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ENGINEERING-SCIENCE, INC.

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May 18, 1993

Mr. Jim Williams P.G., C.G.W.P.
Department of the Air Force
Center for Environmental Excellence
DERA Restoration Division (ESR)
8001 Inner Circle Drive Suite 2
Brooks AFB, Texas 78235-5328

Subject: F33615 - 90 - D - 4014, Order 04,
O&M Effort for the Bioventing System at the 7th Street BX Service Station
(May 1992 through 1st Week in May 1993), Eglin, AFB

Dear Mr. Williams:

A copy of the letter report for the monitoring effort for the Bioventing System at the 7th Street BX Service Station, over the referenced period are attached. This report includes a summary of operation and maintenance, and monitoring efforts performed for the subject period.

Upon your approval, two copies of this report will be sent to Mr. John Krushek (Eglin AFB). If you have any questions please call me.

Sincerely,

ENGINEERING-SCIENCE, INC.



Ola A. Awosika, P.G.
Project Manager

OAA:bb
Attachment

cc/att: Lt. Col. Miller (AFCEE)
D. Downey, (ES)

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**O&M EFFORT FOR THE BIOVENTING SYSTEM AT THE 7TH STREET BX
SERVICE STATION (MAY 1992 THROUGH 1ST WEEK IN MAY 1993),
EGLIN, AFB**

OPERATION AND MAINTENANCE

Operation and maintenance (O&M) effort since installation of the bioventing system in May 1992 has included a check on each of the bioventing system components (i.e., blower, gauges, air filter, vapor extraction wells, and injection trenches) to evaluate operating status and to make adjustment where appropriate or necessary. The O&M effort also involved measurement of the following physical parameters:

- Temperature at both blower suction and exhaust;
- Vacuum at air filter;
- Head loss through filter; and
- Pressure at Blower exhaust

May-July, 1992

Over the period May 20 through July 22, 1992, no significant adjustment was made to the system other than increasing the air dilution rate at the air dilution valve on the intake to the blower unit. This adjustment was made to reduce off gas concentration at the injection trenches and to minimize emission of gases into the atmosphere. Prior to making this adjustment a pressure relief valve was installed downstream of the blower. The air filter was changed twice to maximize air flow from the air intake line to the blower and to ensure removal of fugitive materials.

August 1992

Because of continued reports of strong gasoline odor at the gasoline station, a decision was made to replace the existing 2.5 horse power (hp) blower unit being used with a 1 hp unit. On August 3, 1992, the 2.5 hp blower was replaced with a 1 hp blower. A visit to the site on August 20 revealed the blower has not been operating continuously because of power failures associated with frequent storms in the area. A decision was made to rewire the starter for the blower to allow continued operation once power is restored after a storm event. Rewiring of the starter was completed the week ending August 28. A summary of the data gathered since the 1 hp blower was installed in August is presented in Table 1.

September 1992

An in-situ respiration test was performed on September 2 and 3. The respiration test was performed to ensure that nutrients, moisture, or oxygen are not limiting biodegradation. The respiration test included oxygen and carbon dioxide monitoring over a 24 to 48 hour period. The results of the respiration test were presented in a letter report dated October 7, 1992. Based on the results of this test, a fuel biodegradation rate of 5.36 to 25.85 mg/kg/day was estimated. This variation in the biodegradation rate is related to the location of the monitoring point where the rate was calculated. When compared to rates estimated at startup of system operation, current fuel biodegradation

rates are indicative of significant increase in bioactivity and suggest that a more active bacterial population has been established. During this period no adjustments were made to the system.

October 1992

O&M effort in October involved replacement of the air filter and measurement of physical parameters. A summary of the data gathered since the 1 hp blower was installed is presented on Table 1.

November-December 1992

Monitoring effort in November was delayed to early December (Dec. 3). An in-situ respiration test was also scheduled for December 3. This test could not be completed as planned because high water table condition prevented collection of representative samples for analysis during the test. Available information indicated that the Eglin area had experienced heavy rainfall during the month of November. Long range weather forecast indicated this high water table condition may continue into the spring. Engineering - Science monitored storm events during December and January to explore possible opportunity to perform the respiration test.

January 1993

An O&M visit was made on January 8, 1993. Water level measurements collected during this visit indicated the high water table condition persisted. However, samples were collected at routine sampling ports (e.g., vapor monitoring points - VMP-1D and VMP-2D, well MW10, and blower suction and discharge). The air filter was replaced with a new part. A repeat of the respiration test may not be possible until the 3rd Quarter O&M effort scheduled for the first week in March. On the basis of the data collected to date, adjustments to system components were not warranted during this O&M visit.

February 1993

Off gas monitoring effort in February reflected a similar trend in attenuation of total hydrocarbons in the soil gas as in previous months. Other physical parameters measured in the field were consistent with previous data and indicated adjustment to the system components was not warranted. A fair amount of rainfall occurred during early to mid February but was not as much as in previous months (November through January). An in-situ respiration test was scheduled for the 2nd week in March. Data gathered during the month of February is included in Tables 1 and 2 and depicted in Figure 2.

March 1993

ES visited the site on March 10. O&M and monitoring efforts were performed on March 11. Water level measurements obtained during this visit indicated high water table conditions persisted. Therefore, the in-situ respiration test was again postponed. From all indications further attempts to perform this test will not be made again until May. It was observed during this visit that only two recovery wells were in operation. Effort was in progress to get two additional recovery wells back in service. If operation of these four wells is maintained, subsequent drawdown may be sufficient to lower the water table below the screened portion of the vapor monitoring points. The data

collected during this visit is provided in Tables 1 and 2 and depicted in Figure 2. The air filter for the blower was in good condition. No adjustments were made to the bioventing system components.

April 1993

ES made two visits to the site during this period; one on April 7 and another on April 22. The lowest temperature readings since startup of system operation were recorded (Table 1). This was attributed to cold weather conditions experienced during this period. Oxygen levels dropped in both VMP-1D and VMP-2D and this was complimented by an increase in carbon dioxide levels. A continued decline in total hydrocarbons' level was evident at VMP-1D. A slight increase (>200 ppmv) in TH level was observed at VMP-2D. Other physical parameters remained virtually the same. The results of the soil gas samples taken from monitoring points at the site are presented in Figures 1 through 2. Water level measurements taken this period indicates a gradual decline in water table conditions (Table 3). It is anticipated that by the end of May the water table would have dropped low enough to allow performance of a respiration test.

May 1993

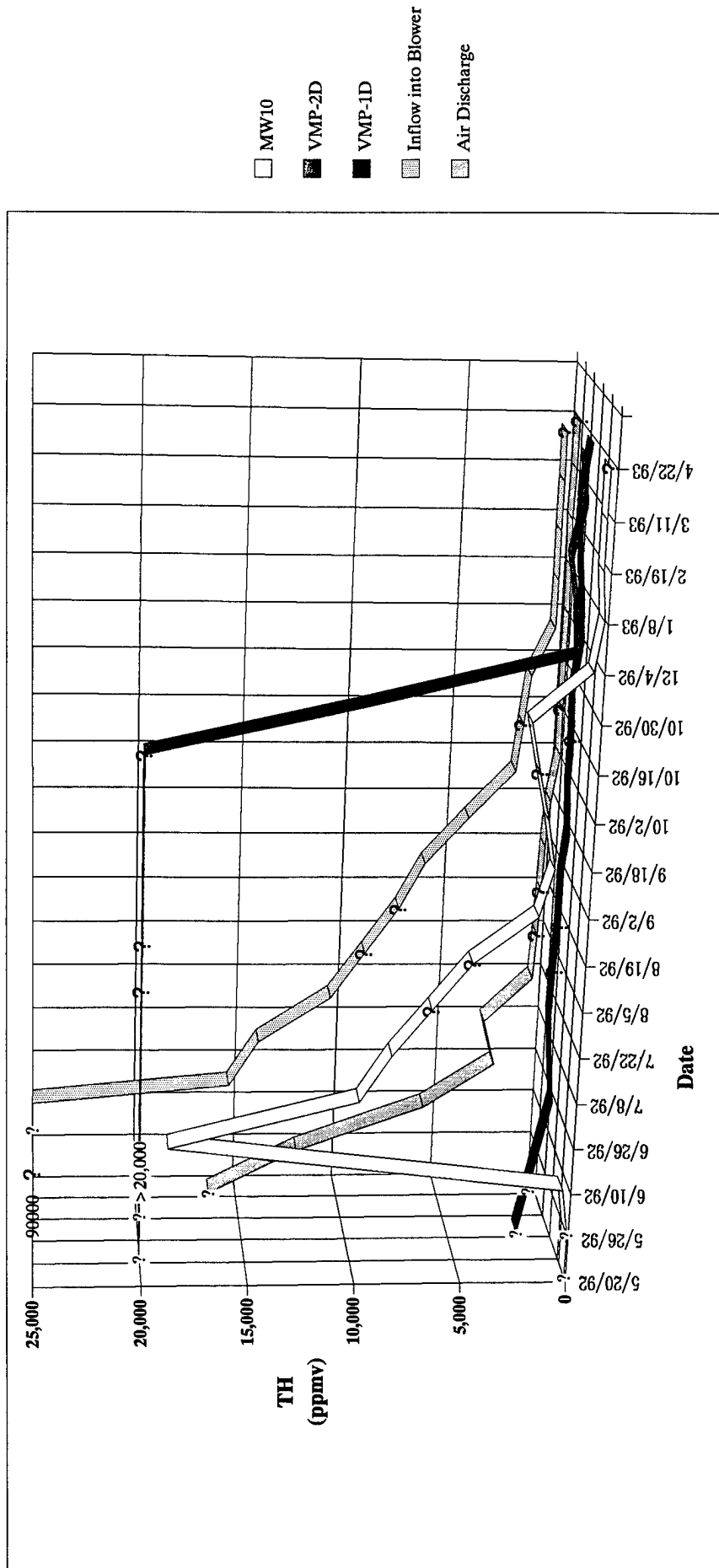
O&M visit was made to the site on May 6. The system components were inspected to ensure continued operation of the system as desired. Data obtained suggest the filter may need to be replaced. This will be accomplished on the next O&M visit. A respiration test is planned for May 26/27. Available water level data suggest subsurface conditions will be appropriate for the test (i.e., lower water table conditions are anticipated).

OVERVIEW OF ANALYTICAL RESULTS (Update)

Results of biweekly/monthly concentrations of oxygen, carbon dioxide and Total Hydrocarbons throughout the bioventing system are presented in Table 2 and depicted in the attached charts (Figures 1 through 3). These results continued to indicate increased biological activity in the subsurface and suggest potential increase in aerobic bacterial population. Results indicate oxygen supply to the subsurface has been adequately sustained except for a recent measurement that showed a pronounced decrease in oxygen concentration and slight increase in Carbon dioxide concentration at monitoring location VMP-1D. This monitoring point will be observed closely to determine if increase in bio-uptake of oxygen is the reason for the decline in oxygen level. Available data indicate a rapid decline in total hydrocarbon concentration over the past five months (December through April). Volatilization and to a greater extent biodegradation are believed to be responsible for the total hydrocarbons removed. The system will be watched closely to observe changes that would likely occur as a result of increasing warm weather conditions.

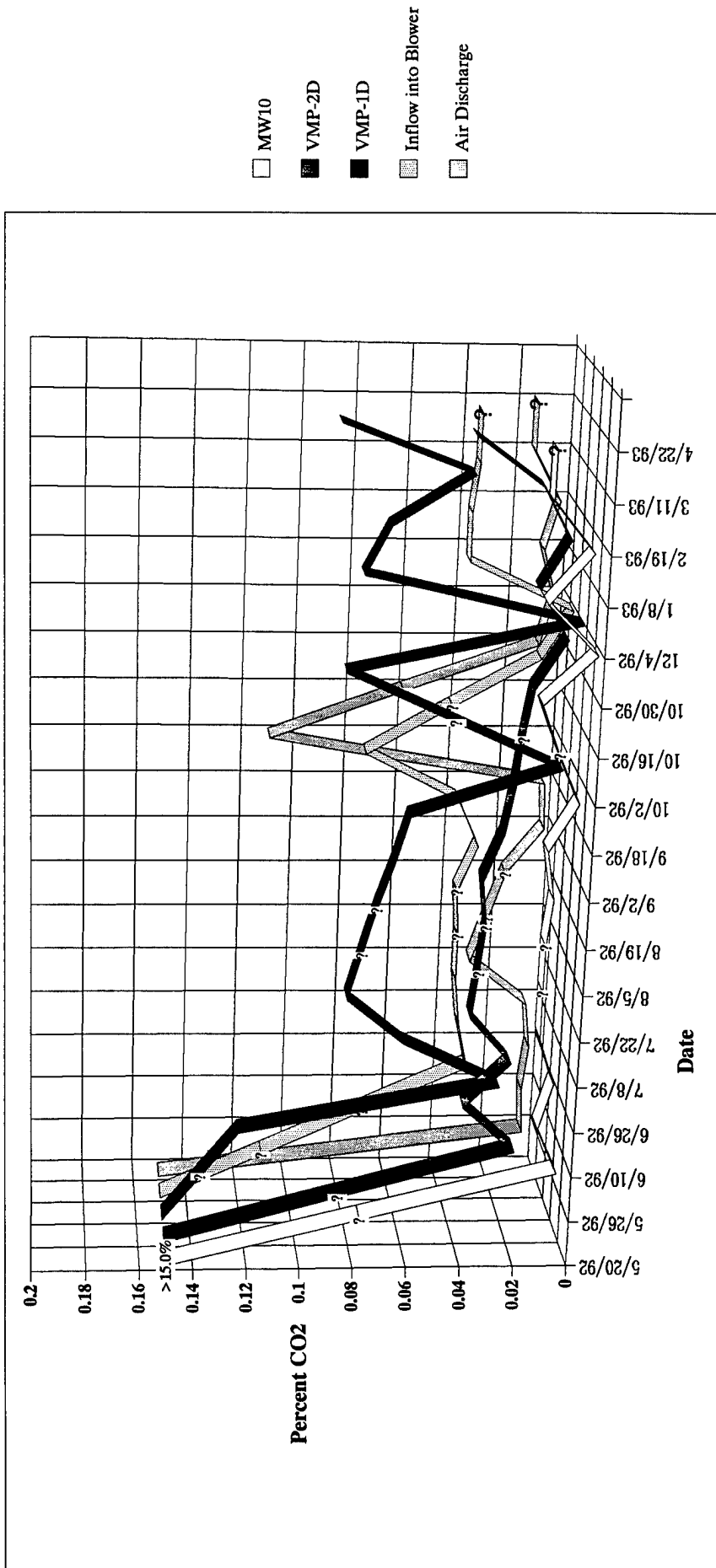
Figure 1

**TOTAL HYDROCARBON LEVELS DURING BIOVENTING
AT 7TH STREET BX SERVICE STATION (5/20/92 - 4/22/93)**



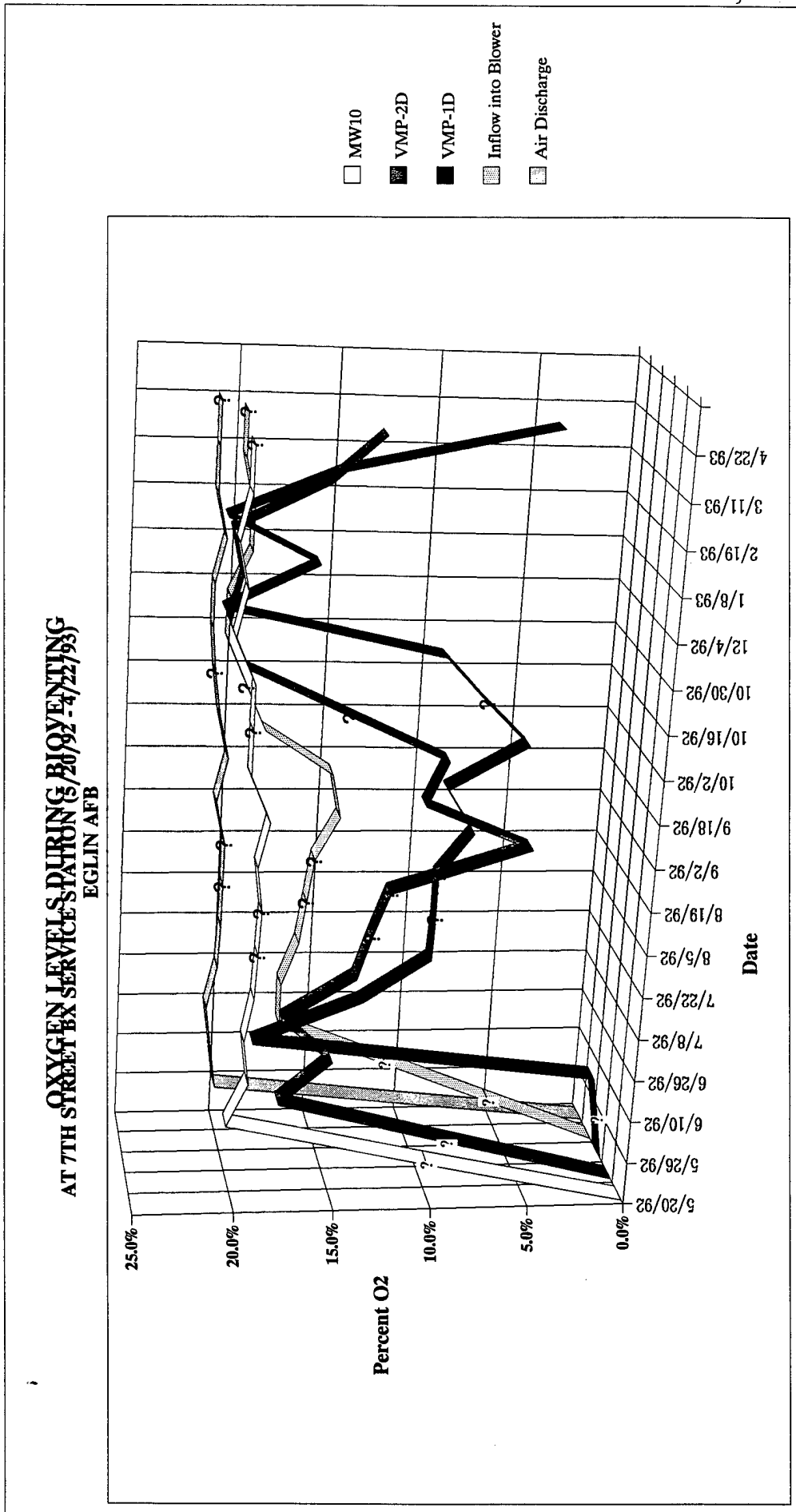
Note: "?" indicates no data was recorded on this date; slopes are assumed to be linear.

**CARBON DIOXIDE LEVELS DURING BIOVENTING
AT 7TH STREET BX SERVICE STATION (5/20/92 - 4/22/93)
EGLIN AFB**



Note: "?" indicates no data was recorded on this date; slopes are assumed to be linear.

Figure 3



Note: "?" indicates no data was recorded on this date; slopes are assumed to be linear.

TABLE 1

**MEASUREMENTS OF OTHER PHYSICAL PARAMETERS
BIOVENTING SYSTEM AT THE 7TH STREET BX SERVICE STATION**

Date	BLOWER SUCTION			BLOWER EXHAUST	
	Temp (Deg. F)	Vacuum Air Filter (ins. of H ₂ O)	Head loss Filter (ins of H ₂ O)	Temp (Deg. F)	Pressure (ins. of H ₂ O)
8/6/92 *					
9/2/92	100	4	12	110	16
10/15/92	92	2	12	93	20
10/30/92	78	4	12	100	20
12/3/92	60	4	12	83	22
1/8/93	60	4	12	78	14
2/12/93	60	4	12	82	19
3/11/93	69	4	14	89	18
3/25/93	72	4	12	98	17
4/7/93	64	4	12	75	18
4/22/93	54	4	12	71	18
5/6/93	100	4	16	90	16

* New (1 hp) Blower was installed

TABLE 2
RESULTS OF SOIL GAS ANALYSES
DURING BIOVENTING (5/20/92 - 4/22/93)
AT 7TH STREET BX SERVICE STATION
EGLIN AFB

Location	Baseline(1)			1st Week(2)			3rd Week		
	5/20/92	5/26/92	6/10/92	5/26/92	5/26/92	6/10/92	5/26/92	5/26/92	6/10/92
	TH	O2	CO2	TH	O2	CO2	TH	O2	CO2
	ppmv	%	%	ppmv	%	%	ppmv	%	%
Air Discharge to Injection Trench	-	0.0%	> 15.0%	12,000	20.0%	0.6%	5,800	20.3%	0.7%
Inflow into Blower	90,000	0.0%	> 15.0%	-	-	-	-	-	-
VMP-1D	-	0.0%	> 15.0%	-	-	-	680	0.7%	12.1%
VMP-2D	-	0.0%	> 15.0%	-	-	-	> 20,000	17.6%	1.8%
MW10	-	0.0%	> 15.0%	-	-	-	320	20.5%	0.5%

(1) - Baseline background conditions were: Oxygen - 20.4%, Carbon Dioxide - 0.6%.

(2) - Week since start-up of system operation

TH - Total Hydrocarbons

ppmv - parts per million by volume

TABLE 2 - Continued
RESULTS OF SOIL GAS ANALYSES
DURING BIOVENTING (5/20/92 - 4/22/93)
AT 7TH STREET BX SERVICE STATION
EGLIN AFB

Location	5th Week 6/26/92		7th Week 7/8/92		9th Week 7/22/92		
	TH ppmv	O2 %	TH ppmv	O2 %	TH ppmv	O2 %	CO2 %
Air Discharge to Injection Trench	2,400	20.6%	3,000	20.1%	720	20.0%	3.0%
Inflow into Blower	15,600	17.1%	14,200	17.1%	10,800	16.3%	3.8%
VMP-1D	220	18.7%	396	13.2%	540	9.8%	8.1%
VMP-2D	> 20,000	15.0%	> 20,000	17.6%	> 20,000	14.0%	3.7%
MW10	18,800	19.5%	10,000	19.8%	8,600	19.4%	1.4%

TABLE 2 - Continued
RESULTS OF SOIL GAS ANALYSES
DURING BIOVENTING (5/20/92 - 4/22/93)
AT 7TH STREET BX SERVICE STATION
EGLIN AFB

Location	11th Week		13th Week		15th Week		
	TH ppmv	O2 %	TH ppmv	O2 %	TH ppmv	O2 %	
Air Discharge to Injection Trench	-	-	-	-	480	20.5%	0.4%
Inflow into Blower	-	-	-	-	6,550	14.5%	3.2%
VMP-1D	-	-	-	-	390	8.0%	6.5%
VMP-2D	-	-	-	-	> 20,000	5.5%	3.5%
MW10	-	-	-	-	2,200	19.5%	1.2%

TABLE 2 - Continued
RESULTS OF SOIL GAS ANALYSES
DURING BIOVENTING (5/20/92 - 4/22/93)
AT 7TH STREET BX SERVICE STATION
EGLIN AFB

Location	17th Week		19th Week		21st Week	
	9/18/92	10/2/92	10/2/92	10/16/92	10/16/92	10/16/92
	TH	O2	TH	O2	TH	O2
	ppmv	%	ppmv	%	ppmv	%
		CO2		CO2		CO2
		%		%		%
Air Discharge to Injection Trench	340	20.0%	20	20.5%	-	-
Inflow into Blower	4,600	15.0%	2,500	18.5%	-	-
VMP-1D	200	9.5%	300	5.5%	-	-
VMP-2D	> 20,000	11.0%	> 20,000	10.0%	-	-
MW10	1,600	19.0%	2,000	20.0%	-	-

TABLE 2 - Continued
RESULTS OF SOIL GAS ANALYSES
DURING BIOVENTING (5/20/92 - 4/22/93)
AT 7TH STREET BX SERVICE STATION
EGLIN AFB

Location	23rd Week 10/30/92			28th Week 12/4/92 *			33rd Week 1/8/93 *		
	TH ppmv	O2 %	CO2 %	TH ppmv	O2 %	CO2 %	TH ppmv	O2 %	CO2 %
Air Discharge to Injection Trench	35	21.0%	1.0%	10	21.0%	0.5%	34	20.5%	1.0%
Inflow into Blower	2,000	20.5%	1.2%	1,000	20.5%	0.1%	998	19.5%	4.0%
VMP-1D	360	10.0%	8.5%	80	21.0%	0.1%	200	16.5%	8.0%
VMP-2D	> 10,000	20.0%	2.0%	650	21.0%	0.9%	800	20.5%	2.0%
MW10	3,000	20.0%	2.0%	400	21.0%	0.2%	68	20.5%	2.0%

* - High water table conditions observed.

TABLE 2 - Continued
RESULTS OF SOIL GAS ANALYSES
DURING BIOVENTING (5/20/92 - 4/22/93)
AT 7TH STREET BX SERVICE STATION
EGLIN AFB

Location	39th Week 2/19/93 *			42nd Week 3/11/93 *			48th Week 4/22/93		
	TH ppmv	O2 %	CO2 %	TH ppmv	O2 %	CO2 %	TH ppmv	O2 %	CO2 %
Air Discharge to Injection Trench	100	21.0%	0.5%	45	21.0%	1.5%	45	21.0%	1.5%
Inflow into Blower	ND	ND	ND	1,000	2.0%	3.8%	1,000	2.0%	3.8%
VMP-1D	400	21.0%	7.1%	500	15.5%	4.2%	210	5.0%	9.0%
VMP-2D	1,200	21.0%	1.0%	700	16.5%	2.0%	> 900	14.0%	4.5%
MW10	250	21.0%	0.5%	ND	ND	ND	ND	ND	ND

ND - Sample could not be obtained at this sampling location.

* - High water table conditions observed.

TABLE 3

WATER LEVEL DATA (March through 1st Week in May)								
Well ID	Depth To Water						Drop in Water Level since Jan.	Attributes
	9-Jan	10-Mar	25-Mar	7-Apr	22-Apr	6-May		
FP-1	4.37	4.88	5.00	5.00	4.95	5.30	0.93	
FP-2	5.24	4.42	6.05	5.65	5.85	6.20	0.96	near MP-2
GW-1	6.30	4.41	6.60	6.35	7.20	8.10	1.80	
GW-2	5.52	6.10	6.40	6.30	6.70	6.92	1.40	
GW-3	5.36	5.61	5.85	5.85	6.10	6.50	1.14	
MW-1	6.55	6.63	7.30	7.15	7.35	7.70	1.15	near MP-2
MW-8	5.27	5.47	5.82	5.73	5.90	6.20	0.93	near MP-1
MW-9	4.85	5.56	5.40	5.34	5.48	5.78	0.93	near MP-1
MW-10	4.37	4.62	5.80	4.92	5.10	5.42	1.05	