## **ALS Environmental**



# CHEMICAL ANALYSIS REPORT

Date:

September 9, 2002

ALS File No.

P7199r

Report On:

Polaris Mine Seawater Analysis

Report To:

Gartner Lee Ltd.

Sperling Plaza

Suite 490, 6400 Roberts Street

Burnaby, BC V5G 4C9

Attention:

Ms. Arlene Laudrum

Received:

July 19, 2002

ALS ENVIRONMENTAL

per:

Brent C. Mack, B.Sc. - Project Chemist Leanne Harris, B.Sc. - Project Chemist GARTNER LEE LTD.

#### REMARKS



This report replaces the previously issued P7199 and includes added analysis for Polycyclic Aromatic Hydrocarbons (PAH) for the samples identified as 'MW02-005', 'MW02-007', and 'MW02-010.

Please note the detection limits for certain PAHs have been increased for the samples reported in the following data tables due to sample matrix interferences.

Qualifications for the QC Report Data:

1. Method Spikes - Decane (nC10) - The Decane (nC10) data, by GC-FID does not meet data quality objectives. This low spike recovery does not affect the samples reported for EPH, however, as the low recovery was determined to be due to the preparation of the spike itself prior to the extraction stage.

All other QC data presented for these samples meets ALS Data Quality Objectives. For more information, contact your ALS service representative.

## **RESULTS OF ANALYSIS - Seawater**



Sample ID	MW02-003	MW02-004	MW02-005	MW02-006	MW02-007
Sample Date Sample Time ALS ID	02 07 16 13:00 1	02 07 16 13:00 2	02 07 16 13:00 3	02 07 16 13:00 4	02 07 16 13:00 5
Polycyclic Aromatic Hydrocarbons Acenaphthene Acenaphthylene Acridine Anthracene Benz(a)anthracene	-		<0.008 <0.003 <0.002 <0.001 <0.0005	:	<0.00005 <0.00005 <0.00005 <0.00005 <0.00005
Benzo(a)pyrene Benzo(b)fluoranthene Benzo(g,h,i)perylene Benzo(k)fluoranthene Chrysene	- - - -		<0.00001 <0.00005 <0.00005 <0.00005 <0.0005	-	<0.00001 <0.00005 <0.00005 <0.00005 <0.00005
Dibenz(a,h)anthracene Fluoranthene Fluorene Indeno(1,2,3-c,d)pyrene Naphthalene Phenanthrene	- - - -		<0.00005 <0.0005 0.0125 <0.00005 0.0611		<0.00005 <0.00005 <0.00005 <0.00005 <0.00005
Pyrene Quinoline  Extractable Hydrocarbons	- -	-	0.0010	-	<0.00005 <0.00005
EPH10-19 EPH19-32 LEPH HEPH	<0.3 <1 -	<0.3 <1 -	69.7 7 69.6 7	39.5 4 -	<0.3 <1 <0.3 <1

Remarks regarding the analyses appear at the beginning of this report. Results are expressed as milligrams per litre except where noted. <= Less than the detection limit indicated. EPH = Extractable Petroleum Hydrocarbons EPH10-19 is equivalent to EHw10-19. LEPH & HEPH = Light and Heavy Extractable Petroleum Hydrocarbons.

## **RESULTS OF ANALYSIS - Seawater**



Sample ID	MW02-009	MW02-010	MW02-011	MW02-012	MW02-013
Sample Date Sample Time ALS ID	02 07 16 13:00 6	02 07 16 13:00 7	02 07 16 13:00 8	02 07 16 13:00 <i>9</i>	02 07 16 13:00 10
Polycyclic Aromatic Hydrocarbons Acenaphthene Acenaphthylene Acridine Anthracene Benz(a)anthracene	- - - -	<0.0009 <0.0004 <0.0002 <0.0002 <0.0005	-	- - - -	
Benzo(a)pyrene Benzo(b)fluoranthene Benzo(g,h,i)perylene Benzo(k)fluoranthene Chrysene	- - - -	0.00001 <0.00005 0.00005 <0.00005 <0.00005	-	- - -	
Dibenz(a,h)anthracene Fluoranthene Fluorene Indeno(1,2,3-c,d)pyrene Naphthalene	- - - -	<0.00005 0.00023 0.00206 <0.00005 <0.002	- - -	- - -	
Phenanthrene Pyrene Quinoline	:	0.00236 0.00114 <0.002	:	- - -	
Extractable Hydrocarbons EPH10-19 EPH19-32 LEPH HEPH	5.5 1	7.7 2 7.7 2	<0.3 <1 -	<0.3 <1	12.4

Remarks regarding the analyses appear at the beginning of this report. Results are expressed as milligrams per litre except where noted. <= Less than the detection limit indicated. EPH = Extractable Petroleum Hydrocarbons EPH10-19 is equivalent to EHw10-19. LEPH & HEPH = Light and Heavy Extractable Petroleum Hydrocarbons.

#### **RESULTS OF ANALYSIS - Seawater**



Sample ID	MW02-014	MW02-017	MW02-018	MW02-021	MW02-022
Sample Date Sample Time ALS ID	02 07 16 13:00 11	02 07 16 13:00 12	02 07 16 13:00 13	02 07 16 13:00 14	02 07 16 13:00 15
Extractable Hydrocarbons EPH10-19 EPH19-32 LEPH	5.2 <1	19.5	9.8	7.5	7.0
НЕРН	-	-	-	-	-

Remarks regarding the analyses appear at the beginning of this report. Results are expressed as milligrams per litre except where noted. <= Less than the detection limit indicated. EPH = Extractable Petroleum Hydrocarbons. EPH10-19 is equivalent to EHw10-19. LEPH & HEPH = Light and Heavy Extractable Petroleum Hydrocarbons.

## Appendix 1 - QUALITY CONTROL - Spikes



Seawater

	Result	Target	Units	DL	ALSQC#	Method
Polycyclic Aromatic Hydrocarbons Naphthalene	0.055	0.100	mg/L	0.005	298198	a
Phenanthrene Pyrene	0.106	0.100	mg/L mg/L	0.005	298198 298198	a
Extractable Hydrocarbons	0.000					
Decane (nC10)	0.055	0.100	mg/L	0.005	298198 298198	а
Dodecane (nC12) Dotriacontane (nC32)	0.096	0.100	mg/L mg/L	0.005	298198	a
Eicosane (nC20) Hexadecane (nC16)	0.097 0.096	0.100	mg/L mg/L	0.005 0.005	298198 298198	a
Nonadecane (nC19)	0.099	0.100	mg/L	0.005	298198	а
Triacontane (nC30)	0.094	0.100	mg/L	0.005	298198	а

Methods: a = GC-FID

## Appendix 1 - QUALITY CONTROL - Blanks



Seawater

	Result	Target	Units	DL	ALSQC#	Method
Extractable Hydrocarbons EPH10-19 EPH19-32	<0.3 <1	<0.3 <1	mg/L mg/L	0.3	298197 298197	a a

Methods: a = GC-FID

#### Appendix 2 - METHODOLOGY



Outlines of the methodologies utilized for the analysis of the samples submitted are as follows

#### Extractable Hydrocarbons in Water

This analysis is carried out in accordance with the British Columbia Ministry of Environment, Lands and Parks (BCMELP) Analytical Method for Contaminated Sites "Extractable Petroleum Hydrocarbons in Water by GC/FID" (Version 2.1, July 1999). The procedure involves extraction of the entire water sample with dichloromethane. The extract is then solvent exchanged to toluene and analysed by capillary column gas chromatography with flame ionization detection (GC/FID). EPH results include Polycyclic Aromatic Hydrocarbons (PAH) and are therefore not equivalent to Light and Heavy Extractable Petroleum Hydrocarbons (LEPH/HEPH).

Recommended Holding Time:

Sample: 7 days Extract: 40 days

Reference: BCMELP

For more detail see ALS Environmental "Collection & Sampling Guide"

#### Polycyclic Aromatic Hydrocarbons in Water

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3510, 3630 & 8270, published by the United States Environmental Protection Agency (EPA). The procedure involves extraction of the entire water sample with dichloromethane. The extract is then solvent exchanged to toluene prior to analysis by capillary column gas chromatography with mass spectrometric detection (GC/MS).

Recommended Holding Time:

Sample: 7 days Extract: 40 days

Reference: EPA

For more detail see ALS Environmental "Collection & Sampling Guide"

#### Light and Heavy Extractable Petroleum Hydrocarbons in Water

These results are determined according to the British Columbia Ministry of Environment, Lands, and Parks Analytical Method for Contaminated Sites "Calculation of Light and Heavy Extractable Petroleum Hydrocarbons in Solids or Water". According to this method, LEPH and HEPH are calculated by subtracting selected Polynuclear Aromatic Hydrocarbon results from Extractable Petroleum Hydrocarbon results. To calculate LEPH, the individual results for Acenaphthene, Acridine, Anthracene, Fluorene, Naphthalene, and Phenanthrene are subtracted from EPH(C10-19). To calculate HEPH, the individual results for Benz(a)anthracene, Benzo(a)pyrene, Fluoranthene, and Pyrene are subtracted from EPH(C19-32). Analysis of Extractable Petroleum Hydrocarbons adheres to all prescribed elements of the BCMELP method "Extractable Petroleum Hydrocarbons in Water by GC/FID" (Version 2.1, July 20, 1999).

Recommended Holding Time: Not Applicable

## Appendix 2 - METHODOLOGY - Continued



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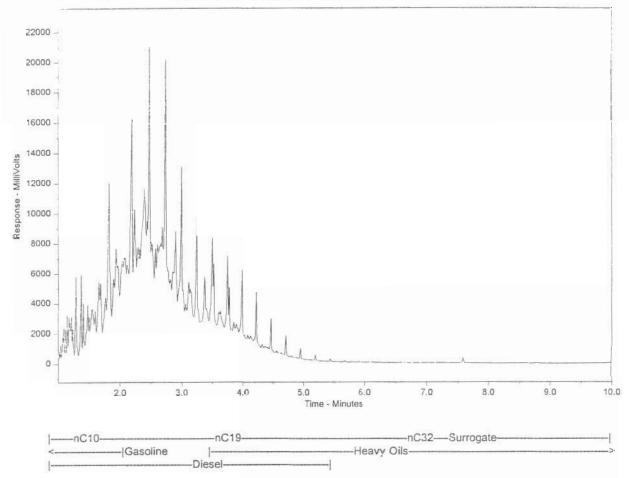
End of Report

Client Sample ID:

ALS Sample ID:

P7199-T--3

File Name: Run Information: i:\Chrom\gc21\data\gc21\_24julA.0031.RAW Acquired on GC21, 7/25/2002 3:07:48 AM



Sample Amount = 500.0 (g or mL)

Dilution Factor = 1.0

The Hydrocarbon Distribution Report is intended to assist you in characterizing hydrocarbon products that may be present in your sample. The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and of three n-alkane hydrocarbon marker compounds. Comparison of this report with those of reference standards may also assist in characterizing hydrocarbons present in the sample. A current library of reference products is available upon request.

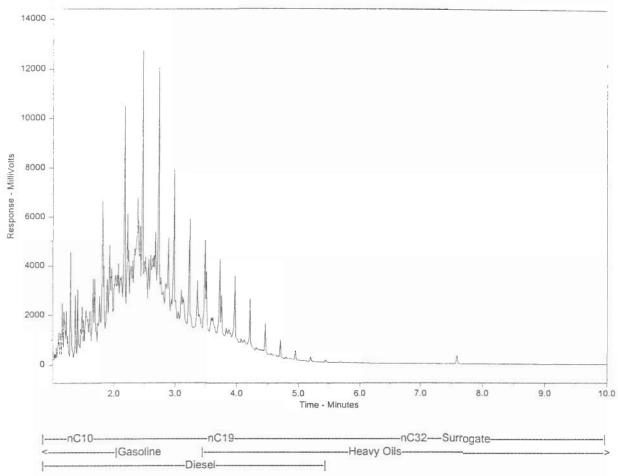
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Client Sample ID:

ALS Sample ID:

P7199-T--4

File Name: Run Information: i\Chrom\gc21\data\gc21\_24julA.0032.RAW Acquired on GC21, 7/25/2002 3:27:05 AM



Sample Amount = 460.0 (g or mL)

Dilution Factor = 1.0

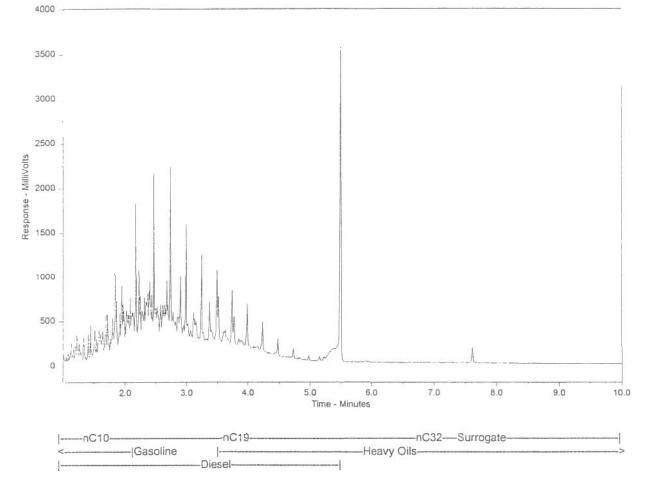
The Hydrocarbon Distribution Report is intended to assist you in characterizing hydrocarbon products that may be present in your sample. The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and of three n-alkane hydrocarbon marker compounds. Comparison of this report with those of reference standards may also assist in characterizing hydrocarbons present in the sample. A current library of reference products is available upon request.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Client Sample ID:

ALS Sample ID: P7199-T--6

File Name: i:\Chrom\gc21\data\gc21\_24julB.0018.RAW
Run Information: Acquired on GC21, 7/24/2002 10:57:33 PM



Sample Amount = 500.0 (g or mL)

Dilution Factor = 1.0

The Hydrocarbon Distribution Report is intended to assist you in characterizing hydrocarbon products that may be present in your sample. The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and of three n-alkane hydrocarbon marker compounds. Comparison of this report with those of reference standards may also assist in characterizing hydrocarbons present in the sample. A current library of reference products is available upon request.

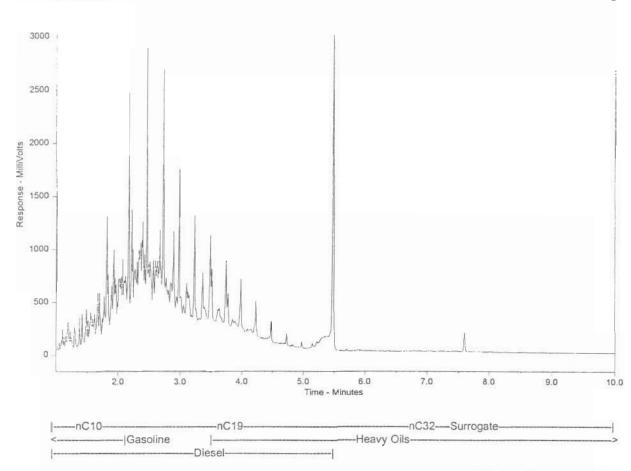
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Client Sample ID:

ALS Sample ID:

P7199-T--7

File Name: Run Information: i:\Chrom\gc21\data\gc21\_24juIB.0019.RAW Acquired on GC21, 7/24/2002 11:16:47 PM



Sample Amount = 440.0 (g or mL)

Dilution Factor = 1.0

The Hydrocarbon Distribution Report is intended to assist you in characterizing hydrocarbon products that may be present in your sample. The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and of three n-alkane hydrocarbon marker compounds. Comparison of this report with those of reference standards may also assist in characterizing hydrocarbons present in the sample. A current library of reference products is available upon request.

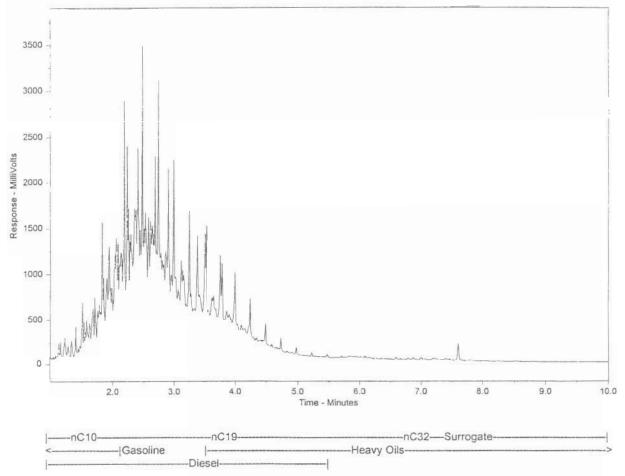
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Client Sample ID:

ALS Sample ID:

P7199-T--10

File Name: Run Information: i:\Chrom\gc21\data\gc21\_24julB.0022.RAW Acquired on GC21, 7/25/2002 12:14:40 AM



Sample Amount = 440.0 (g or mL)

Dilution Factor = 1.0

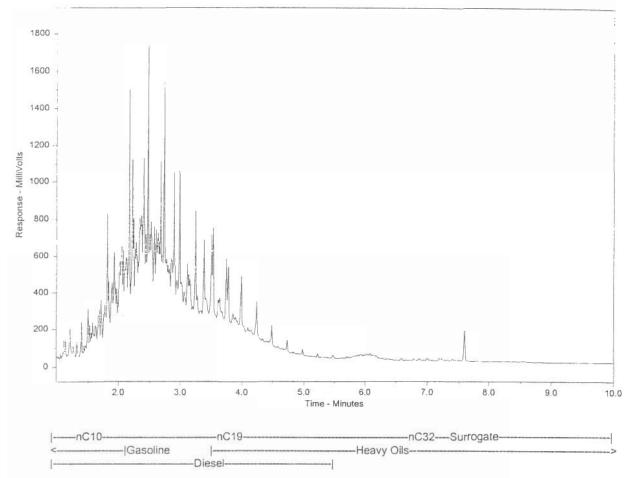
The Hydrocarbon Distribution Report is intended to assist you in characterizing hydrocarbon products that may be present in your sample. The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and of three n-alkane hydrocarbon marker compounds. Comparison of this report with those of reference standards may also assist in characterizing hydrocarbons present in the sample. A current library of reference products is available upon request.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Client Sample ID:

ALS Sample ID: P7199-T--11

File Name: i:\Chrom\gc21\data\gc21\_24julB.0023.RAW
Run Information: Acquired on GC21, 7/25/2002 12:33:52 AM



Sample Amount = 500.0 (g or mL)

Dilution Factor = 1.0

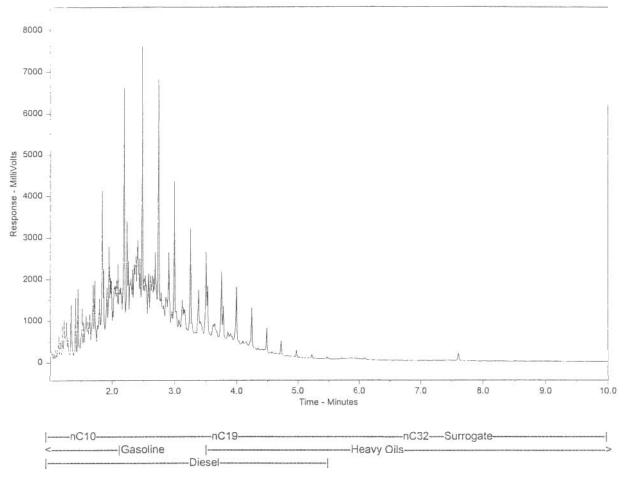
The Hydrocarbon Distribution Report is intended to assist you in characterizing hydrocarbon products that may be present in your sample. The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and of three n-alkane hydrocarbon marker compounds. Comparison of this report with those of reference standards may also assist in characterizing hydrocarbons present in the sample. A current library of reference products is available upon request.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Client Sample ID:

ALS Sample ID: P7199-T--12

File Name: i:\Chrom\gc21\data\gc21\_24julB.0024.RAW
Run Information: Acquired on GC21, 7/25/2002 12:53:06 AM



Sample Amount = 420.0 (g or mL)

Dilution Factor = 1.0

The Hydrocarbon Distribution Report is intended to assist you in characterizing hydrocarbon products that may be present in your sample. The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and of three n-alkane hydrocarbon marker compounds. Comparison of this report with those of reference standards may also assist in characterizing hydrocarbons present in the sample. A current library of reference products is available upon request.

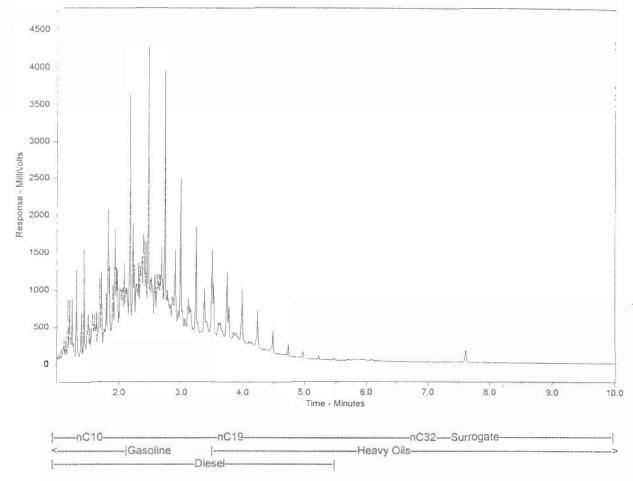
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Client Sample ID:

ALS Sample ID:

P7199-T--13

File Name: Run Information: i:\Chrom\gc21\data\gc21\_24juIB.0026.RAW Acquired on GC21, 7/25/2002 1:31:37 AM



Sample Amount = 490.0 (g or mL)

Dilution Factor = 1.0

The Hydrocarbon Distribution Report is intended to assist you in characterizing hydrocarbon products that may be present in your sample. The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and of three n-alkane hydrocarbon marker compounds. Comparison of this report with those of reference standards may also assist in characterizing hydrocarbons present in the sample. A current library of reference products is available upon request.

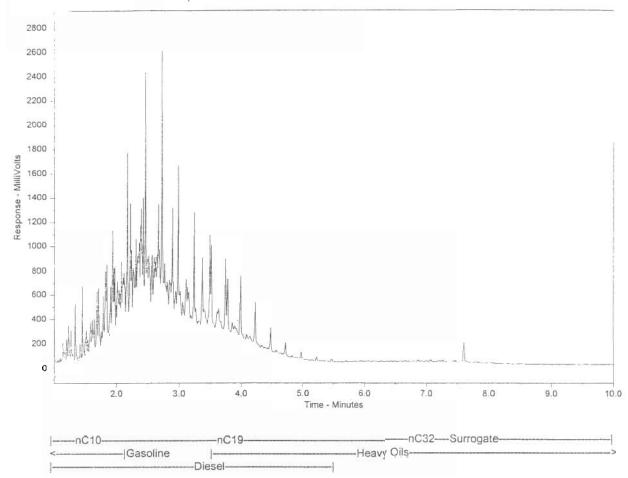
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Client Sample ID:

ALS Sample ID:

P7199-T--14

File Name: Run Information: i:\Chrom\gc21\data\gc21\_24julB.0027.RAW Acquired on GC21, 7/25/2002 1:50:51 AM



Sample Amount = 460.0 (g or mL)

Dilution Factor = 1.0

The Hydrocarbon Distribution Report is intended to assist you in characterizing hydrocarbon products that may be present in your sample. The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and of three n-alkane hydrocarbon marker compounds. Comparison of this report with those of reference standards may also assist in characterizing hydrocarbons present in the sample. A current library of reference products is available upon request.

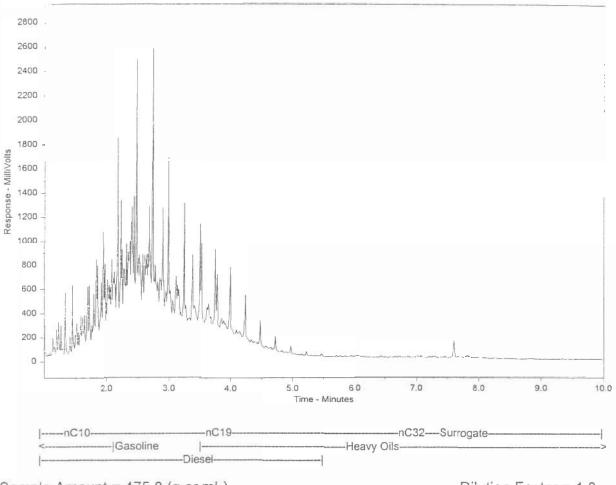
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Client Sample ID:

ALS Sample ID:

P7199-T--15

File Name: Run Information: i:\Chrom\gc21\data\gc21\_24juIB.0028.RAW Acquired on GC21, 7/25/2002 2:10:09 AM



Sample Amount = 475.0 (g or mL)

Dilution Factor = 1.0

The Hydrocarbon Distribution Report is intended to assist you in characterizing hydrocarbon products that may be present in your sample. The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and of three n-alkane hydrocarbon marker compounds. Comparison of this report with those of reference standards may also assist in characterizing hydrocarbons present in the sample. A current library of reference products is available upon request.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

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