



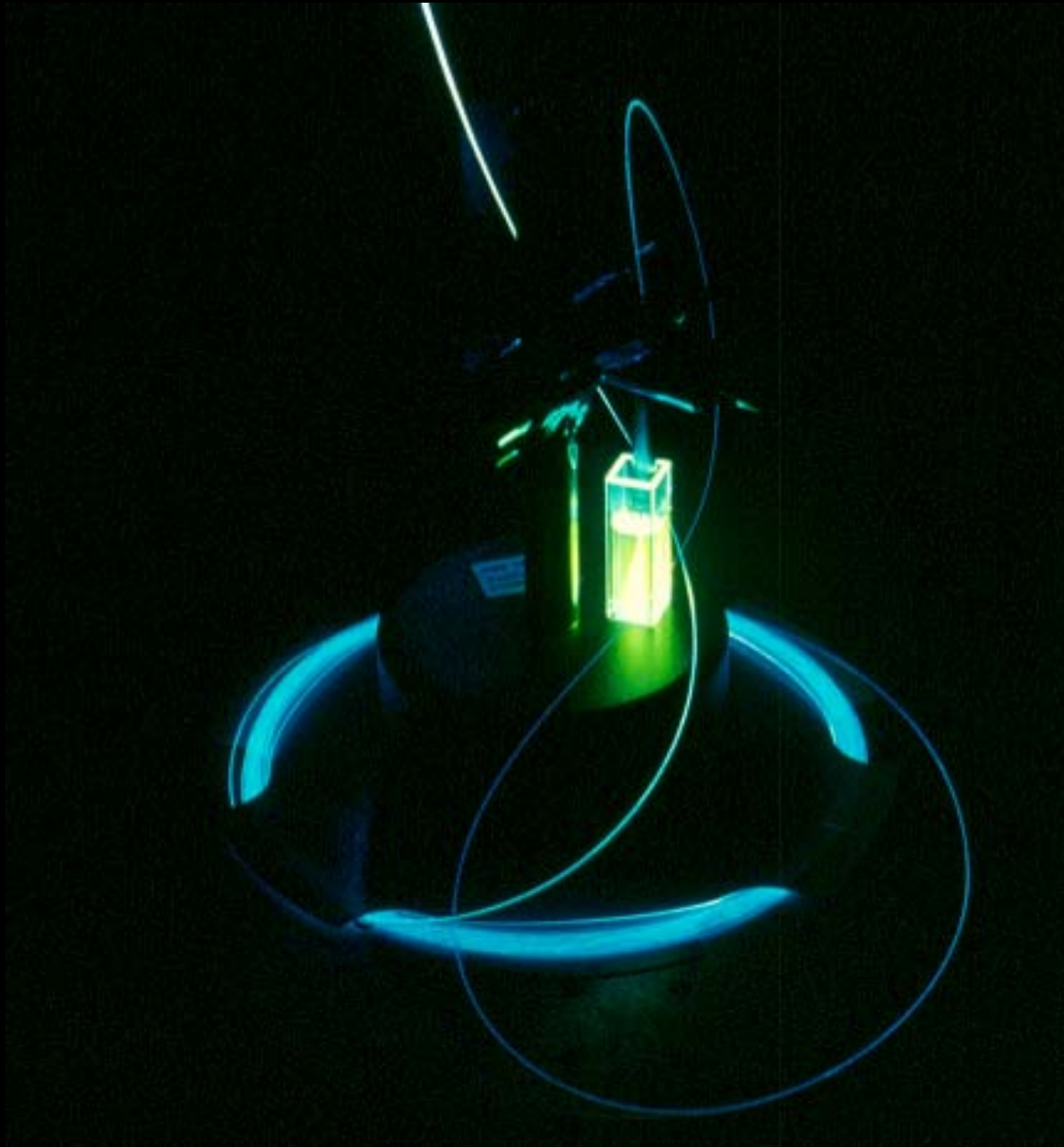
*Laboratory Certification for Triad Analytical Methods presentation of...*

# **New Jersey DEP's Certification of UV Fluorescence Technology for Detecting and Distinguishing Fuels and TPHs**

**U.S. EPA Triad Community of Practice Call  
Tuesday, January 19<sup>th</sup> 2010 2:00 - 3:00 pm Eastern Time**

**Steve Greason  
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# What is Fluorescence?

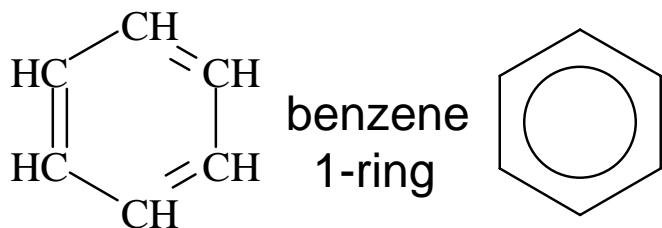


# Types of Aromatic Hydrocarbons...

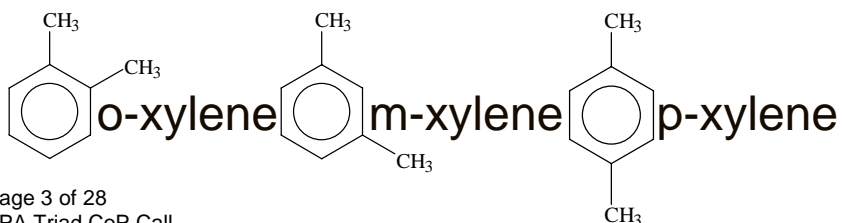
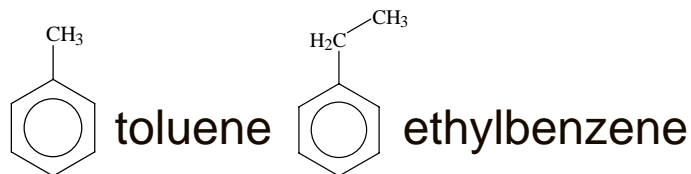
## BTEX Compounds:

**Benzene, Toluene, Ethylbenzene & Xylenes + other Monoaromatics**

**C6 to C10 Volatile Petroleum or Gasoline Range Hydrocarbons**



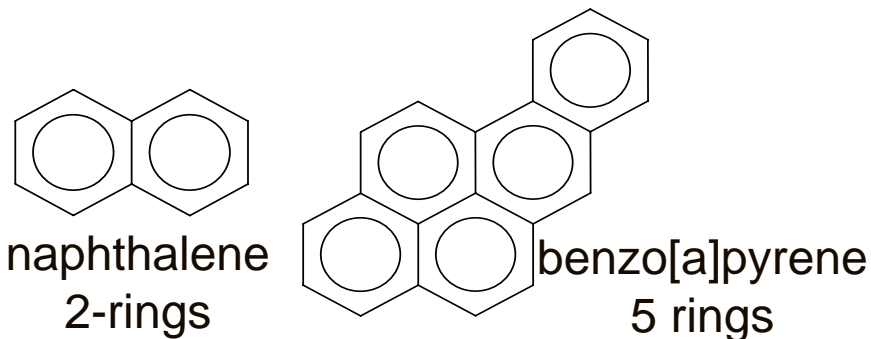
Carbon weight equals the number of C atoms per molecule.



## PAH Compounds:

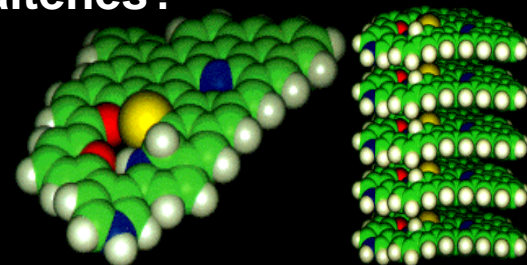
**Polycyclic or Polynuclear Aromatic Hydrocarbons**

**Semi to Non-Volatile Compounds in the C10 to C36+ Diesel and Oil Hydrocarbon Range**

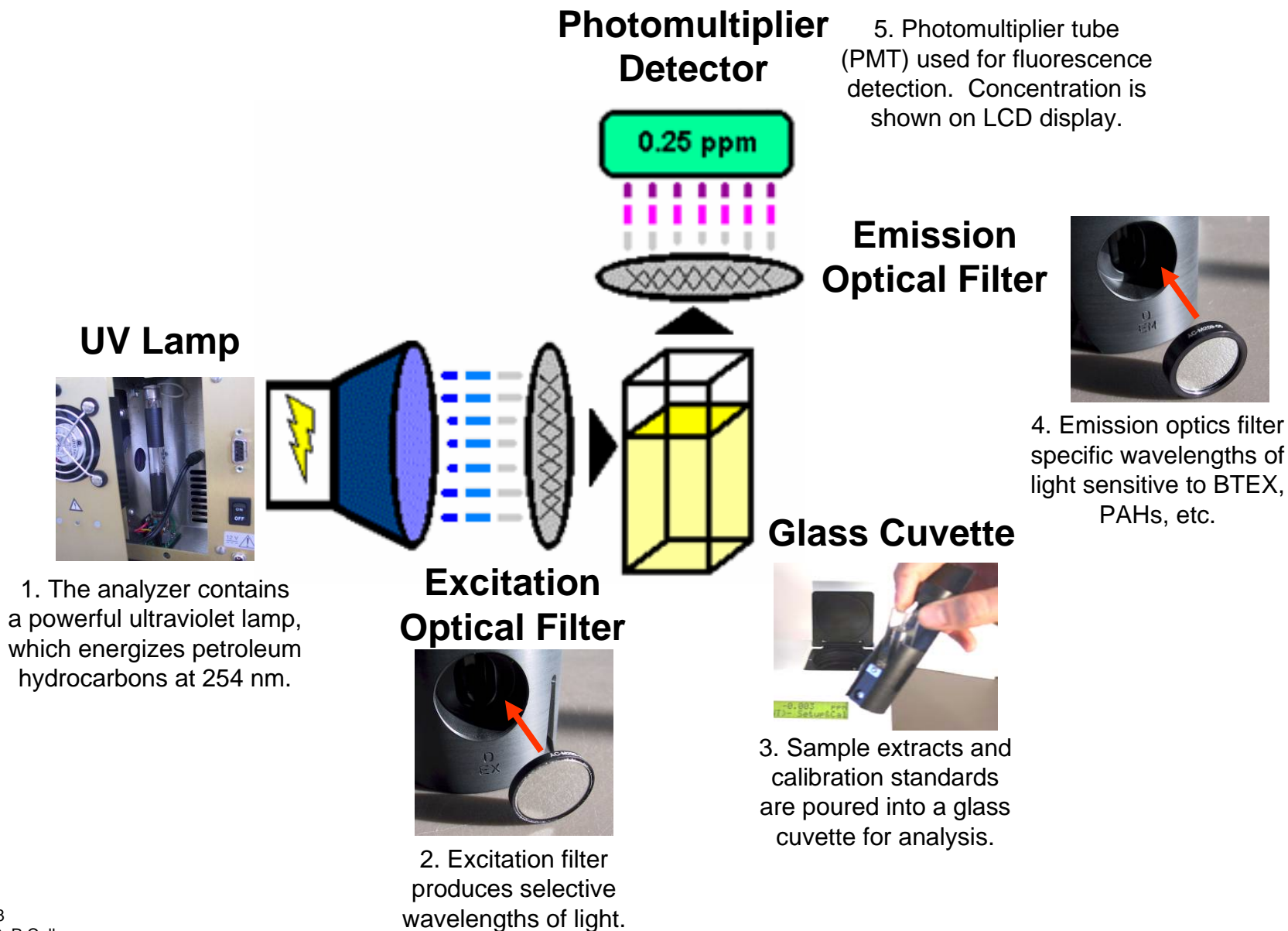


## What are Asphaltenes?

Large, highly aromatic compounds with stacks of PAHs having a carbon weight close to and greater than C40. Used for making road asphalt.



# Fixed Wavelength Fluorometer



# What Fluoresces

- ✓ Gasoline
- ✓ Jet Fuel
- ✓ Kerosene
- ✓ Diesel Fuel
- ✓ Home Heating Oil, No 2. Fuel Oil
- ✓ Heavy Fuel Oil, No. 6 Fuel Oil
- ✓ Motor Oils
- ✓ Waste Oils
- ✓ Lubricating Oils
- ✓ Cutting Oils
- ✓ Transformer Oil
- ✓ Hydraulic Fluid
- ✓ Gas Condensates
- ✓ Drilling Muds
- ✓ Crude Oils
- ✓ Bitumen
- ✓ Coal Tars
- ✓ Creosote
- ✓ Coal Ash

# And What Doesn't

Fluorescence cannot detect straight chain, aliphatic hydrocarbon contaminants, including:

- ✓ PCE, TCE, dry cleaning solvents
- ✓ Other SVOC chlorinated solvents
- ✓ Some synthetic motor or lub oils

# Products & Services available from Sitelab Corporation



# Portable Analyzers to Rent or Purchase:



U VF-3100



TD-500

# Sample Extraction Kits:



# Calibration Kits:



# Laboratory Services:



# UVF-3100 Calibration Kits

## GRO



**C6-C10  
Gasoline Range  
Hydrocarbons**

Use with  
Slot B Optics

## DRO



**C10-C36  
Extended Diesel  
Range Hydrocarbons**

Use with  
Slot A Optics

## PAHs



**Poly Aromatic  
Hydrocarbons**

Use with Slot A  
Optics for Total PAHs  
(EPH C11-C22  
Aromatics)

or Slot D Optics for  
Target PAHs

## TPH-Oil



**Total Petroleum  
Hydrocarbons**

Product No.  
CAL-057 used with  
Slot A Optics



**Sitelab's UVF-3100  
features a movable  
optical filter cylinder  
to detect GRO, DRO  
and PAHs separately**

# Test Procedure is Fast & Easy...



**1. Weigh Soil**



**2. Add Solvent**



**3. Filter Extract**



**4. Dilute Extract**



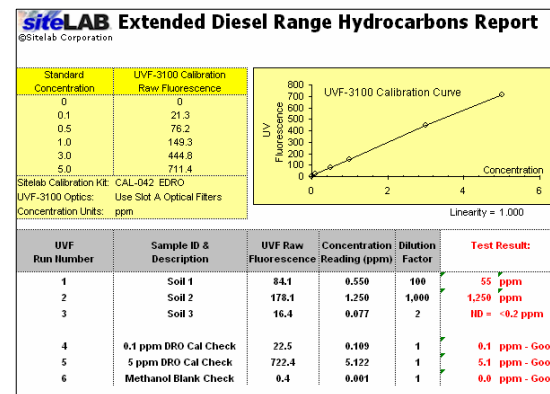
**5. Pour into Cuvette**



**6. Test Sample**

# Record and Report Test Results

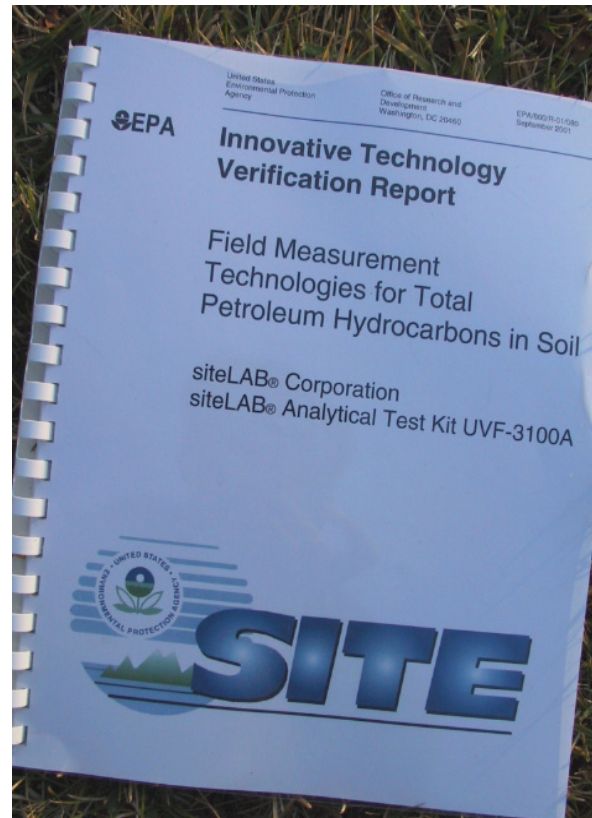
<u>Soil ID</u>	<u>UVF Reading</u>	<u>Dilution Tested</u>	<u>Final Concentration</u>
1	"0.550"	100X	Report as 55 ppm
2	"OVER"	100X	Retest a bigger dilution
	"1.250"	1,000X	Report as 1,250 ppm
3	"0.011"	100X	Low < 0.1 ppm Det limit
	"0.077"	2X Extract	Report as ND <0.2 ppm (2X x 0.1 ppm Det Limit)



*5-point calibration curve and sample results can be downloaded to a computer using UVF-3100 software*

<u>Quality Control Tests to Perform</u>	<u>UVF Reading</u>	<u>Comments</u>
0.1 ppm DRO Std	"0.109"	✓ Close to 0.1 ppm
5 ppm DRO Std	"5.122"	✓ Close to 5.0 ppm
Methanol Blank	"0.001"	✓ Solvent clean, zero

# U.S. EPA TPH in Soil Evaluation



U.S. EPA Innovative Technology Verification Report  
#600/R-01/080 September 2001

# U.S. EPA Evaluation Comparing UVF-3100 to Other Field Screening Technologies

	<u>Accuracy</u> Percentage of Spike Samples within 50% to Lab GC Results	<u>Method Detection Limit</u> Compared to Lab GC Result of 6.3 ppm
<b>Sitelab Corporation UVF-3100 - Fluorescence</b>	<b>72%</b>	<b>3.4 ppm</b>
<b>Horiba Instruments, Inc. OCMA-350 - Infrared (IR)</b>	<b>50%</b>	<b>15.2 ppm</b>
<b>Chemetrics, Inc. RemediAid – Fiedel Crafts Reaction</b>	<b>48%</b>	<b>60 ppm</b>
<b>Wilks Enterprise, Inc. Infracal TOG - Infrared</b>	<b>48%</b>	<b>76 ppm</b>
<b>Dexsil Corporation Petroflag - Emulsion Turbidity</b>	<b>21%</b>	<b>20 ppm</b>
<b>Strategic Diagnostics, Inc. Ensys - Immunoassay</b>	<b>Inconclusive</b>	<b>Inconclusive</b>

# Examples comparing UVF Performance from Contaminated Sites





# UVF vs. Photo-Ionization Detectors at Gasoline Site



## Concentrations in ppm (mg/Kg)

Soil Depth:	UVF-3100 GRO results	Jar Headspace PID Results	PID vs. UVF? Correlation
2'	ND	1	Good
3'	1,010	6	Low!
5'	7	320	High!
7'	2,690	10,000	Fair
8'	400	8	Low!
11'	3,370	115	Low!
14'	9	435	High!
15'	4	28	Fair
16'	5	63	High!
18'	175	590	Good
19'	600	1,010	Good



# Performance Testing Gasoline Range Organic Hydrocarbons in Soil

## Concentrations in ppm (mg/Kg)

UVF-3100 GRO results	Laboratory GC-FID Results:		
	EPA Method 8015-GRO	Massachusetts *Total VPH	DEP VPH Method *includes: C5-C8 Aliphatics + C9-C12 Aliphatics + C9-C10 Aromatics + Target BTEX, MtBE
176	260	292	
666	1,500	886	
1,481	1,500	1,526	
3,037	2,300	2,665	
5,570	8,000	8,103	
5,704	6,000	7,025	
<b>Accuracy:</b>	<b>UVF vs. GRO</b>	<b>UVF vs. Total VPH</b>	
	$R^2 = 0.90$	$R^2 = 0.96$	
	$y = 1.19x$	$y = 1.34x$	



# Performance Testing Diesel Range Organic Hydrocarbons in Soil

## Concentrations in ppm (mg/Kg)

Lab GC-FID results using Massachusetts DEP EPH Method

UVF-3100 EDRO	vs. Lab Total	C9-C18 Aliphatics	C19-C36 Aliphatics	C11-C22 Aromatics	Sum of PAHs
350	241	67	78	96	ND
390	478	270	57	140	11
1,300	2,491	1,600	120	750	21
1,750	2,465	1,600	170	650	45
2,450	2,529	1,700	150	630	49
3,500	5,252	3,200	280	1,700	72
5,050	4,103	2,700	220	1,100	83
6,872	5,692	3,600	290	1,700	102
12,800	12,170	8,800	750	2,400	220
16,420	16,682	12,000	1,100	3,400	182

Accuracy:  $R^2 = 0.97$ ,  $y = 0.95x$



# Performance Testing Polyaromatic Hydrocarbons in Soil

## Concentrations in ppm (mg/Kg)

Sites with PAH Contamination:	TD-500	UVF-3100D	EPA Method 8270 Sum of PAHs
1. Asphalt/urban fill in soil	85	61	69
2. Coal ash from power plant	12	9	10
	33	30	21
3. MGP coal tar site	63	44	46
	262	184	174
4. Fuel oil site with LNAPL plume	40	97	82
	80	180	130
	214	370	350
5. UST site with gasoline & diesel	2	8	7
	3	17	15
	12	60	57



# Performance Testing GRO and DRO in Water vs. 83 Laboratories

## Concentrations in ppm (mg/L)



**GRO Certified Value**  
**3.47**

**UVF-3100 GRO**  
**3.33**

**Laboratory Mean GRO by GC**  
**3.60**

**Acceptance Limits**  
**1.34 – 6.11**



**DRO Certified Value**  
**3.62**

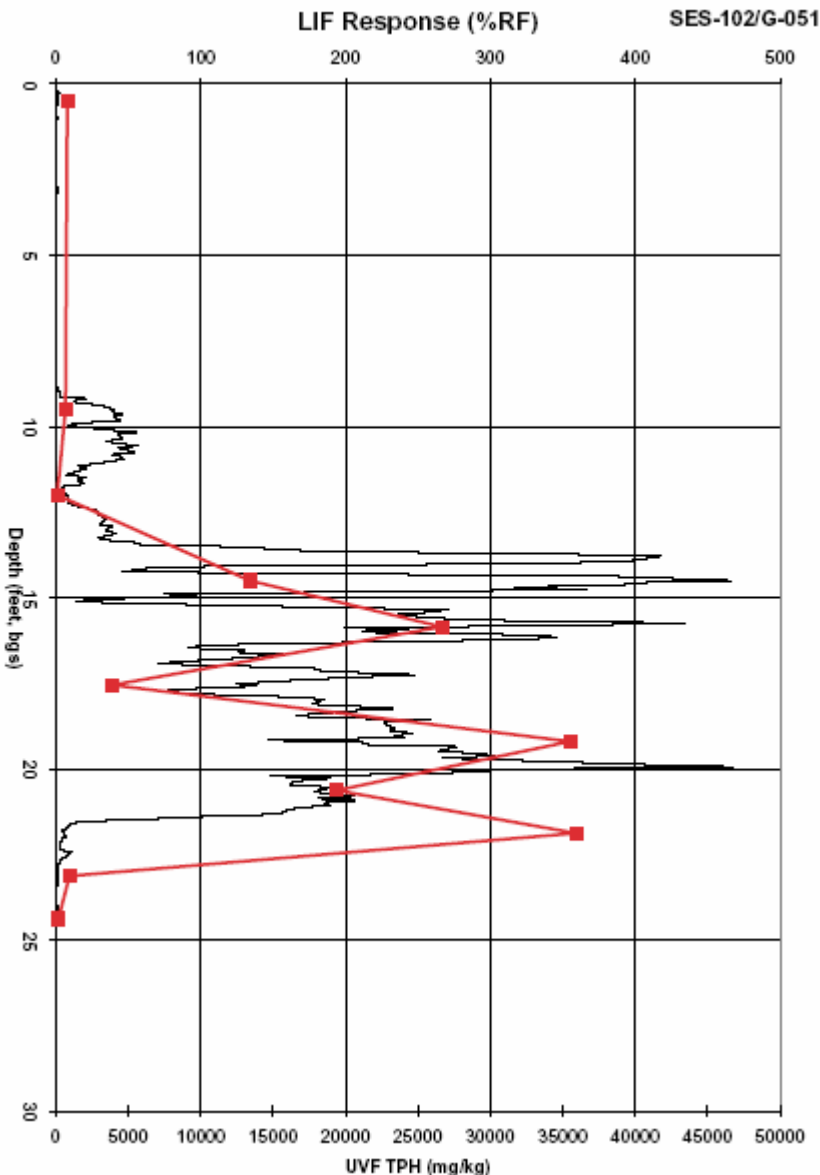
**UVF-3100 DRO**  
**3.78**

**Laboratory Mean DRO by GC**  
**2.60**

**Acceptance Limits**  
**0.897 – 4.66**

Water samples included blind, NELAC certified, Proficiency Evaluation spike samples provided by Environmental Resource Associates, Inc. (Arvada, CO)

# UVF vs. LIF (Laser Induced Fluorescence)



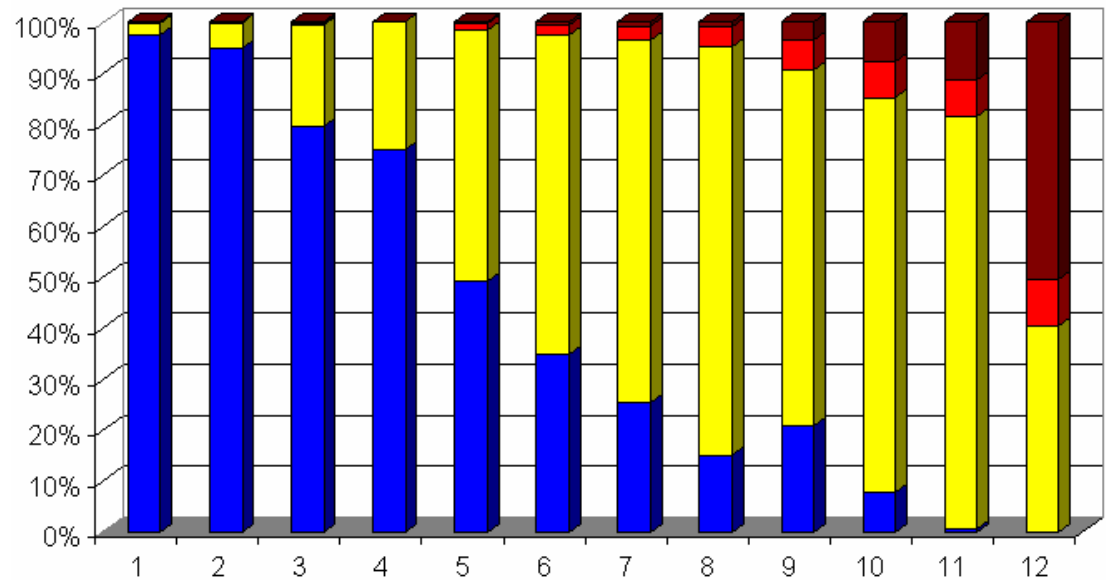
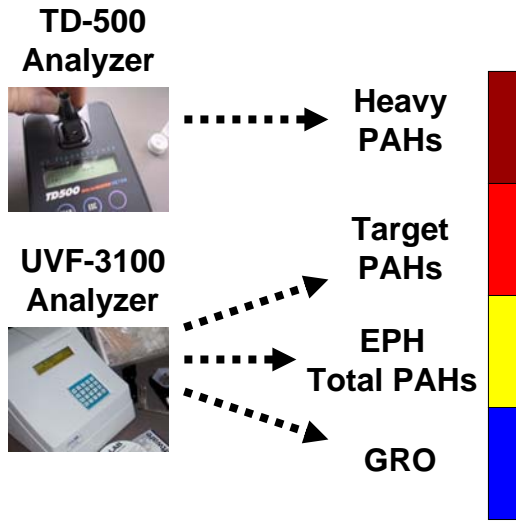
## Comparison of Sitelab UVF TPH Concentrations to LIF Response is Close

- ▶ Former oil refinery site contains a large 100 acre subsurface plume of LNAPL.
- ▶ Sitelab's laboratory service used to test 255 soils collected from 30 borings during a 5-day site investigation.
- ▶ Similar vertical profiles performed by LIF contractor located near each boring.
- ▶ Both UVF and LIF technologies are listed by EPA at Triad and CLU-IN websites.

# Hydrocarbon Fingerprinting



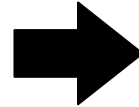
# Proportions of GRO, EPH and PAHs vary in Different Petroleum Contaminants



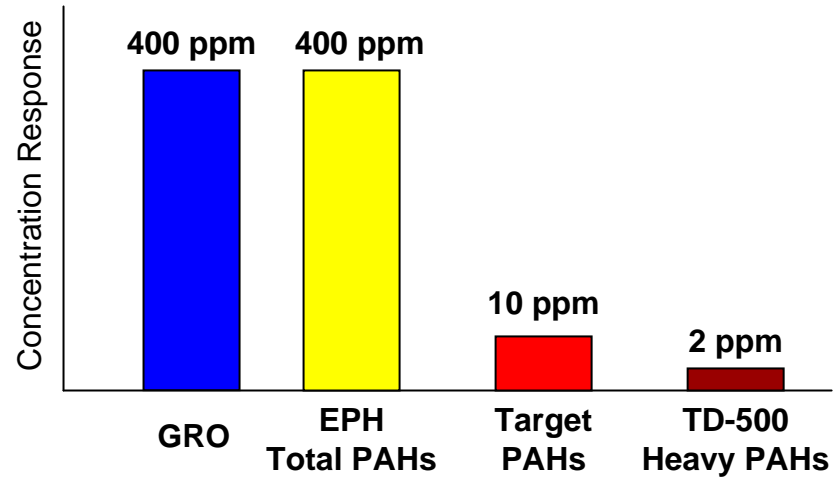
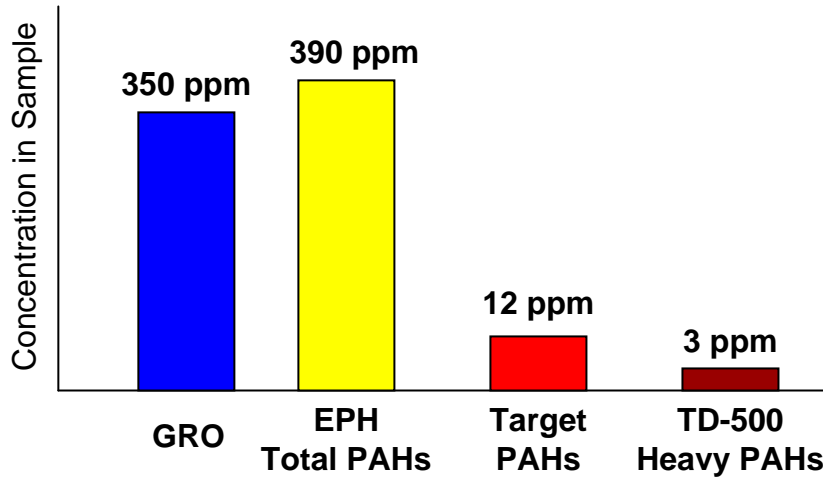
- 1 Fresh Gasoline
- 2 Weathered Gasoline
- 3 Weathered Gas + Diesel
- 4 Weathered Jet Fuel
- 5 Fresh Diesel Fuel (heating oil)
- 6 25% Weathered Diesel
- 7 50% Weathered Diesel
- 8 75% Weathered Diesel
- 9 Waste Motor Oil
- 10 MGP Coal Tar
- 11 No. 6 Fuel Oil
- 12 Humic Acid (brown coal lignite)

# Determine which Petroleum Type Matches the Sample's Contamination

Soil collected from old UST site:



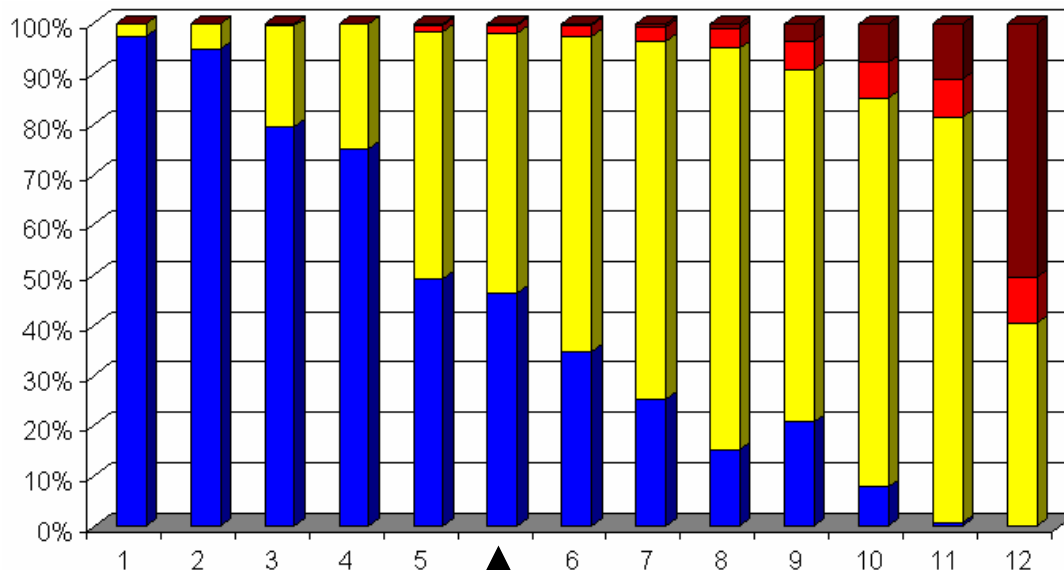
Is similar to Fresh No.2 Diesel Fuel



## Compare Percentage of GRO, EPH and PAHs to the Total Concentration

	<u>% GRO</u>	<u>% EPH</u>	<u>% Target PAHs</u>	<u>% PAHs TD-500</u>
Soil from old UST site Total Conc. = 755 ppm	46%	52%	1.5%	0.3%
Fresh No. 2 Diesel Fuel Total Conc. = 812 ppm	50%	50%	1.2%	0.2%

# Compare Sample Signature to Common Petroleum Contaminants



	<u>Examples Tested at 2,000 ppm concentration</u>	<u>GRO</u>	<u>EPH Total PAH</u>	<u>Target PAHs</u>	<u>TD-500 PAHs</u>
1	Fresh Gasoline	600	15	0.4	0.04
2	Weathered Gasoline	1,500	80	0.6	0.20
3	Weathered Gas + Diesel	950	240	5.0	1.0
4	Weathered Jet Fuel	300	100	0.02	0.012
5	Fresh Diesel Fuel (heating oil)	400	400	10	2.0
	<b>Soil collected from Old UST Site</b>	<b>350</b>	<b>390</b>	<b>12</b>	<b>3</b>
6	25% Weathered Diesel	300	540	18	3.5
7	50% Weathered Diesel	250	700	28	7
8	75% Weathered Diesel	160	850	42	10
9	Waste Motor Oil	65	220	18	11
10	MGP Coal Tar	100	1000	90	100
11	No. 6 Fuel Oil	10	1300	120	180
12	Humic Acid (brown coal lignite)	0	80	18	100

# New Jersey DEP Laboratory Certification



Laboratory Certification ID #MA013, Category Code SHW12  
Effective Date: 7/1/2009 to 6/30/2010

# Sitelab's Certification Process with NJ DEP's Office of Quality Assurance...



- ▶ Sitelab was required to prepare SOP with supporting QA/QC documentation using the same strict protocols required by conventional laboratories for certification.
- ▶ 4-Hour audit performed at DEP facility in Trenton, NJ.
- ▶ Corrective actions taken for deficiencies identified during the audit include: MDL studies performed, all traceability records relating to UVF instruments and use of calibration standards, copies of Certificates of Analysis, second-source quality assurance materials, etc.
- ▶ Time it took to get certified? 9 Months
- ▶ Total cost of getting certified? \$2,000 - \$3,000

Press release online @ [www.site-lab.com/NJDEP\\_Certification.htm](http://www.site-lab.com/NJDEP_Certification.htm)

# Home heating oil project in New Jersey

## Sitelab Petroleum Hydrocarbons Analysis Report

### Customer:

Continental Remediation, LLC  
184 Riverview Avenue  
Waltham, MA 02453

(617) 512-8106  
John Patterson

Sitelab Operator: Steve Greason

Signature: \_\_\_\_\_  
Date & Time: \_\_\_\_\_

### Project Name:

Job/File Number: 091079  
Matrix: Soil  
Date Collected: 11/5/2009  
Date Received: 11/5/2009  
Date Extracted: 11/5/2009  
Date Analyzed: 11/5/2009  
Date Reported: 11/5/2009



Sample ID No.	Test 1: GRO C6-C10 Gasoline Range Hydrocarbons Cal Kit #025 Slot B Optics	Test 2: EDRO C10-C36 Diesel Range Hydrocarbons Cal Kit #042 Slot A Optics	Test 3: Total PAHs EPH C11-C22 Aromatics Cal Kit #060 Slot A Optics	Test 4: Target PAHs (EPA 8270 PAHs) Cal Kit #060 Slot D Optics	Test 5: TD-500 Analyzer Heavy PAHs Using same PAH Cal Kit as UVF-3100
PI-1 9'	ND <10	ND <2	ND <1	ND <1	ND <1
PI-1 11'	ND <10	ND <0.2	ND <0.1	ND <0.1	ND <0.1
PI-1 13'	1.4	0.5	0.1	ND <0.1	ND <0.1
PI-1 15'	ND <10	ND <0.2	ND <0.1	ND <0.1	ND <0.1
PI-1 17'	1,100	2,915	737	26	4.0
PI-1 19'	1,100	3,313	863	23	3.0
PI-1 21'	1.2	2.0	0.6	ND <0.1	0.1
PI-1 23'	1.0	1.4	0.4	ND <0.1	0.1
PI-1 24'	ND <2	2.2	0.6	ND <0.1	0.1

This test correlates to EPA Method 8015-GRO or NJ-DEP OQA-QAM-025

This test correlates to EPA Method 8015-DRO

This test correlates to EPA Method 8270 as sum of PAH compounds

**TPH Fingerprinting:** Contaminated samples have GRO, EPH and PAH ratios - or signatures - similar to fresh heating oil.

New Jersey DEP Laboratory Certification No. MA013 • Expires June 30, 2010

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Direct push drill rigs are used to inject a solution of Nano Peroxide deep into the ground, which accelerates the natural bioremediation activity in the soil.

Data is used to define extent of contamination and monitor progress.

Continental Remediation, LLC  
John Patterson: 781-891-0431

Acorn DP, LLC  
Brett Amspacher: 973-401-1916

Visit: [www.continentalremediation.com](http://www.continentalremediation.com)

# Costs for using Sitelab in New Jersey for Certified Laboratory Analysis



- ▶ **Option 1:** In-house laboratory service with 24-hour turnaround time

**Price is \$50 per sample. Samples are tested for GRO, DRO, EPH and PAHs using UVF-3100 and TD-500 analyzers.**

- ▶ **Option 2:** Mobile laboratory service on-site

**Price is \$2,000 per day. Samples are tested for same parameters listed above. 40 to 50 samples can be tested in a day.**

- ▶ **Forensic hydrocarbon fingerprinting is included with either option. Soil, sediment, water or LNAPL oil samples can be tested!**



**The End - Thank You**

**Visit us at: [site-lab.com](http://site-lab.com)**

**Contact Steve Greason  
[sgreason@site-lab.com](mailto:sgreason@site-lab.com)**

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