

PACIFIC  
ENVIRONMENTAL  
GROUP INC.

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DEC 17 1996

DEPT. OF ECOLOGY

August 16, 1995  
Project 530-009.4A

Mr. Chuck Hutchens  
ARCO Petroleum Products Company  
12520 NE 160th Place  
Woodinville, WA 98072-7960

Re: ARCO Service Station No. 6175  
3910 South 320th Street  
Federal Way, Washington

400435		DEPARTMENT OF ECOLOGY	
		NWRO/TCP TANK UNIT	
INTERIM CLEANUP REPORT		<input checked="" type="checkbox"/>	
SITE CHARACTERIZATION		<input type="checkbox"/>	
FINAL CLEANUP REPORT		<input type="checkbox"/>	
OTHER _____		<input type="checkbox"/>	
AFFECTED MEDIA: SOIL		<input checked="" type="checkbox"/>	
OTHER _____		<input type="checkbox"/>	
INSPECTOR (INIT.) WM	DATE 5-19-97		

Dear Mr. Hutchens:

Pacific Environmental Group, Inc. (PACIFIC) is pleased to submit this report detailing the installation and start-up of the soil vapor extraction (SVE) system at the site referenced above.

#### SITE BACKGROUND

PACIFIC performed a soil investigation at the site between April and June of 1991 to assess soil conditions prior to UST replacement. The scope of work consisted of drilling seven soil borings, converting two borings to SVE wells (VE-1 and VE-2), and performing field screening of soil samples in the field for volatile organic compounds. Wells VE-1 and VE-2 were located adjacent to the UST complex. The results of this investigation were reported to ARCO in a letter report dated June 10, 1991. The scheduled UST removal activities were subsequently postponed.

PACIFIC performed a soil vapor extraction test on September 5, 1991 to assess the feasibility of soil vapor extraction as an interim remedial alternative. Wells VE-1 and VE-2 were individually tested with a vacuum pump while flowrate, organic vapor emission levels, and the vacuum influence in the other well were monitored.

PACIFIC performed another environmental investigation in August and September, 1992 to assess groundwater conditions on site. This investigation was performed as a result of elevated organic vapor concentrations noted during the above referenced soil vapor extraction test. While four monitoring wells were originally proposed for this

investigation, groundwater was not encountered and only two soil borings (B-8 and B-9) were installed. Results were reported to ARCO in a letter report dated September 15, 1992.

PACIFIC observed the construction of a SVE system at the site in May, 1992. The SVE system operated from September, 1992 until February, 1993. The SVE system was shut down and dismantled in March, 1993. Prior to its closure in March, 1993, the SVE system operated for approximately 3,816.0 total hours and removed approximately 507.3 lbs. of total volatile hydrocarbons (TVH).

PACIFIC performed another environmental investigation in April, 1993 to assess soil conditions in the area proposed for the new USTs. The investigation consisted of the installation of three soil borings (B-1 through B-3). Results of this investigation were presented to ARCO in a report dated June 10, 1993.

UST removal and replacement activities were performed at the site by Joe Hall Construction, Inc. of Fife, Washington between July 13, 1993 and the week of August 9, 1993. Soil containing concentrations of total petroleum hydrocarbon (TPH) as gasoline and/or benzene, toluene, ethylbenzene, and xylenes (BTEX) compounds above the Model Toxics Control Act (MTCA) Method A cleanup standards were identified in seven trench samples collected adjacent to the three product islands. None of the soil samples collected from the UST excavation exceeded MTCA Method A cleanup standards for TPH-gasoline or BTEX compounds. SVE Wells VE-1 and VE-2 were removed during removal of the USTs. Results of this investigation were presented to ARCO in a report dated September 2, 1993.

## **REMEDIAL SYSTEM**

The remedial alternative selected for use at the site incorporates the use of a SVE system to remove volatile hydrocarbons from the subsurface through volatilization. The SVE system also enhances the bio-degradation of hydrocarbons in the saturated and unsaturated zones through the addition of oxygen to the subsurface. Based on observations of hydrocarbon distribution in soil during the UST upgrade, the SVE wells were located adjacent to the two product islands south of the station building.

### **Well Installation**

Five soil borings were drilled by Bayland Drilling, Inc., of Woodburn, Oregon on December 16 and 17, 1993. The borings were drilled to a depth of 15 feet below grade using eight-inch diameter hollow-stem auger drilling equipment. Prior to drilling, the well locations were cleared to a depth of five feet below grade with a stainless steel hand auger. The five borings were then converted to vapor extraction wells (VE-1 through VE-5) with

the installation of 2 inch-diameter slotted PVC well casing. The screened interval of the wells extended from five to 15 below grade.

The borings were logged by a PACIFIC geologist using the Unified Soil Classification System and standard geologic techniques. Soils encountered during drilling consisted primarily of gravelly, silty sand. Groundwater was not encountered in the soil borings on site. Boring logs are presented in Attachment A.

A stockpile of approximately one cubic yard of soil was created during drilling. One soil sample (SP-1) was collected from the stockpile to characterize the soil for disposal. TPH-gasoline, BTEX compounds, and total lead were not detected above laboratory reporting limits in the samples submitted for analysis. The certified analytical report and the chain of custody documentation for the analysis of this soil sample can be found in Attachment B. The stockpiled soil was spread across an unpaved portion of the site.

### **Remedial System Description**

Four vapor extraction wells (VE-1 through VE-4) are utilized in the SVE system. Each well is connected below-grade to a 2-inch diameter PVC pipe to convey soil vapor to the equipment enclosure. The individual vapor lines are manifolded above grade and each is equipped with a ball valve, vacuum gauge and monitoring port prior to connecting to a main conveyance line. A 55-gallon condensation tank removes water vapor before the soil vapor enters the vacuum blower (Rotron EN505 2.0-horsepower regenerative blower). The condensate drum is equipped with a high level switch to stop operation of the remedial system should the condensate drum fill with water. The blower is equipped with an in-line air filter, a vacuum relief valve, and a sound enclosure. The extracted soil vapor is discharged directly to the atmosphere through a 3.0-inch diameter, 15-foot high steel stack. A control panel controls the operation of the vacuum blower, and includes a 24-hour timer, an hour meter, and a motor starter with overload protection.

A site map is included as Figure 1 and a process and instrumentation diagram of the remedial system is included as Figure 2. System details are included as Figure 3 and Figure 4.

### **Air Discharge Permit**

The SVE system is permitted with the Puget Sound Air Pollution Control Agency (PSAPCA) Order of Approval to Construct number 4505, dated September 30, 1992. The permit allows for a maximum air discharge of 15 pounds per day (lbs/day) of total volatile hydrocarbons (TVH). Start-up was performed on March 22, 1995.

### **Remedial System Construction**

Conveyance piping for the remedial system was installed by Joe Hall Construction, Inc. of Fife, Washington during tank replacement activities in August 1993. PACIFIC initiated construction of the remainder of the remedial system during March 1995. The previously installed Single phase, 230/115 volt, 100 amps electrical service was used to provide power to the SVE system.

### **Remedial System Start-up and Operation**

PACIFIC performed start-up of the remedial system on March 22, 1995. Upon start-up, PACIFIC monitored the SVE system using a Flame Ionization Detector (FID). During start-up, measurements with the FID for the individual SVE wells ranged from 90 to >10,000 ppm. For the final system configuration, all wells were completely open. FID measurements showed 90 ppm of volatile organic compounds (VOCs) in the effluent. Analytical data for an air bag sample collected from the system influent indicated VOCs were present at a concentration of 37.1 ppm. The SVE system performance data is included as Table 1, and SVE system operational data is included as Table 2. Certified analytical reports and chain-of-custody documentation is included in Attachment A.

### **Remedial System Monitoring**

PACIFIC has been monitoring and will continue to monitor the SVE system on a monthly basis. This monitoring schedule is in accordance with the PSAPCA Order of Approval. Monitoring consists of screening the SVE system effluent for VOC concentrations with a FID from each individual vapor extraction well as well as the final system configuration. An air bag sample is collected during each monitoring event and analyzed for TPH-gasoline and BTEX compounds. Individual flow rates are taken with a Kurtz anemometer. The vapor extraction system is adjusted during each visit to comply with the air discharge permit and to maintain optimum remedial system performance.

### **Remedial System Results**

On April 21, 1995, an electrical problem caused the SVE system to shut down. The system remained inoperable until June 19, 1995 when the problem was remedied and the system was re-started.

Between March 22, 1995 and July 18, 1995, the system operated for approximately 1,440 hours and removed approximately 494 pounds of total volatile hydrocarbons (TVH). The total mass removed between each monitoring event is approximated by calculating an average mass removal rate from the TVH analytical results and flow rates observed at

August 16, 1995

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the start and end of the monitoring period. The SVE system data evaluation is included as Table 1. Individual SVE well monitoring data is included as Table 2.

Monitoring results indicate that the SVE system is operating within the PSAPCA emission guidelines. PACIFIC will continue to operate the SVE system to maximize removal of hydrocarbon vapors from in-situ soils.

PACIFIC appreciates this opportunity to be of continued service. If you have any questions regarding this report please feel free to call.

Sincerely,

**Pacific Environmental Group, Inc.**



Dawna Leong  
Project Engineer



Eric Larsen  
Project Manager

Attachments: Table 1 - Soil Vapor Extraction System Performance  
Table 2 - Soil Vapor Extraction System Monitoring Data  
Figure 1 - Site Map  
Figure 2 - Process and Instrumentation Diagram  
Figure 3 - System Details  
Figure 4 - System Details  
Attachment A - Boring Logs  
Attachment B - Certified Analytical Results  
Chain-of-Custody Documentation

**TABLE 1**  
**SOIL VAPOR EXTRACTION SYSTEM PERFORMANCE**

1 of 1

ARCO Service Station 6175  
3190 South 320th Street  
Federal Way, Washington

Sample Date	t (days)	td (days)	TVH (ppm)	Flow Rate (cfm)	TVH (lbs/day)	Net TVH (lb)	Total TVH (lb)	Total TVH (gallons)
3/22/95	0	0	37.1	34	0.4	0	0	0
4/21/95	30	0	520*	39	6.7	200	200	30
6/29/95	10	59	193	133	7.5	75	276	41
7/18/95	20	0	523	79	10.9	218	494	74
Total Mass Removed (lbs):							494	
Total Gallons Removed:								145
t = time of period since last sampling td = down time during period since last sampling TVH = total volatile hydrocarbons ppm = parts per million cfm = cubic feet per minute lb/day = pounds per day Net = since last period only Total = since beginning of operation * = value obtained from FID reading								

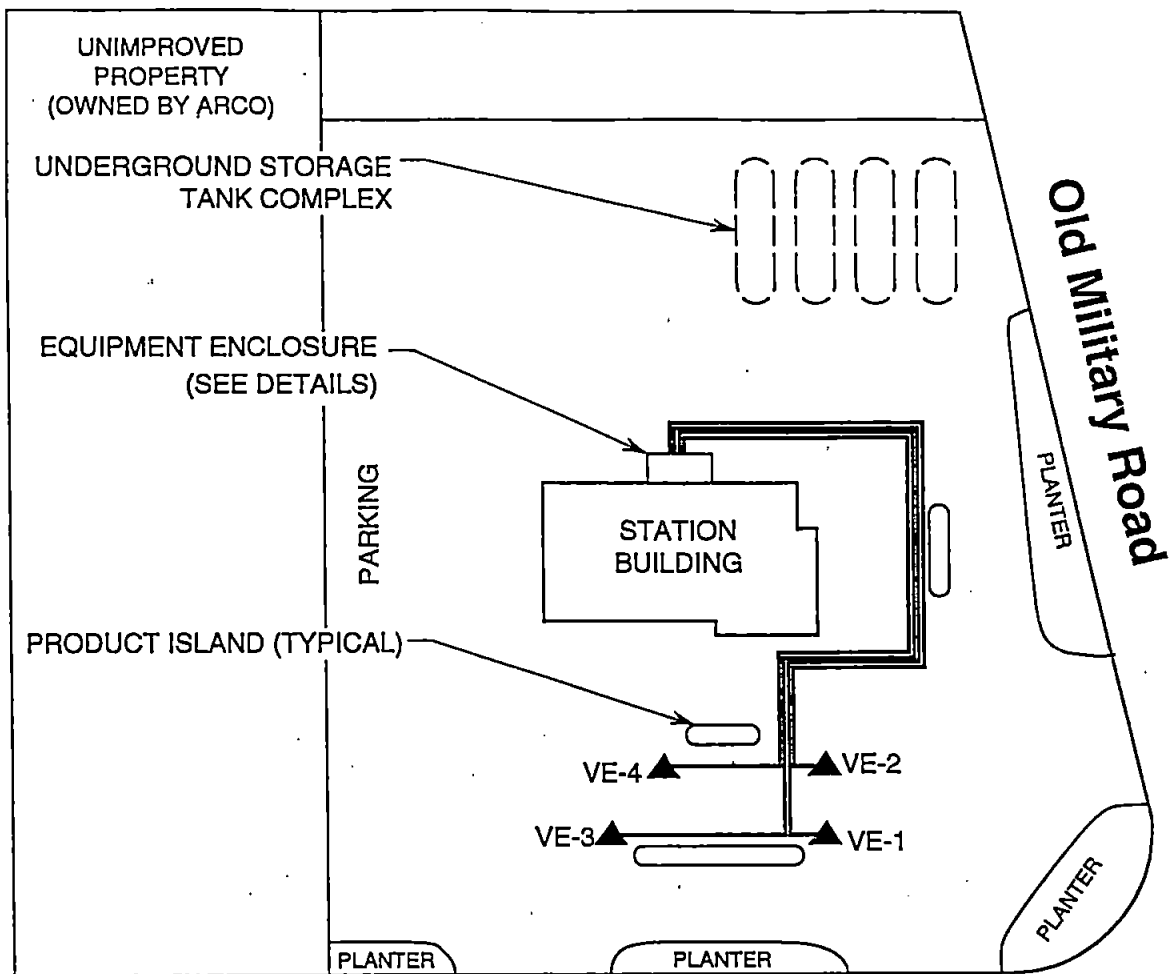
**TABLE 2**  
**SOIL VAPOR EXTRACTION SYSTEM MONITORING DATA**

ARCO Service Station 6175  
3190 South 320th Street  
Federal Way, Washington

Date System Monitore	Well Number											
	VE-1				VE-2				VE-3			
	Vapor Conc. (ppm)	Vacuum (in. H2O)	Flow Rate (CFM)	Removal Rate (lb/day)	Vapor Conc. (ppm)	Vacuum (in. H2O)	Flow Rate (CFM)	Removal Rate (lb/day)	Vapor Conc. (ppm)	Vacuum (in. H2O)	Flow Rate (CFM)	Removal Rate (lb/day)
03/22/95	10,000	47	20	64.2	10,000	46	20	64.2	100	48	20	0.64
04/21/95	1,000	*	NC	NC	**	*	NC	NC	1,000	*	NC	NC
06/29/95	18,911	11.5	4	27.0	21,687	11.5	7	46.4	18,710	11.5	2	13.4
07/18/95	6,117	10.5	11	21.8	8,637	9.5	7	18.5	8,474	11.5	11	30.2

Date System Monitore	Well Number			
	VE-4			
	Vapor Conc. (ppm)	Vacuum (in. H2O)	Flow Rate (CFM)	Removal Rate (lb/day)
03/22/95	90	47	20	0.58
04/21/95	**	*	NC	NC
06/29/95	16,308	11.5	2	11.6
07/18/95	7,532	12.0	2	5.4

ppm = parts per million as measured by a Flame Ionization Detector (FID)
cfm = cubic feet per minute
lb/day = pounds per day
* = measurement not possible due to water the presence of water in the below grade conveyance piping.
** = measurement not possible due to equipment failure
NC = not calculated

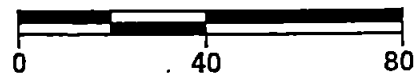


### LEGEND

VE-3 ▲ SOIL VAPOR EXTRACTION WELL LOCATION AND DESIGNATION

└─┘ SOIL VAPOR EXTRACTION BELOW GRADE CONVEYANCE PIPING

SCALE IN FEET



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ARCO SERVICE STATION #6175  
3910 South 320th Street  
Auburn, Washington

SITE MAP

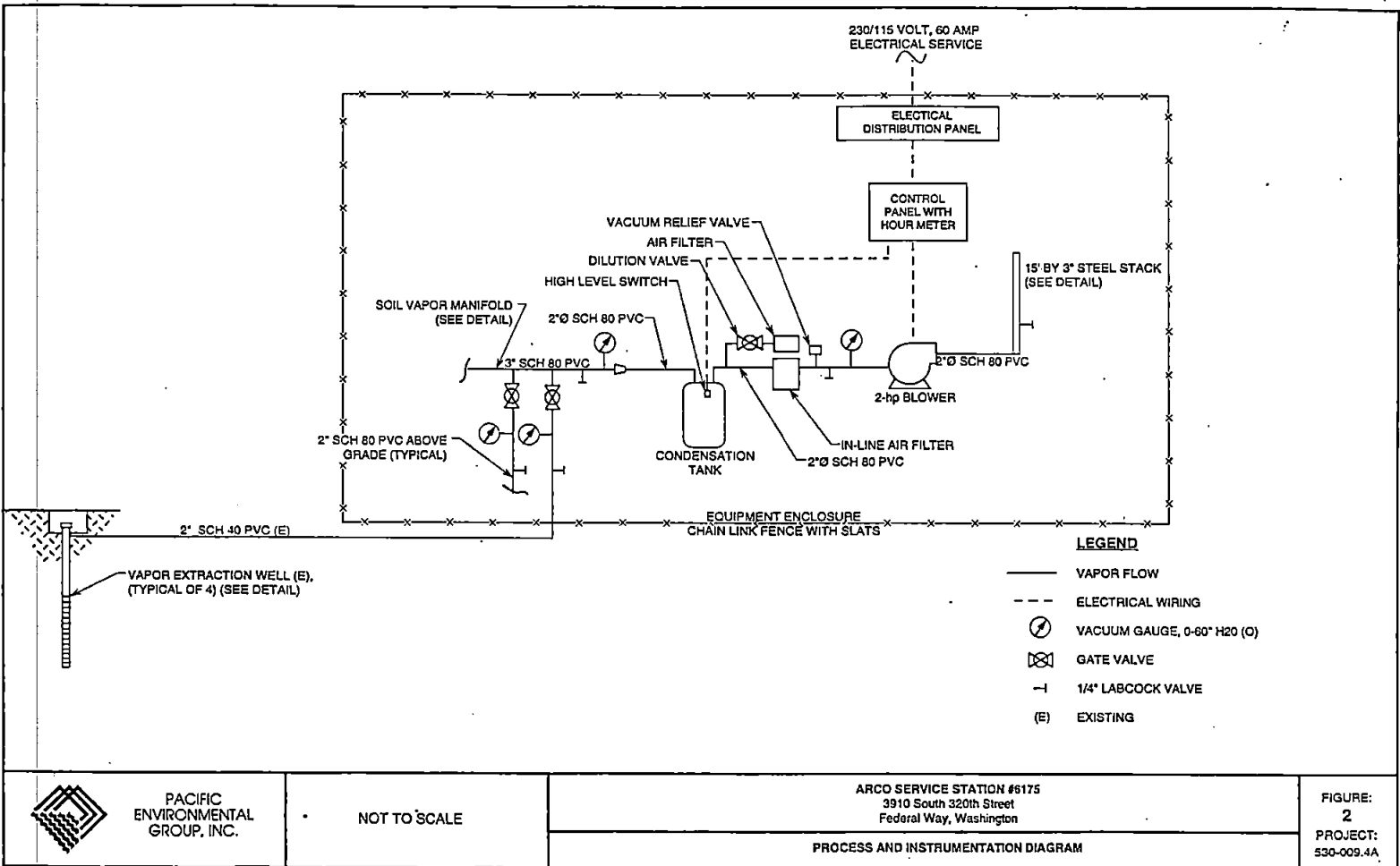
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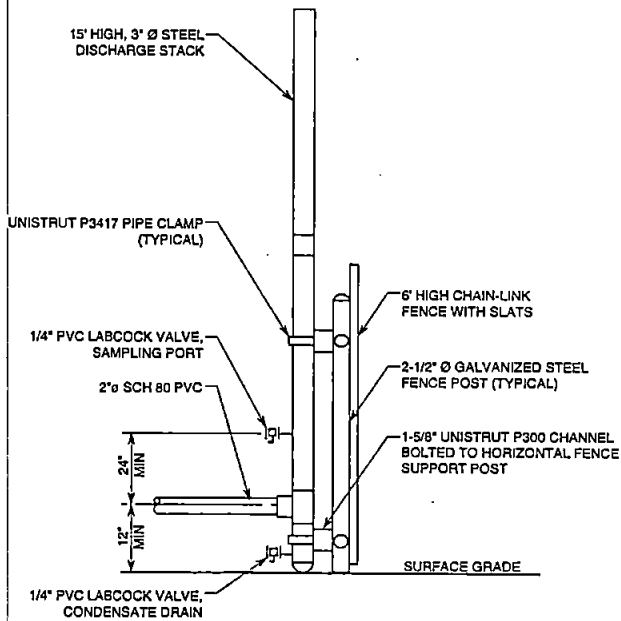
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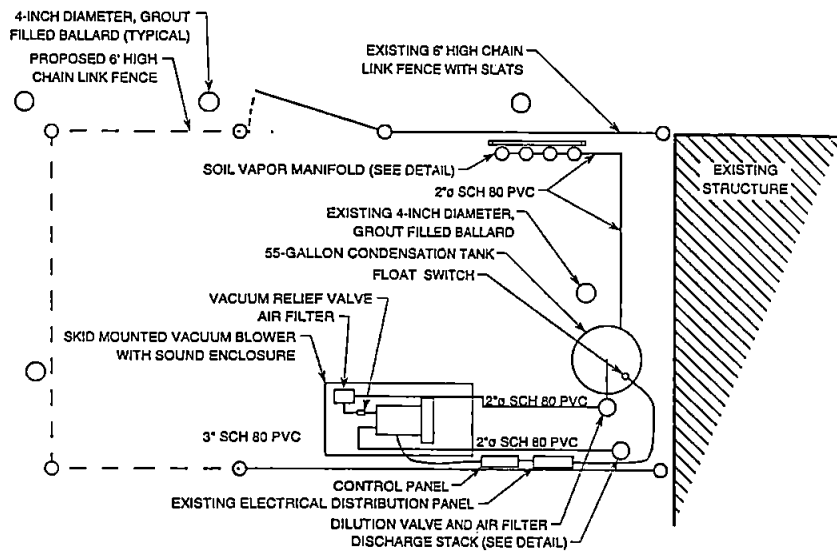
530-009.4A







**DISCHARGE STACK**  
NOT TO SCALE



**TREATMENT SYSTEM ENCLOSURE PLAN**  
NOT TO SCALE



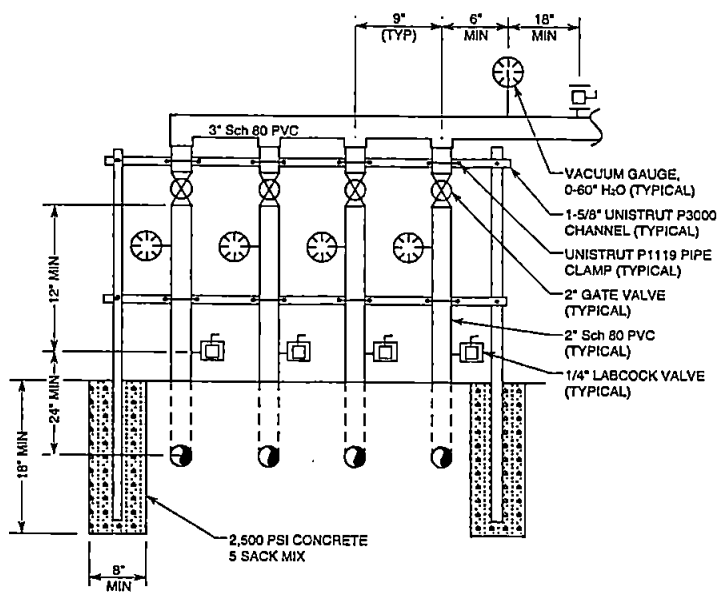
PACIFIC  
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NOT TO SCALE

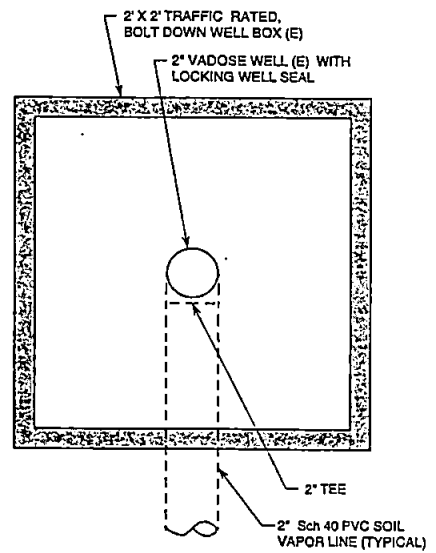
ARCO SERVICE STATION #6175  
3910 South 320th Street  
Federal Way, Washington

DETAILS

FIGURE:  
3  
PROJECT:  
530-009.4A



**SOIL VAPOR MANIFORD ASSEMBLY**  
NOT TO SCALE



**SOIL VAPOR WELL HEAD PLAN**  
NOT TO SCALE



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GROUP, INC.

NOT TO SCALE

ARCO SERVICE STATION #6175  
3910 South 320th Street  
Federal Way, Washington

DETAILS

FIGURE:  
4  
PROJECT:  
530-009.4A

**ATTACHMENT A**  
**BORING LOGS**

# WELL LOG KEY TO ABBREVIATIONS

## Drilling Method

HSA - Hollow stem auger  
CFA - Continuous flight auger  
Air - Reverse air circulation

## Gravel Pack

CA - Coarse aquarium sand

## Sampling Method

SS - Split-spoon sampler (1.5" inner diameter) driven 18" by a 140-pound hammer having a 30" drop. Where penetration resistance is designated "P", sampler was instead pushed by drill rig.  
Disturbed - Sample taken from drill-return materials as they surfaced.  
Shelby - Shelby Tube thin-walled sampler (3" diameter), where sampler is pushed by drill-rig.

## Moisture Content

Dry - Dry  
Dp - Damp  
Mst - Moist  
Wt - Wet

## Sorting

PS - Poorly sorted  
MS - Moderately sorted  
WS - Well sorted

## Plasticity

L - Low  
M - Moderate  
H - High

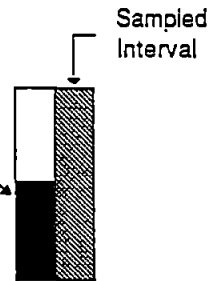
## PID (ppm)

ND - No detection

## Symbols

▽ - First encountered ground water  
▼ - Static ground water level

Sample Recovery  
\* Sample submitted for laboratory analysis



## Density (Blows/Foot - Split Spoon Sampler)

### Sands and gravels

0 - 4 - Very Loose  
4 - 10 - Loose  
10 - 30 - Medium dense  
30 - 50 - Dense  
over 50 - Very dense

### Silts and Clays

0 - 2 - Very Soft  
2 - 4 - Soft  
4 - 8 - Firm  
8 - 16 - Stiff  
16 - 32 - Very Stiff  
32 - 50 - Hard  
over 50 - Very Hard

## GRAIN - SIZE SCALE

### GRADE LIMITS

U.S. Standard

### GRADE NAME

inch	sieve size	
12.0		Boulders
3.0	3.0 in.	Cobbles
0.19	No. 4	Gravels
0.08	No. 10	coarse
	No. 40	medium
	No. 200	fine
		Silt
		Clay Size

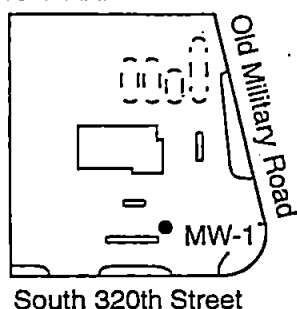
Primary Divisions		Group Symbol/Graphic		Typical Names
COARSE GRAINED SOILS  more than half is larger than #200 sieve	GRAVELS  half of coarse fraction larger than #4 sieve	CLEAN GRAVELS	GW	Well graded gravels, gravel-sand mixtures; little or no fines
		(less than 5% fines)	GP	Poorly graded gravels or gravel-sand mixtures; little or no fines
		GRAVEL WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS  half of coarse fraction smaller than #4 sieve	CLEAN SANDS	SW	Well graded sands, gravelly sands, little or no fines
		(less than 5% fines)	SP	Poorly graded sands or gravelly sands; little or no fines
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures, plastic fines
FINE GRAINED SOILS  more than half is smaller than #200 sieve	SILTS AND CLAYS  liquid limit less than 50%		ML	Inorganic silts and very fine sand, rock flour, silty or clayey fine sands or clayey silts, with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS  liquid limit more than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils	



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## Unified Soil Classification System

# LOCATION MAP



# PACIFIC ENVIRONMENTAL GROUP, INC.

WELL NO. MW-1

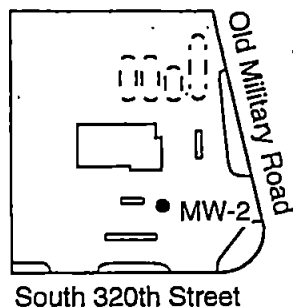
PAGE 1 OF 1

PROJECT NO. 530-009.4A  
 LOGGED BY: LB  
 DRILLER: BAYLAND DRILLING  
 DRILLING METHOD: HSA  
 SAMPLING METHOD: SS  
 CASING TYPE: Sch 40PVC  
 SLOT SIZE: 0.020"  
 GRAVEL PACK: 2X12 SAND

CLIENT: ARCO # 6175  
 DATE DRILLED: 12-16-93  
 LOCATION: Auburn, Washington  
 HOLE DIAMETER: 8"  
 HOLE DEPTH: 15'  
 WELL DIAMETER: 2"  
 WELL DEPTH: 15'  
 CASING STICKUP: NA

WELL COMPLETION	MOISTURE CONTENT	PID	PENETRATION (BLOWS/FT)	DEPTH (FEET)	RECOVERY SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY / REMARKS
SAND BENTONITE	Dp	70	50	2			SM	VAULT BOX: 2.5' to grade.
	Wet	10	>50	4				SILTY SAND: gravelly; gray; 20-30% fines; 10-20% very fine to fine sand; medium sand; trace to 10% coarse sand; 10-20% gravel; very dense.
	Dp	0	>50	10				@10': as above.
				15				@15': increasing gravel.
				16				BOTTOM OF BORING AT 15'
				18				
				20				
				22				
				24				
				26				
				28				
				30				
				32				
				34				
				36				
				38				
				40				
				42				
				44				

## LOCATION MAP



## PACIFIC ENVIRONMENTAL GROUP, INC.

WELL NO. MW-2

PAGE 1 OF 1

PROJECT NO. 530-009.4A  
 LOGGED BY: LB  
 DRILLER: BAYLAND DRILLING  
 DRILLING METHOD: HSA  
 SAMPLING METHOD: SS  
 CASING TYPE: Sch 40PVC  
 SLOT SIZE: 0.020"  
 GRAVEL PACK: 2X12 SAND

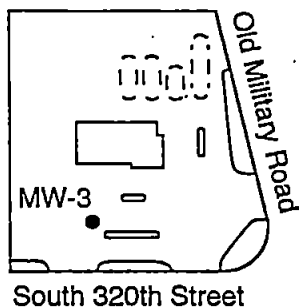
CLIENT: ARCO # 6175  
 DATE DRILLED: 12-16-93  
 LOCATION: Auburn, Washington  
 HOLE DIAMETER: 8"  
 HOLE DEPTH: 15'  
 WELL DIAMETER: 2"  
 WELL DEPTH: 15'  
 CASING STICKUP: NA

WELL COMPLETION	MOISTURE CONTENT	PID	PENETRATION (BLOWS/FT)	DEPTH (FEET)	RECOVERY SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY / REMARKS
				2				VAULT BOX: 2.5'.
				4			SM	SILTY SAND: gravelly; dark grayish brown; 20-30% fines; trace to 10% very fine to fine sand; medium to coarse sand; 20-30% gravel; very dense.
	Dp	0	>50	6				
				8				
				10				@11': olive gray; increasing gravel (30-40%).
	Wet	3	>50	12				
				14				@14': dark grayish brown; decreasing gravel (20-30%).
	Mst	0	50	16				
				18				
				20				
				22				
				24				
				26				
				28				
				30				
				32				
				34				
				36				
				38				
				40				
				42				
				44				

BOTTOM OF BORING AT 15'



## LOCATION MAP



## PACIFIC ENVIRONMENTAL GROUP, INC.

WELL NO. MW-3

PAGE 1 OF 1

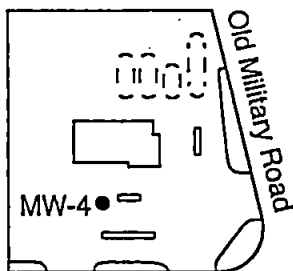
PROJECT NO. 530-009.4A  
 LOGGED BY: LB  
 DRILLER: BAYLAND DRILLING  
 DRILLING METHOD: HSA  
 SAMPLING METHOD: SS  
 CASING TYPE: Sch 40PVC  
 SLOT SIZE: 0.020"  
 GRAVEL PACK: 2X12 SAND

CLIENT: ARCO # 6175  
 DATE DRILLED: 12-17-93  
 LOCATION: Auburn, Washington  
 HOLE DIAMETER: 8"  
 HOLE DEPTH: 15'  
 WELL DIAMETER: 2"  
 WELL DEPTH: 15'  
 CASING STICKUP: NA

WELL COMPLETION	MOISTURE CONTENT	PID	PENETRATION (BLOWS/FT)	DEPTH (FEET)	RECOVERY SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY / REMARKS
				2				VAULT BOX: 2.5'.
				4			SM	SILTY SAND: gravelly; grayish brown; 20-30% fines; trace very fine sand; fine to medium sand; 10-20% coarse sand; 10-20% gravel; very dense.
	Dp	0	>50	6				
				8				
	Wet	0	37	*10				@10': dense.
				12				
	Mst	0	>50	14				@14': very dense.
				16				
				18				
				20				
				22				
				24				
				26				
				28				
				30				
				32				
				34				
				36				
				38				
				40				
				42				
				44				

BOTTOM OF BORING AT 15'

## LOCATION MAP



South 320th Street

## PACIFIC ENVIRONMENTAL GROUP, INC.

WELL NO. MW-4

PAGE 1 OF 1

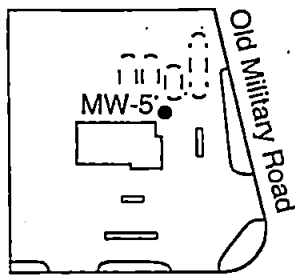
PROJECT NO. 530-009.4A  
 LOGGED BY: LB  
 DRILLER: BAYLAND DRILLING  
 DRILLING METHOD: HSA  
 SAMPLING METHOD: SS  
 CASING TYPE: Sch 40PVC  
 SLOT SIZE: 0.020"  
 GRAVEL PACK: 2X12 SAND

CLIENT: ARCO # 6175  
 DATE DRILLED: 12-17-93  
 LOCATION: Auburn, Washington  
 HOLE DIAMETER: 8"  
 HOLE DEPTH: 15'  
 WELL DIAMETER: 2"  
 WELL DEPTH: 15'  
 CASING STICKUP: NA

WELL COMPLETION	MOISTURE CONTENT	PID	PENETRATION (BLOWS/FT)	DEPTH (FEET)	RECOVERY SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY / REMARKS
				2				VAULT BOX: 2.5'.
				4			SM	SILTY SAND: gravelly; grayish brown; 20-30% fines; trace very fine sand; fine to medium sand; 10-20% coarse sand; 10-20% gravel; very dense.
	Mst	0	>50	6				
				8				
	Wet	0	>50	*10				@10': increasing gravel.
				12				
	Wet	0	>50	14				@14': as above.
				16				
				18				
				20				
				22				
				24				
				26				
				28				
				30				
				32				
				34				
				36				
				38				
				40				
				42				
				44				

BOTTOM OF BORING AT 15'

## LOCATION MAP



South 320th Street

## PACIFIC ENVIRONMENTAL GROUP, INC.

WELL NO. MW-5

PAGE 1 OF 1

PROJECT NO. 530-009.4A  
 LOGGED BY: LB  
 DRILLER: BAYLAND DRILLING  
 DRILLING METHOD: HSA  
 SAMPLING METHOD: SS  
 CASING TYPE: Sch 40PVC  
 SLOT SIZE: 0.020"  
 GRAVEL PACK: 2X12 SAND

CLIENT: ARCO # 6175  
 DATE DRILLED: 12-16-93  
 LOCATION: Auburn, Washington  
 HOLE DIAMETER: 8"  
 HOLE DEPTH: 15'  
 WELL DIAMETER: 2"  
 WELL DEPTH: 15'  
 CASING STICKUP: NA

WELL COMPLETION	MOISTURE CONTENT	PID	PENETRATION (BLOWS/FT)	DEPTH (FEET)	RECOVERY SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY / REMARKS
				2				VAULT BOX: 2.5'.
	Dp	0	40	4			SM	SILTY SAND: gravelly; grayish brown; 10-20% fines; trace very fine sand; fine sand; trace medium to coarse sand; 10-20% gravel; dense.
	Mst	0	50	8				@9': as above.
	Mst	0	>50	14				@14.5': as above.
				16				
				18				
				20				
				22				
				24				
				26				
				28				
				30				
				32				
				34				
				36				
				38				
				40				
				42				
				44				

BOTTOM OF BORING AT 15'

**ATTACHMENT B**  
**LABORATORY ANALYTICAL METHODS AND REPORTS**  
**CHAIN-OF-CUSTODY DOCUMENTATION**

## ATTACHMENT B

---

### Laboratory Analytical Methods

Analysis for TPH-gasoline was performed according to Washington State DOE Method WTPH-G. Benzene, toluene, ethylbenzene, and xylenes analysis was performed in accordance with EPA Method 8020/602. A methanol solvent extraction was used for the TPH analysis with final detection by gas chromatography using a flame-ionization detector. A headspace or purge and trap technique was utilized for BTEX analysis. Final detection was by gas chromatography using a photoionization detector.



July 14, 1995

Service Request No.: B950524

Matt Miller  
Pacific Environmental Group, Inc.  
4020 148th Avenue NE, Suite B  
Redmond, WA 98052

Re: ARCO #6175 - Auburn/Task Order #1723500-L

Dear Matt:

Attached are the results of the sample(s) submitted to our laboratory on June 30, 1995. For your reference, these analyses have been assigned our service request number B950524.

All analyses were performed consistent with our laboratory's quality assurance program. All results are intended to be considered in their entirety, and CAS is not responsible for use of less than the complete report. Results only apply to samples analyzed.

Please call if you have any questions.

Respectfully submitted,

Columbia Analytical Services, Inc.

A handwritten signature in cursive script, appearing to read "Colin B. Elliott".

Colin B. Elliott  
Laboratory Manager

Columbia Analytical Services, Inc.

A handwritten signature in cursive script, appearing to read "Dave Cogan".

Dave Cogan  
Quality Assurance Coordinator

CBE/bdr

Page 1 of 6

## COLUMBIA ANALYTICAL SERVICES, INC.

## Analytical Report

Client: Pacific Environmental Group  
Project: ARCO #6175 - Auburn  
Sample Matrix: Air

Service Request: B950524  
Date Collected: 6/29/95  
Date Received: 6/30/95  
Date Extracted: NA  
Date Analyzed: 6/30/95

BTEX and TPH as Gasoline  
EPA Methods 5030/8020/Modified 8015

Sample Name: Effl  
Lab Code: B950524-01

	MRLs		Results	
	ug/L	uL/L (ppmv)	ug/L	uL/L (ppmv)
Benzene	0.05	0.02	5.58	1.75
Toluene	0.05	0.01	55.8	14.8
Ethylbenzene	0.05	0.01	11.4	2.62
Total Xylenes	0.05	0.01	88.5	20.4
TPH	2	0.5	789	193

Approved By: \_\_\_\_\_



Date: \_\_\_\_\_

7/14/95

4A/102194

## COLUMBIA ANALYTICAL SERVICES, INC.

## Analytical Report

Client: Pacific Environmental Group  
Project: ARCO #6175 - Auburn  
Sample Matrix: Air

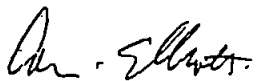
Service Request: B950524  
Date Collected: NA  
Date Received: NA  
Date Extracted: NA  
Date Analyzed: 6/30/95

BTEX and TPH as Gasoline  
EPA Methods 5030/8020/Modified 8015

Sample Name: Method Blank  
Lab Code: B950524-MB

	MRLs		Results	
	ug/L	uL/L (ppmv)	ug/L	uL/L (ppmv)
Benzene	0.05	0.02	ND	ND
Toluene	0.05	0.01	ND	ND
Ethylbenzene	0.05	0.01	ND	ND
Total Xylenes	0.05	0.01	ND	ND
TPH	2	0.5	2	0.5

Approved By: \_\_\_\_\_



Date: 7/14/95



**COLUMBIA ANALYTICAL SERVICES, INC.**

**QA/QC Report**

**Client:** Pacific Environmental Group  
**Project:** ARCO #6175 - Auburn  
**LCS Matrix:** Air

**Service Request:** B950524  
**Date Collected:** NA  
**Date Received:** NA  
**Date Extracted:** NA  
**Date Analyzed:** 6/30/95

Laboratory Control Sample Summary  
 BTEX and TPH as Gasoline  
 EPA Methods 5030/8020/Modified 8015  
 ug/L

Analyte	True Value	Result	Percent Recovery	CAS
				Percent Recovery Acceptance Limits
Benzene	34	42	124	60-137
Toluene	41	50	122	56-130
Ethylbenzene	34	39	115	55-130
Total Petroleum Hydrocarbons	2,200	2590	118	53-135

Approved By: \_\_\_\_\_

LCS/102194

Date: \_\_\_\_\_

## COLUMBIA ANALYTICAL SERVICES, INC.

## QA/QC Report

Client: Pacific Environmental Group  
Project: ARCO #6175 - Auburn  
Sample Matrix: Air

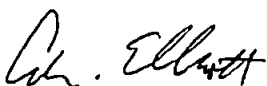
Service Request: B950524  
Date Collected: 6/29/95  
Date Received: 6/30/95  
Date Extracted: NA  
Date Analyzed: 6/30/95

Duplicate Summary  
BTEX and TPH as Gasoline  
EPA Methods 5030/8020/Modified 8015  
ug/L

Sample Name: Effl  
Lab Code: B950524-01

Analyte	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference	CAS RPD Acceptance Limit
Benzene	0.05	5.58	5.41	5.50	3	30
Toluene	0.05	55.8	56.6	56.2	1	30
Ethylbenzene	0.05	11.4	11.6	11.5	2	30
Total Xylenes	0.05	88.5	90.4	89.5	2	30
Total Petroleum Hydrocarbons	2	789	806	798	2	30

Approved By: \_\_\_\_\_



Date: 7/18/95

## ARCO Products Company

Division of AtlanticRichfieldCompany

530-009,58 Task Order No. 1723500-L

## Chain of Custody

ARCO Facility no.

617.5

City  
(Facility)

Auburn, Wa

Project manager  
(Consultant)

Matt Miller

ARCO engineer

Chuck Hutchens

Telephone no.  
(ARCO)Telephone no.  
(Consultant)

864-5099

Fax no.

(Consultant)

864-5639

Laboratory name

Columbia

Contract number

Consultant name

Pacific Environmental Group

Address

(Consultant)

4020 148th Ave NE Ste. B Redmond

Method of shipment

Special detection  
Limit/reporting

Special QA/QC

Remarks

Lab number

B150524

Turnaround time

Priority Rush  
1 Business Day☐Rush  
2 Business Days☐Expedited  
5 Business Days☐Standard  
10 Business Days☒

Condition of sample:

Relinquished by sampler

Relinquished by

Relinquished by

Date

Date

Date

Time

Time

Time

Temperature received:

Received by

Received by

Received by laboratory

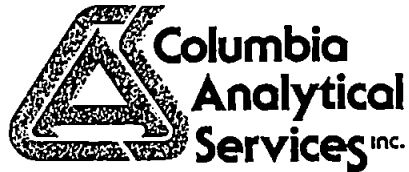
Date

Time

Matt Miller 6/3

6/30/95 0830

AJ Moxie 6/30/95 0830



March 29, 1995

Service Request No.: B950211

Eric Larson  
Pacific Environmental Group, Inc.  
4020 148th Avenue NE, Suite B  
Redmond, WA 98052

Re: **ARCO #6175 - Auburn/Task Order #17235-00-L**

Dear Eric:

Attached are the results of the sample(s) submitted to our laboratory on March 17, 1995. For your reference, these analyses have been assigned our service request number B950211.

All analyses were performed consistent with our laboratory's quality assurance program. All results are intended to be considered in their entirety, and CAS is not responsible for use of less than the complete report. Results only apply to samples analyzed.

Please call if you have any questions.

Respectfully submitted,

Columbia Analytical Services, Inc.

A handwritten signature in dark ink, appearing to read "Colin B. Elliott".

Colin B. Elliott  
Laboratory Manager

Columbia Analytical Services, Inc.

A handwritten signature in dark ink, appearing to read "Dave Cogan".

Dave Cogan  
Quality Assurance Coordinator

CBE/bdr

Page 1 of 6

## COLUMBIA ANALYTICAL SERVICES, INC.

## Analytical Report

Client: Pacific Environmental Group  
Project: ARCO #6175 - Auburn  
Sample Matrix: Air

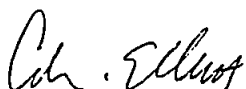
Service Request: B950211  
Date Collected: 3/17/95  
Date Received: 3/17/95  
Date Extracted: NA  
Date Analyzed: 3/20/95

BTEX and TPH as Gasoline  
EPA Methods 5030/8020/Modified 8015

Sample Name: Effl  
Lab Code: B950211-01

	MRLs		Results	
	ug/L	uL/L (ppmv)	ug/L	uL/L (ppmv)
Benzene	0.05	0.02	0.6	0.19
Toluene	0.05	0.01	2.91	0.77
Ethylbenzene	0.05	0.01	0.66	0.15
Total Xylenes	0.05	0.01	3.25	0.74
TPH	2	0.5	116	28.4

Approved By: \_\_\_\_\_



Date: 3/30/95

4A/102194

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Pacific Environmental Group  
Project: ARCO #6175 - Auburn  
Sample Matrix: Air

Service Request: B950211  
Date Collected: 3/17/95  
Date Received: 3/17/95  
Date Extracted: NA  
Date Analyzed: 3/20/95

BTEX and TPH as Gasoline  
EPA Methods 5030/8020/Modified 8015

Sample Name: Method Blank  
Lab Code: B950211-MB

	MRLs		Results	
	ug/L	uL/L (ppmv)	ug/L	uL/L (ppmv)
Benzene	0.05	0.02	ND	ND
Toluene	0.05	0.01	ND	ND
Ethylbenzene	0.05	0.01	ND	ND
Total Xylenes	0.05	0.01	ND	ND
TPH	2	0.5	ND	ND

Approved By: \_\_\_\_\_

*Ch. Elliott*

Date: \_\_\_\_\_

*3/30/95*

**COLUMBIA ANALYTICAL SERVICES, INC.**

**QA/QC Report**

**Client:** Pacific Environmental Group  
**Project:** ARCO #6175 - Auburn  
**Sample Matrix:** Air

**Service Request:** B950211  
**Date Collected:** 3/17/95  
**Date Received:** 3/17/95  
**Date Extracted:** NA  
**Date Analyzed:** 3/20/95

**Duplicate Summary**  
**BTEX and TPH as Gasoline**  
**EPA Methods 5030/8020/Modified 8015**  
**ug/L**

**Sample Name:** Effl  
**Lab Code:** B950211-01

<b>Analyte</b>	<b>MRL</b>	<b>Sample Result</b>	<b>Duplicate Sample Result</b>	<b>Average</b>	<b>Relative Percent Difference</b>	<b>CAS RPD Acceptance Limit</b>
Benzene	0.05	0.6	0.72	0.66	18	30
Toluene	0.05	2.91	2.98	2.95	2	30
Ethylbenzene	0.05	0.66	0.66	0.66	<1	30
Total Xylenes	0.05	3.25	3.11	3.18	4	30
Total Petroleum Hydrocarbons	2	116	116	116	<1	30

**Approved By:** \_\_\_\_\_

*C. Elliott*

**Date:** 3/30/95

**COLUMBIA ANALYTICAL SERVICES, INC.**

**QA/QC Report**

**Client:** Pacific Environmental Group  
**Project:** ARCO #6175 - Auburn  
**LCS Matrix:** Air

**Service Request:** B950211  
**Date Collected:** NA  
**Date Received:** NA  
**Date Extracted:** NA  
**Date Analyzed:** 3/20/95

Laboratory Control Sample Summary  
 BTEX and TPH as Gasoline  
 EPA Methods 5030/8020/Modified 8015  
 ug/L

Analyte	True Value	Result	Percent Recovery	CAS Percent Recovery Acceptance Limits
Benzene	34	32	94	60-137
Toluene	41	39	95	56-130
Ethylbenzene	34	34	100	55-130
Total Petroleum Hydrocarbons	2,200	2280	104	53-135

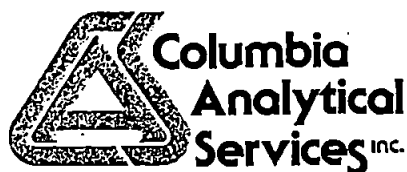
Approved By: \_\_\_\_\_  
 LCS/102194

*Ch. Elliott*

Date: 3/30/95



ARCO Products Company Division of AtlanticRichfieldCompany						Task Order No.								Chain of Custody												
ARCO Facility no.			City (Facility)			Project manager (Consultant)			Laboratory name																	
ARCO engineer			Telephone no. (ARCO)			Telephone no. (Consultant)			Fax no. (Consultant)					Contract number												
Consultant name						Address (Consultant)																				
Sample I.D.	Lab no.	Container no.	Matrix			Preservation		Sampling date	Sampling time	BTEX EPA 8020	BTEX TPH EPA M602/8020/8015	TPH Modified 8015 Gas Diesel	Oil and Grease 413.1 413.2	TPH EPA 418.1/SMS03E	EPA 601/8010	EPA 624/8240	EPA 625/8270	TCLP Metals VOA VOC	CAM Metals EPA 601.0/7000 TTLC STLCTL	Lead Org/DHS Lead EPA 7420/7421	Method of shipment					
EFFL	211-1	L	Soil	Water	AIR	Ice	Acid	3-17-95	1200PM	X												Special detection Limit/reporting				
																						Special QA/QC				
																						Remarks				
																						Lab number B95-211				
																						Turnaround time				
Condition of sample:										Temperature received:																
Relinquished by sampler										Date	Time	Received by														
Relinquished by										Date	Time	Received by														
Relinquished by										Date	Time	Received by laboratory Date Time Standard 10 Business Days														



July 26, 1995

Service Request No.: B950551

Matt Miller  
Pacific Environmental Group, Inc.  
4020 148th Avenue NE, Suite B  
Redmond, WA 98052

Re: ARCO #6175 - Auburn/Project #530-009.5B

Dear Matt:

Attached are the results of the sample(s) submitted to our laboratory on July 18, 1995. Preliminary results were transmitted via facsimile on July 26, 1995. For your reference, these analyses have been assigned our service request number B950551.

All analyses were performed consistent with our laboratory's quality assurance program. All results are intended to be considered in their entirety, and CAS is not responsible for use of less than the complete report. Results only apply to samples analyzed.

Please call if you have any questions.

Respectfully submitted,

Columbia Analytical Services, Inc.

A handwritten signature in cursive script, appearing to read "Colin B. Elliott".

Colin B. Elliott  
Laboratory Manager

Columbia Analytical Services, Inc.

A handwritten signature in cursive script, appearing to read "Dave Cogan".

Dave Cogan  
Quality Assurance Coordinator

CBE/bdr

Page 1 of 6

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Pacific Environmental Group  
Project: ARCO #6175 - Auburn  
Sample Matrix: Air

Service Request: B950551  
Date Collected: 7/18/95  
Date Received: 7/18/95  
Date Extracted: NA  
Date Analyzed: 7/19/95

BTEX and TPH as Gasoline  
EPA Methods 5030/8020/Modified 8015

Sample Name: Effl  
Lab Code: B950551-01

	MRLs		Results	
	ug/L	uL/L (ppmv)	ug/L	uL/L (ppmv)
Benzene	0.05	0.02	50.6	15.8
Toluene	0.05	0.01	68.1	18.1
Ethylbenzene	0.05	0.01	7.52	1.73
Total Xylenes	0.05	0.01	29.8	6.86
TPH	2	0.5	2140	523

Approved By: \_\_\_\_\_

*C. E. Elsworth*

Date: 7/26/95

4A/102194

## COLUMBIA ANALYTICAL SERVICES, INC.

## Analytical Report

Client: Pacific Environmental Group  
Project: ARCO #6175 - Auburn  
Sample Matrix: Air

Service Request: B950551  
Date Collected: NA  
Date Received: NA  
Date Extracted: NA  
Date Analyzed: 7/19/95

BTEX and TPH as Gasoline  
EPA Methods 5030/8020/Modified 8015

Sample Name: Method Blank  
Lab Code: B950551-MB

	MRLs		Results	
	ug/L	uL/L (ppmv)	ug/L	uL/L (ppmv)
Benzene	0.05	0.02	ND	ND
Toluene	0.05	0.01	ND	ND
Ethylbenzene	0.05	0.01	ND	ND
Total Xylenes	0.05	0.01	ND	ND
TPH	2	0.5	ND	ND

Approved By: \_\_\_\_\_



Date: \_\_\_\_\_

7/26/95

## COLUMBIA ANALYTICAL SERVICES, INC.

## QA/QC Report

Client: Pacific Environmental Group  
Project: ARCO #6175 - Auburn  
Sample Matrix: Air

Service Request: B950551  
Date Collected: 7/18/95  
Date Received: 7/18/95  
Date Extracted: NA  
Date Analyzed: 7/19/95

Duplicate Summary  
BTEX and TPH as Gasoline  
EPA Methods 5030/8020/Modified 8015  
ug/L

Sample Name: Effl  
Lab Code: B950551-01

Analyte	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference	CAS RPD Acceptance Limit
Benzene	0.05	50.6	50.8	50.7	1	30
Toluene	0.05	68.1	68.1	68.1	<1	30
Ethylbenzene	0.05	7.52	7.32	7.42	3	30
Total Xylenes	0.05	29.8	28.3	29.05	5	30
Total Petroleum Hydrocarbons	2	2140	2220	2180	4	30

Approved By: 

Date: 7/26/95

## COLUMBIA ANALYTICAL SERVICES, INC.

## QA/QC Report

Client: Pacific Environmental Group  
Project: ARCO #6175 - Auburn  
LCS Matrix: Air

Service Request: B950551

Date Collected: NA

Date Received: NA

Date Extracted: NA

Date Analyzed: 7/19/95

Laboratory Control Sample Summary  
BTEX and TPH as Gasoline  
EPA Methods 5030/8020/Modified 8015  
ug/L

Analyte	True Value	Result	Percent Recovery	CAS Percent Recovery Acceptance Limits
Benzene	34	34	100	60-137
Toluene	41	41	100	56-130
Ethylbenzene	34	33	97	55-130
Total Petroleum Hydrocarbons	2,200	2390	109	53-135

Approved By: Ch. Elliott

LCS/102194

Date: 7/26/95

5

**Distribution:** White copy — Laboratory; Canary copy — ARCO Environmental Engineering; Pink copy — Consultant