-4.5	2-34				96			47.22	
BB-4	2-35				41942		3.25	278.1	
AA-4	2-36		nd →				1.18	69.18	
~~AA-5 2-3~~			~~nd~~						
DD-4	2-37		nd →					.58 (tr)	
C-3.5	2-38			tr.	49709		4.26	683.1	
B-3.5	2-39				tr.			1.76	
A-3.5	2-40		nd →			nd →			
A-2	2-41		nd →			NO SAMPLE			
B-1	2-42		nd →		?	NO SAMPLE			

nd = non–detect
tr = trace
ns = no sample collected

Photovac 10S70 Portable Gas Chromatograph
North Casper Soil–Gas and Groundwater Survey Results
Huntingdon Engineering & Environmental

Sample Information			Field Screenig Results (parts per billion)						
Grid Location	Probe Number	Date Collected	Soil–Gas ~~111–TCA~~	Soil–Gas ~~TCE~~	Soil–Gas ~~PCE~~	Groundwater ~~111–TCA~~	Groundwater ~~TCE~~	Groundwater ~~PCE~~	
0929	01	9/29/94	nd →			nd →			
	02		nd →			nd →			
	03		nd →					17.75	
	04		nd →			nd →			
	05		nd →			nd →			
	06	↓	nd →			nd →			
0930	01	9/30	nd →			16.03	T	18.5 84	83
	02		nd →			nd →			
	03		nd →			Free Prod →			
	04		nd →			Free Prod →			
	05		nd →			25			
	06		nd →						
	07		nd →						
	08		Peaked GC →			FREE PROD →			
1003	01	10/3/94	nd →			nd →			
	02		nd →			nd →			
	03				61.7			692.3	
	04				43495			3046.2	
	05		nd →			nd →			
1004	01		nd →			nd →			
	02		nd →			nd →			
	03		NS (Surface H2O)			176.0 *	166.1 *	132.6 *	Pb ≥
	04		nd →			32.3 *	16.22 *		
	05		nd →			nd →			
	06		nd →			nd →			
	07		nd →			FREE PROD →			
	08		nd →			17.55		50.99	
1005	01		nd →			25.83		>1000	
	02		nd →			NO SAMPLE			
	03		nd →			NS →			
	04		nd →			NS →			E
	05		nd →			NS →			
	06		nd →			tr		~~7.3~~	14.6
	07		nd →			tr		~~21.6~~	~~4~~ 21.6
	08		nd →			NS →			
	09		nd →			NS →			
	10		nd →			tr		30.03	

nd = non–detect
tr = trace
ns = no sample collected

B T E X

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Huntingdon Engineering & Environmental
PHOTOVAC 10S70 PORTABLE GAS CHROMATOGRAPH
FIELD ANALYSIS LOG SHEET

Sample Name	Sample Matrix	Anl. No.	Injection Volume (ul)	Internal Temp (C)	Time Stopped	Analysis Duration (seconds)	Field Screening Results: 111TCA	TCE	PCE		Comments
GC Blnk	GC	1	—	26	1607	458.3	Clean	—	—		
Syringe Blnk 500	Amb	2	500	29	708	430.4	Clean	—	—		
#2-1 D6	SGas *	3	300	30	0718	600.0			Er		
Syringe Blnk 100	Amb	4	100	32	0730	390.7	Clean	—	—		
Calib Std. GW	STD-1	5	10	34	0739	510.5	will	Redo	Later		
Syringe Blnk 25	Amb	6	25	35	0746	394.2	Clean	—	—		
Calib Std GW	STD-1	7	10	34	0829	600.0	Plugged	Syringe	wi/	Fix	
#2-1 D-6	GW	8	50	35	0843	557.5	Clean	—	—		nd
#2-2 A-5	SG	9	300	37	0851	410.0					nd
#2-2 A-5	SG *	10	2500	37	0858	413.7					nd
#2-1 D-6	GW *	11	500	37	0907	500.3					nd
Calib Std GW	STD-1	12	10	36	0917	561.2					
Syringe Blnk 500	Amb	13	500	37	0928	412.5	Clean				
#2-2 A-5	GW	14	100	37	0937	455.0			42.79		
#2-3 C-3	SG	15	100	41	0946	355.6					
#2-3 C3	SG *	16	3000	37	0954	463.0					nd
#2-2 A-5	GW *	17	500	36	0917	592.4			17.8 VS	48.2	°Clock in Gal. Add 1h.
Calib Std.	STD-1	18	10	37	0925	454.6		2626.	~~[illegible]~~	106.1 VS	USE FOR RES reg.
#2-4 C-4	SG *	19	300	37	0937	470.1			8.7 VS		
Syringe Blnk 500	Amb	20	500	37	0947	558.0	Clean				
#2-3 C-3	GWD	21	100	37	0954	327.8					nd
SG Std	STD	22	300	38	1001	405.2					
2-5 C2	SG	23	300	37	1010	444.2					
C2	SG *	24	3000	37	1017	415.0					
C-3	GWD *	25	500	39	1025	474.7			nd		nd
C-4	GWD	26	30	40	1034	408.5					nd
C-1	SG	27	300	42	1040	348.1					nd
C-1	SG *	28	3000	43	1046	356.6					
C-4	GW *	29	400	42	1054	475.3		.248	176.9		
C-2	GW	30	100	43	1102	345.5					nd

Date: 9/24/94
Project Name: Casper 2
Project Location: Casper, WY
Project Number:

Analyst Name: GM
Carrier Gas Flow Rate: 10
Oven Temperature: 50
Gain: 10 Run: 600 BF: 160

Huntingdon Engineering & Environmental
PHOTOVAC 10S70 PORTABLE GAS CHROMATOGRAPH
FIELD ANALYSIS LOG SHEET

Sample Name	Sample Matrix	Anl. No.	Injection Volume (ul)	Internal Temp (C)	Time Stopped	Analysis Duration (seconds)	Field Screening Results: 111TCA	TCE	PCE		Comments
C-2	GW *	31	500	42	1110	444.8					nd Lg Early Peak
C-1	GW	32	100	42	1133	372.6					nd
C-1	GW *	33	500	42	1142	450.5			.27		nd EP
Syringe Blank	Amb	34	2000	44	1149	341.9	Clean				Clean
B-2	SG	35	300	44	1155	362.7					nd Fixed Time
B-2	SG *	36	3000	43	1258	600.0					na
B-3	SG	37	300	43	1312	354.5					nd
B-3	SG *	38	3000	43	1319	461.2					nd
B-2	GW *	39	500	42	1329	509.7				54.0 uV	Large Early Peak.
B-2	GW	40	250	45	1334	321.6					
B-3	GW	41	250	44	1342	398.2					
B-4	SG	42	300	43	1350	425.7					nd
B-4	SG *	43	3000	43	1357	430.6			.71.0 mVs		
B-3	GW *	44	500	43	1406	461.3					nd
B-4	GW	45	1000	41	1441	431.9			3.034	EP	
B-4	GW *	46	500	42	1450	460.6			39.46	EP	
B-5	SG	47	300	43	1457	365.2			71.9 mVs		
B5	SG *	48	3000	43	1506	453.3			1.0 Vs		
Syringe Blank 50	Amb	49	500	43	1517	600.0					
B-5	GW	50	50	43	1527	457.1			3.396		
B-5	GW *	51	500	43	1538	564.0			41.96		
C-5	SG *	52	300	43	1548	439.3			2.6 Vs		
Syringe Blank 50	Amb	53	500	42	1602	564.6					Clean
C-5	GW	54	100	42	1612	517.4			6.08		
C-5	GW *	55	500	43	1621	457.4			56.60		
Carrier Gas	CG	56	—								

Date: 9/24/94
Project Name: Casper 2
Project Location: Casper WY
Project Number:

Analyst Name: GM
Carrier Gas Flow Rate: 10
Oven Temperature: 50
Gain: 10

Huntingdon Engineering & Environmental
PHOTOVAC 10S70 PORTABLE GAS CHROMATOGRAPH
FIELD ANALYSIS LOG SHEET

Sample Name	Sample Matrix	Anl. No.	Injection Volume (ul)	Internal Temp (C)	Time Stopped	Analysis Duration (seconds)	Field Screening Results				Comments
							111TCA	TCE	PCE		
CG Blnk	CGas	1	—	27	0912	600.0					Clean column
Syringe Blnk	Amb	2	500	30	0921	344.5					Clean
C-6	SG *	3	300	32	0930	574.9			17.3Vs		
Syringe Blnk	Amb	4	3000	33	0942	574.7					Early Peak. No PCE
CG Blnk	CGas	5	—	35	0948	302.4					Clean
GW STD Check	STD	6	5	35	0957	486.9					checked OK
Syringe Blnk	Amb	7	100	36	1004	372.8					Clean
B-6	SG	8	300	37	1011	405.6					nd.
B-6	SG *	9	3000	38	1017	369.9					nd
C-6	GW	10	50	37	1026	489.0			2.186		
C-6	GW *	11	500	37	1036	554.0			72.06		
C-6	GW	12	500	37	1047	600.0			70.04		
Syringe Blnk 25	Amb	13	25	39	1056	343.7					Clean
A-6	SG	14	300	38	1105	447.2			~~13.8Vs~~		
A-6	SG *	15	3000	30	1117	592.0		1.0Vs	13.8Vs		
B-6	GW *	16	10	38	1130	600.0					Will not Get PCE Single to
CG Blnk	CG	17	—	40	1140	580.2					Clean
A-7	SG	18	300	41	1146	361.6					nd
A-7	SG *	19	3000	43	1153	385.3					nd
A-6	GW	20	100	41	1201	477.0			~~.377~~		nd
A-6	GW *	21	500	41	1210	475.9			.341		Bad Inj?
A-6	GW *	22	500	40	1221	598.6			.3126		
C-7	SG	23	300	40	1237	600.0					nd
C-7	SG *	24	3000	41	1243	370.0					nd
A-7	GW	25	250	40	1254	600.0					nd
A-7	GW *	26	500	39	1304	600.0					nd
C-7	GW	27	250	41	1314	365.9					nd
D-5	SG	28	300	42	1321	356.8					nd
D-5	SG *	29	3000	42	1330	430.9					nd
C-7	GW *	30	500	41	1340	600.0					

Date: 9/25/94
Project Name: Casper 2
Project Location: Casper, WY
Project Number:

Analyst Name: GM
Carrier Gas Flow Rate: 10
Oven Temperature: 50
Gain: 10 Run: 600 BF=160

Page 2

Huntingdon Engineering & Environmental
PHOTOVAC 10S70 PORTABLE GAS CHROMATOGRAPH
FIELD ANALYSIS LOG SHEET

Sample Name	Sample Matrix	Anl. No.	Injection Volume (ul)	Internal Temp (C)	Time Stopped	Analysis Duration (seconds)	Field Screening Results: 111TCA	Field Screening Results: TCE	Field Screening Results: PCE	Field Screening Results	Comments
Syringe Blank	Amb	31	500	40	1355	552.9					Clean
D-4	SG	32	300	42	1401	398.6					nd
D-4	SG dup	33	3000	42	1403	359.4					nd
D-5	GW	34	260	42	1415	397.5					nd
D-5	GW *	35	500	40	1425	600.0					nd
A-4	SG	36	300	41	1449	421.0					nd
A-4	SG *	37	3000	42	1455	367.4					nd
D-4	GW	38	260	42	1504	502.0					nd
D-4	GW *	39	500	43	1513	548.9					nd
A-3	SG	40	300	42	1523	600.0					nd
A-4	~~SG~~ GW	41	200	44	1530	344.6					nd
A-3	SG	42	3000	44	1536	346.7					nd
A-4	GW	43	300	44	1544	496.5					nd
Carrier Gas Blank	CG	44	—								

Date: 9/25/94

Project Name: Casper 2

Project Location: Casper W,

Project Number:

Analyst Name: GM

Carrier Gas Flow Rate: 10

Oven Temperature: 50

Gain: 10 Rn =600 BF= 160

Huntingdon Engineering & Environmental
PHOTOVAC 10S70 PORTABLE GAS CHROMATOGRAPH
FIELD ANALYSIS LOG SHEET

Sample Name	Sample Matrix	Anl. No.	Injection Volume (ul)	Internal Temp (C)	Time Stopped	Analysis Duration (seconds)	Field Screening Results: 1,1TCA	TCE	PCE		Comments
CG Blnk	CG	1	—	26	0735	367.7					
AA-6	SG *	2	300	27	0744	543.1			669.5mVs	5200	
AA-6	SG	3	2000	30	0753	505.1			60.2mVs		
Syringe Blnk 25	Amb	4	25	31	0803	506.7					Clean.
Standard GW	Std-1	5	10	33	0814	599.7					Good Correlation.
Syringe Blnk 500	Amb	6	500	35	0824	399.3					Clean
BB-6	SG *	7	300	34	0838	600.0		38082	~520000		
Syringe Blnk 500	Amb	8	500	35	0847	440.4					Sl Contam will be lo.
Syringe Blnk 500	Amb	9	500	36	0855	443.3					
DD-6	SG *	10	300	36	0904	531.1		82.0mVs	5.7Vs		
AA-6	GW	11	100	35	0913	526.2					nd
AA-6	GW *	12	500	38	0920	390.2					nd
BB-6	GW	13	30	37	0929	515.0			1030.3		
BB-6	GW *	14	40	38	0938	476.8			1173.9		
DD-5	SG	15	300	38	0946	468.9					
DD-5	SG *	16	3000	38	0955	463.3			14.2Vs	11.29	
Syringe Blnk 5000	Amb	17	3000	38	1003	471.3					Clean
Syringe Blnk 25	Amb	18	25	39	1013	379.6					Clean
AA-5	SG	19	300	40	1020	393.5			Er		
AA-5	SG *	20	3000	39	1028	505.8				5437	
DD-6	GW	21	10	40	1036	364.2					
DD-6	GW *	22	100	39	1046	600.0		22.7	26.8		
Syringe Blnk 500	Amb	23	500	39	1057	537.2					Dirty
DD-5	GW	24	100	39	1108	502.6					
DD-5 *	GW	25	500	40	1116	471.8					nd
AA-5	GW	26	100	39	1127	557.2		6.032	86.06		
AA-5 *	GW	27	250	39	1136	484.3		6.728	85.04		
Syringe Blnk 500	Amb	28	500	39	1151	420.7					Clean.
AAA-5	SG	29	300	40	1201	600.0			7.4Vs	57476	
CG Blnk	C	30	—								

Date: 9/27/94
Project Name: Casper 2
Project Location: Casper WY
Project Number:

Analyst Name: GM
Carrier Gas Flow Rate: 10
Oven Temperature: 50
Gain: 10

Piso 2

Huntingdon Engineering & Environmental
PHOTOVAC 10S70 PORTABLE GAS CHROMATOGRAPH
FIELD ANALYSIS LOG SHEET

Sample Name	Sample Matrix	Anl. No.	Injection Volume (ul)	Internal Temp (C)	Time Stopped	Analysis Duration (seconds)	Field Screening Results 111TCA	TCE	PCE		Comments
C-6.5	SG	31	300	40	1313	600.0					nd
C-6.5	SG *	32	3000	40	1324	600.0					nd.
AAA-5	GW *	33	100	41	1334	547.9		40.37	425.0		
Syringe Blnk	Amb.	34	100	42	1350	332.3					Clean
B-6.5	SG	35	300	43	1357	396.9					nd
B-6.5	SG *	36	3000	44	1404	401.0					nd
C-6.5	GW	37	250	44	1411	361.7					nd
C-6.5	GW *	38	500	40	1421	581.5					nd
A-6.5	SG	39	300	43	1437	600.0					nd
A-6.5	SG *	40	3000	47	1447	580.4					na
B-6.5	GW	41	250	47	1454	357.3					nd
B-6.5	GW *	42	500	44	1505	600.0					nd
A-6.5	GW	43	250	43	1531	563.0		tr.			nd
A-6.5	GW *	44	500	43	1541	474.3		2.496			nd
C-5.5	SG *	45	300	42	1553	600.0			54.8Vs	425630	
Syringe Blnk	Amb	46	500	42	1606	522.4					Clean
BB-5.5	SG	47	300	43	1612	370.7					nd
BB-5.5	SG *	48	3000	42	1621	513.0				3262	
C-5.5	GW	49	25	41	1631	521.3			814.8		
C-5.5	GW *	50	50	40	1641	600.0			1008.8		
Syringe Blnk 100	Amb	51	100	41	1651	600.0					Clean
BB-5.5	GW	52	50	41	1703	411.1					
BB-5.5	GW	53	500	42	1714	600.0			0.39		
CGas Blnk	CG	54	—								

Date: 9/27/94
Project Name: Casper 2'
Project Location: Casper, Wy
Project Number:

Analyst Name: GM
Carrier Gas Flow Rate: 10
Oven Temperature: 50
Gain: 10

Page 1

Huntingdon Engineering & Environmental
PHOTOVAC 10S70 PORTABLE GAS CHROMATOGRAPH
FIELD ANALYSIS LOG SHEET

Sample Name	Sample Matrix	Anl. No.	Injection Volume (ul)	Internal Temp (C)	Time Stopped	Analysis Duration (seconds)	Field Screening Results: 111TCA	TCE	PCE		Comments
Carrier Gas Blnk	CG	1	—	35	~~3415~~	341.5					Clean.
B-5.5	SG	2	300	35	0949	567.1					nd.
B-5.5 X	SG *	3	3000	36	0957	504.3			113.9mVs	88.5	
Syringe Blnk	Amb	4	5000	36	1008	600.0					Clean
B-5.5	GW	5	50	38	1026	385.9			tr.		
A-5.5	SG *	6	300	38	1035	486.3			14.6 Vs	113394	
B-5.5	GW *	7	500	38	1047	600.0					nd
A-5.5	GW	8	50	38	1106	450.6			8.79		
A-4.5	SG	9	300	40	1114	382.5					
A-4.5	SG *	10	3000	39	1123	517.7			.96		
A-5.5	GW *	11	500	40	1133	600.0		2.322	155.32		
A-4.5	GW	12	100	39	1206	583.1			1.956		
A-4.5	GW *	13	500	41	1214	463.0			47.22		
BB-4	SG *	14	300	40	1225	500.0			41942		
Syringe Blnk	Amb	15	500	40	1237	600.0					Clean
BB-4	GW	16	100	40	1249	458.3			278.1		
BB-4	GW *	17	250	40	1259	565.7		3.25	242.76		
AA-54	SG	18	~~240~~	41	1307	426.8					nd
AA-54	SG *	19	300	41	1318	600.0					nd
AA-4	GW	20	200	42	1331	465.4		tr.	56.1		
DD-4	SG	21	300	43	1337	406.7					nd
DD-4	SG *	22	3000	43	1344	377.9					nd
AA-4	GW *	23	500	43	1354	600.0		1.18	69.18		
Carrier Gas Blnk	CG	24	—	42	1408	600.0					Clean
C-3.5	SG *	25	300	42	1422	490.0		tr	6.4	49709	
DD-4	GW	26	250	43	1428	343.7					nd
DD-4	GW *	27	500	43	1438	600.0			.58		
B-3.5	SG	28	300	45	1450	350.3					
B-3.5	SG *	29	3000	44	1459	509.6			tr		nd
C-3.5	GW *	30	100	44	1508	480.0		4.26	630.1		

Date: 4/28/94
Project Name: Casper 2
Project Location: Casper, Wy
Project Number:

Analyst Name: GM
Carrier Gas Flow Rate: 10
Oven Temperature: 50
Gain: 10

Huntingdon Engineering & Environmental

PHOTOVAC 10S70 PORTABLE GAS CHROMATOGRAPH

FIELD ANALYSIS LOG SHEET

Sample Name	Sample Matrix	Anl. No.	Injection Volume (ul)	Internal Temp (C)	Time Stopped	Analysis Duration (seconds)	Field Screening Results B	T	E	X	Comments
CG Blnk	CG	1	—								
BTEX STD	STD	2	10	29	728	600.0					
CG Blnk	CG	3	—	30	742	595.3					
BTEX STD	STD	4	10	32	757	470.2					
BTEX STD	STD	5	10	33	758	396.4					
0930-01	SG	6	300	34	805	365.8					nd.
0930-01	SG*	7	1500	36	818	496.4					
STD-1	STD	8	70	36	826	436.4					
0930-02	SG	9	300	35	838	397.0					nd
0930-02	SG	10	1500	36	0845	387.9					nd
BTEX STD-2	STD	11	10	36	0856	495.5					
0930-01	GW	12	25	37	0907	600.0					
0930-01	GW	13	250	37	0920	600.0	13.18	~~[illegible]~~	13.39	478.8	
0930-02	GW	14	250	37	920	600.0					nd
0930-02	GW*	15	500	37	1013	546.4					nd
0930-03	SG	16	300	38	1022	476.1					nd
0930-03	SG*	17	1500	37	1031	538.3					nd
0930-01	GW*	18	300	38	1042	672.3	16.03		19.53	8483	
0930-04	SG	19	300	39	1050	414.0					
0930-04	SG*	20	1500	38	1058	493.8					
0930-03	GW	21	10								
CG Blnk	Amb	22	—								
Syring Blnk	Amb	23	25								
0930-05	SG	24	300	38	1154	412.8					
0930-05	SG*	25	1500	38	1206	700.0					nd
0930-06	SG	26	300	38	1221	357.4					
0930-06	SG*	27	1500	37	1232	600.0					
0930-05	GW	28	15	37	1240	422.0					
0930-07	SG	29	300	37	1247	400.1					nd
0930-07	SG	30	1500	37	1257	635.5					nd

Date: 9/30/94
Project Name: Casper BTEX
Project Location: Casper, WY
Project Number:

Analyst Name: GM
Carrier Gas Flow Rate: ~~20~~ 25
Oven Temperature: 50
Gain: 20

Huntingdon Engineering & Environmental
PHOTOVAC 10S70 PORTABLE GAS CHROMATOGRAPH
FIELD ANALYSIS LOG SHEET

Sample Name	Sample Matrix	Anl. No.	Injection Volume (ul)	Internal Temp (C)	Time Stopped	Analysis Duration (seconds)	Field Screening Results B	T	E	X	Comments
0930-05	GW	37	100	37	1305	392.3	13.12				
0930-05	GW *	38	500	37	1313	490.0					
0930-08	SG *	39	300	Regged	Column	will	Flush	for	awhile		
0930-06	GW	40	100	37	1355	383.9					
0930-06	GW *	41	500	37	1407	800.0	13.68		73.02		
~~0930-07~~	GW *	42	500				10.21		43.2		
CG Blnk	~~Gst~~	1	—	29	1360	509.9	na				
CG Blnk	CG	2	—	30	1354	251.7					
1003-01	SG	3	300	31	1401	347.3					nd
1003-01	SG *	4	2000	31	1413	700.0					nd
SG Std	SG *	5	100	32	1426	570.5					Bad Run.
Syringe Blnk	Amb	6	200	34	1434	416.7					Clean.
1003-02	SG	7	300	34	1440	351.1					
1003-02	SG *	8	2000	34	1450	572.7					nd
1003-01	GW	9	100	35	1455	329.7					
1003-01	GW *	10	500	35	1502	373.6					
1003-03	SG	11	300	30	1509	370.7					136.0 RT/.2253
1003-03	SG *	12	1000	36	1524	578.3					(133 h .800
1003-02	GW *	13	500	37	1527	375.9					
1003-04	SG *	14	500	37	1533	343.3					(134.8 / Hgt 5.6
STD GW	STD *	15	15	37	1543	586.3					* NOTE CAL FOR 15 Bull on 20 Benz 54.1 *
1003-03	GW	16	100	38	1552	285.5					
1003-03	GW	17	500	38	1558	363.9					Will Redo.
1003-05	SG	18	300	38	1607	534.4					nd
1003-05	SG *	19	2000	38	1614	388.8					
1003-03	GW *	20	500	39	1621	465.3					131.2/1.9
1003-04	GW *	21	250	39	1627	309.9					~~Bx~~ 132.4/3.3
PCE STD	STD	22	15	39	1635	449.1					~PCE @ 132.8/1.3
1003-05	GW	23	250	39	1644	313.3					nd
~~BTEX STD~~-05	GW *	24	500	39	1652	401.9					nd

Date: 9/30/94 10/3/94
Project Name: Casper BTEX
Project Location: Casper, Wy
Project Number:

Analyst Name: GM
Carrier Gas Flow Rate: 25
Oven Temperature: 50
Gain: 20

Huntingdon Engineering & Environmental
PHOTOVAC 10S70 PORTABLE GAS CHROMATOGRAPH
FIELD ANALYSIS LOG SHEET

Sample Name	Sample Matrix	Anl. No.	Injection Volume (ul)	Internal Temp (C)	Time Stopped	Analysis Duration (seconds)	Field Screening Results B	T	E	X	Comments
BTEX STD	STD	25	15	41	1704	700.0					
Syringe Blnk	Amb	26	25	39	1710	325.8					
BTEX STD	STD	27	10	END OF DAY RUN							Reduced Flow (B.l/m 15)
10/4											
CG Blnk	CG	1	—	27	0819	700.0					
BTEX STD	STD	2	10	29	0838	592.3	BAD RUN				
1004-01	SG	3	300	31	0846	471.7					nd
1004-01	SG *	4	2500	32	0857	700.0					
BTEX Gas STD	STD	5	100	32	0912	481.2					
1004-02	SG	6	300	34	0918	305.0					
1004-02	SG *	7	3000	37	0926	465.0					nd
1004-01	GW *	8	500	34	0937	581.4					
Syringe Blnk	Amb	9	25	36	0944	383.2					
1004-02	GW *	10	500	35	0954	569.8					nd
1004-04	SG	11	300	37	1011	390.0					nd
1004-04	SG *	12	3000	36	1022	700.0					
1004-03	GW	13	50	37	1038	700.0					
1004-03	GW *	14	300	36	1051	700.0	176.0*	166.1 *	132.6*		#5 probably greater
Syringe Blnk	Amb	15	500	38	1059	373.1					Clean
1004-05	SG	16	200	38	1104	328.2					nd
1004-05	SG *	17	2000	38	1113	491.9					nd
1004-04	GW *	18	50	37	1125	700.0	32.3 *	16.22*			
1004-06	SG	19	300	38	1138	389.5					nd
1004-06	SG *	20	3000	37	1147	587.0					nd
1004-05	GW	21	100	37	1154	374.5					
1004-05 *	GW *	22	500	38	1201	406.7					nd
1004-07	SG	23	300	38	1208	367.8					
1004-07 *	SG *	24	3000	37	1220	700.0					nd
1004-06	GW	25	100	37	1244	700.0					
1004-06	GW *	26	500	37	1259	700.0					nd

Date: ~~10/3~~ 10/3 10/4
Project Name: Casper BTEX
Project Location: Casper WY
Project Number:

Analyst Name: GM
Carrier Gas Flow Rate: 20
Oven Temperature: 50
Gain: 10

Huntingdon Engineering & Environmental

PHOTOVAC 10S70 PORTABLE GAS CHROMATOGRAPH

FIELD ANALYSIS LOG SHEET

Sample Name	Sample Matrix	Anl. No.	Injection Volume (ul)	Internal Temp (C)	Time Stopped	Analysis Duration (seconds)	Field Screening Results				Comments
							B	T	E	X	
1005-08	SG*	25	2000	35	1324	700.0					
1005-07	GW	26	100	36	1331	285.6					
1005-09	SG	27	300	36	1337	543.2					
1005-09	SG*	28	2000	35	1344	426.3					
1005-07	GW*	29	500	35	1357	700.0	tr		21.4	x2	
1005-06	GW*	30	300	34	1417	526.8	tr		7.24	x2	
1005-07	GW	31	300	34	1425	470.8	tr		16.0	x2	
1005-10	SG*	32	300	35	1433	374.0					
1005-10	SG*	33	2000	34	1445	700.0					
1005-10	GW	34	500	34	1504	700.0	tr		15.27	x2	
1005-10 DUP	GW	35	500	34	1514	553.4	tr.		12.75	x2	
1005-10 DUP	GW*	36	500	35	1523	475.5	tr		30.03		
1005-07	GW	37	500	35	1533	510.2	2.5		21.61		
1005-06	GW	38	500								

Date: 10/5/94

Project Name: Casper BTEX

Project Location: Casper WY

Analyst Name: GM

Carrier Gas Flow Rate: 20

Oven Temperature: 60

Gain: [illegible]

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Huntingdon Engineering & Environmental
PHOTOVAC 10S70 PORTABLE GAS CHROMATOGRAPH
FIELD ANALYSIS LOG SHEET

Sample Name	Sample Matrix	Anl. No.	Injection Volume (ul)	Internal Temp (C)	Time Stopped	Analysis Duration (seconds)	Field Screening Results: B	T	E	X	Comments
CG Blnk	Amb	1	—	30	0840	248.2					
0929-01	SG	2	300	31	0847	423.1					nd
0929-01	SG *	3	3000	32	0857	600.0					nd
Syringe Blnk	Amb	4	500	33	0909	510.7					
0929-02	SG	5	300	34	0914	440.0					nd
0929-02	SG *	6	2000	35	0929	600.0					nd
0929-03	SG	7	300		1000	600.0					
0929-03	SG *	8	2000	36	1013	600.0					
~~0929-04~~	~~SG~~	~~9~~	~~300~~				111TCA	TCE	PCE		
CG Blnk	CG	9	—	35	1418	406.0					
0929-04	SG	10	300	37	1425	384.8					
0929-04	SG *	11	3000	36	1435	600.0	nd				
Syringe Blnk	Amb	12	25	38	1450	363.3					Clean.
STD-1	STD	13	10	38	1500	483.5					Good Correlation
0929-05	SG	14	300	39	1507	400.9					
0929-05	SG *	15	3000	39	1517	600.0					
0929-06	SG	16	300	40	1546	337.5					nd.
0929-06	SG *	17	3000								
~											
Syringe Blnk	Amb	18	25	34	1809	600.0					Can't Use PCE set-up.
BTEX STD	STD	19	10	35	1829	600.0					
CG Blnk	CG	20	—	35	1839	600.0					
0929-01	GW	21	200	36	1849	438.1					nd
0929-01	GW *	22	500	36	1858	557.8					nd
0929-02	GW *	23	500	37	1907	491.0					nd
0929-03	GW *	24	500	36	1918	600.0			17.75		
0929-03	GW	25	500	35	1944	600.0					
0929-04	GW *	26	500	36	2003	418.0					nd
0929-05	GW *	27	500	37	2011	422.9					nd
0929-06	GW *	28	500	37	2019	455.6					

Date: 9/29/94
Project Name: Casper BTEX
Project Location: Casper, WY
Project Number:

Analyst Name: GM
Carrier Gas Flow Rate: 20
Oven Temperature: 50
Gain: 20

Page 2

Huntingdon Engineering & Environmental
PHOTOVAC 10S70 PORTABLE GAS CHROMATOGRAPH
FIELD ANALYSIS LOG SHEET

Sample Name	Sample Matrix	Anl. No.	Injection Volume (ul)	Internal Temp (C)	Time Stopped	Analysis Duration (seconds)	Field Screening Results				Comments
							111TCA	TCE	PCE		
A-3.5	SG	31	300	45	1516	333.1					
A-3.5	SG *	32	3000	43	1525	501.7					nd
B-3.5	GW	33	100	42	1534	462.0			1.737		
B-3.5	GW *	34	500	41	1544	600.0			1.22		
A-3.5	GW *	35	500	43	1551	359.3					nd
A-2	SG	36	800	43	1557	373.5					nd
A-2	SG *	37	3000	41	1607	600.0					nd
B-1	SG	38	300	42	1624	388.6					
B-1	SG *	39	3000	41	1635	600.0					
C G Blnk	G	40	—								

Date: 9/28/94
Project Name: Casper 2
Project Location: Casper WY
Project Number:

Analyst Name: GM
Carrier Gas Flow Rate: 10
Oven Temperature: 50
Gain: 10

Huntingdon Engineering & Environmental

PHOTOVAC 10S70 PORTABLE GAS CHROMATOGRAPH

FIELD ANALYSIS LOG SHEET

Sample Name	Sample Matrix	Anl. No.	Injection Volume (ul)	Internal Temp (C)	Time Stopped	Analysis Duration (seconds)	Field Screening Results: B	T	E	X	Comments
STD GWD	STD	27	10	37	1314	700.0					
1004-08	SG *	28	3000	37	1328	700.0					nd.
~~1004~~ CG	Blk	29	—	37	1350	700.0					
1004-08	GW	30	500	37	1404	536.8	14.84		28.92		
1004-08	GW	31	250	38	1413	450.0	7.55		50.99		
~~CG Blk~~											
CG Blk	CG	1	—	23	0730	700.0					
BTEX STD	STD	2	200	27	802	700.0					
1005-01	SG	3	200	29	814	392.2					nd
1005-01	SG *	4	3000	29	826	700.0					nd
1005-02	SG	5	300	31	847	102.1					
1005-02	SG *	6	3000	32	0857	469.5					
1005-01	GW	7	100	33	0900	492.3					
1005-01	GW *	8	500	33	0914	466.6	~~22.98~~	92.18	71000	—	
1005-01	GW	9	600	34	0923	465.9	25.3		71000	—	
1005-01	GW *	10	500	33	0933	545.5	25.83				
Syringe Blk	Amb	11	500	34	0957	700.0					
1005-03	SG	12	300	34	1003	329.2					nd
1005-03	SG *	13	2000	34	1016	700.0					
~~STD~~ BTEX	STD	14	10	33	1041	700.0					
1005-04	SG	15	300	34	1050	285.5					nd
1005-04 *	SG *	16	2000	34	1101	700.0					nd
1005-05	SG	17	300	35	1128	342.6					nd.
1005-05 *	SG *	18	2000	35	1142	700.0					
1005-06 *	SG *	19	2000	36	1201	700.0					nd
1005-07	SG	20	300	36	1233	568.8					nd
1005-07	SG *	21	2000	36	1240	333.0					nd
1005-06	GW	22	200	36	1252	683.4					
1005-06	GW	23	500	36	1304	700.0	tr.		5.7		
1005-08	SG	24	300	36	1312	375.9					nd

Date: 10/4 10/5

Project Name: Carper BTEX

Project Location: Chaper Wy

Project Number:

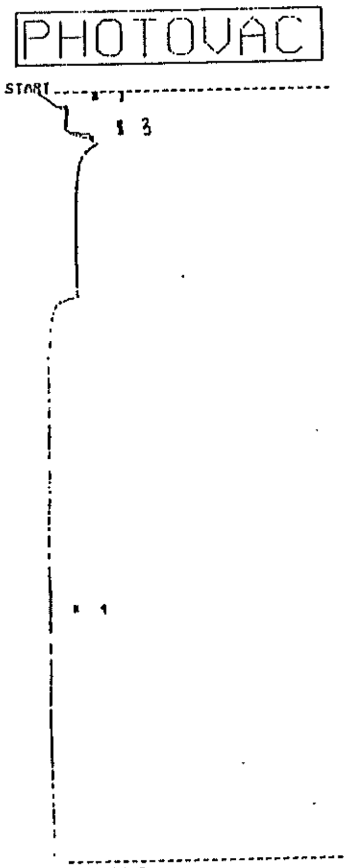
Analyst Name: Cm

Carrier Gas Flow Rate: 20

Oven Temperature: 50

Gain: 10

D-6

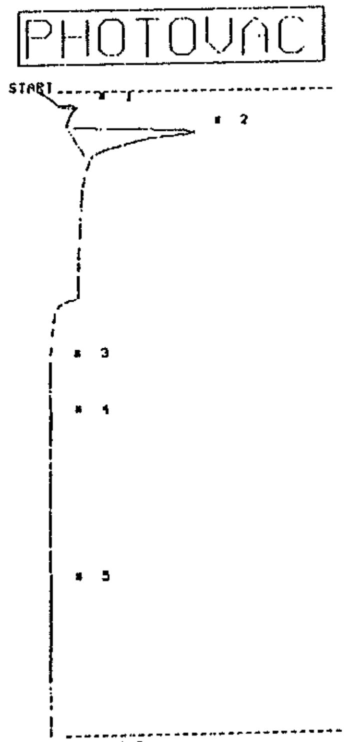


STOP @ 600.0
SAMPLE LIBRARY 3 SEP 24 94 7:18
ANALYSIS # 3 CASPER
INTERNAL TEMP 38 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	35.1	23.5 mUS

D-6

Soil-Gas

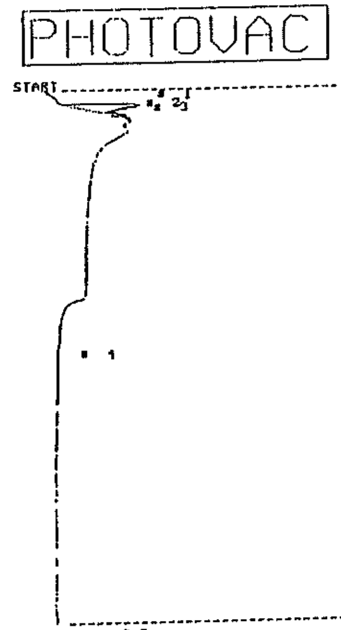


STOP @ 500.3
SAMPLE LIBRARY 3 SEP 24 94 9:?7
ANALYSIS # 11 CASPER
INTERNAL TEMP 37 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	13.2	58.1 mUS
UNKNOWN	2	34.0	4.3 US

Groundwater

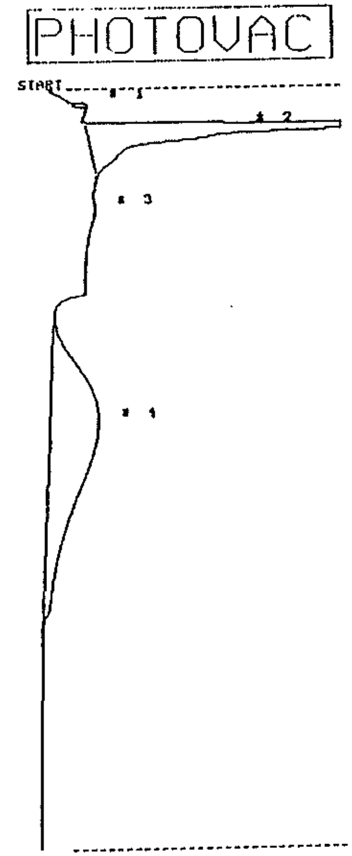
A-5



STOP @ 413.7
SAMPLE LIBRARY 3 SEP 24 94 8:58
ANALYSIS # 10 CASPER
INTERNAL TEMP 37 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	12.6	735.0 mUS

Soil-Gas

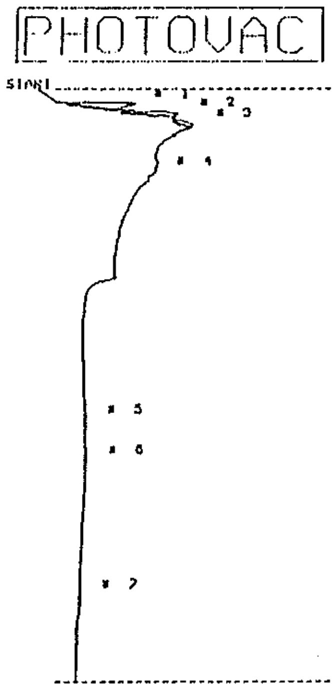


STOP @ 332.4
SAMPLE LIBRARY 3 SEP 24 94 9:17
ANALYSIS # 12 CASPER
INTERNAL TEMP 36 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	13.6	61.6 mUS
UNKNOWN	2	30.5	14.4 US
UNKNOWN	4	262.6	17.0 US

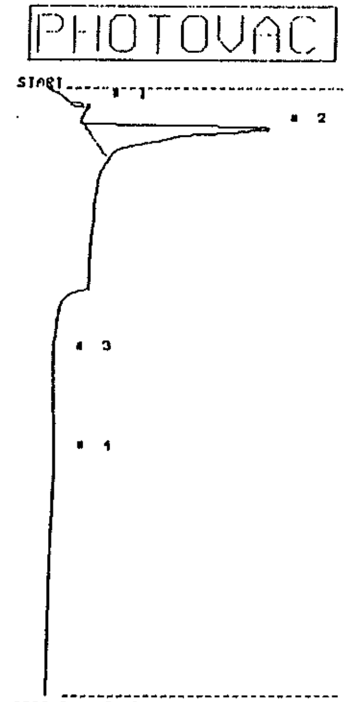
A-5

Groundwater



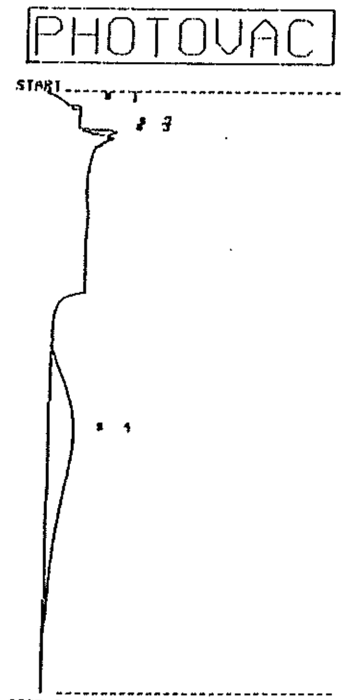
STOP @ 163.0
SAMPLE LIBRARY 4 SEP 24 94 9:54
ANALYSIS # 10 LA-Z-BOY UTAH
INTERNAL TEMP 32 TREMONTON, UTAH
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	12.8	831.8 mVS
UNKNOWN	2	20.6	218.2 mVS
UNKNOWN	3	23.0	57.5 mVS



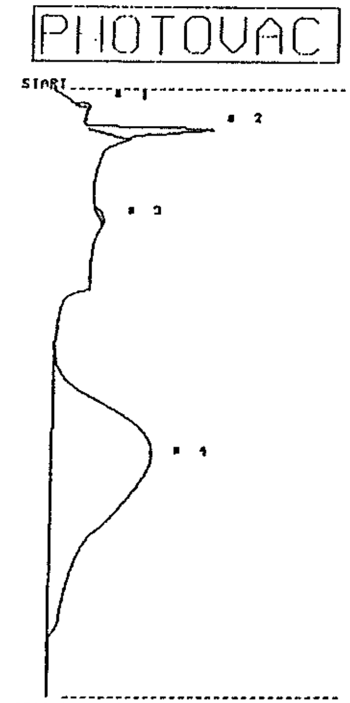
STOP @ 121.7
SAMPLE LIBRARY 3 SEP 24 94 10:25
ANALYSIS # 25 CASPER
INTERNAL TEMP 35 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	13.6	57.5 mVS
UNKNOWN	2	31.9	6.1 VS



STOP @ 170.1
SAMPLE LIBRARY 4 SEP 24 94 9:32
ANALYSIS # 15 LA-Z-BOY UTAH
INTERNAL TEMP 32 TREMONTON, UTAH
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	13.7	10.2 mVS
UNKNOWN	2	32.3	285.4 mVS
UNKNOWN	3	37.7	26.8 mVS
UNKNOWN	4	275.2	8.7 VS



STOP @ 175.3
SAMPLE LIBRARY 3 SEP 24 94 10:54
ANALYSIS # 23 CASPER
INTERNAL TEMP 42 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	13.4	55.2 mVS
UNKNOWN	2	32.8	1.8 VS
TCE2	3	186.3	9.933 PPB
PCE2	4	234.7	7.022 PPM

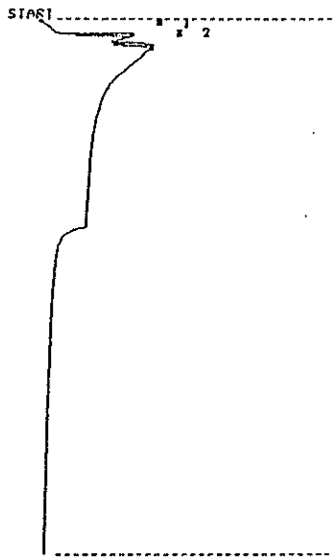
C - 3

Soil-Gas Groundwater

C - 4

Soil-Gas Groundwater

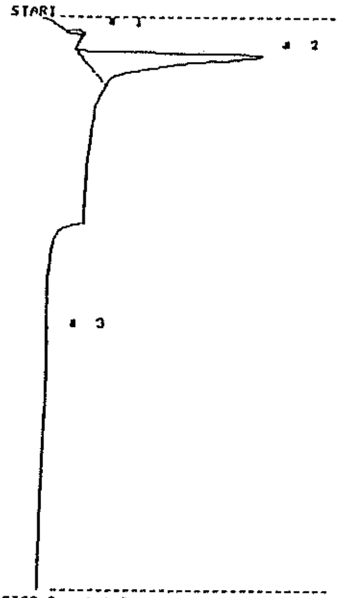
PHOTOVAC



STOP # 415.0
SAMPLE LIBRARY 3 SEP 24 94 10:12
ANALYSIS # 24 CASPER
INTERNAL TEMP 32 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	12.5	191.2 mVS
UNKNOWN	2	20.5	188.3 mVS

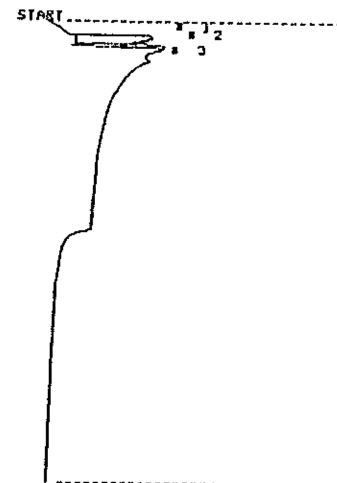
PHOTOVAC



STOP # 444.8
SAMPLE LIBRARY 3 SEP 24 94 11:10
ANALYSIS # 31 CASPER
INTERNAL TEMP 12 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	13.4	86.5 mVS
UNKNOWN	2	31.3	6.0 VS

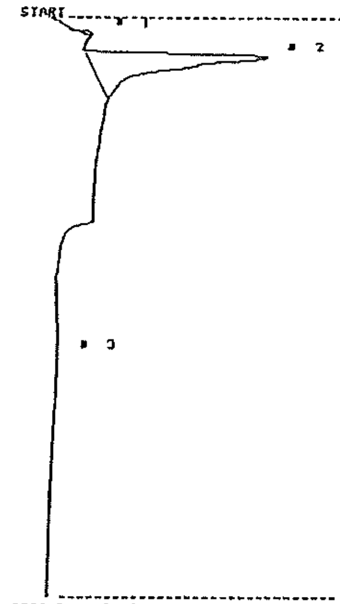
PHOTOVAC



STOP # 356.0
SAMPLE LIBRARY 3 SEP 24 94 10:48
ANALYSIS # 28 CASPER
INTERNAL TEMP 43 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	12.8	1.4 VS
UNKNOWN	2	19.4	382.4 mVS

PHOTOVAC



STOP # 459.5
SAMPLE LIBRARY 3 SEP 24 94 11:42
ANALYSIS # 2 CASPER
INTERNAL TEMP 42 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	31.8	7.5 VS
PCE2	3	264.8	13.50 PPB

C-2

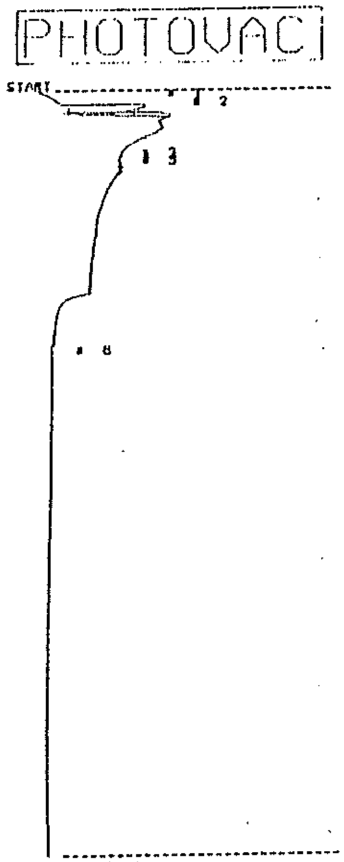
Soil Gas

Groundwater

C-1

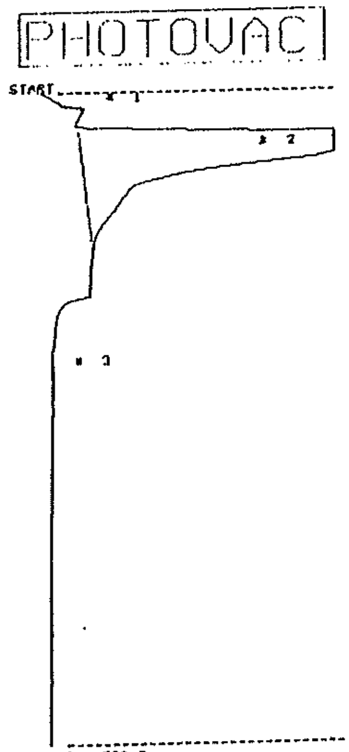
Soil Gas

Groundwater



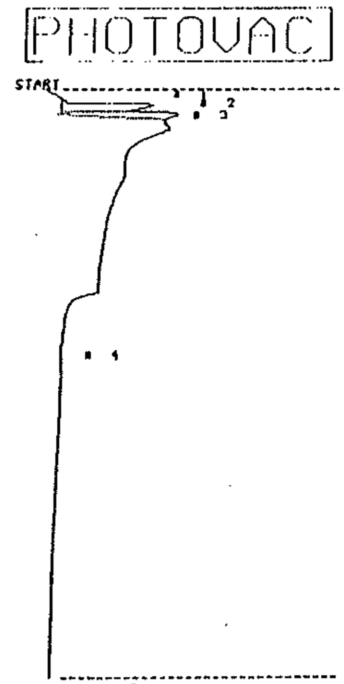
STOP @ 888.0
SAMPLE LIBRARY 3 SEP 24 94 17:59
ANALYSIS # 5 CASPER
INTERNAL TEMP 43 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	12.5	1.3 US
UNKNOWN	2	15.7	572.5 mUS



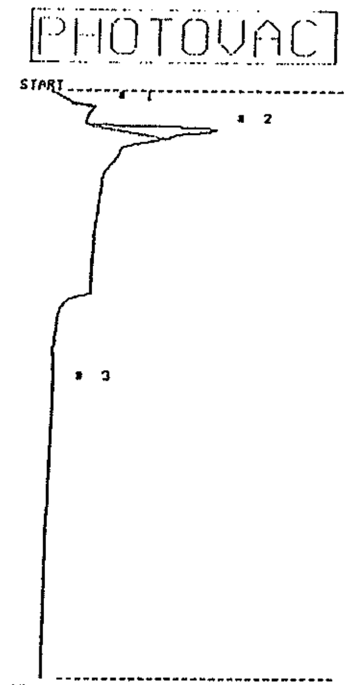
STOP @ 505.7
SAMPLE LIBRARY 3 SEP 24 94 13:29
ANALYSIS # 8 CASPER
INTERNAL TEMP 42 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	40.8	54.8 US



STOP @ 461.2
SAMPLE LIBRARY 3 SEP 24 94 13:19
ANALYSIS # 7 CASPER
INTERNAL TEMP 43 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	12.7	1.7 US
UNKNOWN	2	15.8	1.0 US



STOP @ 461.3
SAMPLE LIBRARY 3 SEP 24 94 14:0
ANALYSIS # 13 CASPER
INTERNAL TEMP 43 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	31.3	1.7 US

B-2

Soil-Gas

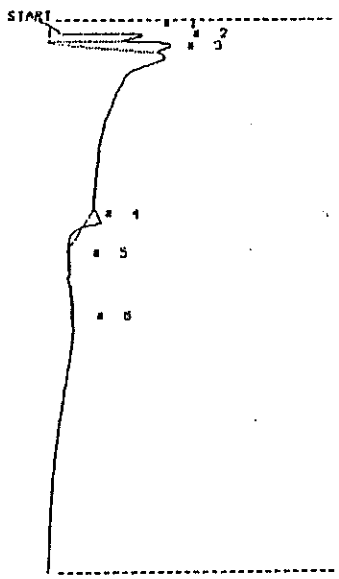
Groundwater

B-3

Soil-Gas

Groundwater

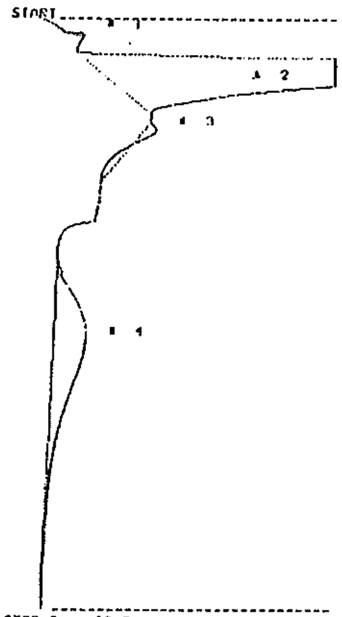
PHOTOVAC



STOP @ 430.6
SAMPLE LIBRARY 3 SEP 24 94 13:57
ANALYSIS # 12 CASPER
INTERNAL TEMP 13 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	12.5	1.7 US
UNKNOWN	2	20.6	1.6 US
UNKNOWN	4	163.7	206.7 mUS
PCE2	6	210.5	37.06 PPB

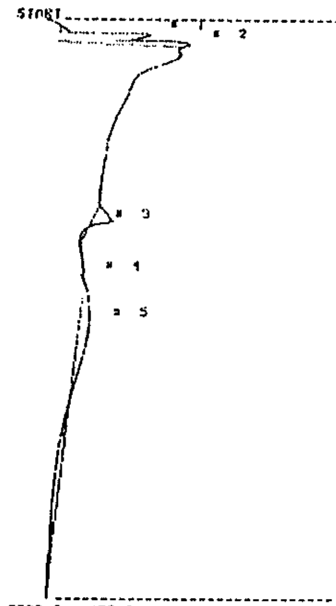
PHOTOVAC



STOP @ 460.6
SAMPLE LIBRARY 3 SEP 24 94 14:50
ANALYSIS # 2 CASPER
INTERNAL TEMP 12 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	13.1	58.5 mUS
UNKNOWN	2	42.2	61.0 US
PCE2	4	251.2	1.573 PPM

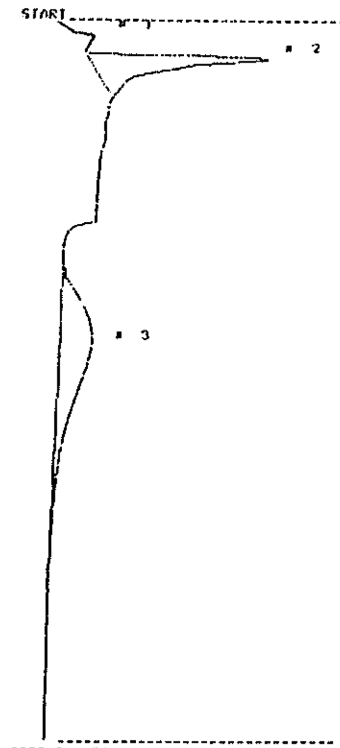
PHOTOVAC



STOP @ 453.3
SAMPLE LIBRARY 3 SEP 24 94 15: 6
ANALYSIS # 4 CASPER
INTERNAL TEMP 13 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	12.7	1.8 US
UNKNOWN	2	20.0	1.0 US
UNKNOWN	3	164.2	526.5 mUS
PCE2	5	240.2	232.1 PPB

PHOTOVAC



STOP @ 561.0
SAMPLE LIBRARY 3 SEP 24 94 15:38
ANALYSIS # 7 CASPER
INTERNAL TEMP 13 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	31.2	6.4 US
PCE2	3	252.7	2.098 PPM

B-4

Soil-Gas

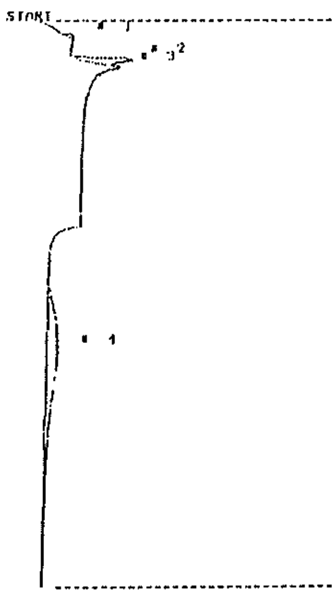
Groundwater

B-5

Soil-Gas

Groundwater

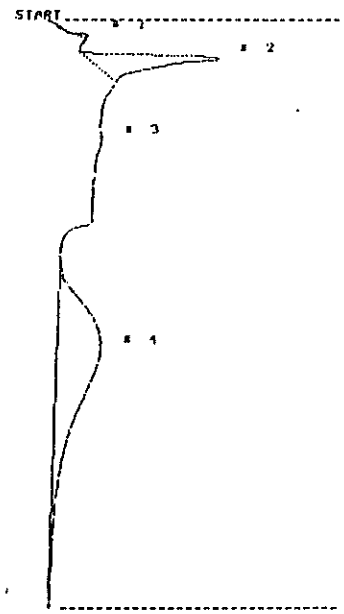
PHOTOVAC



STOP @ 439.3
SAMPLE LIBRARY 3 SEP 24 91 15:48
ANALYSIS # 8 CASPER
INTERNAL TEMP 40 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	32.2	484.3 mVS
PCE2	4	258.3	582.2 PPB

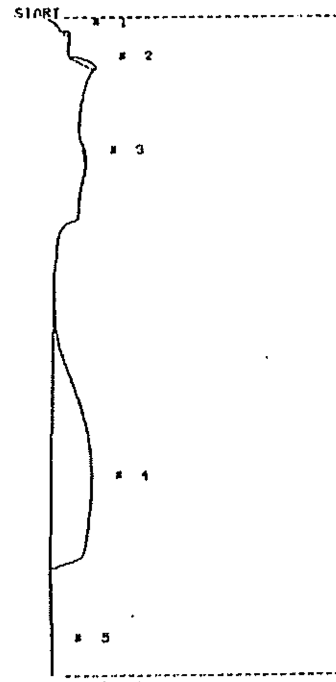
PHOTOVAC



STOP @ 457.4
SAMPLE LIBRARY 3 SEP 24 91 16:21
ANALYSIS # 11 CASPER
INTERNAL TEMP 40 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	31.8	3.5 VS
PCE2	4	253.1	2,833 PPM

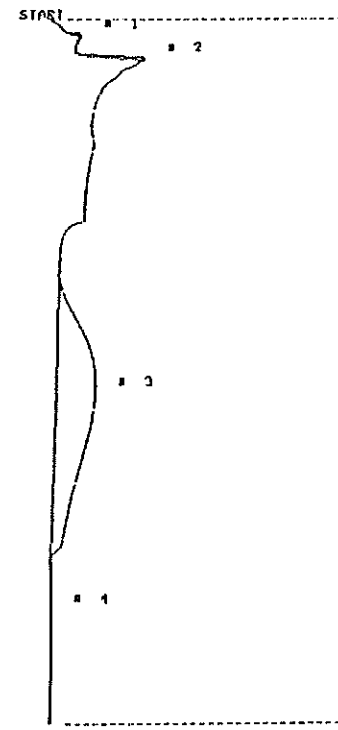
PHOTOVAC



STOP @ 514.9
SAMPLE LIBRARY 3 SEP 25 91 9:30
ANALYSIS # 3 CASPER
INTERNAL TEMP 32 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	10.7	223.3 mVS
TCE2	3	118.8	3.459 PPB
UNKNOWN	4	368.2	17.3 VS
UNKNOWN	5	435.3	34.5 mVS

PHOTOVAC



STOP @ 554.0
SAMPLE LIBRARY 3 SEP 25 91 10:36
ANALYSIS # 11 CASPER
INTERNAL TEMP 37 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	32.1	146.4 mVS
PCE2	3	255.5	3.683 PPM

C-5

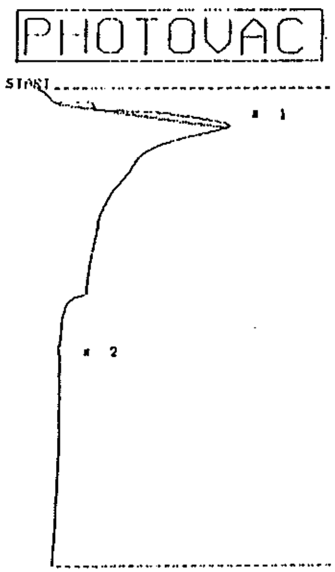
Soil Gas

Groundwater

Soil Gas

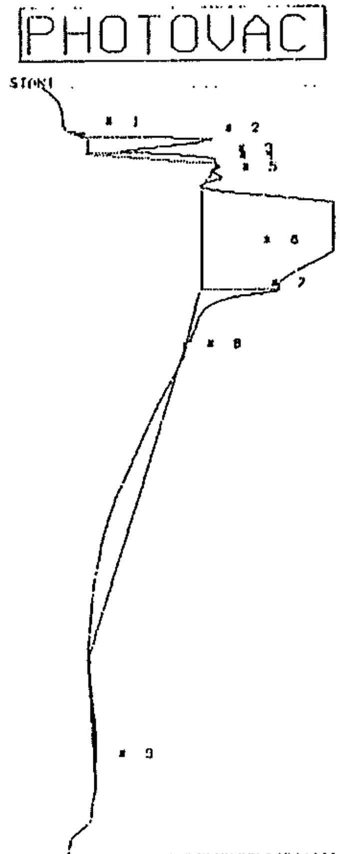
C-6

Groundwater



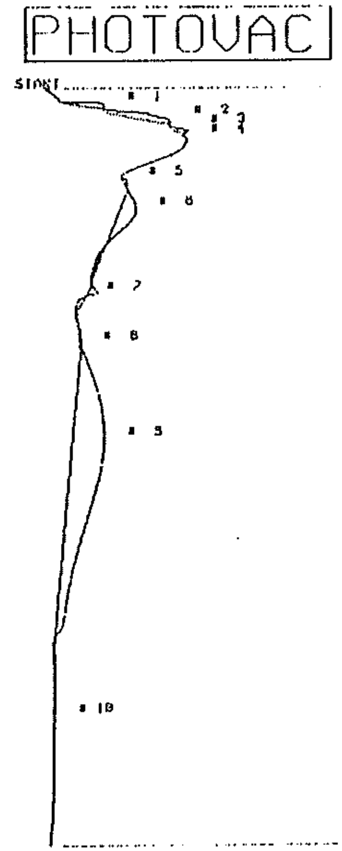
STOP 0 360.0
SAMPLE LIBRARY 3 SEP 25 94 10:12
ANALYSIS # 5 CASPER
INTERNAL TEMP 38 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	25.7	1.2 VS



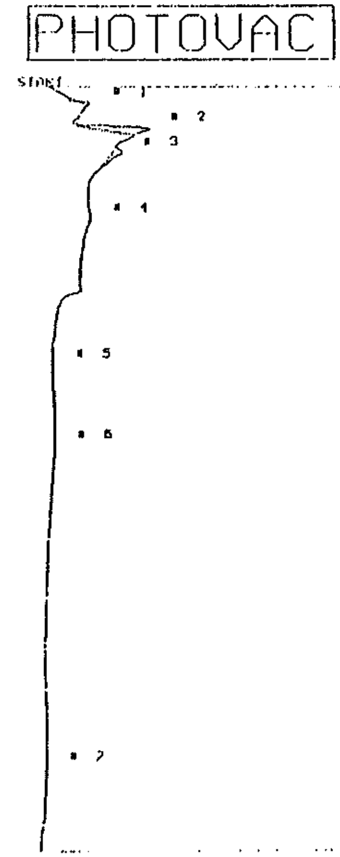
STOP 0 600.0
SAMPLE LIBRARY 3 SEP 25 94 11:30
ANALYSIS # 17 CASPER
INTERNAL TEMP 38 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	36.3	85.9 mVS
UNKNOWN	2	41.9	3.3 VS
UNKNOWN	3	50.1	1.2 VS
[illegible]	5	71.5	1.516 PPM
TCE?	6	111.0	2.335 PPM
UNKNOWN	7	164.2	2.6 VS
UNKNOWN	9	523.9	102.9 mVS



STOP 0 592.0
SAMPLE LIBRARY 3 SEP 25 94 11:12
ANALYSIS # 16 CASPER
INTERNAL TEMP 38 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	15.3	267.1 mVS
UNKNOWN	2	26.7	479.6 mVS
UNKNOWN	3	33.6	61.0 mVS
TCE?	6	97.0	113.0 PPB
UNKNOWN	7	104.2	80.3 mVS
PCE?	9	279.5	2.993 PPM
UNKNOWN	10	434.0	70.7 mVS



STOP 0 500.6
SAMPLE LIBRARY 3 SEP 25 94 12:21
ANALYSIS # 23 CASPER
INTERNAL TEMP 19 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	32.5	658.5 mVS
UNKNOWN	5	51.9	297.4 mVS
PCE?	6	202.7	15.63 PPB

Soil-Gas

B-6

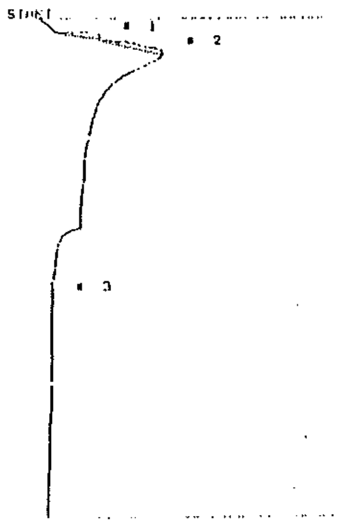
Groundwater

Soil Gas

A-6

Groundwater

PHOTOVAC

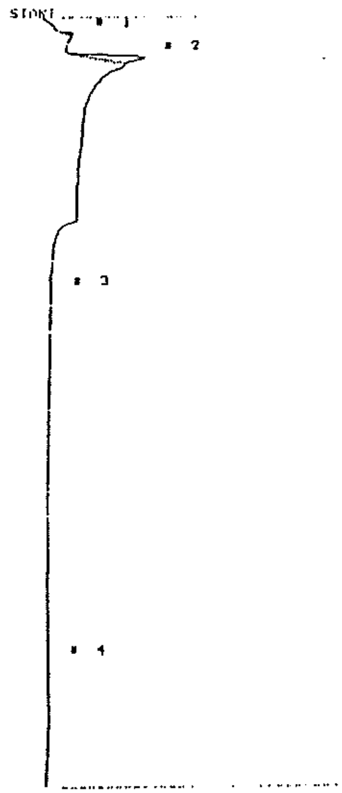


STOP @ 300.3
SAMPLE LIBRARY 3 SEP 25 51 11:53
ANALYSIS # 20 CASPER
INTERNAL TEMP 13 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME PEAK R.T. AREA/PPM

UNKNOWN 1 15.3 [illegible]
UNKNOWN 2 22.2 [illegible]

PHOTOVAC



STOP @ 600.0
SAMPLE LIBRARY 3 SEP 25 51 13: 4
ANALYSIS # 22 CASPER
INTERNAL TEMP 35 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME PEAK R.T. AREA/PPM

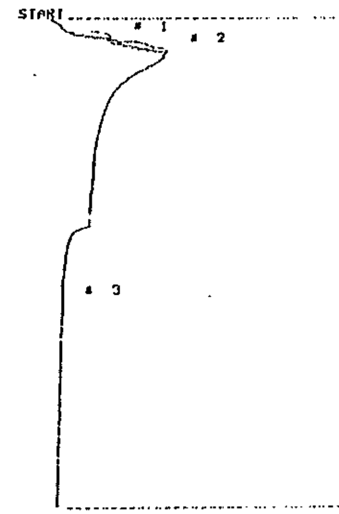
UNKNOWN 2 32.6 602.1 mVS

A-7

Soil-Gas

Groundwater

PHOTOVAC

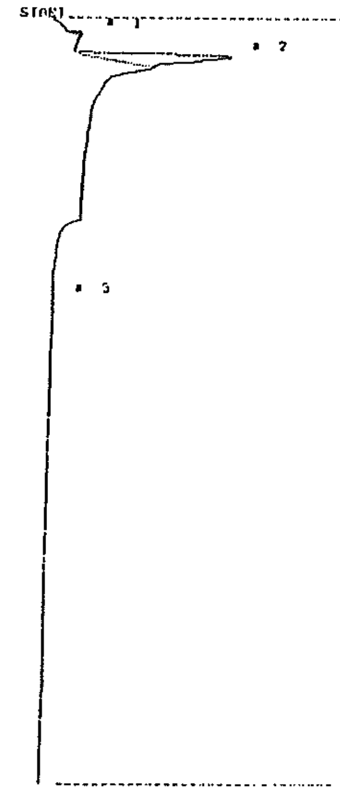


STOP @ 328.0
SAMPLE LIBRARY 3 SEP 25 51 12:43
ANALYSIS # 25 CASPER
INTERNAL TEMP 41 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME PEAK R.T. AREA/PPM

UNKNOWN 1 15.5 250.5 mVS
UNKNOWN 2 25.5 301.1 mVS

PHOTOVAC



STOP @ 600.0
SAMPLE LIBRARY 3 SEP 25 51 13:40
ANALYSIS # 32 CASPER
INTERNAL TEMP 41 WYOMING
GAIN 10 HUNTINGDON

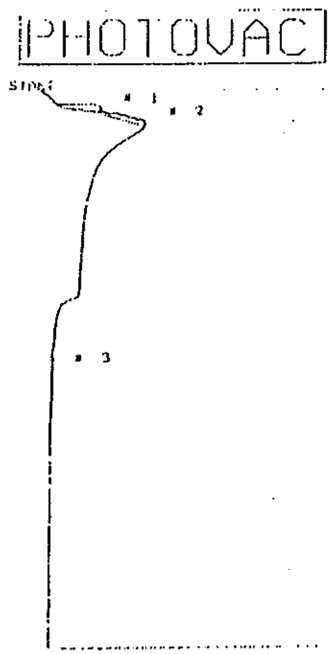
COMPOUND NAME PEAK R.T. AREA/PPM

UNKNOWN 2 31.8 2.4 lu

C-7

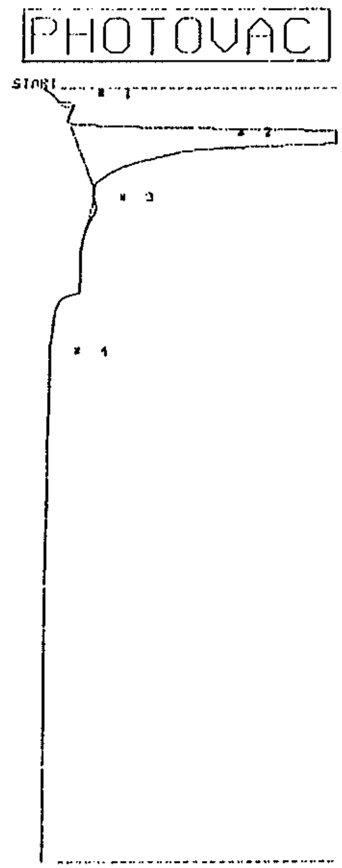
Soil-Gas

Groundwater



STOP @ 430.9
SAMPLE LIBRARY 3 SEP 25 91 13:30
ANALYSIS # 31 CASPER
INTERNAL TEMP 12 WYOMING
GAIN 10 HUNTINGDON

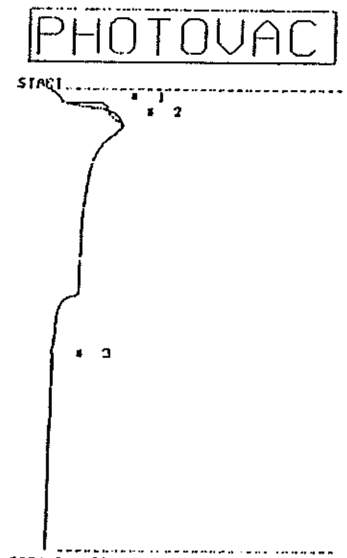
COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	15.2	304.5 mVS
UNKNOWN	2	20.5	261.4 mVS



STOP @ 600.0
SAMPLE LIBRARY 3 SEP 25 91 14:25
ANALYSIS # 37 CASPER
INTERNAL TEMP 10 WYOMING
GAIN 10 HUNTINGDON

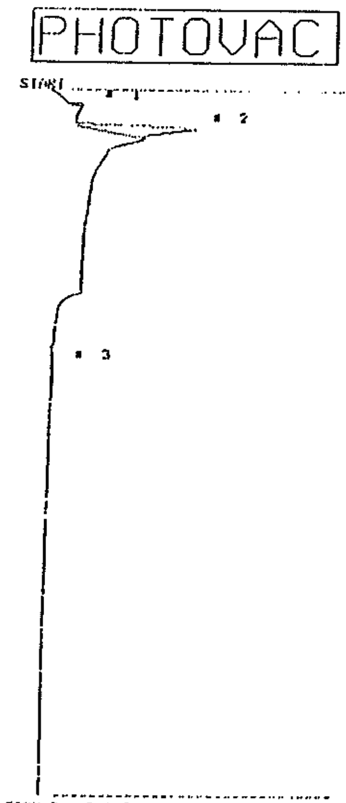
COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	26.4	13.2 VS
[illegible]	3	34.3	1.698 PPM

D-5 Soil-Gas Groundwater



STOP @ 353.4
SAMPLE LIBRARY 3 SEP 25 91 14:08
ANALYSIS # 35 CASPER
INTERNAL TEMP 12 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	15.5	201.0 mVS
UNKNOWN	2	20.1	109.0 mVS



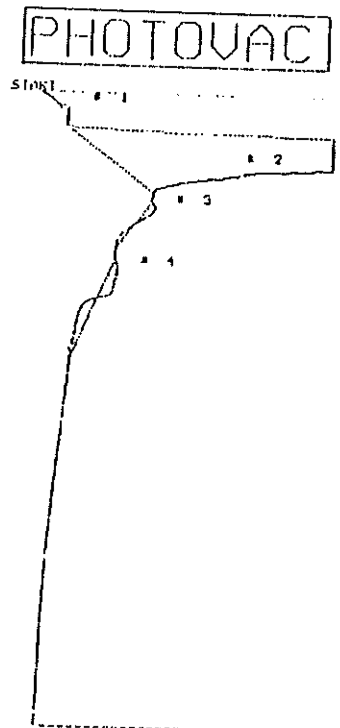
STOP @ 540.9
SAMPLE LIBRARY 3 SEP 25 91 15:13
ANALYSIS # 41 CASPER
INTERNAL TEMP 13 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	31.3	1.5 VS

D-4 Soil-Gas Groundwater

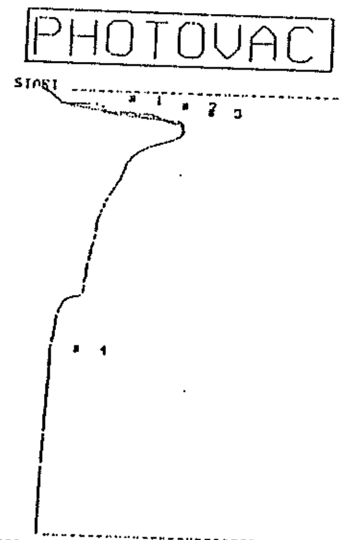
STOP @ 362.4
SAMPLE LIBRARY 3 SEP 25 94 14:55
ANALYSIS # 35 CASPER
INTERNAL TEMP 12 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPB
UNKNOWN	1	15.4	275.9 mVS
UNKNOWN	2	20.8	226.2 mVS
UNKNOWN	3	33.6	34.4 mVS
[illegible]	4	233.5	14.08 PPB



STOP @ 436.5
SAMPLE LIBRARY 3 SEP 25 94 15:44
ANALYSIS # 15 CASPER
INTERNAL TEMP 11 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPB
UNKNOWN	2	46.4	[illegible] VS
[illegible]	3	34.8	1.345 PPB



STOP @ 346.7
SAMPLE LIBRARY 3 SEP 25 94 15:36
ANALYSIS # 11 CASPER
INTERNAL TEMP 11 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPB
UNKNOWN	1	15.2	255.1 mVS
UNKNOWN	2	20.9	218.8 mVS
UNKNOWN	3	24.3	52.8 mVS

A-4

Soil-Gas.

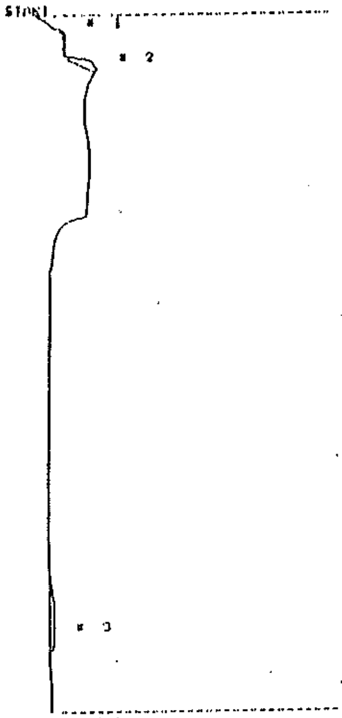
Groundwater

A-3

Soil-Gas

Groundwater (No Sample)

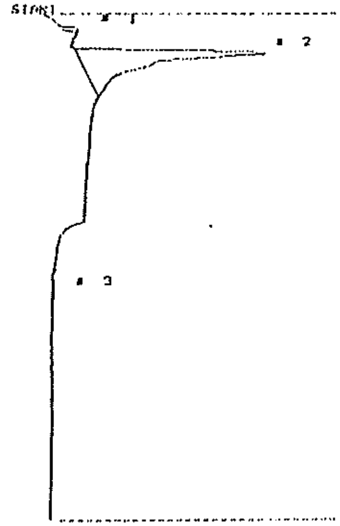
PHOTOVAC



STOP @ 343.1
SAMPLE LIBRARY 3 SEP 27 94 7:44
ANALYSIS # 2 CASPER
INTERNAL TEMP 27 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	15.4	59.6 mVS
UNKNOWN	2	43.7	363.1 mVS
UNKNOWN	3	406.2	609.5 mVS

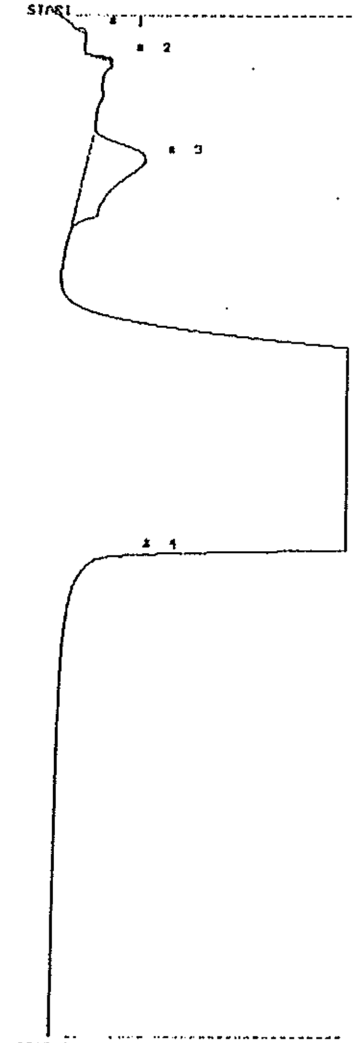
PHOTOVAC



STOP @ 390.2
SAMPLE LIBRARY 3 SEP 27 94 5:20
ANALYSIS # 12 CASPER
INTERNAL TEMP 38 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	13.3	51.8 mVS
UNKNOWN	2	32.3	6.0 VS

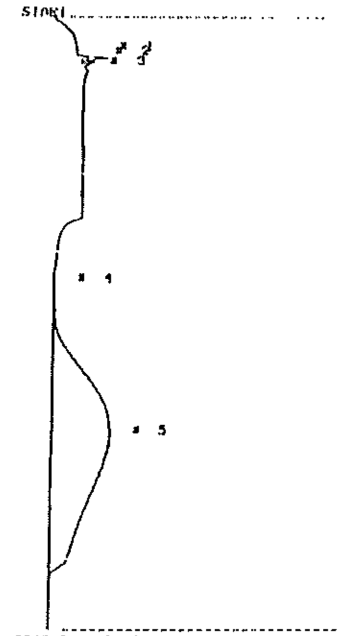
PHOTOVAC



STOP @ 800.0
SAMPLE LIBRARY 3 SEP 27 94 8:30
ANALYSIS # 7 CASPER
INTERNAL TEMP 34 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	36.0	93.7 mVS
TCE2	3	117.7	846.0 PPB

PHOTOVAC



STOP @ 476.0
SAMPLE LIBRARY 3 SEP 27 94 5:30
ANALYSIS # 14 CASPER
INTERNAL TEMP 38 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	32.3	120.2 mVS
UNKNOWN	2	36.8	61.0 mVS
PCE2	5	333.[illegible]	4.605 PPB

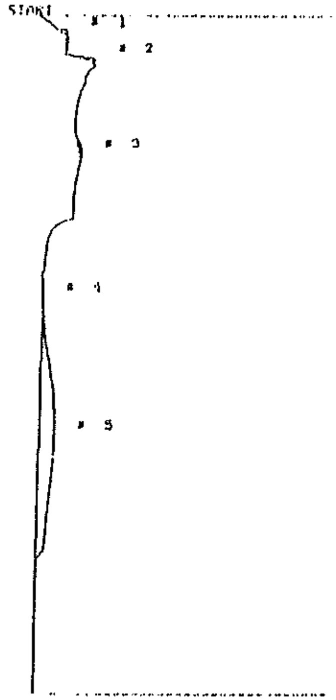
AA-6

Soil-Gas Groundwater

BB-6

Soil-Gas Groundwater

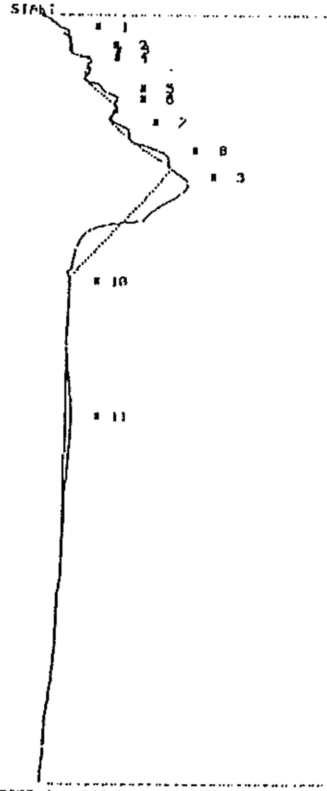
PHOTOVAC



STOP @ 531.1
SAMPLE LIBRARY 3 SEP 27 94 9:14
ANALYSIS # 10 CASPER
INTERNAL TEMP 38 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	34.2	80.1 mVS
TCE?	3	111.4	3.101 PPM
PCE?	5	330.4	1.246 PPB

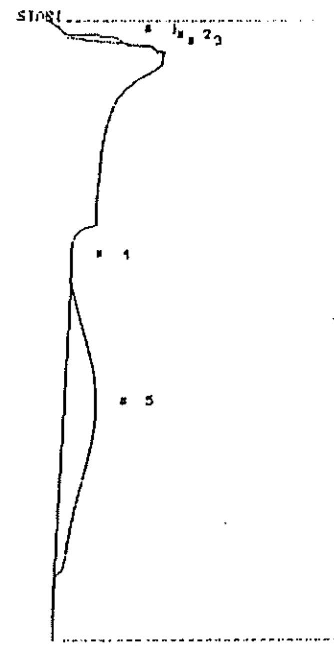
PHOTOVAC



STOP @ 600.0
SAMPLE LIBRARY 3 SEP 27 94 10:10
ANALYSIS # 22 CASPER
INTERNAL TEMP 35 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	13.4	50.0 mVS
UNKNOWN	4	43.2	65.2 mVS
111TCA?	5	60.9	3,412 PPB
111TCA?	6	25.1	431.2 PPB
111TCA?	7	94.3	1.215 PPM
TCE?	8	115.1	41.03 PPB
TCL?	9	135.2	222.3 PPB
PCE?	11	324.1	262.7 PPB

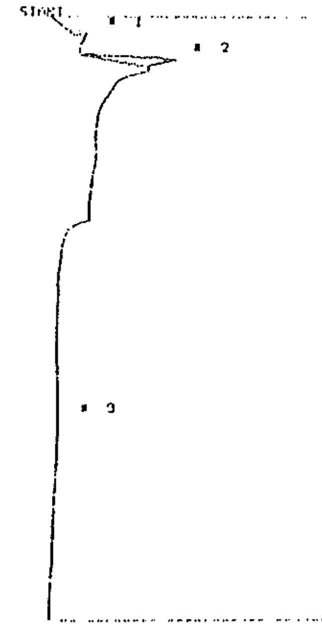
PHOTOVAC



STOP @ 401.3
SAMPLE LIBRARY 3 SEP 27 94 9:55
ANALYSIS # 16 CASPER
INTERNAL TEMP 38 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	15.9	311.9 mVS
UNKNOWN	2	20.4	30.0 mVS
PCE?	5	306.2	3.000 PPB

PHOTOVAC



STOP @ 421.0
SAMPLE LIBRARY 3 SEP 27 94 11:16
ANALYSIS # 25 CASPER
INTERNAL TEMP 40 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	15.6	57.0 mVS
UNKNOWN	2	34.0	1.0 mVS

DD-6

Soil-Gas

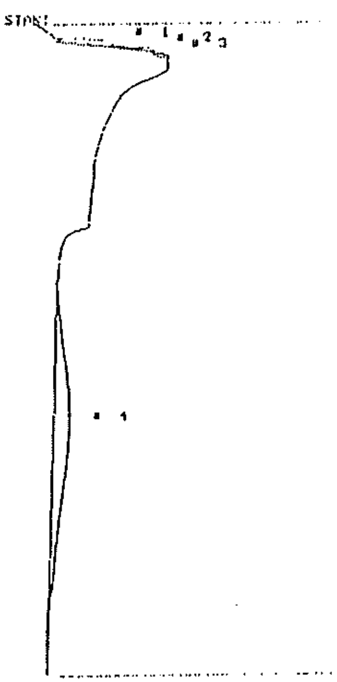
Groundwater

DD-5

Soil-Gas

Groundwater

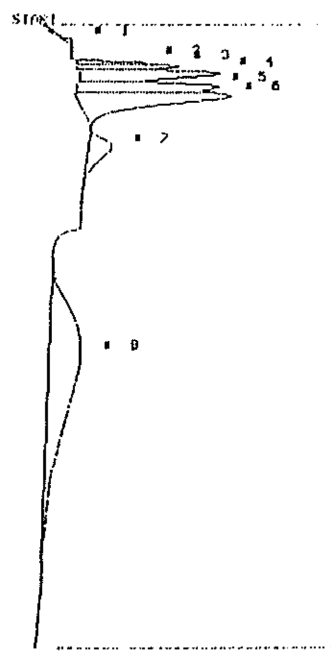
PHOTOVAC



STOP 2 535.0
SAMPLE LIBRARY 3 SEP 27 91 10:28
ANALYSIS # 28 CASPER
INTERNAL TEMP 35 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPB
UNKNOWN	1	15.3	775.0 mVS
UNKNOWN	2	23.2	138.2 mVS
PCE2	4	[illegible]	[illegible]

PHOTOVAC



STOP 0 404.3
SAMPLE LIBRARY 3 SEP 27 91 11:36
ANALYSIS # 27 CASPER
INTERNAL TEMP 35 WYOMING
GAIN 10 HUNTINGDON

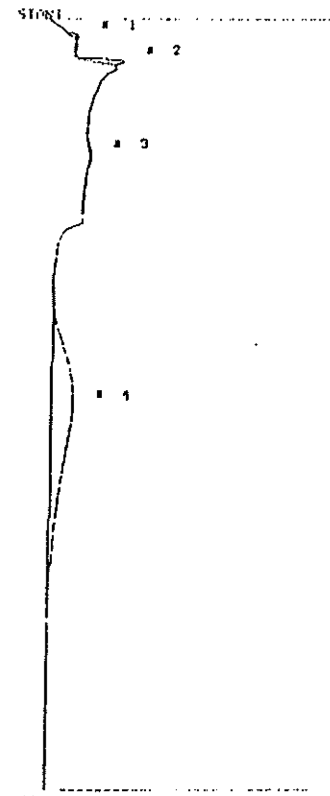
COMPOUND NAME	PEAK	R.T.	AREA/PPB
UNKNOWN	2	30.5	513.9 mVS
UNKNOWN	3	33.4	1.7 VS
UNKNOWN	4	38.7	3.4 VS
UNKNOWN	5	50.1	3.3 VS
UNKNOWN	6	52.5	5.7 VS
TCE2	7	98.2	100.2 PPB
PCE2	8	261.3	[illegible]

AA-5

Soil-Gas

Groundwater

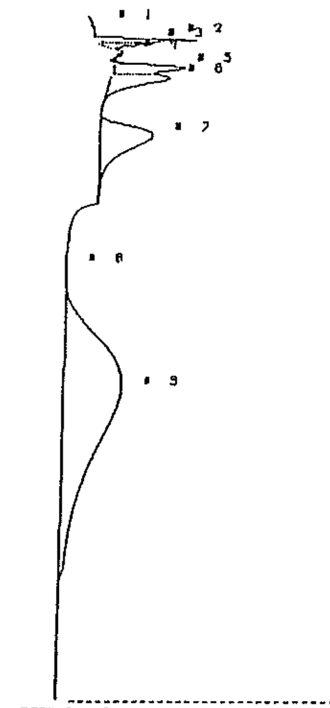
PHOTOVAC



STOP 0 600.0
SAMPLE LIBRARY 3 SEP 27 91 12:13
ANALYSIS # 25 CASPER
INTERNAL TEMP 40 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPB
UNKNOWN	2	34.3	785.2 mVS
PCE2	4	305.9	1,685 PPB

PHOTOVAC



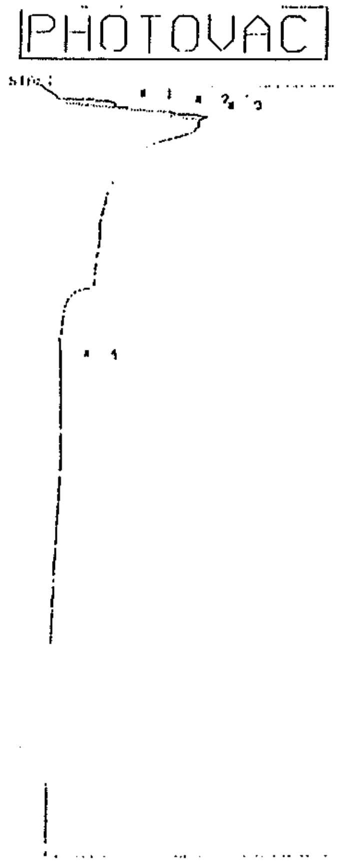
STOP 0 547.9
SAMPLE LIBRARY 3 SEP 27 91 13:3·
ANALYSIS # 33 CASPER
INTERNAL TEMP 41 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPB
UNKNOWN	1	21.9	70.7 mVS
UNKNOWN	2	32.9	706.0 mVS
UNKNOWN	3	35.9	112.0 mVS
UNKNOWN	4	43.9	80.5 mVS
UNKNOWN	5	55.3	1.4 VS
UNKNOWN	6	63.5	1.8 VS
TCE2	7	108.7	483.7 PPB
PCE2	9	310.7	4,250 PPB

AAA-5

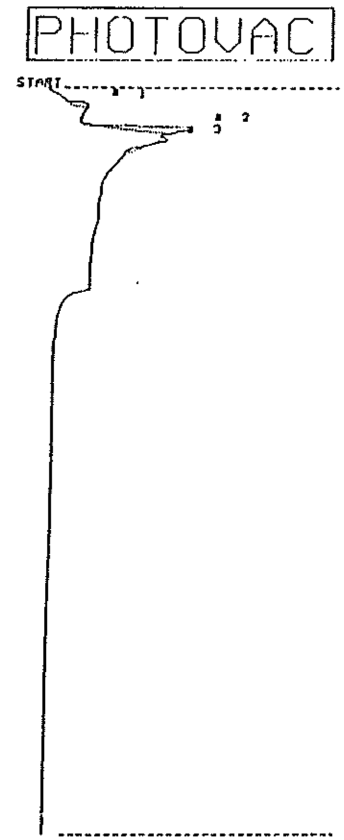
Soil-Gas

Groundwater



STOP @ 600.0
SAMPLE LIBRARY 3 SEP 22 94 13:24
ANALYSIS # 32 CASPER
INTERNAL TEMP 10 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	15.0	200.9 μVS
UNKNOWN	2	19.9	120.4 μVS
UNKNOWN	3	25.4	140.4 μVS



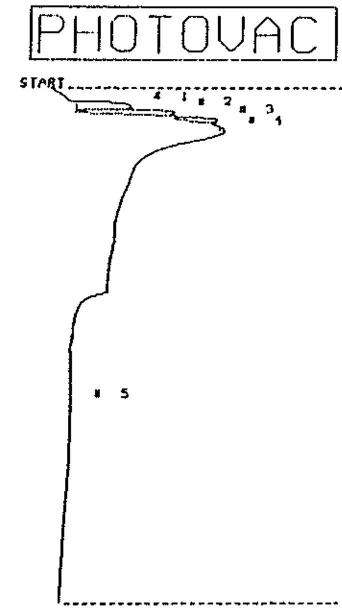
STOP @ 561.5
SAMPLE LIBRARY 3 SEP 22 94 14:21
ANALYSIS # 30 CASPER
INTERNAL TEMP 13 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	13.4	82.8 μVS
UNKNOWN	2	32.1	221.4 μVS
UNKNOWN	3	42.1	115.6 μVS

C-6.5

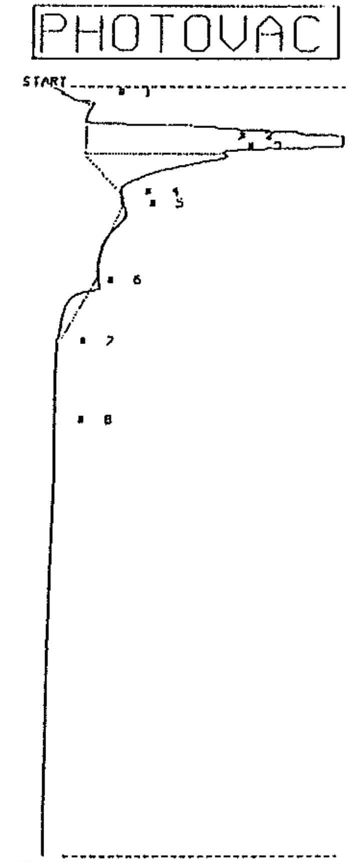
Soil-Gas

Groundwater



STOP @ 401.0
SAMPLE LIBRARY 3 SEP 22 94 14:4
ANALYSIS # 38 CASPER
INTERNAL TEMP 11 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	15.0	552.0 μVS
UNKNOWN	2	15.5	604.4 μVS
UNKNOWN	3	25.5	185.7 μVS



STOP @ 600.0
SAMPLE LIBRARY 3 SEP 22 94 15:5
ANALYSIS # 42 CASPER
INTERNAL TEMP 11 WYOMING
GAIN 10 HUNTINGDON

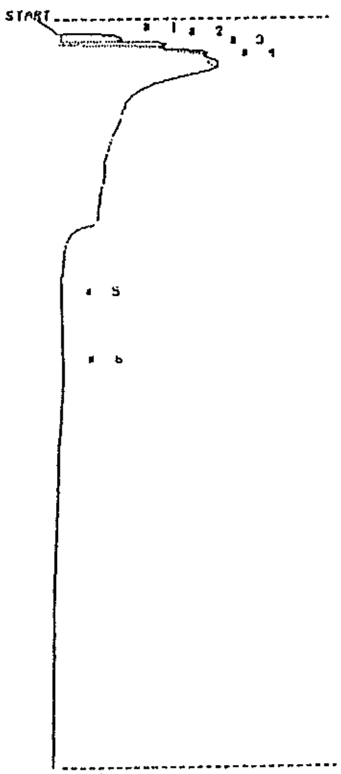
COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	43.2	17.5 US
UNKNOWN	3	56.1	6.0 US
TCE2	5	182.1	36.03 PPB

B-6.5

Soil-Gas

Groundwater

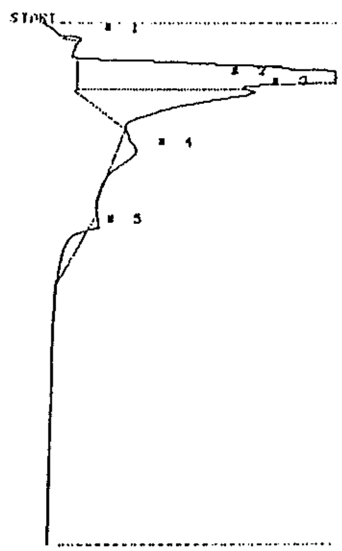
PHOTOVAC



STOP @ 588.4
SAMPLE LIBRARY 3 SEP 27 94 14:42
ANALYSIS # 44 CASPER
INTERNAL TEMP 43 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	15.3	1.0 US
UNKNOWN	2	19.3	150.0 mUS
UNKNOWN	3	26.2	121.1 mUS
UNKNOWN	4	36.1	83.2 mUS

PHOTOVAC



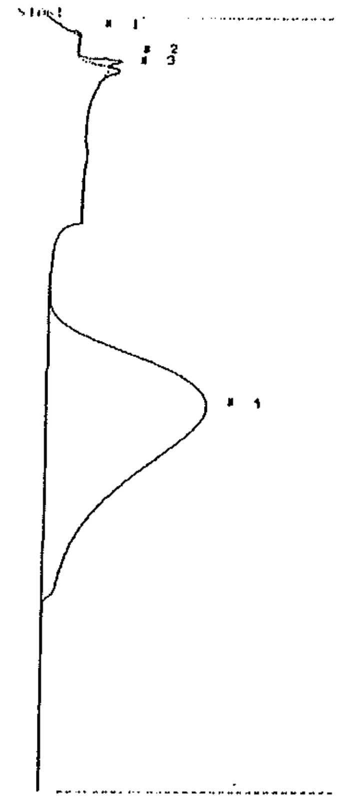
STOP @ 484.3
SAMPLE LIBRARY 3 SEP 27 94 15:41
ANALYSIS # 1 CASPER
INTERNAL TEMP 43 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	15.3	30.4 mUS
UNKNOWN	2	43.7	10.9 US
UNKNOWN	3	56.?	8.1 US
PCE2	4	103.3	124.8 PPM

A-6.5

Soil-Gas Groundwater

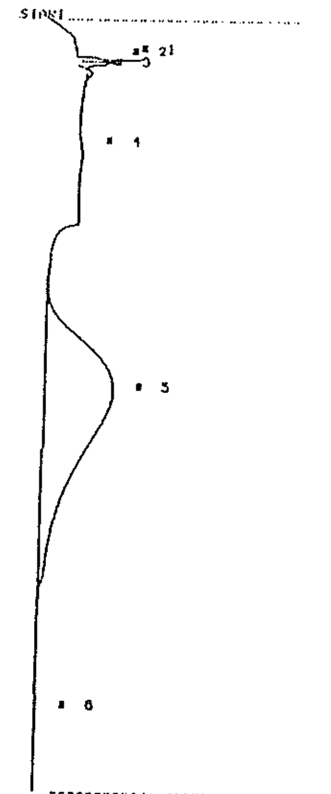
PHOTOVAC



STOP @ 600.0
SAMPLE LIBRARY 3 SEP 27 94 15:53
ANALYSIS # 2 CASPER
INTERNAL TEMP 42 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	35.3	316.2 mUS
UNKNOWN	3	47.1	200.3 mUS
PCE2	4	309.9	11.88 PPM

PHOTOVAC

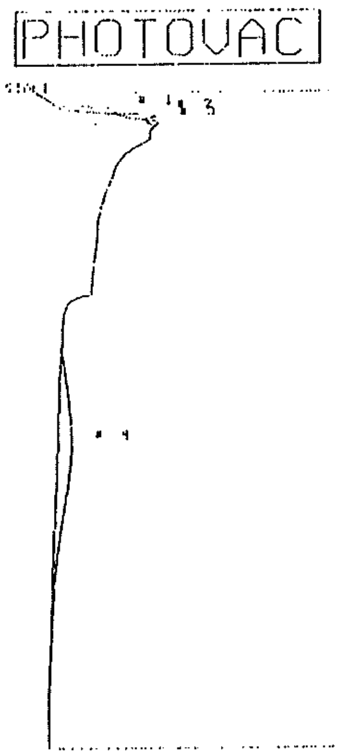


STOP @ 600.0
SAMPLE LIBRARY 3 SEP 27 94 16:41
ANALYSIS # 7 CASPER
INTERNAL TEMP 40 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	32.4	392.5 mUS
UNKNOWN	2	35.2	242.7 mUS
UNKNOWN	3	43.5	188.4 mUS
PCE2	5	292.1	5.949 PPM
UNKNOWN	6	540.4	83.9 mUS

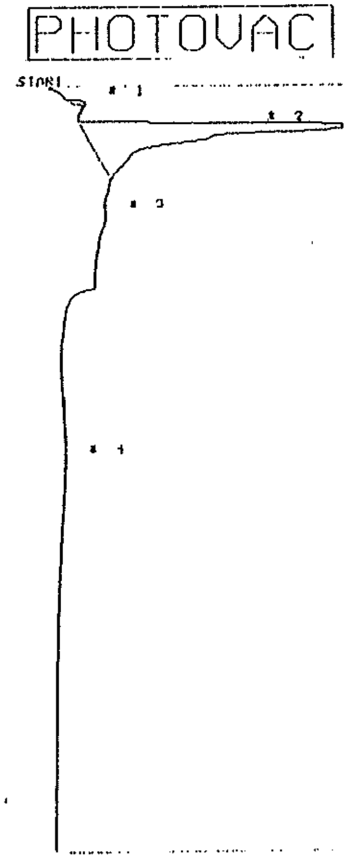
C-5.5

Soil-Gas Groundwater



STOP @ 513.0
SAMPLE LIBRARY 3 SEP 22 94 10:21
ANALYSIS # 5 CASPER
INTERNAL TEMP 12 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	15.0	321.6 mVS
UNKNOWN	2	19.4	250.6 mVS
UNKNOWN	3	25.0	51.0 mVS
PCE2	4	270.0	328.0 PPB

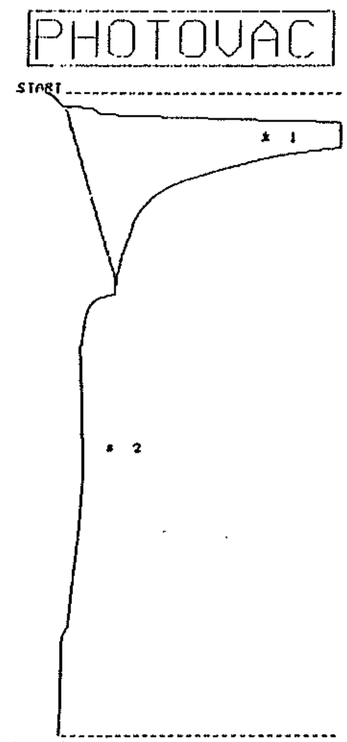


STOP @ 600.0
SAMPLE LIBRARY 3 SEP 22 94 12:14
ANALYSIS # 10 CASPER
INTERNAL TEMP 12 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	13.5	50.3 mVS
UNKNOWN	2	31.3	12.6 VS
PCE2	4	294.[illegible]	[illegible]

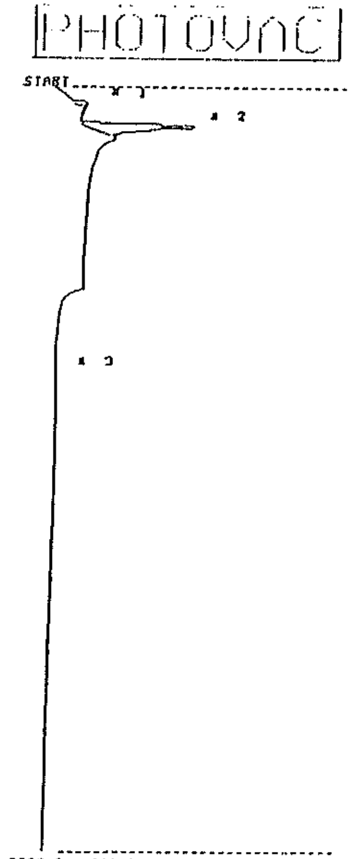
BB-5.5

Soil-Gas Groundwater



STOP @ 504.3
SAMPLE LIBRARY 3 SEP 28 94 9:57
ANALYSIS # 3 CASPER
INTERNAL TEMP 38 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	33.9	61.0 VS
PCE2	2	289.1	24.00 PPB



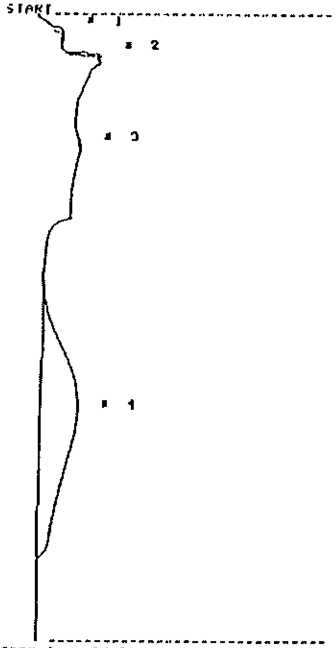
STOP @ 600.0
SAMPLE LIBRARY 3 SEP 28 94 10:47
ANALYSIS # 8 CASPER
INTERNAL TEMP 38 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	39.8	1.6 VS

B-5.5

Soil-Gas Groundwater

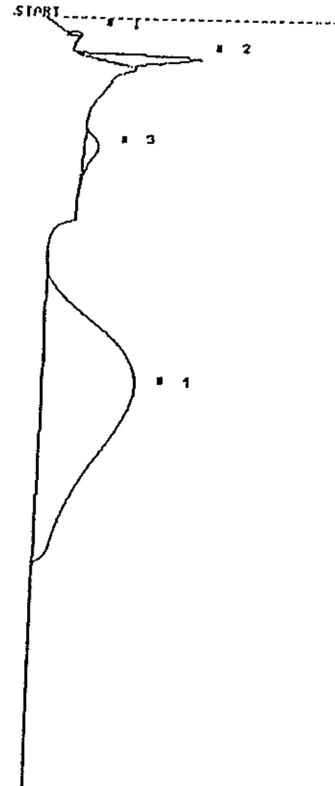
PHOTOVAC



STOP @ 406.3
SAMPLE LIBRARY 3 SEP 28 94 10:35
ANALYSIS # 7 CASPER
INTERNAL TEMP 38 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	34.4	112.0 mVS
TCE2	3	107.8	6.838 PPB
PCE2	1	312.3	3.102 PPM

PHOTOVAC



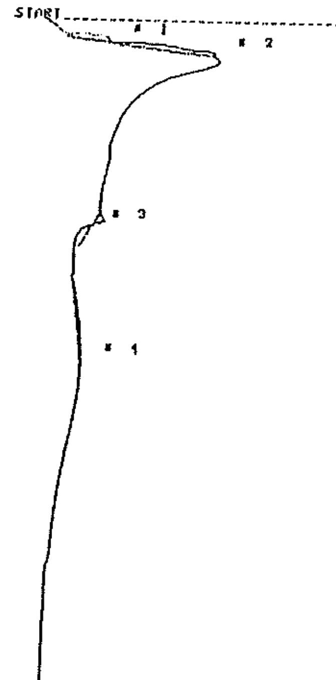
STOP @ 800.0
SAMPLE LIBRARY 3 SEP 28 94 11:33
ANALYSIS # 12 CASPER
INTERNAL TEMP 40 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	13.7	85.9 mVS
UNKNOWN	2	31.6	1.8 VS
TCE2	3	104.2	118.1 PPB
PCE2	1	251.5	2.766 PPM

A-5.5

Soil-Gas Groundwater

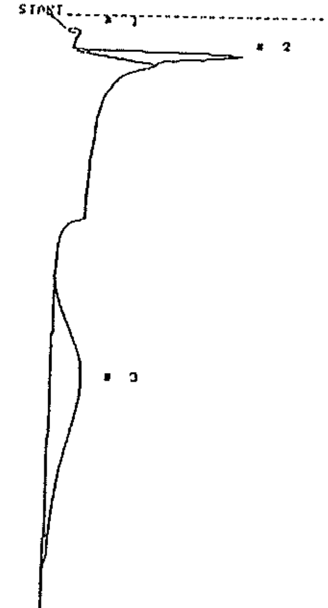
PHOTOVAC



STOP @ 517.5
SAMPLE LIBRARY 3 SEP 28 94 11:23
ANALYSIS # 11 CASPER
INTERNAL TEMP 35 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	15.7	244.5 mVS
UNKNOWN	2	25.7	816.7 mVS
PCE2	1	266.8	82.52 PPB

PHOTOVAC

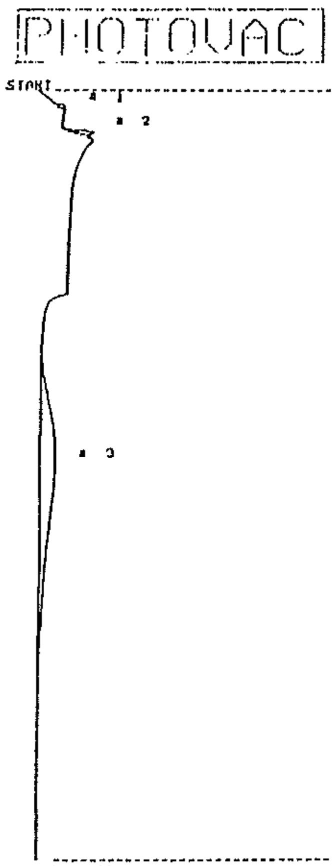


STOP @ 403.0
SAMPLE LIBRARY 3 SEP 28 94 12:14
ANALYSIS # 14 CASPER
INTERNAL TEMP 41 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	32.1	2.5 VS
PCE2	3	291.5	2.361 PPM

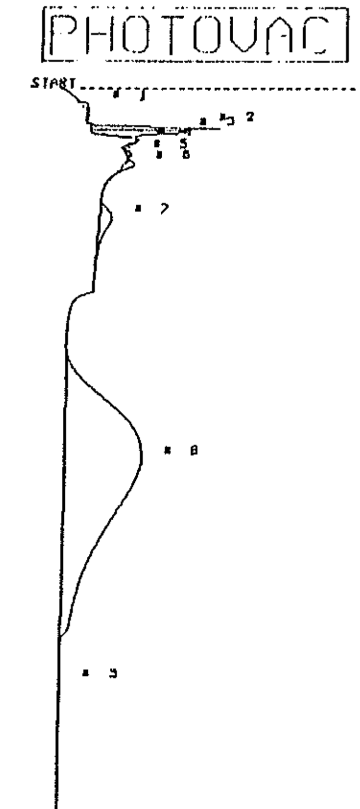
A-4.5

Soil-Gas Groundwater



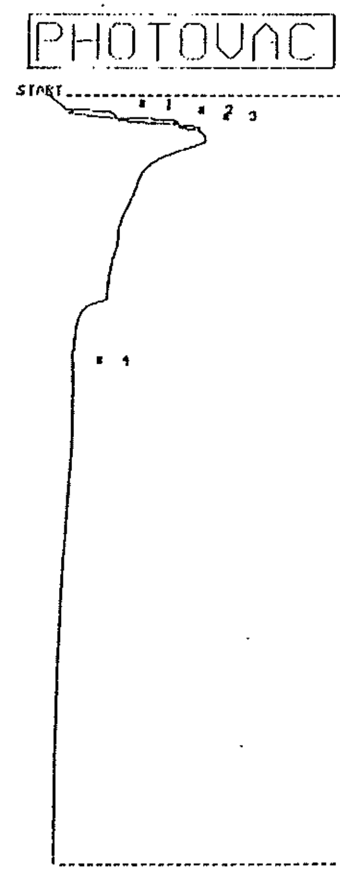
STOP @ 600.0
SAMPLE LIBRARY 3 SEP 28 94 12:25
ANALYSIS # 15 CASPER
INTERNAL TEMP 40 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	33.5	137.8 mVS
PCE2	3	292.3	1.183 PPM



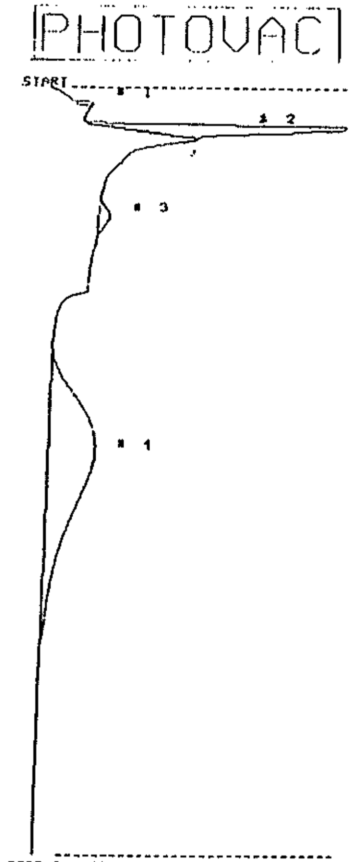
STOP @ 565.7
SAMPLE LIBRARY 3 SEP 28 94 12:55
ANALYSIS # 18 CASPER
INTERNAL TEMP 40 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	31.5	1.2 US
UNKNOWN	3	34.3	795.3 mVS
UNKNOWN	5	52.7	25.4 mVS
UNKNOWN	6	69.5	270.6 mVS
TCE2	7	104.2	81.26 PPB
PCE2	8	232.3	6.069 PPM



STOP @ 600.0
SAMPLE LIBRARY 3 SEP 28 94 13:18
ANALYSIS # 20 CASPER
INTERNAL TEMP 41 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	16.0	201.2 mVS
UNKNOWN	2	20.5	280.0 mVS
UNKNOWN	3	25.6	70.5 mVS



STOP @ 600.0
SAMPLE LIBRARY 3 SEP 28 94 13:54
ANALYSIS # 24 CASPER
INTERNAL TEMP 43 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	13.4	63.3 mVS
UNKNOWN	2	30.5	5.1 US
TCE2	3	102.7	53.23 PPB
PCE2	4	287.5	3.459 PPM

BB-4

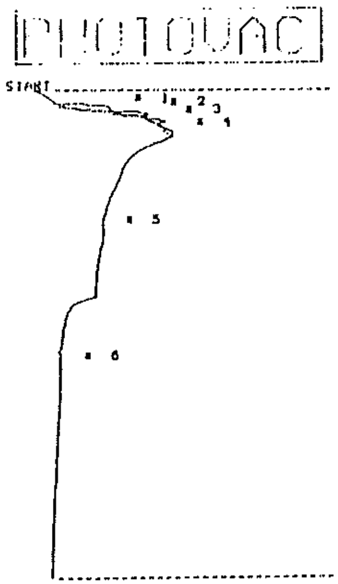
Soil-Gas

Groundwater

AA-4

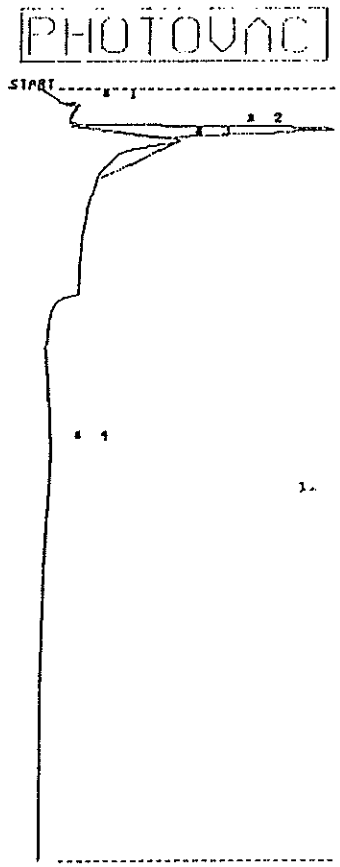
Soil-Gas

Groundwater



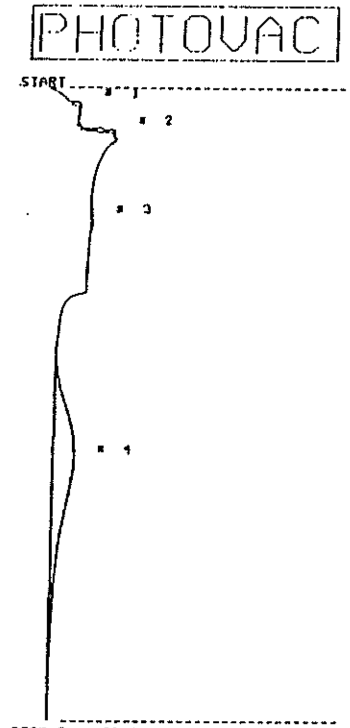
STOP @ 377.9
SAMPLE LIBRARY 3 SEP 28 91 13:44
ANALYSIS # 23 CASPER
INTERNAL TEMP 43 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	15.2	305.6 mVS
UNKNOWN	2	19.5	115.5 mVS
UNKNOWN	3	25.3	168.2 mVS



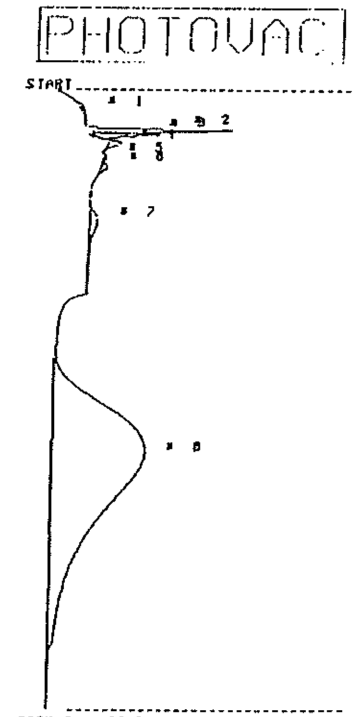
STOP @ 600.0
SAMPLE LIBRARY 3 SEP 28 91 14:38
ANALYSIS # 28 CASPER
INTERNAL TEMP 43 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	13.1	55.1 mVS
UNKNOWN	2	31.9	4.3 VS
PCE2	4	273.5	29.20 PPB



STOP @ 190.0
SAMPLE LIBRARY 4 SEP 28 91 14:22
ANALYSIS # 26 LA-Z-BOY UTAH
INTERNAL TEMP 42 TREMONTON, UTAH
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	13.9	34.4 mVS
UNKNOWN	2	34.3	112.9 mVS
UNKNOWN	3	104.5	21.8 mVS
UNKNOWN	4	283.1	6.4 VS



STOP @ 400.0
SAMPLE LIBRARY 3 SEP 28 91 15:0
ANALYSIS # 31 CASPER
INTERNAL TEMP 44 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	32.2	993.0 mVS
UNKNOWN	3	34.8	535.3 mVS
UNKNOWN	4	42.9	164.5 mVS
UNKNOWN	6	81.7	148.2 mVS
CE2	7	181.5	12.56 PPB
LE2	8	283.9	6.381 PPM

DD-4

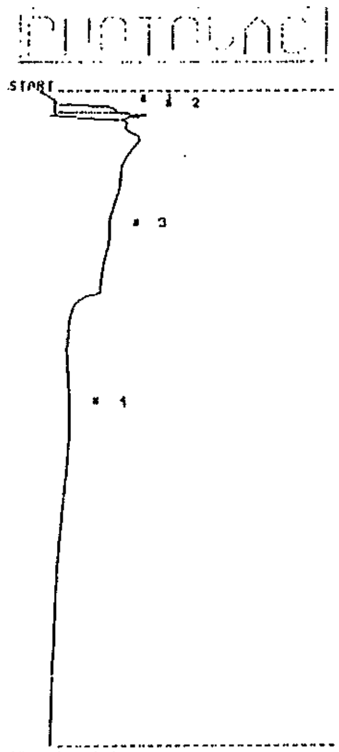
C-3.5

Soil-Gas

Groundwater

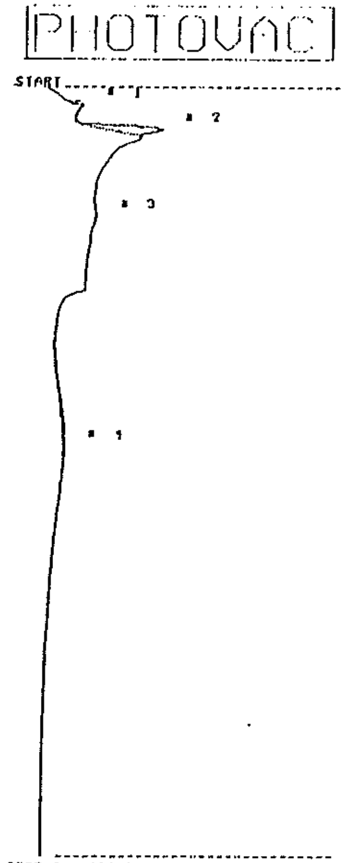
Soil-Gas

Groundwater



STOP @ 509.8
SAMPLE LIBRARY 3 SEP 28 91 14:59
ANALYSIS # 30 CASPER
INTERNAL TEMP 44 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	16.1	1.2 VS
UNKNOWN	2	19.4	823.3 mVS
PCE2	4	252.1	21.42 PPB



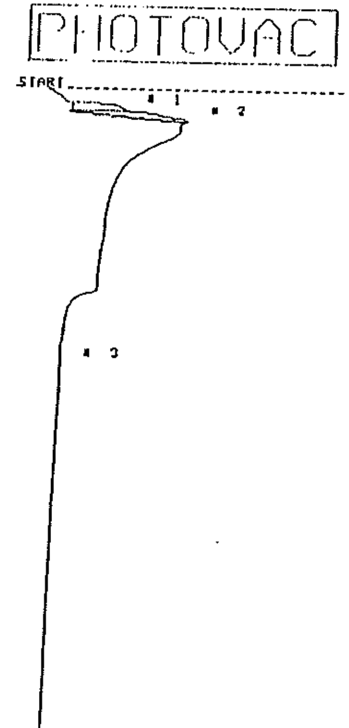
STOP @ 600.0
SAMPLE LIBRARY 3 SEP 28 91 15:44
ANALYSIS # 35 CASPER
INTERNAL TEMP 41 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	32.2	888.4 mVS
PCE2	4	200.3	60.08 PPB

B-3.5

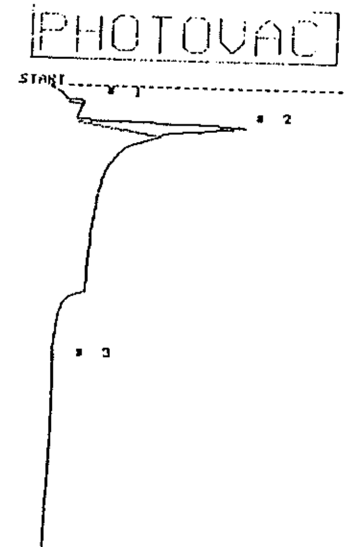
Soil-Gas

Groundwater



STOP @ 501.7
SAMPLE LIBRARY 3 SEP 28 91 15:25
ANALYSIS # 33 CASPER
INTERNAL TEMP 43 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	16.7	332.8 mVS
UNKNOWN	2	25.1	999.1 mVS



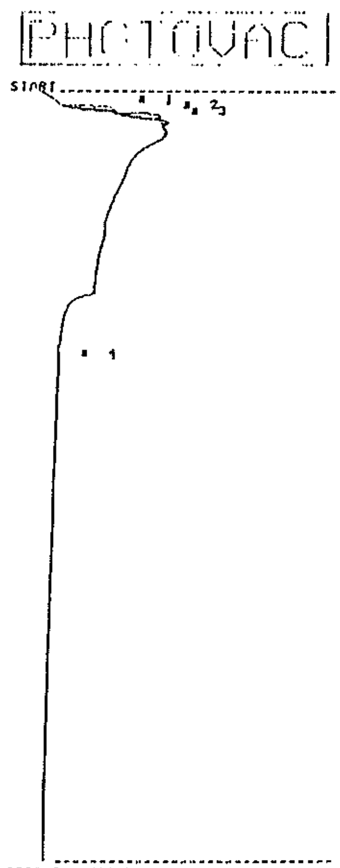
STOP @ 359.3
SAMPLE LIBRARY 3 SEP 28 91 15:51
ANALYSIS # 36 CASPER
INTERNAL TEMP 43 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	13.4	54.9 mVS
UNKNOWN	2	31.8	2.5 VS

A-3.5

Soil-Gas

Groundwater



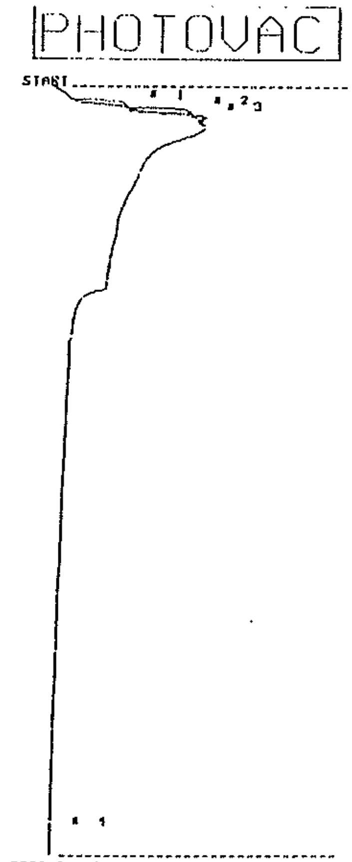
STOP @ 600.0
SAMPLE LIBRARY 3 SEP 28 91 16:2?
ANALYSIS # 30 CASPER
INTERNAL TEMP 41 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	15.6	304.1 mVS
UNKNOWN	2	20.2	267.8 mVS

A-2

Soil-Gas

Groundwater
(" " ")



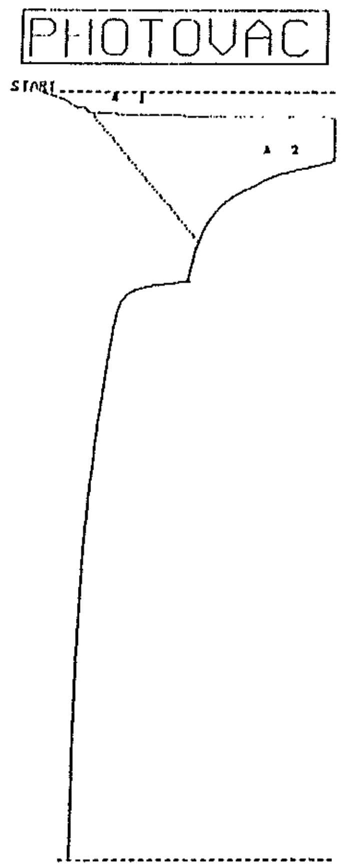
STOP @ 600.0
SAMPLE LIBRARY 3 SEP 28 91 16:35
ANALYSIS # 10 CASPER
INTERNAL TEMP 41 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	15.4	276.5 mVS
UNKNOWN	2	20.6	284.8 mVS
UNKNOWN	3	25.2	88.3 mVS

B-1

Soil-Gas

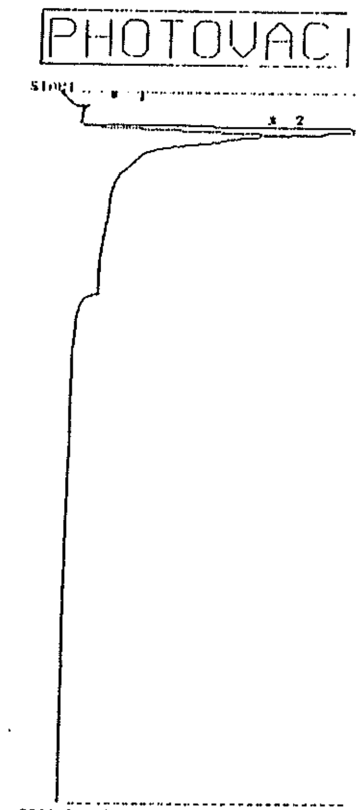
Groundwater
(No Sample)



STOP @ 800.0
SAMPLE LIBRARY 2 SEP 29 94 8:52
ANALYSIS # 3 CASPER, WY
INTERNAL TEMP 32 BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME PEAK R.T. AREA/PPM

UNKNOWN 2 32.3 153.9 US



STOP @ 557.0
SAMPLE LIBRARY 3 SEP 29 94 10:58
ANALYSIS # 6 CASPER
INTERNAL TEMP 38 WYOMING
GAIN 10 HUNTINGDON

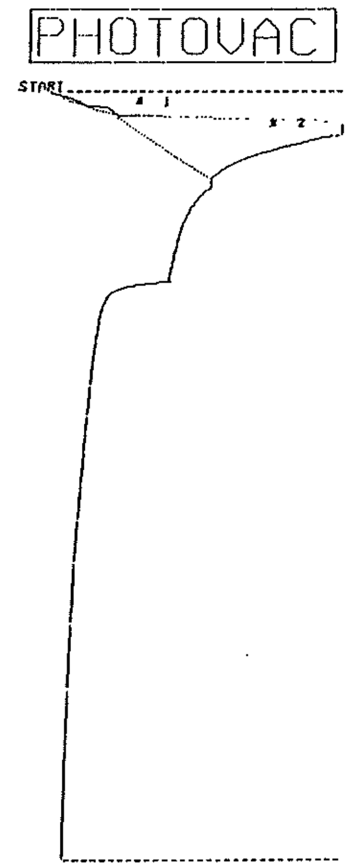
COMPOUND NAME PEAK R.T. AREA/PPM

UNKNOWN 2 30.1 2.5 US

0929-01

Soil-Gas

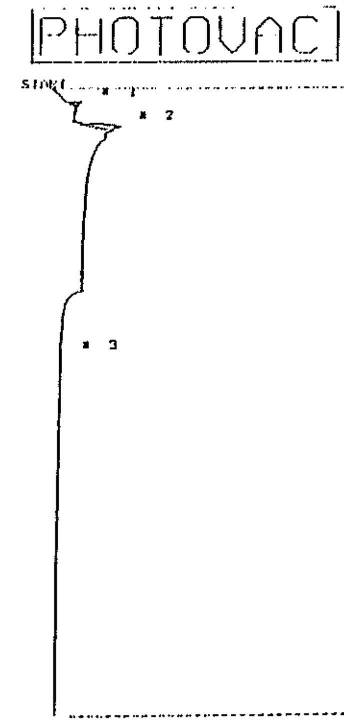
Groundwater



STOP @ 800.0
SAMPLE LIBRARY 2 SEP 29 94 9:20
ANALYSIS # 6 CASPER, WY
INTERNAL TEMP 35 BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME PEAK R.T. AREA/PPM

UNKNOWN 1 10.2 125.1 mUS
UNKNOWN 2 28.6 18.8 US



STOP @ 491.0
SAMPLE LIBRARY 3 SEP 29 94 13:2
ANALYSIS # 7 CASPER
INTERNAL TEMP 37 WYOMING
GAIN 10 HUNTINGDON

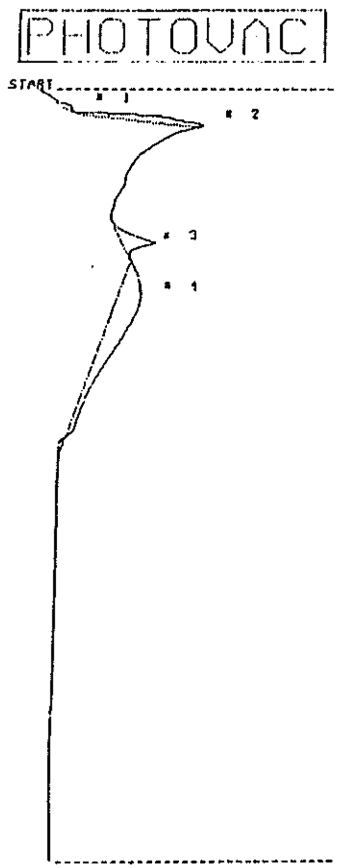
COMPOUND NAME PEAK R.T. AREA/PPM

UNKNOWN 2 31.2 241.5 mUS

0929-02

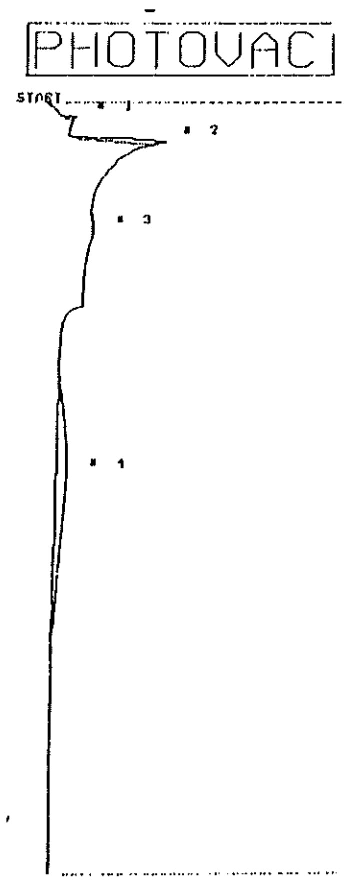
Soil-Gas

Groundwater



STOP @ 600.0
SAMPLE LIBRARY 2 SEP 29 94 10:15
ANALYSIS # 0 CASPER, WY
INTERNAL TEMP 36 RIEK FIELD 20
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	20.7	1.0 US
UNKNOWN	3	124.4	1.0 US
PARA XYLENE^	4	164.2	20.26 PPM



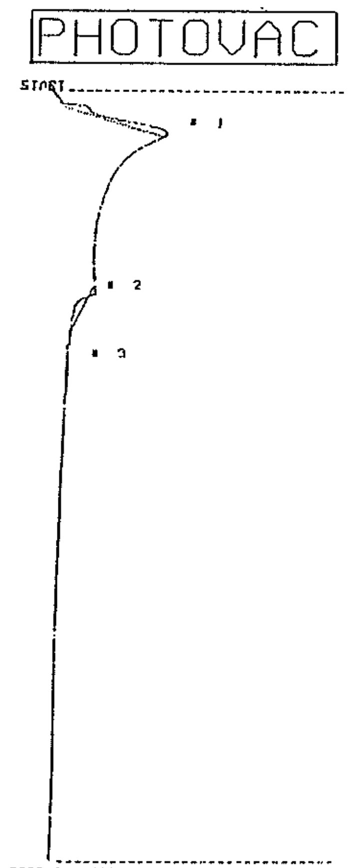
STOP @ 600.0
SAMPLE LIBRARY 3 SEP 29 94 13:10
ANALYSIS # 8 CASPER
INTERNAL TEMP 36 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	31.4	424.5 mVS
PCE?	4	271.5	807.4 PPB

0929-03

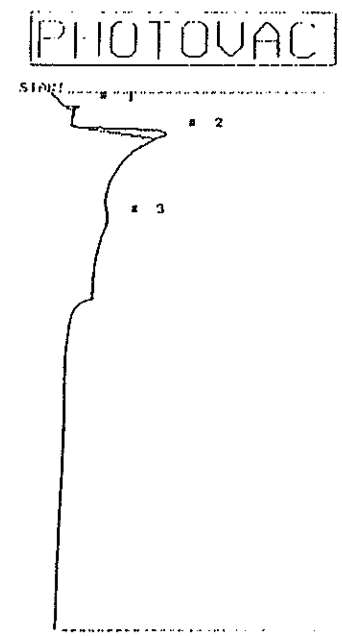
Soil-Gas

Groundwater



STOP @ 600.0
SAMPLE LIBRARY 3 SEP 29 94 14:35
ANALYSIS # 3 CASPER
INTERNAL TEMP 36 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	33.8	520.3 mVS



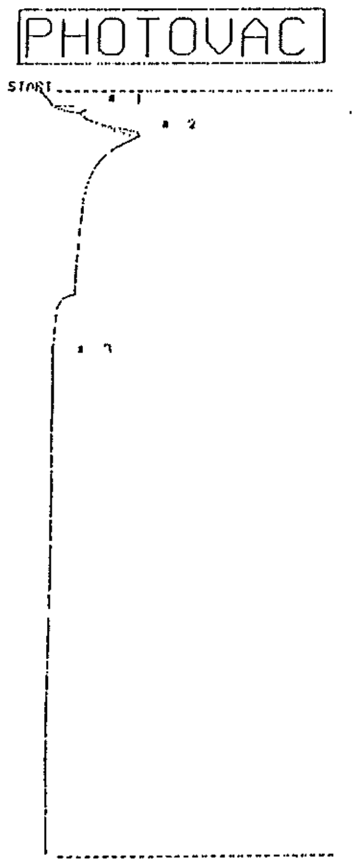
STOP @ 410.0
SAMPLE LIBRARY 3 SEP 29 94 20:13
ANALYSIS # 10 CASPER
INTERNAL TEMP 36 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	33.8	875.0 mVS

0929-04

Soil. Gas

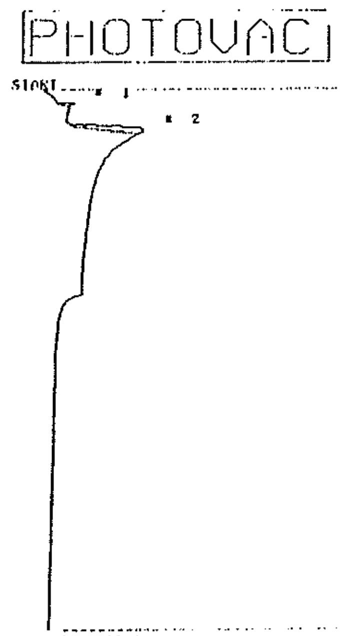
Groundwater



STOP @ 600.0
SAMPLE LIBRARY 3 SEP 29 94 15:12
ANALYSIS # 7 CASPER
INTERNAL TEMP 39 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME PEAK R.T. AREA/PPM

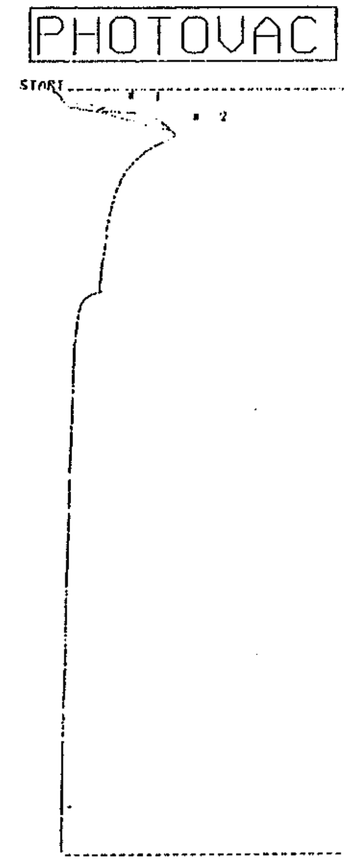
UNKNOWN 1 15.1 215.4 mVS



STOP @ 422.9
SAMPLE LIBRARY 3 SEP 29 94 20:11
ANALYSIS # 11 CASPER
INTERNAL TEMP 37 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME PEAK R.T. AREA/PPM

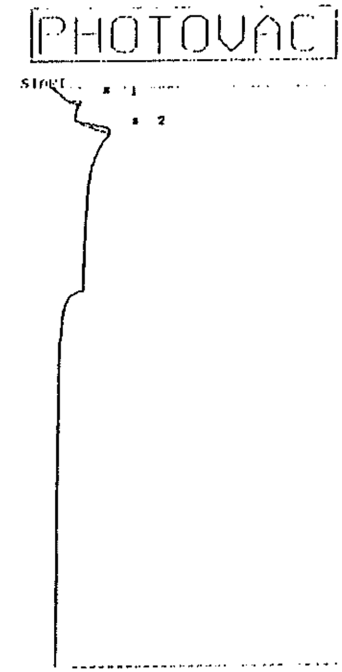
UNKNOWN 2 35.7 333.1 mVS



STOP @ 600.0
SAMPLE LIBRARY 3 SEP 29 94 15:56
ANALYSIS # 9 CASPER
INTERNAL TEMP 39 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME PEAK R.T. AREA/PPM

UNKNOWN 1 14.9 263.6 mVS
UNKNOWN 2 30.8 833.8 mVS



STOP @ 455.6
SAMPLE LIBRARY 3 SEP 29 94 20:15
ANALYSIS # 12 CASPER
INTERNAL TEMP 37 WYOMING
GAIN 10 HUNTINGDON

COMPOUND NAME PEAK R.T. AREA/PPM

UNKNOWN 2 36.9 289.3 mVS

0929-05

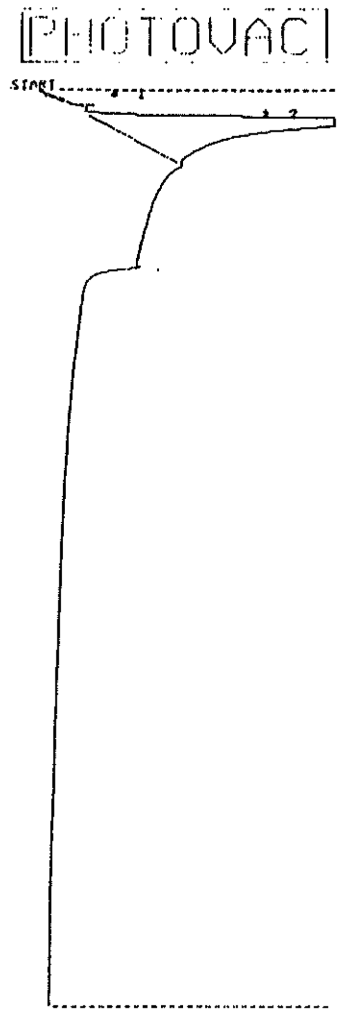
Soil-Gas

Groundwater

0929-06

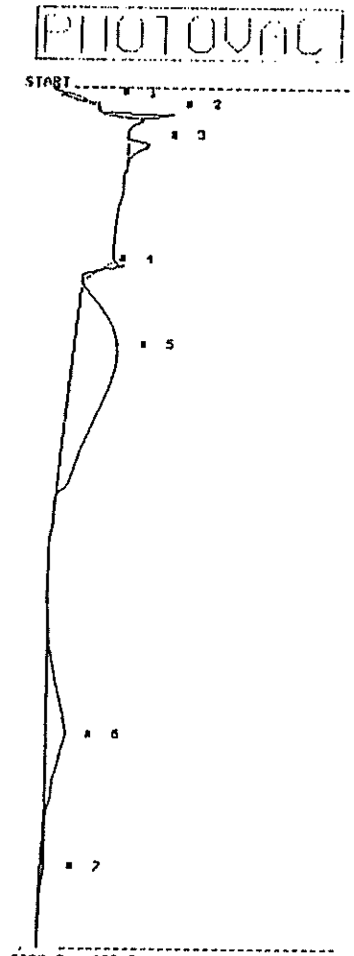
Soil-Gas

Groundwater



STOP @ 718.9
SAMPLE LIBRARY 2 SEP 30 94 8:10
ANALYSIS # 8 CASPER, WY
INTERNAL TEMP 34 BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	24.4	18.2 VS

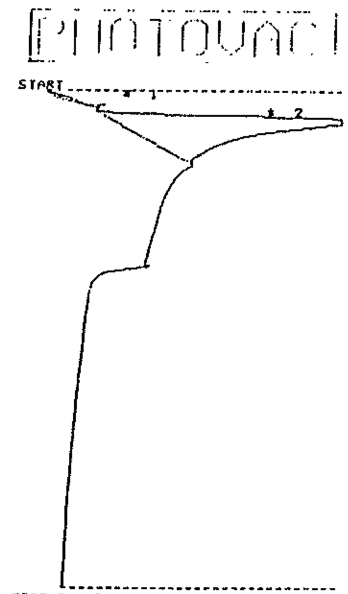


STOP @ 672.3
SAMPLE LIBRARY 2 SEP 30 94 10:42
ANALYSIS # 15 CASPER, WY
INTERNAL TEMP 30 BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	12.3	101.7 mVS
UNKNOWN	2	21.5	115.8 mVS
BENZENE^	3	45.7	101.0 PPB
ETHYLBENZENE^	4	144.4	585.8 PPB
ORTHO-XYLENE^	5	212.4	251.5 PPB
UNKNOWN	6	518.1	4.8 VS
UNKNOWN	7	612.5	113.1 mVS

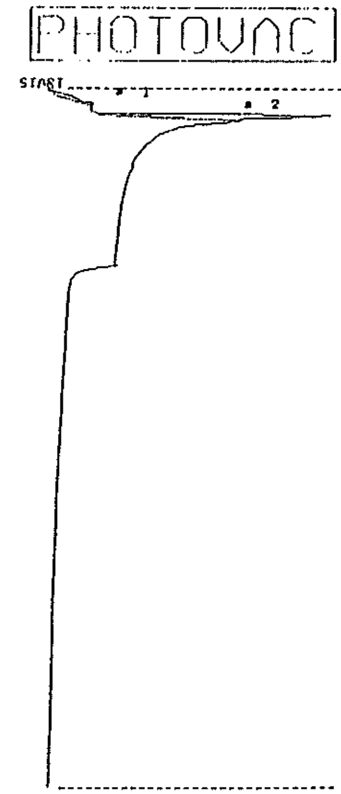
0930-01

Soil-Gas Groundwater



STOP @ 387.5
SAMPLE LIBRARY 2 SEP 30 94 8:45
ANALYSIS # 11 CASPER, WY
INTERNAL TEMP 36 BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	24.2	13.0 VS

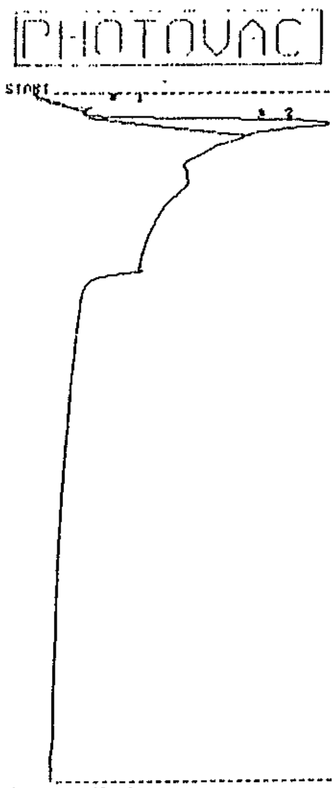


STOP @ 548.4
SAMPLE LIBRARY 2 SEP 30 94 10:13
ANALYSIS # 16 CASPER, WY
INTERNAL TEMP 37 BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	21.5	1.6 VS

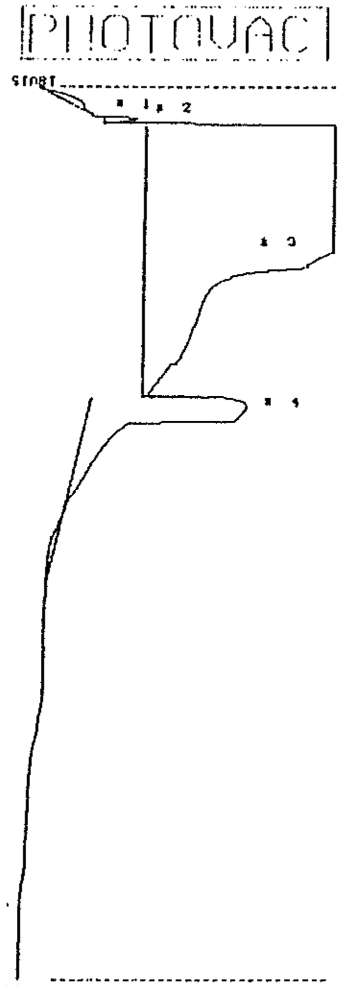
0930-02

Soil-Gas Groundwater



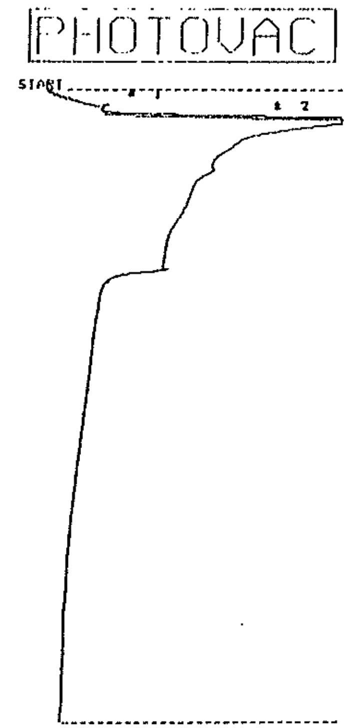
STOP @ 330.3
SAMPLE LIBRARY 2 SEP 30 94 10:31
ANALYSIS # 18 CASPER, WY
INTERNAL TEMP 32 BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	21.1	1.5 US



STOP @ 700.0
SAMPLE LIBRARY 2 SEP 30 94 11:10
ANALYSIS # 22 CASPER, WY
INTERNAL TEMP 30 BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	23.2	566.2 mUS
UNKNOWN	2	26.4	187.3 mUS
TOLUENE*	3	81.3	1815. PPM
UNKNOWN	4	250.4	13.2 US



STOP @ 493.0
SAMPLE LIBRARY 2 SEP 30 94 10:58
ANALYSIS # 21 CASPER, WY
INTERNAL TEMP 30 BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	22.0	223.5 mUS

0930-03

Soil-Gas

Groundwater
(Free Product)

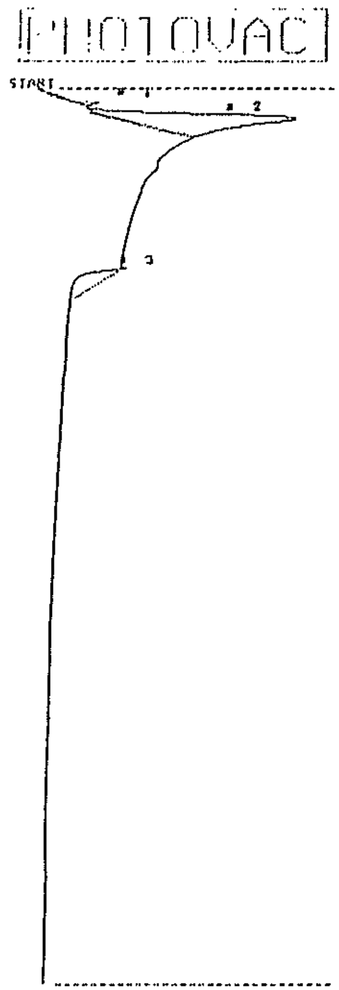
0930-04

Soil-Gas

Groundwater
(Free Product.)

0930-05

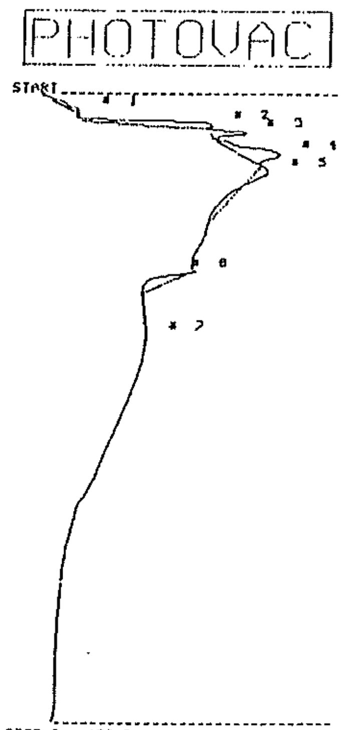
Soil-Gas



STOP @ 200.0
SAMPLE LIBRARY 2 SEP 30 94 12: 6
ANALYSIS # 26 CASPER, HY
INTERNAL TEMP 30 BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	21.5	5.4 US

Groundwater

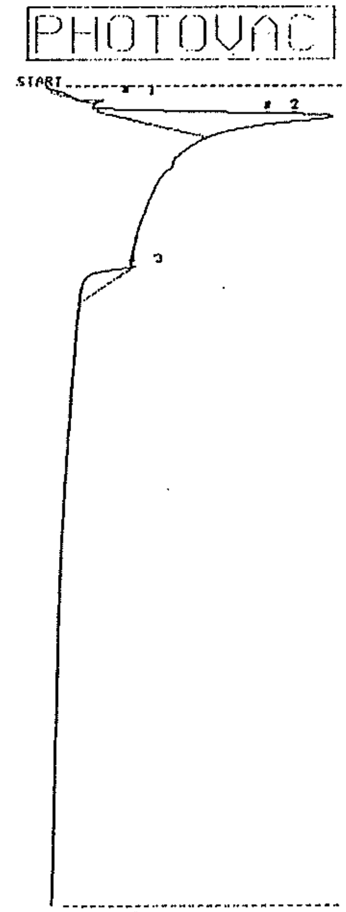


STOP @ 430.0
SAMPLE LIBRARY 2 SEP 30 94 13:13
ANALYSIS # 34 CASPER, WY
INTERNAL TEMP 32 BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	14.0	130.2 mUS
UNKNOWN	2	21.3	718.8 mUS
UNKNOWN	3	30.8	413.5 mUS
BENZENE^	4	40.5	1,250 PPM

0930-06

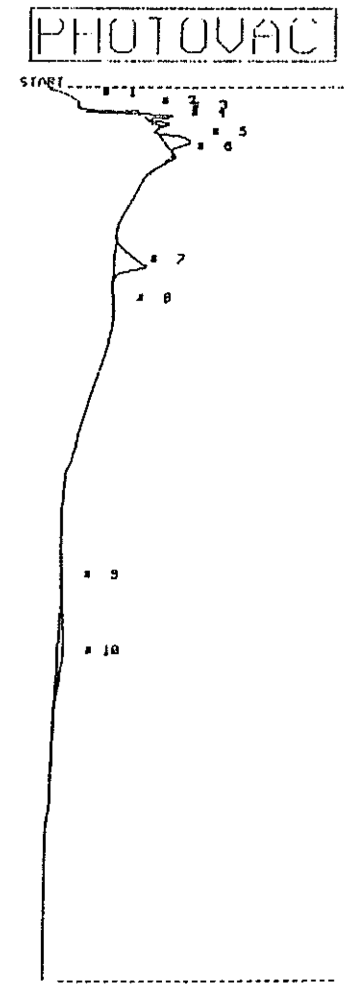
Soil-Gas



STOP @ 640.3
SAMPLE LIBRARY 2 SEP 30 94 12:32
ANALYSIS # 20 CASPER, WY
INTERNAL TEMP 32 BTEX Flow 20
GAIN 20 HUNTINGDON

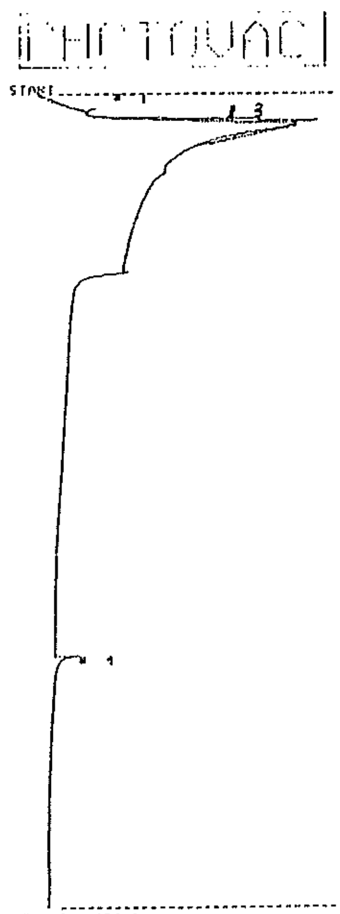
COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	23.9	8.7 US

Groundwater



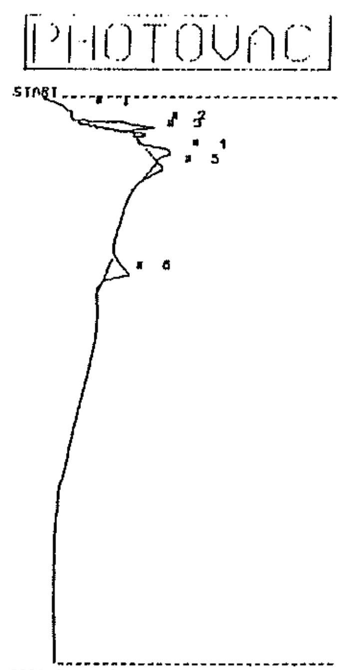
STOP @ 200.0
SAMPLE LIBRARY 2 SEP 30 94 14: 2
ANALYSIS # 35 CASPER, WY
INTERNAL TEMP 32 BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	20.9	128.2 mUS
UNKNOWN	3	24.5	242.7 mUS
BENZENE^	5	45.7	681.5 PPB
UNKNOWN	6	57.7	172.8 mUS
ETHYLBENZENE^	7	144.8	3,651 PPM
UNKNOWN	10	153.2	681.9 mUS



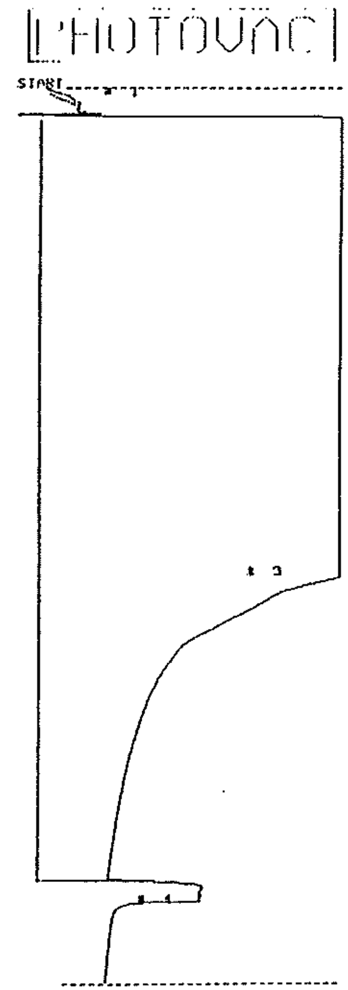
STOP @ 635.5
SAMPLE LIBRARY 2 SEP 30 94 12:52
ANALYSIS # 32 CASPER, WY
INTERNAL TEMP 32 BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	21.6	575.3 mVS



STOP @ 112.4
SAMPLE LIBRARY 2 SEP 30 94 14:02
ANALYSIS # 40 CASPER, WY
INTERNAL TEMP 36 BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	21.1	721.6 mVS
BENZENE*	4	15.5	508.5 PPB
UNKNOWN	5	50.3	341.4 mVS
ETHYLBENZENE*	6	111.4	2.160 PPM



STOP @ 700.0
SAMPLE LIBRARY 2 SEP 30 94 13:25
ANALYSIS # 35 CASPER, WY
INTERNAL TEMP 36 BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	12.1	148.2 mVS
ORTHO-XYLENE*	3	207.5	****** PPM

0930-07

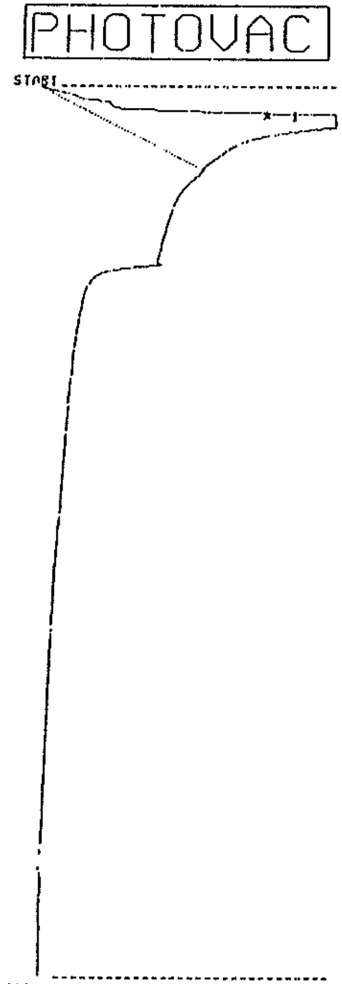
Soil-Gas

Groundwater

0930-08

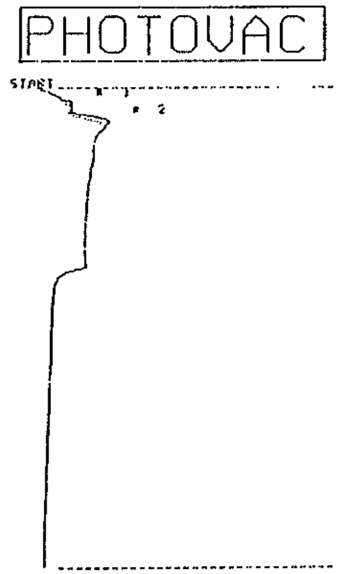
Soil-Gas
(Not-Quantifiable)

Groundwater
(Free-Product)



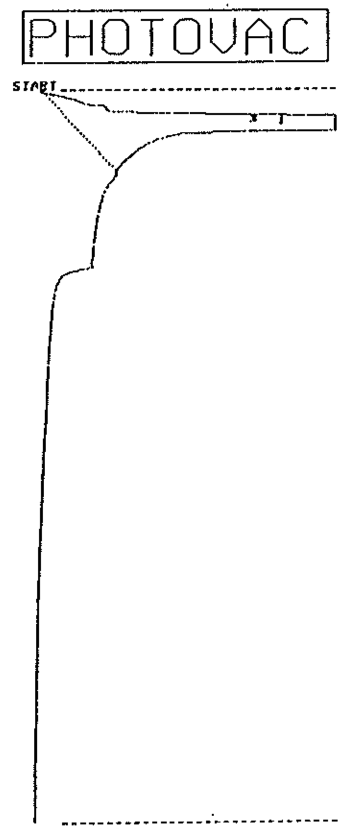
STOP @ 200.0
SAMPLE LIBRARY 2 OCT 3 94 14:13
ANALYSIS # 1 CASPER, WY
INTERNAL TEMP 31 BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	22.1	21.1 VS



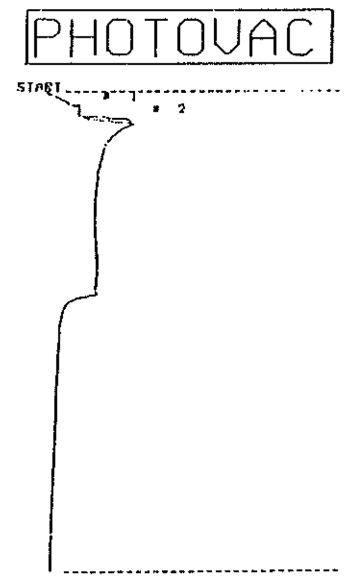
STOP @ 373.6
SAMPLE LIBRARY 2 OCT 3 94 15: 2
ANALYSIS # 10 CASPER, WY
INTERNAL TEMP 35 BTEX Flow 20
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	22.7	187.0 AVS



STOP @ 572.7
SAMPLE LIBRARY 2 OCT 3 94 14:50
ANALYSIS # 8 CASPER, WY
INTERNAL TEMP 34 BTEX Flow 20
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	26.3	25.8 VS



STOP @ 375.3
SAMPLE LIBRARY 2 OCT 3 94 15:22
ANALYSIS # 13 CASPER, WY
INTERNAL TEMP 37 BTEX Flow 20
GAIN 10 HUNTINGDON

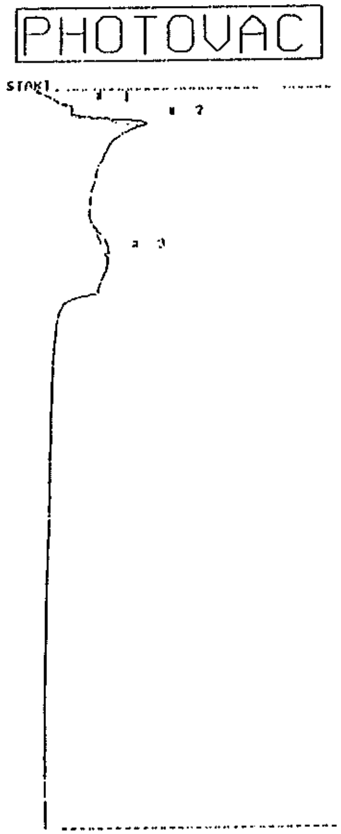
COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	24.5	200.1 AVS

1003-01

Soil-Gas   Groundwater

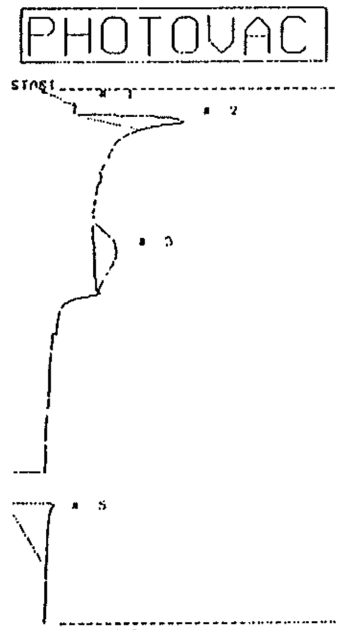
1003-02

Soil-Gas   Groundwater



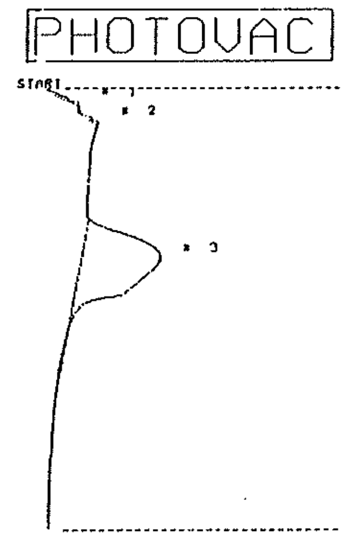
STOP @ 570.3
SAMPLE LIBRARY 2 OCT 3 94 15:19
ANALYSIS # 12 CASPER, WY
INTERNAL TEMP 36 BTEX Flow 20
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	26.5	210.7 mUS
UNKNOWN	3	133.2	252.0 mUS



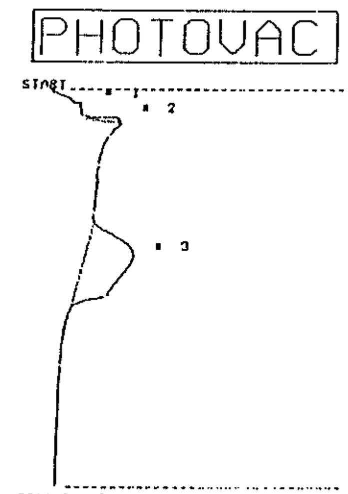
STOP @ 415.3
SAMPLE LIBRARY 2 OCT 3 94 16:21
ANALYSIS # 20 CASPER, WY
INTERNAL TEMP 33 BTEX Flow 20
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	22.3	1.3 US
UNKNOWN	3	131.2	1.7 US
UNKNOWN	5	336.7	2.8 US



STOP @ 313.3
SAMPLE LIBRARY 2 OCT 3 94 15:33
ANALYSIS # 14 CASPER, WY
INTERNAL TEMP 32 BTEX Flow 20
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	3	131.8	11.2 US

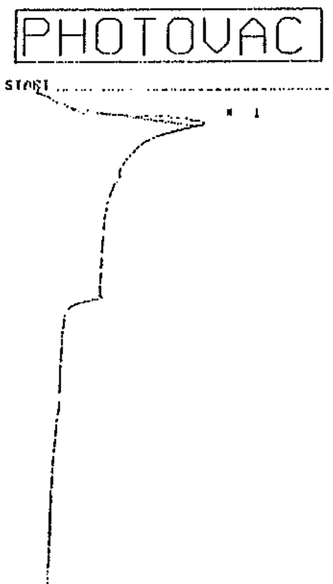


STOP @ 303.3
SAMPLE LIBRARY 2 OCT 3 94 16:27
ANALYSIS # 21 CASPER, WY
INTERNAL TEMP 33 BTEX Flow 20
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	24.5	146.1 mUS
UNKNOWN	3	132.4	6.6 US

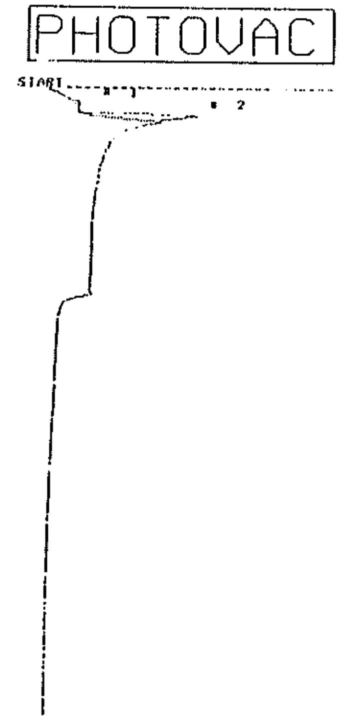
1003-03
Soil-Gas
Groundwater

1003-04
Soil-Gas
Groundwater



STOP @ 703.8
SAMPLE LIBRARY 2 OCT 3 94 16:14
ANALYSIS # 19 CASPER, WY
INTERNAL TEMP 30 BTEX Flow 20
GAIN 10 HUNTINGDON

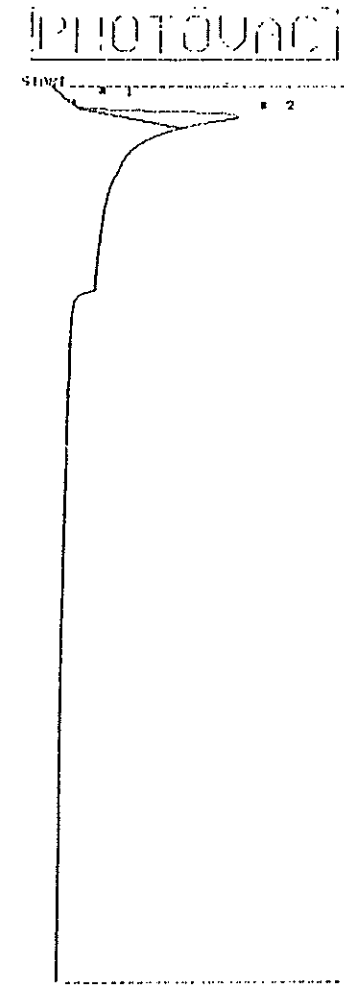
COMPOUND NAME PEAK R.T. AREA/PPM



STOP @ 491.3
SAMPLE LIBRARY 2 OCT 3 94 16:52
ANALYSIS # 24 CASPER, WY
INTERNAL TEMP 33 BTEX Flow 20
GAIN 10 HUNTINGDON

COMPOUND NAME PEAK R.T. AREA/PPM

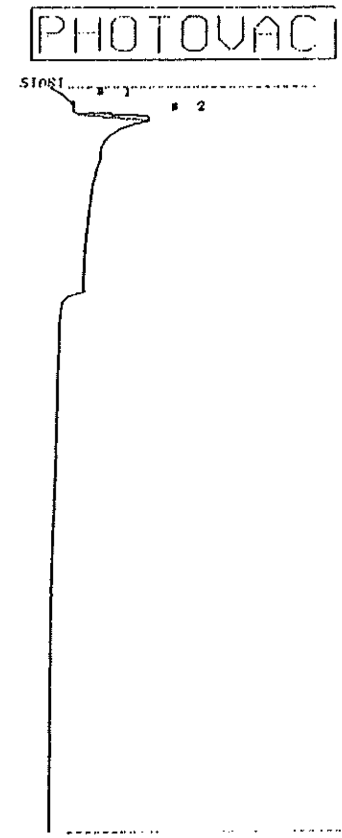
UNKNOWN 2 23.1 879.8 AVG



STOP @ 700.0
SAMPLE LIBRARY 2 OCT 4 94 8:52
ANALYSIS # 1 CASPER, WY
INTERNAL TEMP 32 BTEX Flow 20
GAIN 10 HUNTINGDON

COMPOUND NAME PEAK R.T. AREA/PPM

UNKNOWN 2 25.2 3.0 US



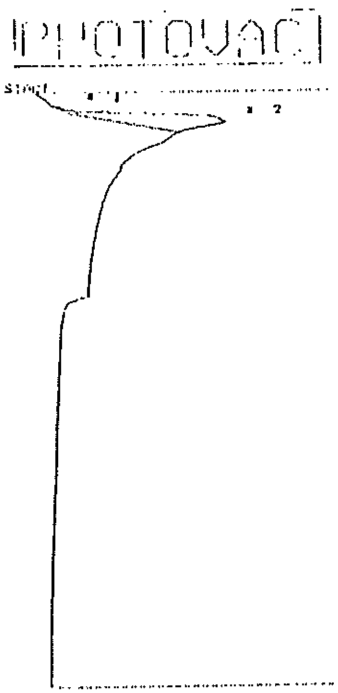
STOP @ 501.4
SAMPLE LIBRARY 2 OCT 4 94 9:32
ANALYSIS # 8 CASPER, WY
INTERNAL TEMP 34 BTEX Flow 20
GAIN 10 HUNTINGDON

COMPOUND NAME PEAK R.T. AREA/PPM

UNKNOWN 2 24.6 264.9 AVG

1003-05 1004-01

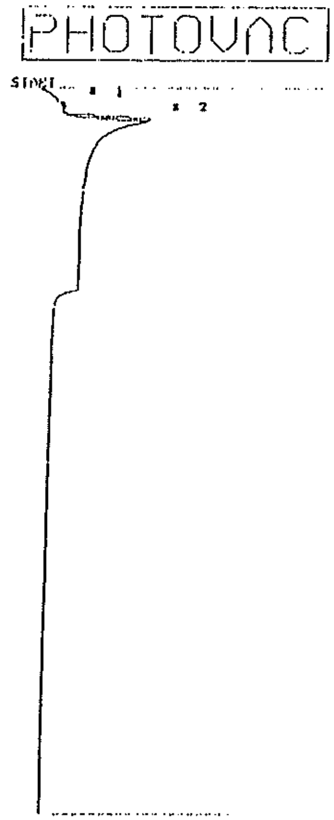
Soil-Gas Groundwater Soil-Gas Groundwater



STOP @ 465.0
SAMPLE LIBRARY 2 OCT 4 91 9:26
ANALYSIS # 7 CASPER, WY
INTERNAL TEMP 34 BTEX Flow 20
GAIN 10 HUNTINGDON

COMPOUND NAME PEAK R.T. AREA/PPM

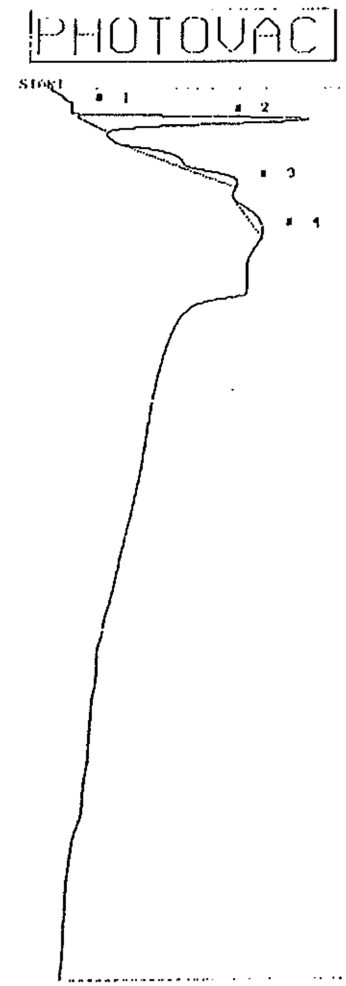
UNKNOWN 2 25.5 3.5 VS



STOP @ 553.0
SAMPLE LIBRARY 2 OCT 4 91 9:54
ANALYSIS # 10 CASPER, WY
INTERNAL TEMP 35 BTEX Flow 20
GAIN 10 HUNTINGDON

COMPOUND NAME PEAK R.T. AREA/PPM

UNKNOWN 2 24.5 214.5 mVS



STOP @ 200.0
SAMPLE LIBRARY 2 OCT 4 91 10:51
ANALYSIS # 14 CASPER, WY
INTERNAL TEMP 36 BTEX Flow 20
GAIN 10 HUNTINGDON

COMPOUND NAME PEAK R.T. AREA/PPM

UNKNOWN 2 25.0 4.7 VS
TOLUENE- 3 26.3 3.332 PPM
UNKNOWN 4 114.2 496.7 mVS

1004-02

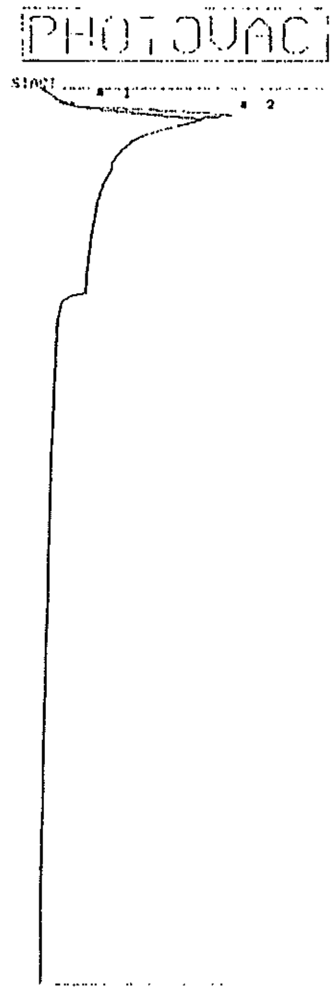
Soil-Gas

Groundwater

1004-03

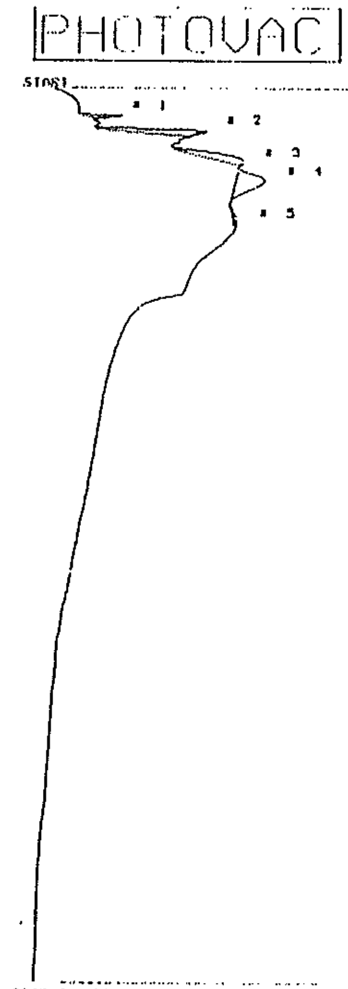
Soil. Gas
(No Sample)

Groundwater



STOP @ 200.0
SAMPLE LIBRARY 2 OCT 4 91 10:23
ANALYSIS # 12 CASPER, WY
INTERNAL TEMP 36 BTEX Flow 20
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	22.3	1.0 VS



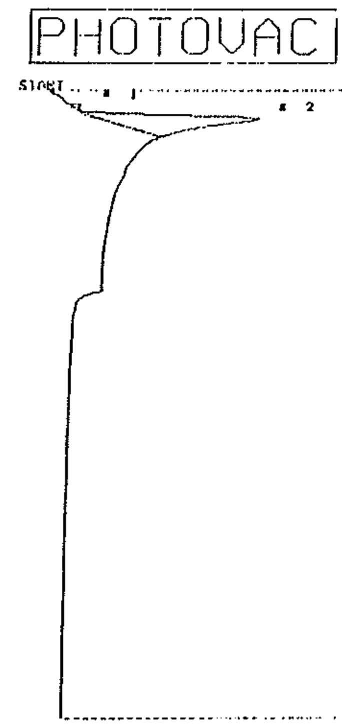
STOP @ 200.0
SAMPLE LIBRARY 2 OCT 4 91 11:25
ANALYSIS # 18 CASPER, WY
INTERNAL TEMP 37 BTEX Flow 20
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	22.8	113.2 mVS
UNKNOWN	2	34.8	685.4 mVS
Benzene	3	50.5	102.5 PPB
UNKNOWN	4	74.3	1.2 VS
Toluene	5	100.4	51.05 PPB

1004-04

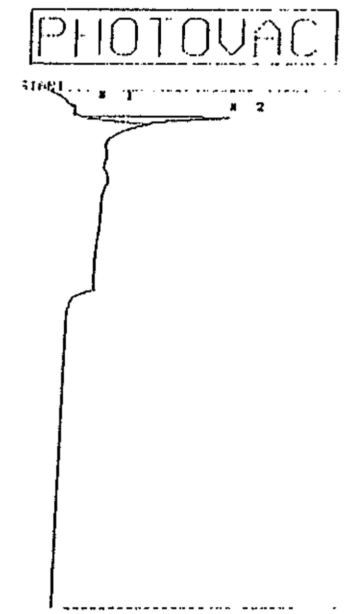
Soil-Gas

Ground water



STOP @ 491.9
SAMPLE LIBRARY 2 OCT 4 91 11:13
ANALYSIS # 17 CASPER, WY
INTERNAL TEMP 38 BTEX Flow 20
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	23.6	1.4 VS



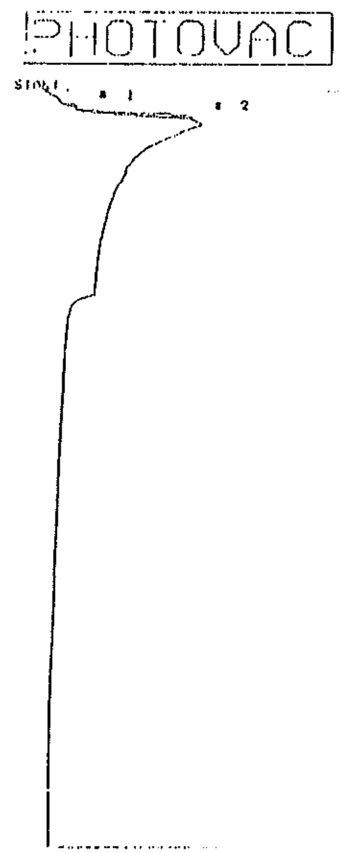
STOP @ 406.7
SAMPLE LIBRARY 2 OCT 4 91 12:1
ANALYSIS # 22 CASPER, WY
INTERNAL TEMP 38 BTEX Flow 20
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	22.5	1.1 VS

1004-05

Soil-Gas

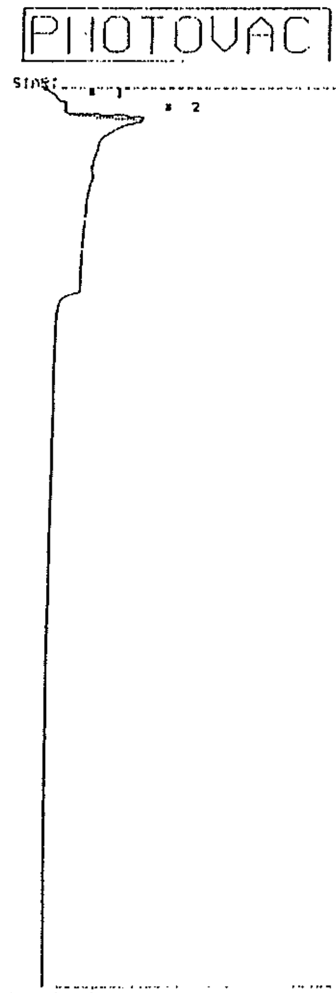
Ground water



STOP V 537.0
SAMPLE LIBRARY 2 OCT 4 91 11:47
ANALYSIS # 20 CASPER, WY
INTERNAL TEMP 37 BTEX Flow 20
GAIN 10 HUNTINGDON

COMPOUND NAME PEAK R.T. AREA/PPM

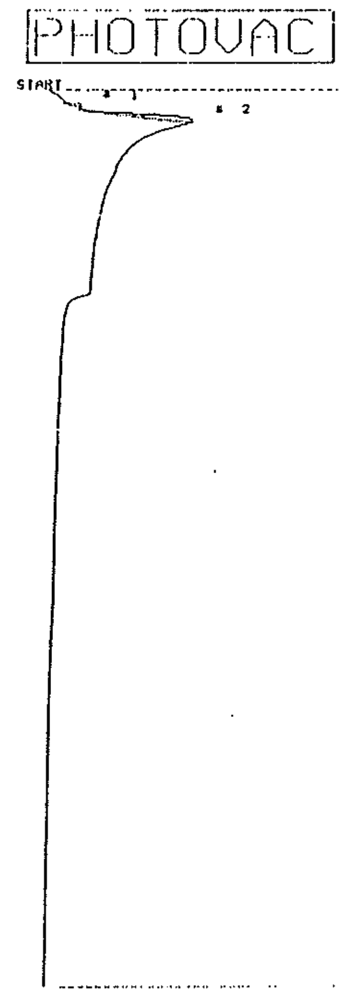
UNKNOWN 2 21.5 369.9 mVS



STOP V 200.0
SAMPLE LIBRARY 2 OCT 4 91 12:55
ANALYSIS # 26 CASPER, WY
INTERNAL TEMP 37 BTEX Flow 20
GAIN 10 HUNTINGDON

COMPOUND NAME PEAK R.T. AREA/PPM

UNKNOWN 2 24.8 256.1 mVS



STOP V 200.0
SAMPLE LIBRARY 2 OCT 4 91 12:20
ANALYSIS # 24 CASPER, WY
INTERNAL TEMP 37 BTEX Flow 20
GAIN 10 HUNTINGDON

COMPOUND NAME PEAK R.T. AREA/PPM

UNKNOWN 2 25.2 889.1 mVS

1004-06

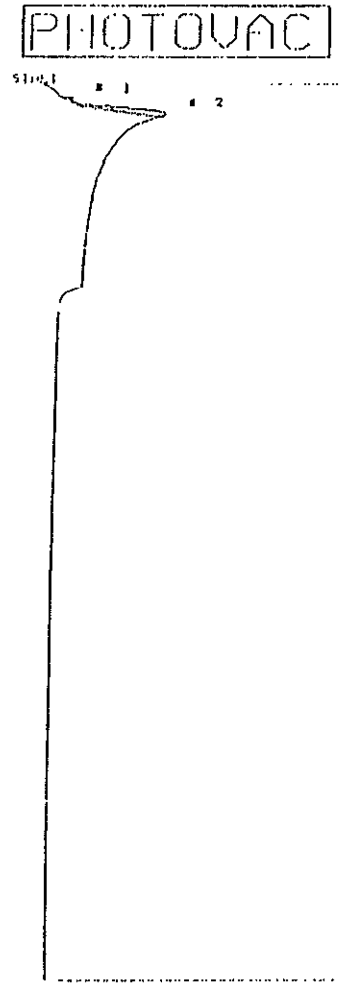
Soil-Gas

Groundwater

1004-07

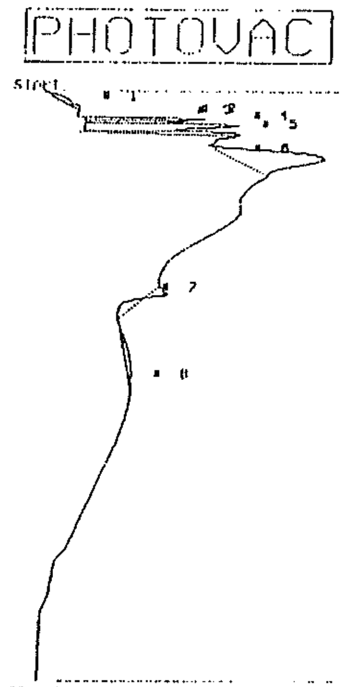
Soil-Gas

Groundwater
(Free Product)



STOP @ 203.3
SAMPLE LIBRARY 2 OCT 4 94 13:28
ANALYSIS # 28 CASPER, WY
INTERNAL TEMP 38 BTEX Flow 20
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	25.2	422.4 mVS



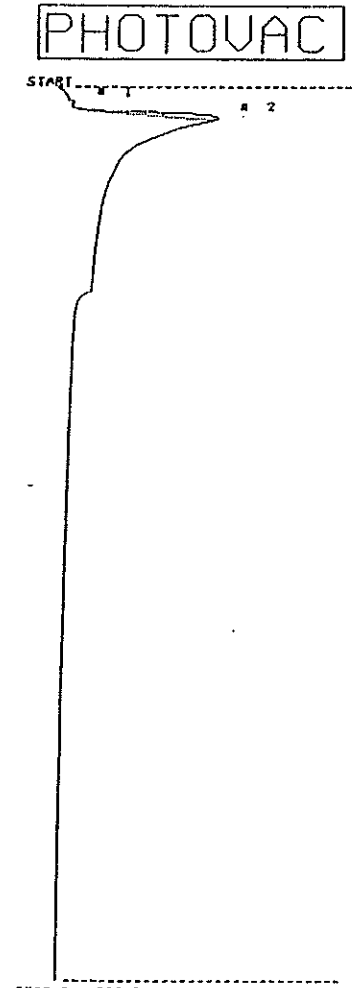
STOP @ 450.0
SAMPLE LIBRARY 2 OCT 4 94 14:13
ANALYSIS # 31 CASPER, WY
INTERNAL TEMP 38 BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	13.4	126.4 mVS
UNKNOWN	2	22.2	858.5 mVS
UNKNOWN	3	23.6	620.1 mVS
UNKNOWN	4	27.5	2.4 VS
UNKNOWN	5	34.6	663.5 mVS
Benzene	6	51.5	212.5 PPB
Ethylbenzene	8	231.3	91.30 PPB

1004-08

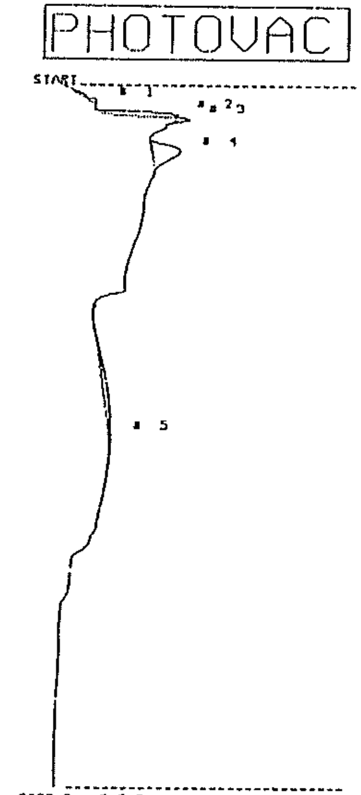
Soil-Gas

Groundwater



STOP @ 208.0
SAMPLE LIBRARY 2 OCT 5 94 8:26
ANALYSIS # 4 CASPER, WY
INTERNAL TEMP 29 BTEX Flow 20
GAIN 10 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	24.3	604.6 mVS



STOP @ 545.5
SAMPLE LIBRARY 2 OCT 5 94 9:33
ANALYSIS # 10 CASPER, WY
INTERNAL TEMP 32 BTEX Flow 20
GAIN 20 HUNTINGDON

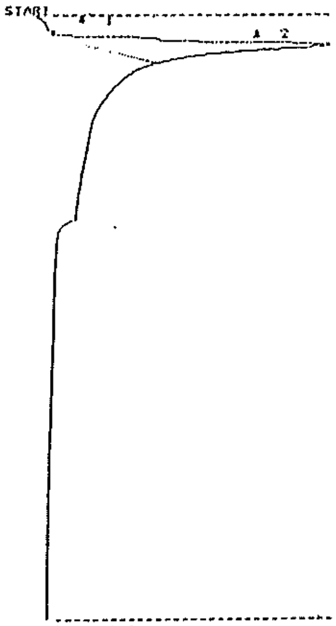
COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	24.1	312.6 mVS
UNKNOWN	3	27.5	153.5 mVS
Benzene	4	52.3	80.10 PPB
UNKNOWN	5	225.3	818.8 mVS

1005-01

Soil-Gas

Groundwater

PHOTOVAC

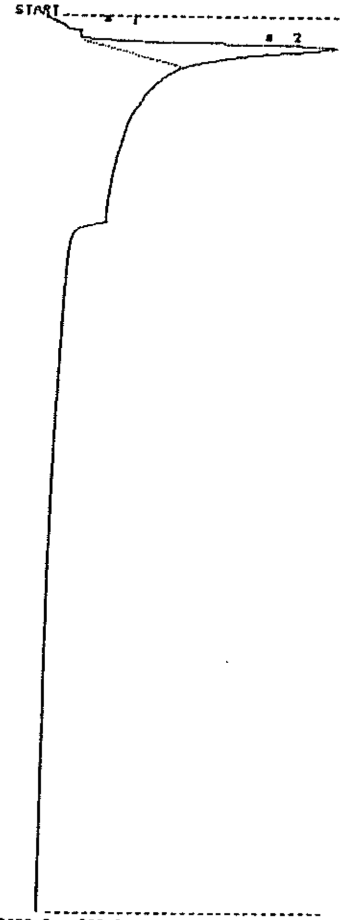


STOP @ 403.5
SAMPLE LIBRARY 2 OCT 5 94 8:57
ANALYSIS # 6 CASPER, WY
INTERNAL TEMP [illegible] BTEX Flow 20
GAIN [illegible] HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	21.1	7.5 US

1005-02
Soil-Gas
Groundwater
(No Sample)

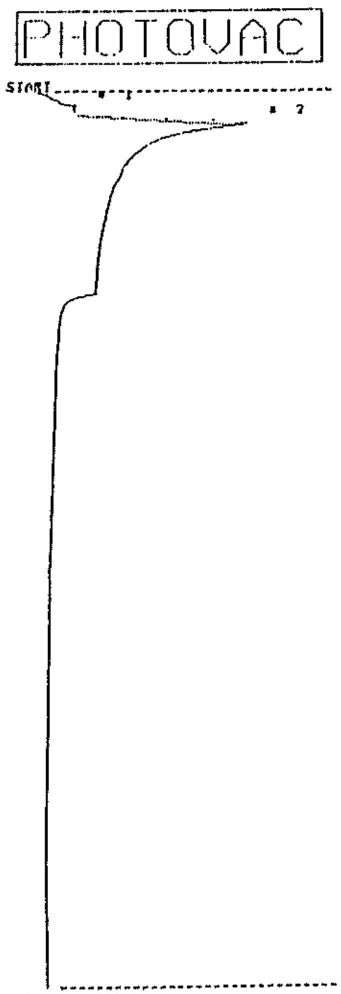
PHOTOVAC



STOP @ 200.0
SAMPLE LIBRARY 2 OCT 5 94 10:10
ANALYSIS # 13 CASPER, WY
INTERNAL TEMP 34 BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	21.7	6.8 US

1005-03
Soil-Gas
Groundwater
(No Sample)



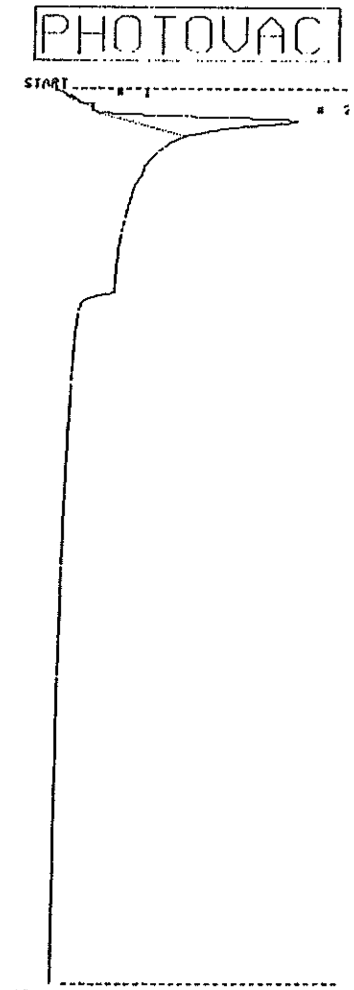
STOP @ 700.0
SAMPLE LIBRARY 2 OCT 5 04 11:1
ANALYSIS # 16 CASPER, WY
INTERNAL TEMP 34 BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	25.3	210.3 mVS

1005-04

Soil-Gas

Groundwater
(No Sample)



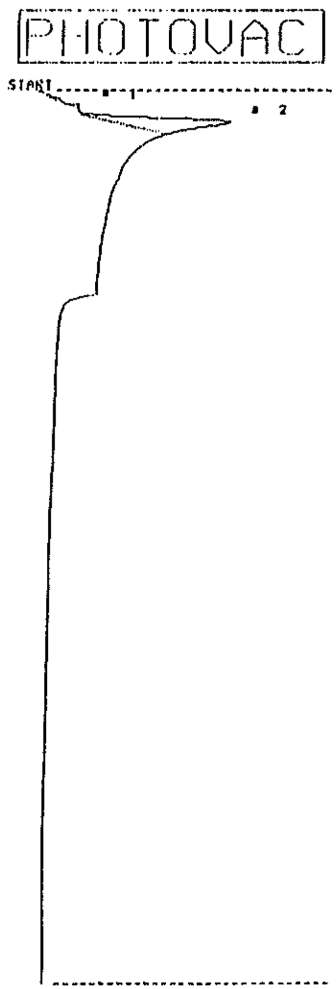
STOP @ 700.0
SAMPLE LIBRARY 2 OCT 5 04 11:40
ANALYSIS # 18 CASPER, WY
INTERNAL TEMP 35 BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	25.3	1.7 VS

1005-05

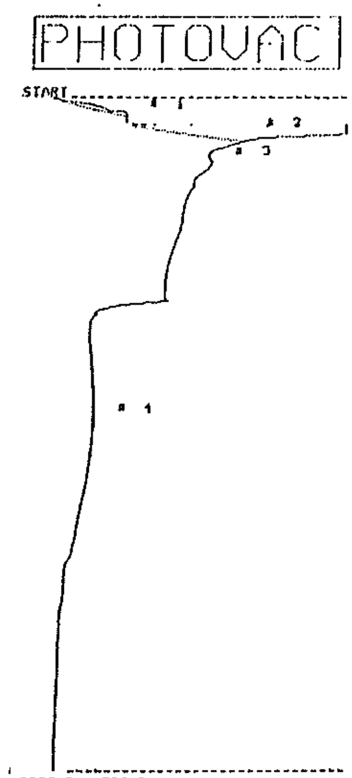
Soil-Gas

Groundwater
(No Sample)



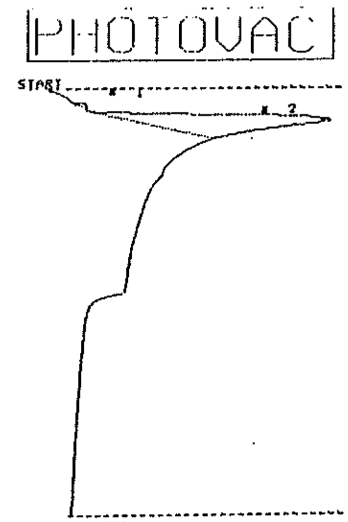
STOP @ 700.0
SAMPLE LIBRARY 2 OCT 5 94 12:1
ANALYSIS # 17 CASPER, WY
INTERNAL TEMP 38 BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	25.5	2.0 VS



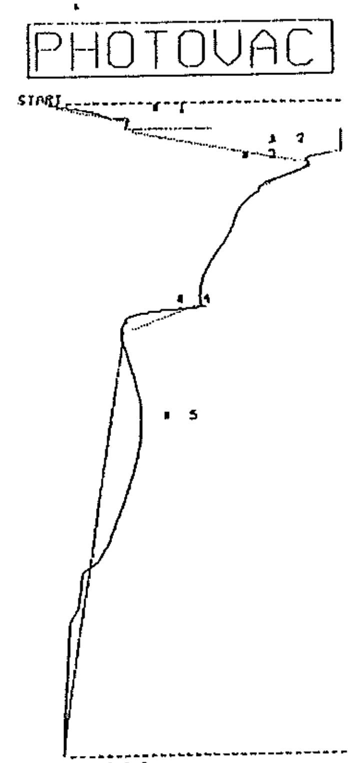
STOP @ 526.8
SAMPLE LIBRARY 2 OCT 5 94 14:12
ANALYSIS # 32 CASPER, WY
INTERNAL TEMP 34 BTEX Flow 20
GAIN 50 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	14.4	385.2 mVS
UNKNOWN	2	24.7	18.5 VS
Ethylbenzene	4	254.2	14.56 PPB



STOP @ 333.0
SAMPLE LIBRARY 2 OCT 5 94 12:40
ANALYSIS # 21 CASPER, WY
INTERNAL TEMP 36 BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	26.0	7.2 VS



STOP @ 510.2
SAMPLE LIBRARY 2 OCT 5 94 15:33
ANALYSIS # 39 CASPER, WY
INTERNAL TEMP 35 BTEX Flow 20
GAIN 50 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	12.0	173.0 mVS
UNKNOWN	2	25.5	62.7 VS
BENZENE-	3	45.3	85.07 PPB
Ethylbenzene	5	252.0	728.3 PPB

1005-06

Soil-Gas

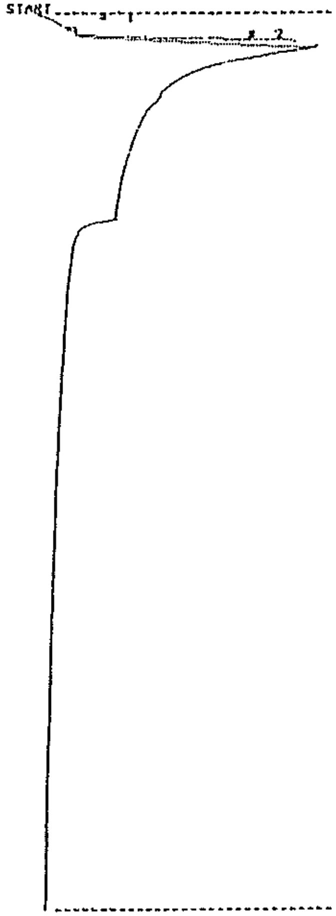
Groundwater

Soil-Gas

1005-07

Groundwater

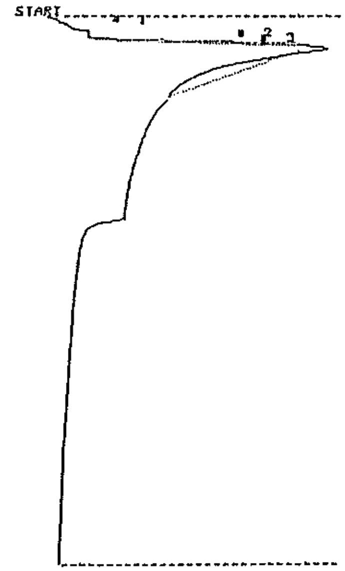
PHOTOVAC



STOP @ 200.0
SAMPLE LIBRARY 2 OCT 5 91 13:24
ANALYSIS # 23 CASPER, WY
INTERNAL TEMP [illegible] BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	20.0	1.5 VS

PHOTOVAC

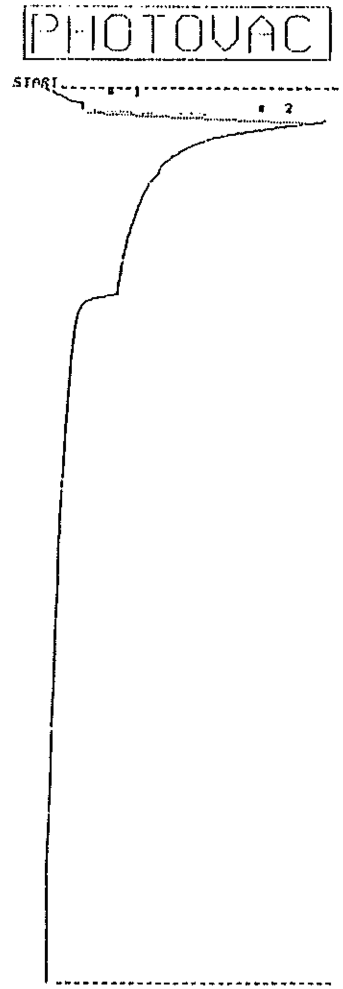


STOP @ 426.9
SAMPLE LIBRARY 2 OCT 6 91 13:44
ANALYSIS # 30 CASPER, WY
INTERNAL TEMP 35 BTEX Flow 20
GAIN 20 HUNTINGDON

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	22.7	117.8 mVS

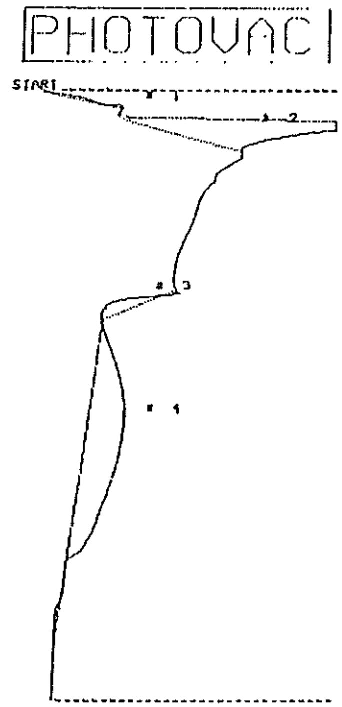
1005-08
Soil-Gas
Groundwater (No Sample)

1005-09
Soil-Gas
Groundwater (No Sample)



STOP @ 200.0
SAMPLE LIBRARY 2 OCT [illegible] 94 14:45
ANALYSIS # 39 CASPER, WY
INTERNAL TEMP [illegible] BFLX Flow 20
GAIN 20 [illegible]

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	2	25.4	1.1 VS



STOP @ 475.5
SAMPLE LIBRARY 2 OCT 5 94 15:23
ANALYSIS # 30 CASPER, WY
INTERNAL TEMP 35 BFLX Flow 20
GAIN 50 [illegible]

COMPOUND NAME	PEAK	R.T.	AREA/PPM
UNKNOWN	1	13.8	176.5 mVS
UNKNOWN	2	26.7	10.7 VS
Ethylbenzene	4	259.1	1.001 PPM

1005-10

Soil-Gas

Groundwater

APPENDIX B

LABORATORY REPORTS - GROUNDWATER

Department Of Environmental Quality
Water Quality Division Laboratory

Report of Analysis

Date of collection: 9/24/94
Collector: L. Fivas
Site: North Casper
Laboratory Number: 940764-940774

Laboratory Number	Sample ID	Tetrachloro-ethylene	Trichloro-ethylene	Comments
940764	D6	<1.0	<1.0	—
940765	A5	64.0	<1.0	
940766	C3	2.5	<1.0	
940767	C4	173.5	2.6	
940768	C2	1.4	<1.0	
940769	C1	1.2	<1.0	
940770	B2	<1.0	<1.0	
940771	B3	<1.0	<1.0	
940772	B4	71.2	<1.0	PCE=0.5
940773	B5	31.4	<1.0	
940774	C5	45.0	<1.0	

NOTES:
1. REPORTING LIMIT = 1.0 ug/l, MDL = 0.5 ug/l.
2. ANALYSIS RESULTS ARE REPORTED IN ug/L.
3. ALL SAMPLES WERE UNPRESERVED.

Edward Mock

Edward Mock, PhD
Laboratory Supervisor
10/20/94

Department Of Environmental Quality
Water Quality Division Laboratory

Report of Analysis

Date of collection: 9/25/94
Collector: L. Fivas
Site: North Casper
Laboratory Number: 940775-940782

Laboratory Number	Sample ID	Tetrachloro-ethylene	Trichloro-ethylene	Comments
940775	C6	145.0	1.2	
940776	B6	126	10.5	
940777	A6	<1.0	<1.0	—
940778	A7	<1.0	<1.0	CHLOROFORM
940779	C7	<1.0	<1.0	
940780	D5	1.2	<1.0	CHLOROFORM
940781	D4	<1.0	<1.0	CHLOROFORM
940782	A4	<1.0	<1.0	CHLOROFORM

NOTES:
1. REPORTING LIMIT = 1.0 ug/l, MDL = 0.5 ug/l.
2. ANALYSIS RESULTS ARE REPORTED IN ug/L.
3. ALL SAMPLES WERE UNPRESERVED.
4. THE PRESENCE OF THE THM CHLOROFORM INDICATES CHLORINATED WATER.

Edward Mock

Edward Mock, PhD
Laboratory Supervisor
10/20/94

Department Of Environmental Quality
Water Quality Division Laboratory

Report of Analysis 777-7317

Date of collection: 9/27/94
Collector: L. Fivas
Site: North Casper
Laboratory Number: 940783-940794

Laboratory Number	Sample ID	Tetrachloro-ethylene	Trichloro-ethylene	Comments
940783	AA6	<1.0	<1.0	—
— 940784	BB6	200	<1.0	
940785	DD6	<1.0	3.0	CHLOROFORM
940786	DD5	<1.0	<1.0	
940787	AA5	270.0	45.0	CHLOROFORM
940788	AAA5	17.3	28.0	CHLOROFORM DCE=70.8
— 940789	C6.5	127.6	<1.0	CHLOROFORM DCE=12.2 BROMOFORM
940790	B6.5	60.0	3.0	DICHLORO- BENZENES
940791	A6.5	<1.0	<1.0	CHLOROFORM DCE=64.5
— 940792	C6.5	1.0 ?	<1.0	
940793	BB5.6	2.7 ?	<1.0	CHLOROFORM
940794	BB6	201	<1.0	CHLOROFORM

NOTES:
1. REPORTING LIMIT = 1.0 ug/l, MDL = 0.5 ug/l.
2. ANALYSIS RESULTS ARE REPORTED IN ug/L.
3. ALL SAMPLES WERE UNPRESERVED.
4. THE PRESENCE OF THE THM CHLOROFORM INDICATES CHLORINATED WATER.

Edward Mock

Edward Mock, PhD
Laboratory Supervisor
10/20/94

Department Of Environmental Quality
Water Quality Division Laboratory

Report of Analysis

Date of collection: 9/28/94
Collector: L. Fivas
Site: North Casper
Laboratory Number: 940808-940816

Laboratory Number	Sample ID	Tetrachloro-ethylene	Trichloro-ethylene	Comments
940808	B-5.5	0.7	<1.0	
940809	A-5.5	16.4	<1.0	
940810	A-4.5	22.8	<1.0	
940811	BB-4	313	<1.0	
940812	AA-4	43.7	<1.0	
940813	DD-4	1.1	<1.0	
940814	C-3.5	613	<1.0	
940815	B-3.5	4.7	<1.0	DCE=8.9
940816	A-3.5	<1.0	<1.0	

NOTES:
1. REPORTING LIMIT = 1.0 ug/l MDL = 0.5 ug/l.
2. ANALYSIS RESULTS ARE REPORTED IN ug/L.
3. ALL SAMPLES WERE UNPRESERVED.

Edward Mock

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10/20/94

Department Of Environmental Quality
Water Quality Division Laboratory

Report of Analysis

Date of collection: 9/29/94
Collector: L. Fivas
Site: North Casper
Laboratory Number: 940817-940827

Laboratory Number	Sample ID	Tetrachloro-ethylene	Trichloro-ethylene	Comments
940817	929-1	<1.0	<1.0	PCE=0.6
940818	929-2	<1.0	<1.0	
940819	929-3	23.1	<1.0	
940820	BB-6	200	<1.0	
940821	DD-6	16.4	7.0	
940822	AA-5	<1.0	<1.0	CHLOROFORM
940823	AAA-5	197	30.2	
940824	C-5.5	220	6.1	
940825	929-4	1.3	<1.0	CHLOROFORM
940826	929-5	<1.0	<1.0	CHLOROFORM
940827	929-6	<1.0	<1.0	CHLOROFORM

NOTES:
1. REPORTING LIMIT = 1.0 ug/l MDL = 0.5 ug/l.
2. ANALYSIS RESULTS ARE REPORTED IN ug/L.
3. ALL SAMPLES WERE UNPRESERVED.
4. THE PRESENCE OF THE THM CHLOROFORM INDICATES CHLORINATED WATER.

Edward Mock

Edward Mock, PhD
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10/20/94

Department Of Environmental Quality
Water Quality Division Laboratory

Report of Analysis

Date of collection: 9/30/94
Collector: L. Fivas
Site: North Casper
Laboratory Number: 940828-940835

Laboratory Number	Sample ID	Tetrachloro-ethylene	Trichloro-ethylene	Comments
940828	930-1	<1.0	<1.0	CHLOROFORM
940829	930-2	<1.0	<1.0	CHLOROFORM
940830	930-3	145	98.0	—
940831	930-4	<1.0	<1.0	
940832	930-5	4.6	1.1	
940833	930-6	<1.0	<1.0	
940834	930-7	<1.0	<1.0	
940835	930-8	<1.0	<1.0	

NOTES:
1. REPORTING LIMIT = 1.0 ug/l MDL = 0.5 ug/l.
2. ANALYSIS RESULTS ARE REPORTED IN ug/L.
3. ALL SAMPLES WERE UNPRESERVED.
4. THE PRESENCE OF THE THM CHLOROFORM INDICATES CHLORINATED WATER.

Edward Mock

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10/20/94

Department Of Environmental Quality
Water Quality Division Laboratory

Report of Analysis

Date of collection: 10/3/94
Collector: L. Fivas
Site: North Casper
Laboratory Number: 940836-940840

Laboratory Number	Sample ID	Tetrachloro-ethylene	Trichloro-ethylene	Comments
940836	1003-1	<1.0	<1.0	
940837	1003-2	<1.0	<1.0	CHLOROFORM
940838	1003-3	9.9	<1.0	
940839	1003-4	27.2	<1.0	
940839	1003-5	<1.0	<1.0	
940840	1003-6	<1.0	<1.0 ?	

NOTES:
1. REPORTING LIMIT = 1.0 ug/l MDL = 0.5 ug/l.
2. ANALYSIS RESULTS ARE REPORTED IN ug/L.
3. ALL SAMPLES WERE UNPRESERVED.
4. THE PRESENCE OF THE THM CHLOROFORM INDICATES CHLORINATED WATER.

Edward Mock
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10/20/94

Department Of Environmental Quality
Water Quality Division Laboratory

Report of Analysis

Date of collection: 10/4/94
Collector: L. Fivas
Site: North Casper
Laboratory Number: 940841-940848

Laboratory Number	Sample ID	Tetrachloro-ethylene	Trichloro-ethylene	Comments
940841	1004-1	<1.0	<1.0	
940842	1004-2	<1.0	<1.0	
940843	1004-3	23.2	19.2	
940844	1004-4	21.9	<1.0	
940845	1004-5	<1.0	<1.0	
940846	1004-6	<1.0	<1.0	
940847	1004-7	<1.0	<1.0	
940848	1004-8	<1.0	<1.0	

NOTES: 1. REPORTING LIMIT = 1.0 ug/l MDL = 0.5 ug/l.
2. ANALYSIS RESULTS ARE REPORTED IN ug/L.
3. ALL SAMPLES WERE UNPRESERVED.

Edward Mock

Edward Mock, PhD
Laboratory Supervisor
10/20/94

Department Of Environmental Quality
Water Quality Division Laboratory

Report of Analysis

Date of collection: 10/5/94
Collector: L. Fivas
Site: North Casper
Laboratory Number: 940849-940853

Laboratory Number	Sample ID	Tetrachloro-ethylene	Trichloro-ethylene	Comments
940849	1005-1	<1.0	<1.0	CHLOROFORM
940850	1005-6	<1.0	<1.0	CHLOROFORM
940851	1005-7	<1.0	<1.0	CHLOROFORM
940852	1005-10	<1.0	<1.0	CHLOROFORM
940853	1003-10	<1.0	<1.0	CHLOROFORM

NOTES:
1. REPORTING LIMIT = 1.0 ug/l MDL = 0.5 ug/l.
2. ANALYSIS RESULTS ARE REPORTED IN ug/L.
3. ALL SAMPLES WERE UNPRESERVED.
4. THE PRESENCE OF THE THM CHLOROFORM INDICATES THE CHLORINATED WATER.

Edward Mock
Edward Mock, PhD
Laboratory Supervisor
10/20/94

Department Of Environmental Quality
Water Quality Division Laboratory

Report of Analysis

Date of collection: 9/24-10/5/94
Collector: L. Fivas
Site: North Casper
Laboratory Number: 940776-940853

LAB NO.	Sample ID	BENZENE	ETHYL-BENZENE	TOLUENE	XYLENE
940776	B6	<50	495	<0.5	5063
940828	930-1	1.7	10.5	<0.5	173
940830	930-3	<50	9214	187	445
940830	930-4	52	3258	<50	6700
940832	930-5	<0.5	29.0	<0.5	58.3
940833	930-6	<0.5	19.2	<0.5	37.4
940834	930-7	<0.5	14.8	<0.5	37.4
940835	930-8	9043	746	2219	6276
940843	1004-3	<0.5	65	12.8	49.8
940844	1004-4	0.7	23.2	11.1	13.8
940847	1004-7	2019	1877	14.3	6969
940848	1004-8	23.5	53.1	1.7	133
940849	1005-1	1.2	14.0	<0.5	51.3
940850	1005-6	<0.5	13.7	<0.5	57.3
940851	1005-7	<0.5	8.0	<0.5	41.5
940852	1005-10	<0.5	11.9	<0.5	53.8
940853	1005-10D	<0.5	25.6	<0.5	10.8

NOTES:
1. REPORTING LIMIT = 0.5 ug/l.
2. ANALYSIS RESULTS ARE REPORTED IN ug/L.
3. ALL SAMPLES WERE UNPRESERVED.

Edward Mock

Edward Mock, PhD
Laboratory Supervisor
10/20/94

Department Of Environmental Quality
Water Quality Division Laboratory

Report of Analysis

Date of collection: 10/25-26//94
Collector: L. Fivas
Site: North Casper
Laboratory Number: 940882-940889

Laboratory Number	Sample ID	Tetrachloro-ethylene	Trichloro-ethylene	Comments
940882	R1	12.2	<1.0	
940883	R1	11.8	<1.0	
940884	MW~~0~~5	7.7	<1.0	
940885	MW~~0~~5	8.1	<1.0	
940886	MW~~5~~6	13.6	<1.0	
940887	MW~~3~~6	13.4	<1.0	
940888	MW4	<1.0	<1.0	TRACE PCE
940889	MW4	<1.0	<1.0	TRACE PCE

NOTES: 1. REPORTING LIMIT = 1.0 ug/l, MDL = 0.5 ug/l.
2. ANALYSIS RESULTS ARE REPORTED IN ug/L.

WELL NUMBERS CHANGED TO CORRESPOND WITH PREVIOUS REPORT

Edward Mock
Edward Mock, PhD
Laboratory Supervisor
11/2/94

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APPENDIX C

STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURE

GEOPROBE OPERATION AND SAMPLE COLLECTION

General Probing

The system is a conventionally mounted Model 8-M Geoprobe sampling assembly that uses a hydraulically-powered percussion hammer to drive 3-foot long, 1-inch diameter, hollow-steel rods.

1. Position the vehicle to the desired probing location and take the vehicle out of gear and engage the parking brake.

2. Using the slow speed on the hydraulic controls, fold the probe out of the van making sure it is level.

3. Lower the foot of the unit so that the vehicle is raised by approximately 6 inches.

4. If probing through surface pavements, use the appropriate carbide-tipped drill steel with the hammer rotation control activated. Keep the hammer lever fully depressed while advancing the probe in small increments.

5. If the surface and near-surface conditions are hard and/or rocky (e.g. road-base), it may be necessary to drive the first one or two rod lengths using the solid point. The hammer rotation control should be deactivated with the hammer anvil in place.

6. Depending on what type of a sample is desired (discussed in more detail below), attach the appropriate sampling tool to the end of a rod and position the rod accordingly. Begin driving the rod by pushing down on the probe control. The rod(s) may be advanced by the static weight of the van alone. If not, employ the hammer control and keeping it depressed advance the probe in small increments until the desired sampling depth is reached or probe refusal is encountered.

7. The rods are also pulled using the Geoprobe system. Lift the latch and remove the driving anvil from the hammer. Install a pull-cap on the rod string and move the probe cylinder down until the latch can be closed over the pull-cap. Retract the rods by holding up on the probe control.

Soil-Vapor Sampling

1. Attach the retractable point assembly to the lead drive-rod making sure the two ball-bearings are in place.

2. Drive the rods to the desired depth and pull them up approximately six inches to allow space for the point to retract. The point may be extracted manually using the small-diameter extension rods.

3. Install the gas-sampling cap on the rods and secure the vacuum tubing to it making sure all connections are tight and leak-free. Using the vacuum, evacuate the rods and tubing of ambient air. The soil-gas may be sampled by piercing the tubing with a syringe and extracting or by connecting a direct reading instrument with an internal pump directly to the tubing.

4. After the sample has been collected, the rods may either be pulled or advanced to a deeper sampling location.

Soil Sampling

1. Attach either the standard or large-bore soil sampler to the lead drive-rod.

2. Drive the sampler to the depth at which you want to begin the sampling interval and disengage the piston stop-pin using extension rods.

3. Drive the rods the length of the interval you want to sample. The standard sampler collects a one-foot sample and the large-bore a two-foot sample.

4. Pull the rods.

5. Take apart the sampler and extrude the sample using a piston by hand or with the probe and the extruder rack.

Groundwater Sampling

1. Use either the mill-slotted rod section or the screen-point sampler as the lead drive-rod.
2. Drive the rods to the desired depth and sample as follows:

    a. When using the screen-point sampler, the rods must be pulled up 18 to 24 inches before a sample can be collected. After this has been done, the rods can no longer be driven deeper without pulling out the entire rod-string and attaching a new disposable drive point to the sampler.

    b. If using the mill-slotted rod section, there is no need to pull the rods up before collecting a sample. Additionally, the rods may continued to be driven if needed.

3. Groundwater samples may be collected with the rods in place using a check-valve small-diameter bailer or peristaltic pump equipped with polyethylene tubing.

Decontamination Procedures

All down-hole equipment (Geprobe rods, sampling tips, bailers, etc.) are decontaminated between each boring in accordance with HE&E SOP-11.

STANDARD OPERATING PROCEDURE

PORTABLE GAS CHROMATOGRAPH OPERATION

FIELD GAS CHROMATOGRAPHY EQUIPMENT

The Photovac 10S70 is a portable gas chromatograph (GC) equipped with a photo-ionization detector (PID), isothermal capillary GC column oven, encapsulated capillary column and data analysis software that allows the detection and identification of numerous organic compounds. The Photovac 10S70 GC produces a chart-recorded chromatogram for each analysis. Using PC Dandi software

The standard Photovac 10S70 GC equipment set-up includes a 10 m long x 0.53 mm i.d. wide-bore CP-Sil 5 CB capillary column, and a standard photo-ionization source of 10.6 eV. The photo-ionization source can be increased to 11.7 eV to increase the detection capabilities for compounds that have photo-ionization potentials above 10.6 eV (such as chloroform)

As a vapor sample travels through the GC capillary column, individual compounds travel at different rates resulting in specific compounds leaving the capillary column and passing by the photo-ionization detector at different times. These different analysis times are referred to as retention times. The individual compounds contained within a given sample are identified by their characteristic chromatogram peaks and retention times.

FIELD GAS CHROMATOGRAPHY ANALYSIS PROTOCOL

Daily Start-Up

1. Before turning the GC on, check and fill (if necessary) the air tank with approximately 1200 psi of zero-grade air only.

2. The GC oven should be turned on with air flowing through the column for at least 30 minutes before any analyses or blanks are run.

3. If a soil or groundwater standard is to be used, they should be prepared using certified organic-free water with ample for them to equilibrate.

4. After turning on the GC, check and set the gain as it will default to 2 whenever it is turned off. Also check the library in use and adjust the date and time accordingly.

5. If using a personnel computer with PCDandi software, set up a job-specific directory with daily subdirectories and set up the software to autostore each run.

6. Check and change, if necessary, the injection port septa. This should be done periodically throughout the day.

7. Initial analyses of pre-calibration ambient air blanks, syringe blanks and carrier-gas blanks should be performed to ensure that no outside contamination bias the results

8. The isothermal-capillary GC column oven temperature is typically maintained at 50-degrees centigrade. The carrier-gas flow rate is maintained at a constant flow rate using an external flow meter.

Record Keeping

All field gas-chromatography notes and observations shall be logged in indelible ink on the Field Gas-Chromatograph Analysis Log. Hard copies of all chromatograms are to be kept and used for reporting, etc. For backup, all chromatogram data is to be stored on the hard disc drive of a lap-top personal computer.

Field Gas Chromatograph Calibration

Calibration of the Photovac 10S70 GC consists of manually injecting a known volume of calibration standard containing the selected analytes into the GC. The appropriate compound name, compound concentration and retention time is assigned to the observed chromatogram peaks, and the compound information stored into one of the four GC analysis libraries. Separate libraries should be used for analyses of different sample matrices (e.g. soil and groundwater).

Calibration Standard Preparation

Soil-Vapor Standards - Gaseous calibration standards used for analyzing soil-vapor samples may be obtained from a compressed gas supplier. Some compounds may require up to four weeks advance notice for the supplier to prepare them. Less accurate soil-vapor standards may also be prepared in the field using the method described in the Photovac Technical Bulletin #21.

Soil and Groundwater Standards - Aqueous calibration standards are used for analyzing soil and water samples. They are prepared in the field from stock solutions prepared by an analytical laboratory. Each stock solution is composed of known masses of reagent-grade organic compounds of concern. The calibration standards are prepared by injecting a known volume (usually one to two microliter) of stock solution into a septa-capped, 40-milliliter sample vial containing 20 milliliters of organic free water. Given the known information, the concentration of the compounds in water can be calculated. The standard is then shaken vigorously to maximize volatilization and allowed to equilibrate for a minimum of 30 minutes before analyzing.

Field Gas Chromatography Analytical Method

Soil-Vapor Samples - Soil-vapor samples are injected directly into the GC. It is recommended that at least two runs for each sample is done. The first injection should be of a conservative volume used as a screening sample so as not to over-saturate the GC column with contaminant. If no contamination is detected, a larger volume (no greater than 100 times the first) is injected in order to get a lower detection limit. Still greater injection volumes may be necessary to achieve a lower detection limit.

Soil Samples - The Photovac 10S70 Portable GC is designed to only accept gas samples. Consequently, soil and ground-water samples are analyzed for VOCs by analyzing a volume of the headspace vapors above the sample. Soil samples are prepared by homogenizing and weighing out a specific mass (usually 10 grams) of the sample into a dry, factory cleaned 40-milliliter glass vial. Twenty milliliters of organic-free water is added and the mixture is capped and vigorously shaken and allowed to sit for at least 30 minutes before it is analyzed.

Groundwater Samples - Sample preparation of groundwater samples for the headspace-extraction method consists of transferring approximately 20 milliliters of ground-water sample into a dry, factory cleaned 40-milliliter glass vial and capping with a septa lid. The sample is vigorously shaken to maximize volatilization, and allowed to equilibrate for a minimum of 30 minutes.

For analysis of both soil and groundwater samples, the septa cap is pierced with a gas-tight syringe and the desired volume of headspace sample is removed. The extracted sample is then manually injected into the Photovac GC for analysis. Prepared headspace samples are typically analyzed within 1 hour of sample preparation. As with the soil-vapor samples, initially small-volume injections should be done working up to sufficient volumes to achieve the desired detection level.

Field Gas Chromatography Quality Assurance and Quality Control

As a quality control measure, the field GC operator shall analyze pre-analysis ambient air and carrier gas blanks to assure the gas-tight sample syringes, ambient air, and GC equipment are free of contamination. In addition to the pre-analysis blanks, one ambient air/syringe blank is to be analyzed for approximately every 10 analytical injections as an additional QC measure. If the field samples being analyzed contain no contamination, fewer blanks between sample analyses are needed. In addition, multiple injections of selected samples are to be analyzed to determine the validity of the field screening results based on sample collection, injection technique, and reproducability of the data.

To prevent cross contamination, the operator shall evacuate a minimum of five syringe volumes of ambient air from the injection syringes prior to loading the injection syringe with the vapor sample. Sample syringes and calibration syringes are segregated to further reduce the potential for cross contamination.

To provide continuous field service and minimize down-time associated with equipment malfunctions, the operator shall maintain a supply of replacement equipment on-site. This extra equipment is to include:

- Gastight Syringes with replacement parts,
- PID UV Lamps,
- GC Capillary column, and
- Back-up copies of computer software.

The HE&E analytical laboratory and the Photovac Technical Applications Department can contacted to provide additional technical support and trouble-shooting capabilities by phone.

EQUIPMENT DECONTAMINATION

The purpose of this section is to describe general decontamination procedures for field equipment in contact with mine/mill tailings, soil, or water. During field sampling activities, sampling equipment will become contaminated after it is used. Sampling equipment must be decontaminated between sample collection points if it is not disposable. Field personnel must wear disposable latex or vinyl gloves while decontaminating equipment at the project site. Change gloves between every sample. Every precaution must be taken by personnel to prevent contaminating themselves with the wash water and rinse water used in the decontamination process.

Table A-1 lists equipment and liquids necessary to decontaminate field equipment.

The following shall be done in order to complete thorough decontamination:

1. Set up the decontamination zone upwind or crosswind from the sampling area to reduce the chances of windborne contamination.

2. Visually inspect sampling equipment for contamination; use stiff brush to remove visible material.

3. The general decontamination sequence for field equipment includes: wash with Liquinox or an equivalent degreasing detergent; deionized water rinse; 10% dilute nitric acid rinse; deionized water rinse; rinse with distilled water three times.

4. Rinse equipment with methanol in place of the nitric rinse if sampling for organic contamination. Follow with a deionized water rinse.

5. Decontaminated equipment that is to be used for sampling organics should be wrapped in aluminum foil if not used immediately.

6. Clean the outside of sample container after filling sample container.

Alternatively, field equipment can be decontaminated by steam cleaning, rinsing with 10% dilute nitric acid, and rinsing with deionized water.

All disposable items (e.g., paper towels, latex gloves) should be deposited into a garbage bag and disposed of in a proper manner. Contaminated wash water does not have to be collected, under most circumstances.
If vehicles used during sampling become contaminated, wash both inside and outside as necessary.

TABLE A-1. EQUIPMENT LIST FOR DECONTAMINATION

5-gallon plastic tubs
5-gallon plastic water-container
5-gallon carboy DI water
1-gallon cube of 10% HNO_3
1-gallon container or spray bottle of
10% Methanol or pesticide
grade acetone for organics

Liquinox (soap)
Hard bristle brushes
Garbage bags
Latex gloves
Squeeze bottles
Paper Towels

GROUNDWATER SAMPLING

EQUIPMENT:

- five gallon bucket graduated in gallons
- coolers and ice
- sample bottles
- preservatives
- filter apparatus
- decontamination equipment & fluids
- water level probe
- pH meter/thermometer
- specific conductance meter
- bailer(s)
- bailer rope or teflon reel
- field sampling forms
- indelible marker
- stop watch

All sampling equipment shall be inspected for damage, and repaired if necessary, prior to arriving on-site.

GENERAL PROCEDURE - PURGING

Purging must be performed on all wells prior to sample collection. Depending on the stability of pH and conductivity readings, three or more borehole volumes of groundwater in casing and backfill (filter pack) shall be withdrawn prior to sample collection. The volume of water present in each well shall be computed using the length of water column, monitoring well inside diameter, borehole diameter, length of filter pack and porosity estimate of filter pack. The total volume of water in the well (gallons) can be approximated using the following formula (depth and water level measurements in feet; borehole diameter in inches):

$$(1/25)(\text{Total Depth - Measured Water Level})(\text{Borehole Diameter})^2 = \text{gallons}$$

Several general methods are used for well purging. Well purging may be achieved using bailers, bladder pumps and submersible pumps. The specific pumping method shall be chosen based on depth to groundwater, diameter of well, existing well configuration and contaminant(s) of concern. In all cases, pH, specific conductance, temperature, and purge volume values will be entered on the Field Sampling Forms. If sampling for hydrocarbon compounds, wells shall be checked for the presence of free product prior to purging and sampling.

Field parameters will be measured periodically during well purging. The well is ready for sampling when either or both of the following conditions are met: 1) measured field parameters stabilize at plus or minus five percent of the reading, over three successive readings or, 2) three to five casing volumes have been evacuated from the well.

If the recovery of a low-yield well exceeds two hours after purging, the sample shall be extracted as soon as sufficient volume is available in the well for a sample to be extracted. At no time will a monitoring well be pumped dry if the recharge rate causes formation water to cascade down the well casing causing an accelerated loss of volatiles and change in pH.

COLLECTING WATER QUALITY SAMPLES

1. Generally, wells shall be sampled from the least contaminated to the most contaminated, if known. Open well and measure water level (SOP-20).

2. Decontaminate sampling equipment using the following procedure: scrub with brush and Liquinox solution; rinse with 10% dilute nitric acid; rinse with methanol, if sampling for organic compounds; rinse three times with deionized water. Use disposal latex or vinyl gloves throughout decontamination and sampling procedure and new gloves for each sampling point.

3. Sampling Monitoring Wells

   a. To collect a water quality sample, use a decontaminated stainless steel or teflon bailer and a spool of polypropylene rope or equivalent bailer cord (teflon-coated stainless steel cable). Tie a bowline knot through the bailer loop to secure.

   b. Slowly lower bailer or other sample collection device to the bottom of the well and remove an additional 5 feet of rope from the spool. Secure end of rope to steel well casing or wrist.

   c. Purge well by bailing or pumping, collecting evacuated water in a graduated 5 gallon bucket to measure the total volume discharged.

   d. Collect a sufficient quantity of water using the bailer or pump into a decontaminated one gallon sample container to fill all sample bottles.

4. Sampling Domestic Wells

   a. Turn-on household fixture (preferably an outside faucet without a hose connected) that is on the well-side of any household water conditioning device.

   b. Using the above equation, calculate the volume of water to be evacuated. Measure the discharge rate from the faucet in a graduated 5 gallon bucket, or other suitable container, to compute the rate of discharge. Calculate the time needed to evacuate the predicted volume from the well. Record all measurements and calculations on field forms.

   c. Samples should be collected directly from hydrant or faucet. Do not collect samples through rubber hoses.

5. Measure pH and specific conductance (SOP-05 and SOP-06). Continue monitoring field parameters (pH and specific conductance) periodically during purging process. The well is ready for sampling when either or both of the following conditions are met: 1) the purged volume is equal to three to five casing volumes and/or, 2) measured field parameters are within plus or minus five percent (± 5%) over three successive readings.

6. If sampling for dissolved metals, field filter sample according to SOP-04.

7. Label each sample container with project number, sample location, well owner, date, military time, sampler's initials, preservative, and analysis required.

8. Sample well using appropriate sample containers and preservatives ("Handbook for Sampling and Sample Preservation of Water and Wastewater", EPA-600/4-82-029; "Guidelines Establishing Test Procedures for the Analyses of Pollutants Under the Clean Water Act", 40 CFR 136; and "Test Methods for Evaluating Solid Wastes," EPA SW-846). A few common sample preservatives are listed below:

Dissolved Metals	Add 3-4 ml. Nitric Acid to 500 ml. sample
Nutrients	Refrigerate to 4°C; Add 3-4 ml. Sulfuric Acid to 500 ml. sample
Common Ions	Refrigerate to 4°C
Hydrocarbon VOA	Refrigerate to 4°C; Add 3-4 drops HCl

For additional bottling and sample preservation information, consult the Chen-Northern laboratory.

9. For volatile analyses add preservative to sample vial and fill vials at the rate of 100 milliliters per minute (24 seconds for 40 milliliter vial); form positive meniscus over vial brim and cap. After capping, invert vial, gently tap and look for air bubbles. If bubbles are present, un-cap vial, add more water and repeat procedure.

10. Perform field parameter tests including pH, SC, Eh, and temperature on water sampled from the well. Record field measurements on field forms.

11. Complete the necessary shipping and handing paperwork, and record all pertinent information on Field Sampling Form in accordance with SOP-10.

FIELD QC SAMPLES

Quality Control (QC) samples are submitted along with natural samples to provide supporting laboratory data to validate laboratory results. QC samples are submitted blind, and do not have any unique identifying codes that would enable the lab or others to bias these samples in any way. Usually, the time or sampling location is modified in a way which will separate blank and standard samples from the rest of the sample train. QC samples are identified only on field forms and in field notebooks. The following codes are typically used:

N - Natural Sample	Soil, water, air, or other of interest material from a field site
SP - Split Sample	A portion of a natural sample collected for independent analysis; used in calculating laboratory precision
D - Duplicate Sample	Two samples taken from the same media under similar conditions; also used to calculate precision
FB - Field Blank	Deionized water collected in sample bottle; used to detect contamination sampling containers
BB - Bailer Blank	Deionized water run through a new unused disposable bailer and analyzed for factory contamination and deionized water contamination
TB - Travel or Trip Blank	Inert material (deionized water or diatomaceous earth) included in sample cooler; sent by the lab, the sample is used to determine if contamination by volatiles is present during collection or shipping

In general, selected QC samples will be inserted into the sample train within a group of twenty samples. Unless otherwise specified, QC samples will be prepared in the field. Deionized water blanks will be collected from carboys and cubitainers used in the field. One exceptions to field preparation of QC samples includes the preparation of some blind field standards. Since the concentration of analytes in the sample is to be mixed according to specific manufacturer's instructions, field conditions may not provide the needed laboratory atmosphere. This is especially true for volatile organic compounds, which need to be prepared just before analyzing. Under these circumstances, standards will be shipped to the laboratory for preparation, keeping the concentration or manufacturer's QC Lot Number as blind as possible.

Strict custody procedures shall be maintained with the field forms. Field forms shall remain with the field team at all times, while being used in the field. Upon completion of the field effort, photocopies of the original field forms will be made and used as working documents; original field forms shall be filed in an appropriately secure manner.

FIELD MEASUREMENT OF GROUND WATER LEVEL

1. Calibrate well probe to a steel tape prior to and following each data gathering episode. Note any corrections to well probe measurements on field forms.

2. Check well probe prior to leaving for field for defects by placing probe in water and testing buzzer of light. Repair as necessary. Make certain the well probe, a tape measure calibrated to tenths of feet and extra batteries are in the carrying case.

3. Measure all wells (monitoring and domestic) from the top of the well casing on the north side or from a designated measuring point, as appropriate. Measure and record distance from measuring point to ground level. Make sure measuring point is labeled on well, so future measurements can be made from the same location.

4. Obtain a depth to water from measuring point to the nearest hundredth of a foot. Record data on appropriate field forms.

5. Decontaminate well probe between each measurement by rinsing with deionized water. Additional decontamination, such as liquinox scrubbing, may be required for certain wells; consult the project work plan.

FIELD FORMS

All pertinent field investigations and sampling information shall be recorded on a field form during each day of the field effort and at each sample site. The field crew leader shall be responsible for ensuring that sufficient detail is recorded on the field forms. No general rules can specify the extent of information that must be entered on the field form. However, field forms shall contain sufficient information so that someone can reconstruct all field activity without relying on the memory of the field crew. All entries shall be made in indelible ink weather conditions permitting. Each day's or site's entries will be initialed and dated at the end by the author.

At a minimum, entries on the field sheet or in field notebook shall include:

- Date and time of starting work and weather conditions.
- Names of field crew leader and team members
- Project name and type
- Description of site conditions and any unusual circumstances.
- Location of sample site, including map reference, if relevant
- Equipment ID numbers
- Details of actual work effort, particularly any deviations from the field work plan or standard operating procedures
- Field observations
- Any field measurements made (e.g., pH)

For sampling efforts, specific details for each sample should be recorded using Chen-Northern's standardized field forms. Surface water and groundwater field forms contain fill-in-the-blank type information in order that all pertinent information shall be recorded. In addition to the items listed above, the following information is recorded on field forms during sampling efforts:

- Time and date samples were collected
- Number and type (natural, duplicate, qa/qc) of samples collected
- Analysis requested
- Sampling method, particularly deviations from standard operating procedures

The minimum number and types of field QA/QC Protocol shall be as follows:

- 10% of all groundwater samples will be duplicates, spikes or replicates
- A trip blank will be prepared for each trip or each day that samples are collected
- A bailer (equipment rinsate) blank will be prepared for each sample batch (up to 20 samples) unless disposable equipment is used.

Methods for computing data validation statements can be found in EPA documents or obtained from the Chen-Northern laboratory.

SAMPLE PACKAGING AND SHIPPING

All environmental samples collected shall be packaged and shipped using the following procedures:

PACKAGING

1. Place labeled sample bottles in a high quality cooler containing an adequate amount of recently frozen blue ice (where applicable), making sure the cooler drain plug is taped shut.

2. Place the samples in an upright position and surround the samples with noncombustible, absorbent, cushioning material for stability during transport.

3. Fill out the appropriate shipping forms, and place the paperwork in a ziploc bag and tape it to the inside lid of the shipping container. Shipping forms usually include: 1) a chain-of-custody form, documenting the samples included in the shipment; 2) an analysis request form, specifying the laboratory analyses for each sample.

4. Close and seal the cooler using fiberglass strapping tape.

5. Secure the shipping label with address, phone number, and return address clearly visible.

SHIPPING HAZARDOUS MATERIALS/WASTE

Hazardous materials need to be shipped using procedures specified under Federal Law. Samples need to be shipped in ziploc bags or paint cans filled with vermiculite, depending on the level of hazard. Special package labeling may be needed. Consult the project manager for specific shipping procedures.

SAMPLE DOCUMENTATION

Sample documentation is an important step to ensure the laboratory, project manager, and field personnel are informed on the status of field samples. Depending on the specifics required for each project, a number of forms will need to be filled out. Most sample documentation forms are preprinted carbonless triplicates, enabling copies to be filed or mailed from labs or offices. The forms will be completed by field personnel, who have custody of the samples. The office copy will be kept in the project file and subsequent copies sent to the laboratory, or other designated parties. The responsibility for the completion of these forms will be with each field crew leader. It is important the field crew leader is certain field personnel are familiar with the completion process for filling out forms, and the expected information is included.

Documents to be completed for each sample generated include:

- Field Form
- Chain-of-Custody Form
- Sample Analysis Request Form
- Custody Seal

If working on Superfund activities, the following additional forms will also be prepared:

- EPA Sample Tags
- SAS Packing Lists
- Sample Identification Matrix Forms
- Organic Traffic Report (if applicable)
- Inorganic Traffic Report (if applicable)