GROUNDWATER TECHNOLOGY

Groundwater Technology, Inc.
19033 W. Valley Highway, Suite D-104, Kent, WA 98032

February 11, 1993

Mr. D. Mark Wells
Texaco Environmental Services
3400 188th Street SW, Suite 630
Lynnwood, WA 98037

RE: **Riverside Project Activity Update**
SR 522 and NE 180th Street

Dear Mark:

This letter presents a Riverside project update covering weeks three through eleven, December 14 through February 10, 1993, of the bioremediation cell operation.

Effluent airstream monitoring and sampling since December 14, 1992 showed that precarbon-treatment emissions of volatile compounds were non-detectable with a photoionization detector.

Monitoring of the bioremediation activity in the cell during early December, 1992 showed the soil temperature stabilizing at approximately 46 °F with air temperatures in the high 30's and low 40's (Figure 1). The negative airflow rate (air removed from the cell) was reduced from 180 cubic feet per minute (cfm) to 90 cfm on December 22, 1992, while the positive airflow (air supplied into the cell) was kept at 90 cfm. This was done in an attempt to keep the soil temperature and the temperature of the air moving through the cell as warm as possible. However, the drop in average daily temperatures through late December and January caused the temperature of the air being removed from the pile to fall into the 30's. The oxygen consumption rates for the last week of December and the first two weeks of January reflected near dormant biologic activity in the cell. Oxygen consumption rates had increased with increased air temperatures by January 25, 1993. A respirometry test, which is an evaluation of the cell's oxygen usage, was conducted on February 6, 1993. The respirometry test analysis indicated that approximately 20 to 25 pounds of hydrocarbons/other carbon were biologically degraded per day. This is a decrease from the 40 to 50 pounds calculated from data collected on December 8, but an increase from the dormant reading obtained on January 13, 1993.

Twelve soil samples were collected from the cell on January 25, 1992 after 65 days of blower operation. A nine-square grid was used as the sample pattern with one sample collected from a depth of four feet in the center of each square. Three additional samples were collected from a depth of two feet in the central three squares. Each sample was analyzed by GTEL Environmental Laboratories in Concord, California for total petroleum hydrocarbons (WTPH) by the Washington modified EPA Method 418.1 and for TPH-as-diesel (WTPHD) by modified EPA Method 8015. Although not a Washington method, the samples were also analyzed for TPH-as-Lube Oil by EPA Method 8015. The results are shown in Table 1. Results of the pre-treatment sample analysis, from July, 1992, is also shown in Table 1.

WTPHD concentrations have been reduced in ten of the twelve samples to less than 50 milligrams/Kilogram (mg/Kg), with the remaining two sample concentrations below the 200 mg/Kg Compliance Cleanup Level

(CCL)[1]. The WTPH concentrations ranged from 180 mg/Kg to 1,600 mg/Kg with an arithmetic mean of 979 mg/Kg. This is an increase of approximately 450 mg/Kg over the July mean. A hydrocarbon "spike" is not uncommon, in Groundwater Technology's experience, during the first stages of bioremediation when EPA Method 418.1 analyses are used. The cause of the spike has been attributed to two hypotheses: 1.) due to the biologic activity, it is possible to extract an increased quantity of hydrocarbons; and 2.) by-products of the biologic processes, biomass, surfactants or other unknown compounds are extracted during the analytical procedure and are "counted" by the 418.1 IR method. The 8015 analyses were run through the lube oil fraction and those results do not confirm an increase in actual hydrocarbon concentrations. In fact, the average lube oil concentration by 8015 was 173 mg/Kg.

The bioremediation cell is currently active, but hydrocarbon degradation rates are less than those observed in November, 1992. Groundwater Technology recommends continued operation of the remediation system through the spring and collecting soil samples on April 8, 1993.

Please contact me if you have any questions.

Sincerely,
GROUNDWATER TECHNOLOGY, INC.

Stan Haskins
Staff Geologist

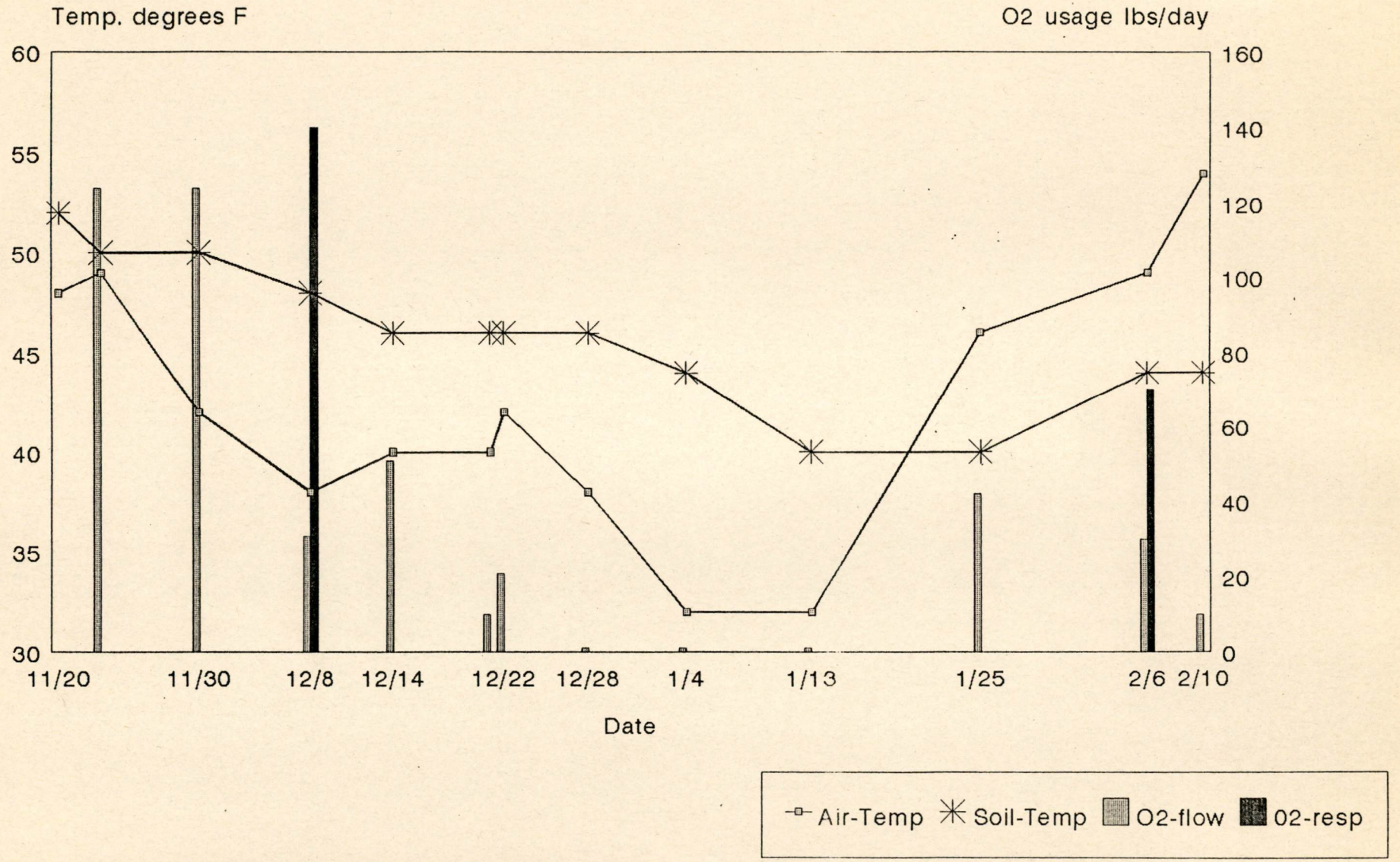
PR
Attachments

[1] Model Toxics Control Act - Method A cleanup level (WAC 173-340).

TES/RIVERSIDE

BIOREMEDIATION CELL CONDITIONS

Temperature and Oxygen Usage



12/8 - Convert blower #1 to positive pressure. 12/22 - Reduce negative flow from 180 cfm to 90 cfm. 12/28, 1/4 & 13 cell inactive by flow calculation.
1/13 - Pile inactive by respirometry test. 2/6 - All 3 blowers to vacuum (270 cfm)

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TABLE 1
SUMMARY OF SOIL ANALYTICAL DATA
WTPH-418.1, WTPHD-modified 8015, TPH-Lube Oil-modified 8015
Results in milligrams/Kilogram

Sample date: 7/27-31/92				Sample date: 1/25/93					
Sample ID	WTPH 418.1	WTPHD 8015	WTPH TOTAL	Sample ID	WTPH 418.1	TPH-Oil 8015	WTPHD 8015	WTPH TOTAL	TPH-TOTAL 8015
7/27-1	NA	810	810	-					
7/27-8	280	620	900	1-4.0	370	27	<10	380	37
7/28-7	920	1100	2,020	2-4.0	800	230	29	829	259
7/28-20	640	1000	1,640	3-4.0	1200	150	34	1234	184
7/28-23	760	NA	760	4-2.0	840	140	29	869	169
7/29-4	950	1500	2,450	4-4.0	1000	160	38	1038	198
7/29-12	820	1300	2,120	5-2.0	180	120	18	198	138
7/29-20	410	510	920	5-4.0	790	170	24	814	194
7/30-3	360	670	1,030	6-2.0	670	260	26	696	286
7/30-12	390	570	960	6-4.0	1300	220	40	1340	260
7/30-19	230	410	640	7-4.0	1500	230	30	1530	260
7/31-2	290	390	680	8-4.0	1500	280	93	1593	373
7/31-9	330	430	760	9-4.0	1600	95	110	1710	205
CCL			200					200	200
Mean	532	775	1307		979	173	40	1019	213
Std. Dev.	268	370	625		454	74	30	477	84

GROUNDWATER TECHNOLOGY

GTEL
ENVIRONMENTAL
LABORATORIES, INC.

Northwest Region
4080-C Pike Lane
Concord, CA 94520
(510) 685-7852
(800) 544-3422 *from inside California*
(800) 423-7143 *from outside California*
(510) 825-0720 (FAX)

Client Number: GTI70TEX01
Consultant Project Number: 020603332
Project ID: Bothell, WA
Work Order Number: C3-01-525

February 9, 1993

Mark Nichols
Groundwater Technology, Inc.
19033 W. Valley Hwy., D-104
Kent, WA 98032

Enclosed please find the analytical results for samples received by GTEL Environmental Laboratories, Inc. on 01/27/93, under chain of custody records 25905 and 25906.

A formal Quality Assurance/Quality Control (QA/QC) program is maintained by GTEL, which is designed to meet or exceed the EPA requirements. Analytical work for this project met QA/QC criteria, unless otherwise stated in the footnotes.

GTEL is certified by the California State Department of Health Services to perform analyses for drinking water, wastewater, and hazardous waste materials according to EPA protocols.

If you have any questions concerning this analysis or if we can be of further assistance, please call our Customer Service Representative.

Sincerely,
GTEL Environmental Laboratories, Inc.

Eileen F. Bullen

Eileen F. Bullen
Laboratory Director

Client Number: GTI70TEX01
Consultant Project Number: 020603332
Project ID: Bothell, WA
Work Order Number: C3-01-525

Table 1

ANALYTICAL RESULTS

Total Petroleum Hydrocarbons in Soil by Infrared Spectrometry[1]

EPA 3550 (Mod.)/WTPH-418.1 (SM 5520 FC)[2]

GTEL Sample Number		01	02	03	04
Client Identification		1-4.0	2-4.0	3-4.0	4-2.0
Date Sampled		01/25/93	01/25/93	01/25/93	01/25/93
Date Prepared		02/04/93	02/04/93	02/04/93	02/04/93
Date Analyzed		02/08/93	02/08/93	02/08/93	02/08/93
Analyte	Detection Limit, mg/Kg	Concentration, mg/Kg			
Total Petroleum Hydrocarbons	5	370	800	1200	840
Detection Limit Multiplier		1	1	1	1
Percent solids		86.6	88.6	89.3	91.0

1. The sample is sonication extracted using a modification of EPA 3550. The extract is analyzed, as in EPA 418.1 (SM 5520 CF), to yield results reported as Total Petroleum Hydrocarbons. Results are reported on a dry weight basis.
2. Standard Methods for the Examination of Water and Wastewater, 17th ed., American Public Health Association, 1989. Modification in TPH Methods as per the state of Washington Department of Ecology, Appendix L, April, 1992.

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Table 1

ANALYTICAL RESULTS

Total Petroleum Hydrocarbons in Soil by Infrared Spectrometry[1]

EPA 3550 (Mod.)/WTPH-418.1 (SM 5520 FC)[2]

GTEL Sample Number		05	06	07	08
Client Identification		4-4.0	5-2.0	5-4.0	6-2.0
Date Sampled		01/25/93	01/25/93	01/25/93	01/25/93
Date Prepared		02/04/93	02/04/93	02/04/93	02/04/93
Date Analyzed		02/08/93	02/08/93	02/08/93	02/08/93
Analyte	Detection Limit, mg/Kg	Concentration, mg/Kg			
Total Petroleum Hydrocarbons	5	1000	180	790	670
Detection Limit Multiplier		1	1	1	1
Percent solids		85.6	70.1	88.6	86.1

1. The sample is sonication extracted using a modification of EPA 3550. The extract is analyzed, as in EPA 418.1 (SM 5520 CF), to yield results reported as Total Petroleum Hydrocarbons. Results are reported on a dry weight basis.
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EPA 3550 (Mod.)/WTPH-418.1 (SM 5520 FC)[2]

GTEL Sample Number		09	10	11	12
Client Identification		6-4.0	7-4.0	8-4.0	9-4.0
Date Sampled		01/25/93	01/25/93	01/25/93	01/25/93
Date Prepared		02/04/93	02/04/93	02/04/93	02/04/93
Date Analyzed		02/08/93	02/08/93	02/08/93	02/08/93
Analyte	Detection Limit, mg/Kg	Concentration, mg/Kg			
Total Petroleum Hydrocarbons	5	1300	1500	1500	1600
Detection Limit Multiplier		1	1	1	1
Percent solids		87.1	87.5	86.4	86.0

1. The sample is sonication extracted using a modification of EPA 3550. The extract is analyzed, as in EPA 418.1 (SM 5520 CF), to yield results reported as Total Petroleum Hydrocarbons. Results are reported on a dry weight basis.
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February 10, 1993

Mark Nichols
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Sincerely,
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Eileen F. Bullen

Eileen F. Bullen
Laboratory Director

Client Number: GTI70TEX01
Consultant Project Number: 020603332
Project ID: Bothell, WA
Work Order Number: C3-01-524

Table 1

ANALYTICAL RESULTS

Total Petroleum Hydrocarbons as Diesel Fuel in Soil

Modified EPA Methods 3550/WTPH-D[a]

a. Test Methods for Evaluating Solid Waste, SW-846, Third Edition, Revision 0, US EPA November 1986. Results reported on a dry weight basis. Modification in TPH as per the state of Washington Department of Ecology, Appendix L, April, 1992.

GTEL Sample Number		01	02	03	04
Client Identification		1-4.0	2-4.0	3-4.0	4-2.0
Date Sampled		01/25/93	01/25/93	01/25/93	01/25/93
Date Extracted		01/29/93	01/29/93	01/29/93	01/29/93
Date Analyzed		02/09/93	02/09/93	02/05/93	02/05/93
Analyte	Detection Limit, mg/Kg	Concentration, mg/Kg			
TPH as diesel fuel	10	<10	33	38	32
TPH as lubricating oil	10	27*	230	150	140
Detection Limit Multiplier		1	1	1	1
Percent solids		86.6	88.6	89.3	91.0

GTEL Sample Number		05	06	07	08
Client Identification		4-4.0	5-2.0	5-4.0	6-2.0
Date Sampled		01/25/93	01/25/93	01/25/93	01/25/93
Date Extracted		01/29/93	01/29/93	01/29/93	01/29/93
Date Analyzed		02/05/93	02/05/93	02/05/93	02/05/93
Analyte	Detection Limit, mg/Kg	Concentration, mg/Kg			
TPH as diesel fuel	10	44	26	27	30
TPH as lubricating oil	10	160	120	170	260
Detection Limit Multiplier		1	1	1	1
Percent solids		85.6	70.1	88.6	86.1

* Surrogate recovery low.

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GTEL ENVIRONMENTAL LABORATORIES, INC.

Client Number: GTI70TEX01
Consultant Project Number: 020603332
Project ID: Bothell, WA
Work Order Number: C3-01-524

Table 1 (Continued)

ANALYTICAL RESULTS

Total Petroleum Hydrocarbons as Diesel Fuel in Soil

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Date Sampled		01/25/93	01/25/93	01/25/93	01/25/93
Date Extracted		01/29/93	01/29/93	01/29/93	01/29/93
Date Analyzed		02/06/93	02/06/93	02/06/93	02/09/93
Analyte	Detection Limit, mg/Kg	Concentration, mg/Kg			
TPH as diesel fuel	10	46	34	110	130
TPH as lubricating oil	10	220	230	280	95
Detection Limit Multiplier		1	1	1	1
Percent solids		87.1	87.5	86.4	86.0