LOAN DOCUMENT

PHOTOGRAPH THIS SHEET

LEVEL

INVENTORY 0

DTIC ACCESSION NUMBER

Bioventing at Operable Units 5, 8, 9, 10 & 11

DOCUMENT IDENTIFICATION

Mar 98

DISTRIBUTION STATEMENT A
Approved for Public Release
Distribution Unlimited

DISTRIBUTION STATEMENT

HANDLE WITH CARE

ACCESSION FOR
NTIS GRA&I
DTIC TRAC
UNANNOUNCED
JUSTIFICATION

BY
DISTRIBUTION/
AVAILABILITY CODES

DISTRIBUTION	AVAILABILITY AND/OR SPECIAL	
A-1		

DISTRIBUTION STAMP

DATE ACCESSIONED

DATE RETURNED

20010116 022

DATE RECEIVED IN DTIC

REGISTERED OR CERTIFIED NUMBER

PHOTOGRAPH THIS SHEET AND RETURN TO DTIC-FDAC

DTIC FORM 70A JUN 90 — DOCUMENT PROCESSING SHEET — PREVIOUS EDITIONS MAY BE USED UNTIL STOCK IS EXHAUSTED.

LOAN DOCUMENT

DTIC QUALITY INSPECTED 1

United States Air Force

Bioventing at Operable Units 5, 8, 9, 10, and 11

DRAFT

Loring Air Force Base

SEMIANNUAL PERFORMANCE REPORT

August — December 1997

March 1998

Revision B

DEFENSE TECHNICAL INFORMATION CENTER
REQUEST FOR SCIENTIFIC AND TECHNICAL REPORTS

Title: AFCEE Collection

1. Report Availability *(Please check one box)*

☒ This report is available. *Complete sections 2a - 2f.*

☐ This report is not available. *Complete section 3.*

2a. Number of Copies Forwarded: 1 each

2b. Forwarding Date: July 2002

2c. Distribution Statement *(Please check ONE box)*

DoD Directive 5230.24, "Distribution Statements on Technical Documents," 18 Mar 87, contains seven distribution statements, as described briefly below. Technical documents MUST be assigned a distribution statement.

☒ DISTRIBUTION STATEMENT A: Approved for public release. Distribution is unlimited.

☐ DISTRIBUTION STATEMENT B: Distribution authorized to U.S. Government Agencies only.

☐ DISTRIBUTION STATEMENT C: Distribution authorized to U.S. Government Agencies and their contractors.

☐ DISTRIBUTION STATEMENT D: Distribution authorized to U.S. Department of Defense (DoD) and U.S. DoD contractors only.

☐ DISTRIBUTION STATEMENT E: Distribution authorized to U.S. Department of Defense (DoD) components only.

☐ DISTRIBUTION STATEMENT F: Further dissemination only as directed by the controlling DoD office indicated below or by higher authority.

☐ DISTRIBUTION STATEMENT X: Distribution authorized to U.S. Government agencies and private individuals or enterprises eligible to obtain export-controlled technical data in accordance with DoD Directive 5230.25, Withholding of Unclassified Technical Data from Public Disclosure, 6 Nov 84.

2d. Reason For the Above Distribution Statement *(in accordance with DoD Directive 5230.24)*

2e. Controlling Office: HQ AFCEE

2f. Date of Distribution Statement Determination: 15 Nov 2000

3. This report is NOT forwarded for the following reasons. *(Please check appropriate box)*

☐ It was previously forwarded to DTIC on _____ *(date)* and the AD number is _____

☐ It will be published at a later date. Enter approximate date if known. _____

☐ In accordance with the provisions of DoD Directive 3200.12, the requested document is not supplied because: _____

Print or Type Name: Laura Peter

Telephone: 210-536-4331

Signature:

Contract: M01-04-0612

[redacted]

United States Air Force

Bioventing at Operable Units 5, 8, 9, 10, and 11

DRAFT

Loring Air Force Base

SEMIANNUAL PERFORMANCE REPORT

August–December 1997

March 1998

Revision B

loring\L-1718cv

AQM01-04-0612

Loring Air Force Base

BIOVENTING AT OPERABLE UNITS 5, 8, 9, 10, AND 11

SEMIANNUAL PERFORMANCE REPORT

August–December 1997

DRAFT

Prepared for:
Department of the Air Force
Air Force Center for Environmental Excellence (AFCEE)
Brooks Air Force Base, Texas 78235-5328

Prepared by:
Bechtel Environmental, Inc.
151 Lafayette Drive
Oak Ridge, Tennessee 37830

Contract No. F41624-94-D-8072
Job No. 22784

March 1998
Revision B

Prepared	Jeff W. Sims	3/13/98 Date
Approved	Willie K. Bamy BEI Project Engineer	3/13/98 Date
Approved	WK Bamy for R.L. Patterson BEI Project Manager	3/13/98 Date

loring\L-1718cv

CONTENTS

Page

FIGURES

TABLES

ACRONYMS AND INITIALISMS

AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
AHS	Auto Hobby Shop
AIW	air injection well
BEI	Bechtel Environmental, Inc.
bgs	below ground surface
BV	biovent points
BXSS	Base Exchange Service Station
COE	U.S. Army Corps of Engineers
ES	Entomology Shop
FJETC	Former Jet Engine Test Cell
FTA	Fire Training Area
FTF	Fuel Tank Farm
GAC	granular-activated carbon
MP	monitoring point
NDA	Nose Dock Area
O&M	operations and maintenance
OU	operable unit
PLC	programmable logic control
PPDP	Power Plant Drainage Pipe
PRG	preliminary remediation goal
TPH	total petroleum hydrocarbon
TVH	total volatile hydrocarbon
VM	vapor monitoring point
VMB	Vehicle Maintenance Building

UNITS OF MEASURE

cfm	cubic feet per minute
ft	foot
ft^3	cubic foot
hr	hour
kg	kilogram
lb	pound
mg	milligram
ppm	parts per million
ppmv	parts per million volatiles
psi	pounds per square inch
scfm	standard cubic feet per minute

1.0 INTRODUCTION

This semiannual bioventing report presents information gathered from operation and maintenance (O&M) activities performed by Bechtel Environmental, Inc. (BEI) on the bioventing systems at Loring Air Force Base (AFB), Maine. Work was conducted under Contract No. F41624-94-D-8072, Delivery Order 0005, for the Air Force Center for Environmental Excellence (AFCEE). This report covers the of O&M activities at 16 bioventing systems from August 1 through December 31, 1997. Table 1-1 briefly summarizes operations at each bioventing site, including the number of air injection wells (AIWs), monitoring points (MPs), and oxygen sensors. Table 1-1 also includes the oxygen utilization rate ranges determined from field tests performed during the summer and fall 1996 and spring and fall 1997 respiration tests at each site.

The objective of this report is to present operations data and an evaluation of bioventing system performance, including site status, problems identified, and recommendations. Operations guidance, summarized in Figure 1-1, facilitates identification of required system changes during normal operations and when remediation is nearing completion.

A pilot-scale treatability study at the Base Exchange Service Station (BXSS) indicated that bioventing was a viable remedial technology (Earth Tech 1995) for petroleum-contaminated soils at Loring AFB. The BXSS treatability study report presented preliminary information and established basic design parameters. Based on the BXSS treatability study, bioventing was selected as the preferred removal action treatment technology at 16 sites in 5 operable units (OUs) at Loring AFB. Bioventing systems were installed and started at four sites in the fall of 1995:

- Former Jet Engine Test Cell (FJETC)
- Fire Training Area (FTA)
- Power Plant Drainage Pipe (PPDP)
- Vehicle Maintenance Building (VMB)

These four units were turned over to AFCEE on February 1, 1996, with BEI performing O&M. At the same time, BEI also took over O&M for the BXSS site, which had been operating since the fall of 1993. The U.S. Army Corps of Engineers (COE) installed additional MPs and AIWs and made system modifications at the BXSS site during the summer and fall of 1996.

The other 11 sites were constructed and began operation in the fall of 1996. BEI began performing O&M for these units on December 1, 1996. These 11 sites are:

- Auto Hobby Shop (AHS)
- Entomology Shop (ES)
- Fuel Tank Farm (FTF)
- Nose Dock Areas (NDA) 1 through 8

An additional bioventing system constructed at the FTF (designated FTF II) during June through August 1997 began operation on August 28, 1997. The installation documentation (e.g., geologic

Table 1-1
Biovent System Summary

Site	Number of AIWs	Number of MPs[2]	Number of O_2 sensors[2]	Total operation (days)[3]	O_2 utilization rate %/hr[4]
AHS	19	20	5	406	0.01-7.5
BXSS	7	12	0	659	0.08-1.3
ES	7	13	1	443	0.01
FJETC	13[1]	8	1	522	0.31 - 0.72
FTA	16	38	1	648	0.04-1.45
FTF	20	15	4	188	0.4-0.77
FTF II	37	17	7	79	1.4-2.8
NDA-1	24	10	1	443	0.13-5.1
NDA-2	23	10	1	398	0.7
NDA-3	21	5	1	438	not tested[5]
NDA-4	36	15	1	364	0.05-0.77
NDA-5	29	7	1	363	0.05-7.2
NDA-6	4	4	2	428	0.1
NDA-7	4	2	1	432	not tested[5]
NDA-8	23	3	1	328	not tested[5]
PPDP	18	24	1	621	0.07-1.7

[1]Two wells which never registered any flow were replaced in July 1997.
[2]Number of MPs represents the total number of MPs (with and without oxygen sensors).
[3]As of December 31, 1997.
[4]Range of values from summer and fall 1996 and spring and fall 1997 measurements.
[5]Not tested due to high water and/or no air flow.

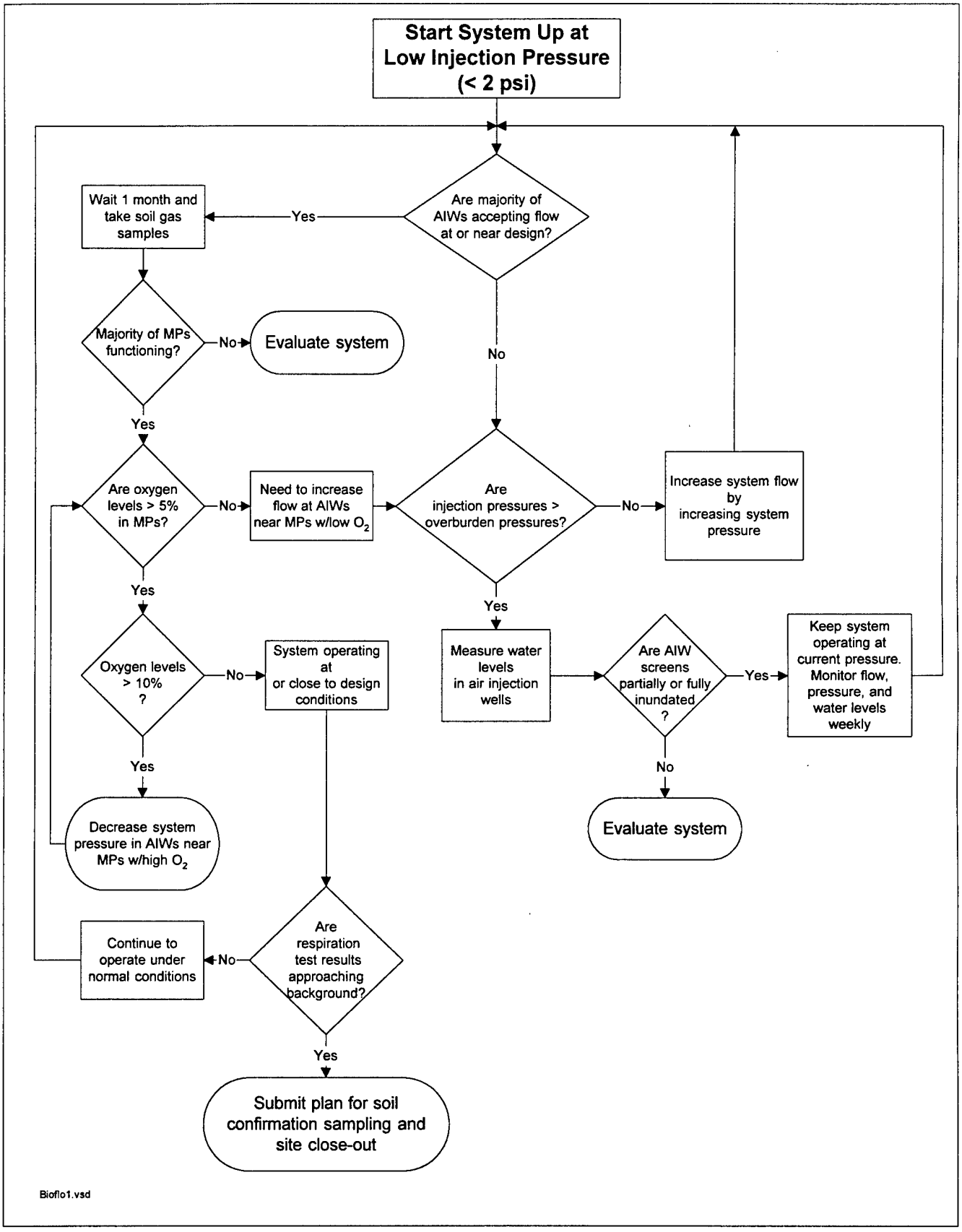


Figure 1-1 Bioventing Process Operation Decision Chart

logs, monitoring well completion logs, and as-built drawings) is included in Bioventing at Operable Units 5, 8, 10, and 11, Removal Action Report, Addendum 2.

Experience gained at Loring AFB enhances understanding of how the biovent systems operate in relationship to site-specific hydrogeology. Figure 1-2 is a conceptual model of a typical bioventing site. In general, each site consists of glacial till (either natural and/or worked), and lenses of higher-permeability material (e.g., gravel, sand) containing perched water. The overburden groundwater table is usually below the area being treated by bioventing, so most groundwater influences on air injection are likely caused by perched groundwater (historic water table depths determined the depths of the screens). Perched water also affects the collection of soil gas samples in MPs.

Advective air flow occurs primarily in regions of higher permeability. In regions of lower permeability, soils are aerated through diffusive transport. Even when soil gas samples cannot be drawn, it is likely that aeration is occurring and supporting biodegradation, but at a reduced rate.

Documents pertaining to bioventing system design, testing, installation, and O&M include:

- *Final Remedial Investigation Reports, Operable Units 5, 8, 9, 10, and 11* (CDM 1996, ABB-ES 1995a, ABB-ES 1995b, ABB-ES 1994, ABB-ES 1996, respectively)
- *Test Plan and Technical Protocol for a Field Treatability Test for Bioventing* (AFCEE 1992)
- *Long-Term Bioventing Treatability Study, Loring AFB, Base Exchange Service Station* (Earth Tech 1995)
- *Operation and Maintenance Manuals for Nose Dock Area & Service Station* (Patrick St. Peter & Sons Inc. 1997)
- *Design Analysis Report, Operable Units 5, 9, 10, and 11* (URS 1995a)
- *Bioventing and Excavation Specifications for Former Jet Engine Test Cell, Fuel Tank Farm, Vehicle Maintenance Building, Power Plant Drainage Pipe, and Entomology Shop* (URS 1995b)
- *Bioventing at Operable Units 5, 8, 9, 10, and 11—Removal Action Report* (BEI 1996a)
- *Operation and Maintenance Plan for Bioventing at Operable Units 5, 8, 9, 10, and 11* (BEI 1996b)
- *Excavations in OUs 5, 8, 9, 10, and 11—Removal Action Report* (BEI 1996c)
- *Bioventing at OUs 5, 8, 9, 10, and 11 Removal Action Work Plan,* Addendum #1 (BEI 1996d)
- *Bioventing Semiannual Report* (BEI 1996e)
- *Bioventing Alternatives Technical Memorandum* (BEI 1996f)
- 1996 *Monthly Bioventing Reports* (BEI 1996g through j)

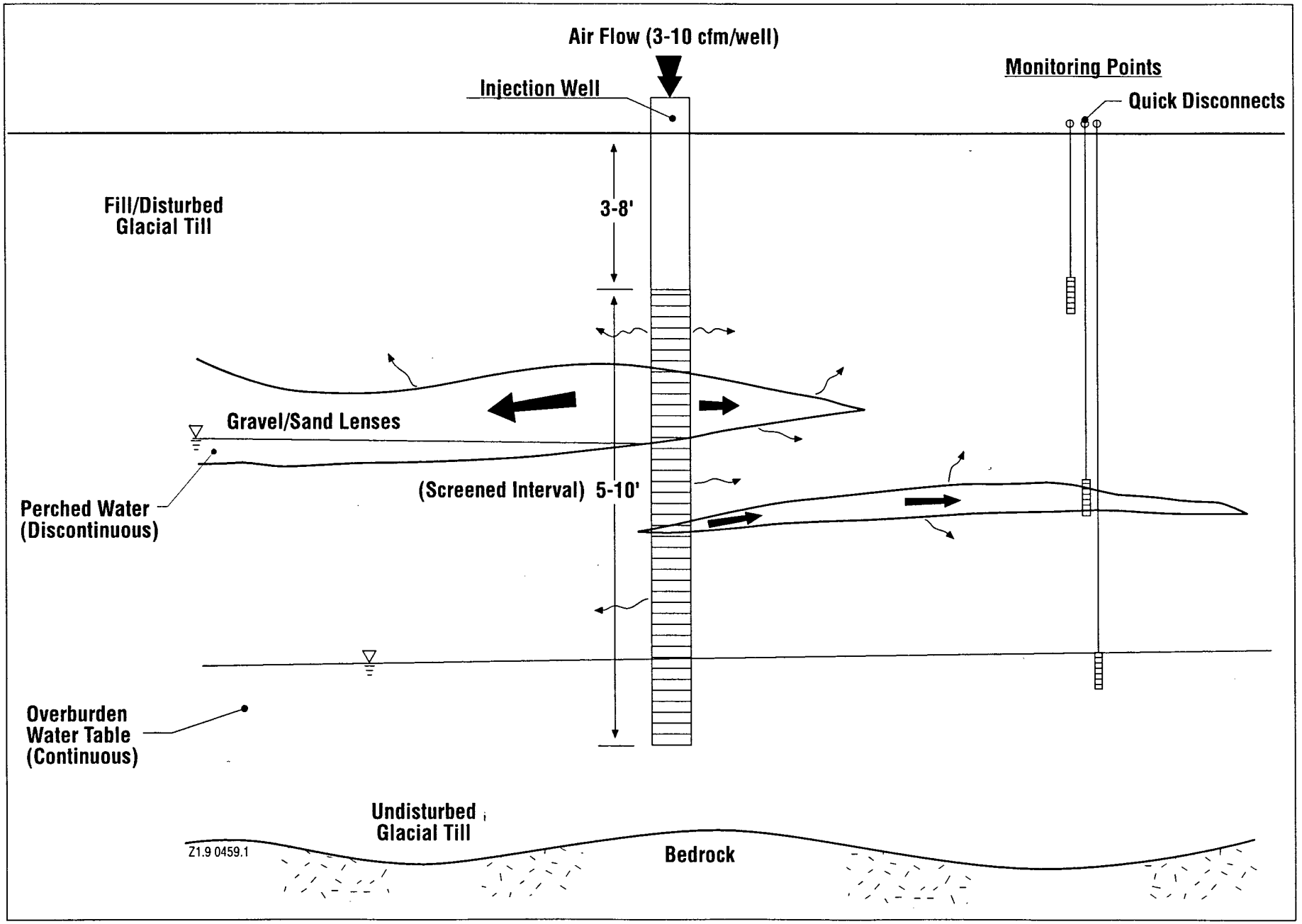


Figure 1-2 Bioventing Conceptual Model

- Final *Bioventing Semiannual Report* (BEI 1997a)
- Final *Bioventing Removal Action Report, Addendum 1* (BEI 1997b)
- *Bioventing at OUs 5, 8, 9, 10, and 11 Removal Action Work Plan, Addendum 2* (BEI 1997c)
- Draft *Bioventing Semiannual Report* (BEI 1997d)
- 1997 *Monthly Bioventing Reports* (BEI 1997e through p)

2.0 SYSTEM MAINTENANCE

Routine weekly, monthly, and time-driven maintenance activities performed in accordance with work plan specifications included checking lubrication levels, air dryer desiccant levels, and blower drive belts; changing blower lubricant at specified intervals; draining fluids from air dryer tanks; and adding desiccant as needed.

No major equipment problems occurred during this period. The programmable logic control (PLC) boards at FTF were found to be malfunctioning in December 1997 when the system was being changed from bioslurp mode to biovent mode for winter operation. As of December 31, 1997, the system had not been started. The system is planned to be repaired in January 1998.

The systems at NDA-4 and NDA-5 were shut down from September to December 1, 1997 due to construction by Depot Roads, a COE subcontractor removing fuel lines.

3.0 SYSTEMS OPERATION

Key operational activities observed over the first 24 months are discussed in Section 3.1. Section 3.2 summarizes problems encountered and sitewide lessons learned since startup. Section 3.3 presents rainfall data.

Operational data collected during this reporting period include monthly flow measurements taken at each AIW, monthly soil gas sampling results from MPs, and in situ respiration results from the fall 1997 tests. During August and September, additional oxygen sensors were installed in the new MPs installed by BEI in July 1997. At least one oxygen sensor was installed at all sites except BXSS to allow collection of soil gas data during winter months. Data downloaded from these oxygen sensors are included in the data tables as monthly averages; daily readings are available in the project files.

3.1 OPERATIONS SUMMARY

3.1.1 Air Flow Rates

The rate of air flow to the wellheads determines the rate at which oxygen is supplied to the subsurface. The wellhead flow rate is a function of soil characteristics (e.g., permeability and saturation). Generally, the tighter the soils (lower permeability), the lower the flow rate at a given pressure. Since injection pressure is directly related to flow rate, an increase in pressure results in

increased flow rates. If the injection pressure is too high, however, the soil may fracture and create macropathways for the air, thus negating any benefit for increased air flow. The maximum allowable injection pressure varies due to varying soil types and the depth of the AIW screen interval, but it is generally kept less than 5 psi (equivalent of approximately 8 ft of overburden pressure). Overburden pressures for each AIW were calculated at the depth of the top of the screen; a soil density of 100 lb/ft^3 was assumed. These values are provided in the site-specific data tables presented in Sections 4.0 through 19.0.

Figure 3-1 plots total monthly air flow at each site since startup. In general, there was a midyear downturn in monthly total flow at each system in 1997, related primarily to the wet weather that spring. Numerous NDA AIWs not performing, as noted in the last semiannual report, were again noted during the second half of 1997. NDAs 1, 3, 4, 7, and 8 continued to have nonfunctional AIWs, but several AIWs in these areas started functioning as designed. Further discussion of this is included in site specific sections presented later in this report.

3.1.2 Soil Gas Monitoring

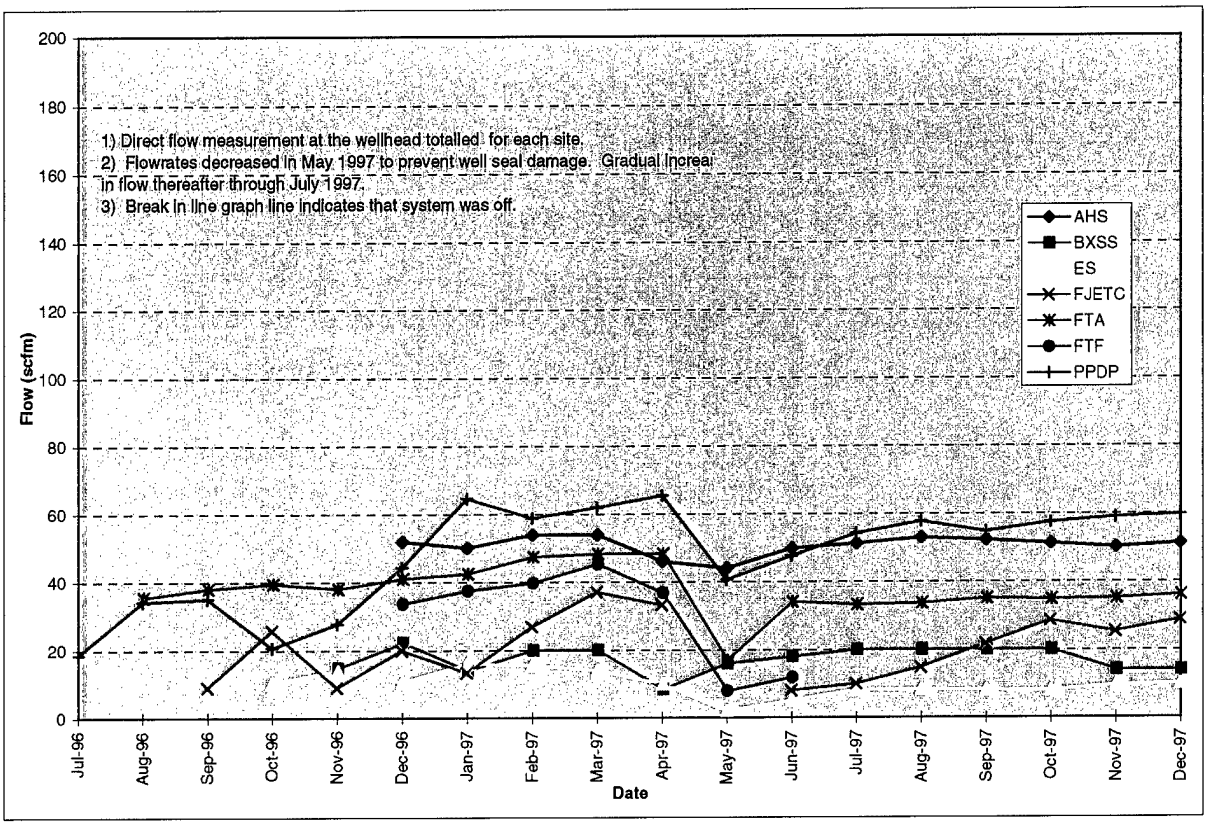
Soil gases are sampled to quantify subsurface aeration rates. AFCEE protocol recommends maintaining an oxygen level of at least 5 percent, the level required to maintain oxygen-limited aerobic degradation (AFCEE 1992); this level is used as a reference point for operation of the biovent systems. Oxygen levels are measured either by taking soil gas samples from the MPs or by in situ oxygen meters. If oxygen levels are found to be below 5 percent at any MP, flow rates from adjacent AIWs are increased to raise oxygen concentrations at that location (see Figure 1-1).

In many instances, soil gas in the MPs cannot be sampled; the lack of soil gas can be attributed to high water table, soil saturation, low-permeability soil, screen clogging, or frozen tubing.

3.1.3 Respiration Testing

In situ respiration tests are performed semiannually, generally in the late spring or early summer and fall; the MPs freeze during the winter and water levels are high in the spring, which make it difficult to perform respiration tests from November to May. Respiration tests will be performed in the oxygen sensors during February 1998. The systems will be shut down and the oxygen sensors reprogrammed to collect readings every 30 minutes.

The in situ respiration tests are conducted in accordance with design specifications (URS 1995b) and AFCEE protocol (AFCEE 1992). MPs that produce soil gas samples with oxygen levels close to ambient conditions are not good candidates for respiration tests. MPs selected for the respiration test are chosen only after the air injection has been turned off for a minimum of 24 hours and a soil gas sample from each MP is analyzed to determine a representative oxygen and carbon dioxide concentration (these soil gas samples are referred to as *pretest* samples). A 1 to 5 percent concentration of helium in air is injected as a tracer for up to 20 hours; after this injection period, the air/helium source is discontinued. Soil gas samples are taken and analyzed by field instruments for oxygen, carbon dioxide, helium, and total volatile hydrocarbons (TVH). Generally the test is concluded once oxygen levels go below 5 percent or 72 hours have passed.



NDA System not yet installed from Jul - Nov 1996.

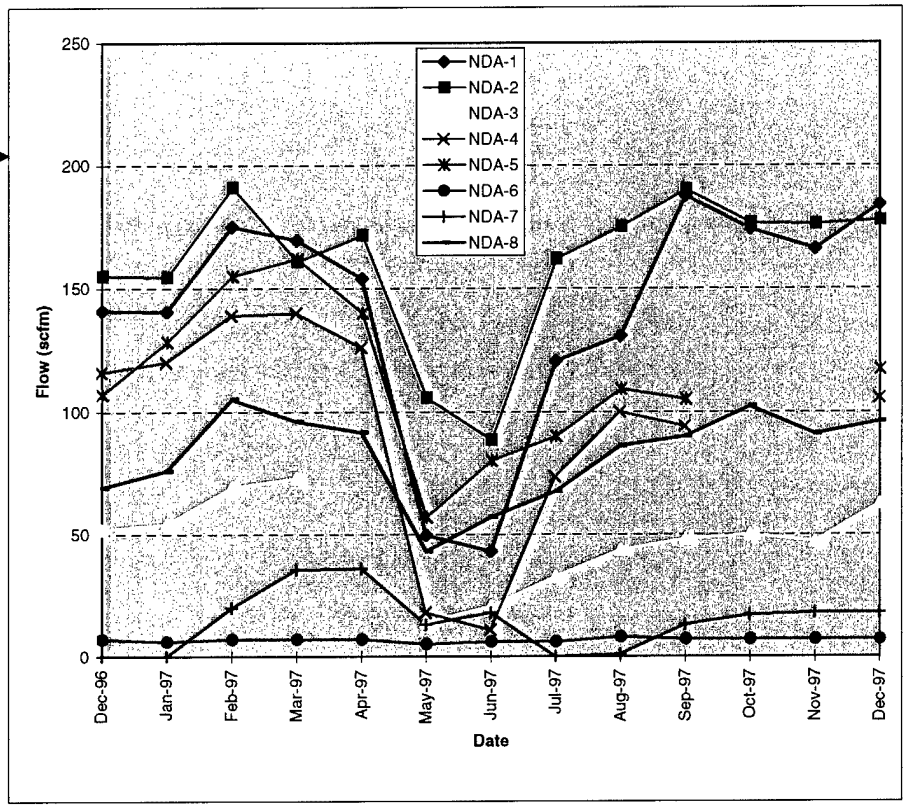


Figure 3-1
Monthly Air Flow

Oxygen utilization rates are then calculated based on the initial linear portion of the curve, typically the first 12 hours. Biovent system operations should continue until a site's oxygen utilization rate matches background levels. At Loring AFB, the background oxygen utilization rate was found to be 0.1 percent/hour (2.4 percent/day) or less. Table 3-1 summarizes and Figure 3-2 displays all in situ respiration tests run in summer and fall 1996 and spring and fall 1997. Biodegradation rates calculated for the fall 1997 respiration results are included in Table 3-1.

3.2 LESSONS LEARNED SUMMARY

System performance has improved over the past year because of increased system operation knowledge. Challenges encountered over the past two years have included well seal leaks, inaccurate flow measurements, inundation of AIWs, lack of soil gas samples, and adverse weather conditions. These items are discussed in more detail in the first and second semiannual reports (BEI 1996e and 1997a).

3.2.1 Well Seal Leaks

Well seal leaks were eliminated either by limiting the injection pressure to 5 psi or less or by removing the AIW from use. This was successful, and no previously installed seals were compromised in the past 12 months. As the winter progressed, injection pressures were monitored carefully to maintain sealed wells, especially during spring thaw. When the well seals were fully hydrated, pressure was increased but kept at 5 psi or less.

3.2.2 Flow Rates

Initial flow measurements were unreliable because of the measurement method being used. A flow meter demonstration performed during the summer of 1996 to evaluate different flow measuring devices (BEI 1996e) indicated that a Dwyer® in-line rotometer provided the most accurate flow readings. All AIWs were retrofitted with these instruments and are working well under all conditions.

3.2.3 Inundation of AIWs

During the spring and summer, inundation of the AIWs is a major inhibitor of air injection. This problem is anticipated to continue because groundwater levels fluctuate seasonally. However, if constant pressure at a high enough level to overcome the hydrostatic head above the top of screen, is applied to an AIW, air will eventually make its way into the subsurface. This scenario is relevant only if a minority of the total number of wells are inundated. During periods of rising groundwater levels, attention will be paid to injection pressures and flow rates. If water levels completely inundate most of the site's AIWs, the system will be turned off until groundwater levels subside because only a small volume of soil designed per treatment is being treated.

Table 3-1
Results from the Summer and Fall 1996 /1997 Respiration Testing

Site	Monitoring Point	Summer 1996 Oxygen Utilization Rate (% / hour)	Fall 1996 Oxygen Utilization Rate (% / hour)	Spring 1997 Oxygen Utilization Rate (% / hour)	Fall 1997 Oxygen Utilization Rate (% / hour)	Fall 1997 Corrected Oxygen[1] Utilization Rate (%/hour)	Biodegradation Rate[2] (mg TPH/kg soil/d
AHS	MP-1-5	Not installed	7.5	1.03	0.75	0.75	12.8
	MP-2-13	Not installed	0.26	0.02	0.04	0.04	0.7
	MP-4-3	Not installed	NT	NT	0.15	0.15	2.6
	MP-4-13	Not installed	0.04	0.06	0.05	0.05	0.9
	MP-5BG-4	Not installed	NT	0.97	NT	na	na
	average =		2.6	0.52	0.25	0.25	4.2
BXSS	VM-1-5	0.41	0.71	0.49	0.46	0.46	7.9
	VM-2-5	0.71	0.11	0.5	NT	na	na
	MP-1-7.5	0.32	0.4	0.08	0.12	0.12	2.1
	MP-2-8.5	1.3	1.1	0.11	0.25	0.25	4.3
	MP-4BG-8	NT	1.3	Water/NT	NT	na	na
	average =	0.69	0.72	0.30	0.28	0.28	4.7
ES	MP-2-3	Not installed	0.01	No flow/NT	NT	na	na
	MP-2-14	Not installed	0.01	High oxygen/NT	0.04	0.00	0.7
	MP-5-9.5	Not installed	Not installed	Not installed	0.01	0.01	0.2
	average =				0.03	0.01	0.4
FJETC	MP-7-3	NT	0.66	0.31	0.72	0.70	12.3
FTA	MP-1-6	NT	NT	0.2	NT	na	na
	MP-9-3	NT	2.4	0.61	0.46	0.43	7.9
	MP-10-3	NT	0.89	0.31	NT	na	na
	MP-11-3	NT	1.45	0.38	0.21	0.19	3.6
	MP-12-6	0.17	0.23	0.16	0.04	0.03	0.7
	MP-14-8.5	0.31	0.26	0.18	0.14	0.14	2.4
	average =	0.24	1.05	0.31	0.21	0.20	3.6
FTF	MP-2-15	Not installed	0.77	No flow	No flow	na	na
	MP-3-10	Not installed	0.4	Water	Water	na	na
	average =		0.59				
FTF II	MP-3-5.5	Not installed	Not installed	Not installed	2.81	2.81	48.1
	MP-13-5.5	Not installed	Not installed	Not installed	1.43	1.41	24.5
	average =				2.12	2.11	36.3
NDA-1	MP-1-3-5.5	Not installed	NT	0.13	NT	na	na
	MP-1-4-8	Not installed	4.2	Water	NT	na	na
	MP-1-6-5	Not installed	4.0	0.18	0.34	0.34	5.8
	MP-1-6-8	Not installed	5.1	Water	0.76	0.76	13.0
	average =		4.65	0.16	0.55	0.55	9.4
NDA-2	MP-2-2-5	Not installed	0.07	High oxygen/NT	High oxygen/NT	na	na
	MP-2-2-8	Not installed	0.07	High oxygen/NT	High oxygen/NT	na	na
NDA-3		No points available for respiration testing due to 'No flow' or Water					
NDA-4	MP-4-2BG	NT	NT	NT	0.05	0.05	0.9
	MP-4-4	NT	NT	NT	0.77	0.77	13.2
	average =				0.41	0.41	7.0
NDA -5	MP-5-1-9.5	Not installed	7.2	Water/NT	Water/NT	na	na
	MP-5-4-7.5	Not installed	0.05	High oxygen/NT	Water/NT	na	na
	average =		3.63				
NDA-6	MP-6-3-8.5	Not installed	0.014	Water/NT	Water/NT	na	na
	MP-6-2BG-7	Not installed	NT	0.1	0.06	0.06	1.0
NDA-7		No points available for respiration testing due to 'No flow' or Water					
NDA -8		No points available for respiration testing due to 'No flow'/Water/High oxygen					
PPDP	MP-2-3	0.65	NT	No flow/NT	NT	na	na
	MP-3-3	1.7	1.2	1.0	NT	na	na
	MP-3-6	0.73	0.46	0.46	0.65	0.65	11.1
	MP-4-3	0.45	0.15	0.19	0.22	0.22	3.8
	MP-6-3	0.56	0.19	0.14	0.09	0.09	1.5
	MP-9-8.5	Not installed	Not installed	Not installed	0.40	0.40	6.8
	average =	0.82	0.50	0.26	0.34	0.34	5.8

na = not applicable
NT = not tested

[1]Oxygen utilization rate corrected as follows:

a) Determine helium loss per hour (all helium data was used to determine slope);
b) Correct helium decay by dividing helium loss per hour by 2.8 (difference in diffusion rate of helium and oxygen);
c) subtract corrected helium decay from initial oxygen utilization rate.

[2] Hydrocarbon biodegradation rate = (K_d)

K_d = degradation rate (mg TPH/kg soil/day)

$$K_d = \frac{K_O \times A \times R \times D_O}{100} \times 24$$

K_o = corrected oxygen utilization rate (%/hour)
A = Air filled porosity per kg of soil, calculated (0.192)
R = Ratio of TPH mineralization to oxygen required (1:3.5 for hexane)
D_O = Density of oxygen at 68° F (1,300 mg/L)
[Equation and values from URS 1995b (Section 02020)]

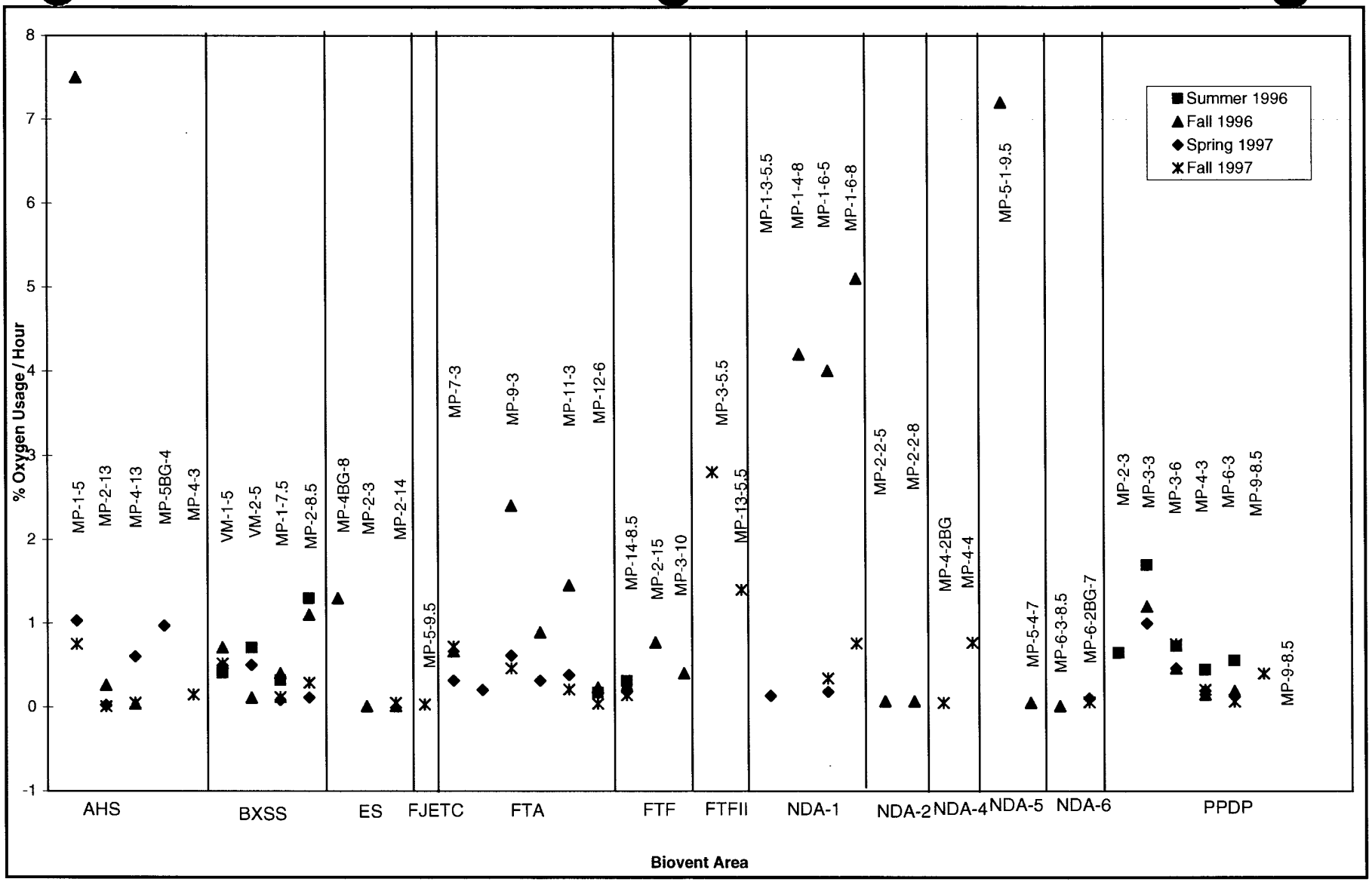


Figure 3-2
Respiration Test Results by Biovent Area

3.2.4 Soil Gas Monitoring

For several reasons, soil gas samples have generally been difficult to collect—well point screened in tight soil, MP inundation, clogged screen, compromised tubing, or frozen tubing—and no better collection method has been found. As recommended in the previous semiannual report, new MPs were added to several sites on July 25–29, 1997; mid-month monitoring of these new MPs began in August. In the site-specific sections that follow, BEI recommends either installing new MPs where improvement in the operation of current MPs is not believed possible, or an alternative remedial action (i.e., excavating and removing soil). Split-spoon samples should be taken during installation of MPs, and the MP screen should be installed in a field-determined permeable contaminated zone—not at predetermined depths. In addition to split-spoon sampling, the depth to water will be determined when practical.

Soil gas samples collected in May 1997 from AHS, BXSS, ES, FJETC, and FTA were considered suspect because of consistently high oxygen and low carbon dioxide levels. Air samples were collected in May from several locations that did not yield samples before or afterward. In addition, high oxygen levels were noted at locations with historically low levels (i.e., FJETC-MP7-3 and FTA-MP9-3). Both of these anomalies suggest leaks in the sampling equipment; for example, the lid to the jar on the air sampling device may have been leaking, thus diluting the soil gas sample with ambient air. The entire sampling system has been checked for leaks, and new tubing has been installed. All soil gas monitoring data will be compared with historic data as an additional verification step.

3.2.5 General

Biovent systems running during the winter of 1997–1998 are expected to run similarly to last winter and therefore will again be run at reduced air flow rates for select sites. As spring thaw begins, attention will be focused on water levels and the pressures required to maintain air injection. Oxygen sensors will be monitored during the winter, and winter respiration tests at select oxygen sensor locations will be conducted (as recommended in last semiannual report), weather permitting. MPs will not be sampled until spring thaw.

Respiration tests scheduled for spring/summer 1998 will include all MPs tested in the past and additional sites where respiration tests have not yet been performed. MPs will be selected on the basis of soil gas sample collectibility.

The site-specific sections that follow provide evaluations and recommendations for each site. Table 3-2 summarizes the recommendations in the subsequent sections. A soil sampling plan will be prepared for any soil sampling proposed in the recommendations.

Table 3-2
Summary of Site-Specific Recommendations

Site	Recommendation
AHS	Functioning well, biodegradation rates are decreasing. Install new AIW near northwest side of background MP-5BG.
BXSS	Maintain airflow into biovent wells during winter months. Collect soil samples early this spring for closure determination.
ES	Maintain airflow into biovent wells during winter months. Collect soil samples early this spring for closure determination.
FJETC	Maintain airflow into biovent wells through early summer. Collect soil samples early this summer for closure determination.
FTA	Maintain airflow into biovent wells through early summer. Collect soil samples early this summer for closure determination.
FTF	Begin bioslurp mode as early as possible in spring.
FTF II	No changes recommended.
NDAs	Combine several NDAs (NDAs 1, 3 and 4, 5) into two systems to save operations costs. Three areas within NDAs 3 and 4 and all of NDA 8 will be evaluated for alternative remedial action since air cannot be injected into AIWs. Collect soil samples early this summer at all NDAs. Determine contaminant concentrations for closure determination.
PPDP	No changes recommended. Collect soil samples early this summer for closure determination.
General	Perform several respiration tests in the winter to help determine the impact winter has on biodegradation. This procedure will use oxygen sensors.

3.3 RAINFALL DATA

Table 3-3 tabulates rainfall data recorded at the weather station in Caribou, Maine, over the past year, and Figure 3-3 illustrates daily totals and cumulative values for the past 3 years. The graph clearly shows that precipitation during April through September 1996 and 1997 have exceeded normal levels. Combined with snowmelt, these high levels may have had an impact on several of the biovent systems as noted in the last semiannual report. Saturated soils have caused air injection rates to be lower than design flow, and several MPs were affected by saturation levels, resulting in reduction of monitoring data. Rainfall amounts from October through December were close to normal. Most inundated wells noted in June and July were either only partially inundated or were not inundated from August through December, primarily due to the decrease in infiltration. Although several wells dried up, partially saturated soils did not allow air flow in several AIWs.

Table 3-3 Precipitation Data Caribou, Maine (1/97 - 12/97)

January Precipitation (in.)		February Precipitation (in.)		March Precipitation (in.)		April Precipitation (in.)		May Precipitation (in.)		June Precipitation (in.)	
1-Jan-97	0	1-Feb-97	0.15	1-Mar-97	0.03	1-Apr-97	0	1-May-97	0.2	1-Jun-97	0
2-Jan-97	0	2-Feb-97	0	2-Mar-97	0.2	2-Apr-97	0	2-May-97	0.15	2-Jun-97	0
3-Jan-97	0.02	3-Feb-97	0.01	3-Mar-97	0	3-Apr-97	0	3-May-97	0.22	3-Jun-97	0.01
4-Jan-97	0	4-Feb-97	0	4-Mar-97	0	4-Apr-97	0	4-May-97	0.08	4-Jun-97	0
5-Jan-97	0.82	5-Feb-97	0.57	5-Mar-97	0	5-Apr-97	0	5-May-97	0	5-Jun-97	0
6-Jan-97	0.12	6-Feb-97	0	6-Mar-97	1.06	6-Apr-97	0.17	6-May-97	0.02	6-Jun-97	0
7-Jan-97	0.01	7-Feb-97	0	7-Mar-97	0	7-Apr-97	0	7-May-97	0.59	7-Jun-97	0
8-Jan-97	0	8-Feb-97	0	8-Mar-97	0	8-Apr-97	0.01	8-May-97	0	8-Jun-97	0
9-Jan-97	0	9-Feb-97	0	9-Mar-97	0	9-Apr-97	0	9-May-97	0	9-Jun-97	0
10-Jan-97	1.01	10-Feb-97	0	10-Mar-97	0.11	10-Apr-97	0	10-May-97	0	10-Jun-97	0.02
11-Jan-97	0	11-Feb-97	0	11-Mar-97	0.07	11-Apr-97	0	11-May-97	0.02	11-Jun-97	0
12-Jan-97	0.01	12-Feb-97	0.01	12-Mar-97	0	12-Apr-97	0	12-May-97	0.09	12-Jun-97	0.1
13-Jan-97	0.01	13-Feb-97	0	13-Mar-97	0	13-Apr-97	0.3	13-May-97	0.1	13-Jun-97	1.7
14-Jan-97	0.01	14-Feb-97	0.52	14-Mar-97	0.21	14-Apr-97	0.03	14-May-97	0.51	14-Jun-97	0.01
15-Jan-97	0	15-Feb-97	0	15-Mar-97	0.16	15-Apr-97	0	15-May-97	0	15-Jun-97	0
16-Jan-97	0.59	16-Feb-97	0	16-Mar-97	0	16-Apr-97	0	16-May-97	1.67	16-Jun-97	0
17-Jan-97	0	17-Feb-97	0	17-Mar-97	0.01	17-Apr-97	0	17-May-97	0.1	17-Jun-97	0
18-Jan-97	0	18-Feb-97	0	18-Mar-97	0	18-Apr-97	0	18-May-97	0	18-Jun-97	0.21
19-Jan-97	0	19-Feb-97	0.37	19-Mar-97	0	19-Apr-97	0	19-May-97	0	19-Jun-97	0.44
20-Jan-97	0.03	20-Feb-97	0.03	20-Mar-97	0	20-Apr-97	0	20-May-97	0.33	20-Jun-97	0
21-Jan-97	0	21-Feb-97	0.26	21-Mar-97	0	21-Apr-97	0	21-May-97	0.07	21-Jun-97	0.14
22-Jan-97	0.06	22-Feb-97	0.4	22-Mar-97	0	22-Apr-97	0	22-May-97	0.14	22-Jun-97	0.41
23-Jan-97	0.04	23-Feb-97	0	23-Mar-97	0	23-Apr-97	0.02	23-May-97	0	23-Jun-97	0
24-Jan-97	0	24-Feb-97	0	24-Mar-97	0	24-Apr-97	0	24-May-97	0	24-Jun-97	0
25-Jan-97	0.43	25-Feb-97	0	25-Mar-97	0.06	25-Apr-97	0	25-May-97	0.52	25-Jun-97	0.65
26-Jan-97	0	26-Feb-97	0.01	26-Mar-97	0.21	26-Apr-97	0	26-May-97	0.04	26-Jun-97	0.59
27-Jan-97	0	27-Feb-97	0.18	27-Mar-97	0	27-Apr-97	0	27-May-97	0	27-Jun-97	0.05
28-Jan-97	0.29	28-Feb-97	0.01	28-Mar-97	0	28-Apr-97	0.69	28-May-97	0	28-Jun-97	0
29-Jan-97	0			29-Mar-97	0.14	29-Apr-97	0.46	29-May-97	0	29-Jun-97	0.04
30-Jan-97	0			30-Mar-97	0.21	30-Apr-97	0	30-May-97	0.08	30-Jun-97	0
31-Jan-97	0.15			31-Mar-97	0			31-May-97	0.09		
Total:	3.6		2.52		2.47		1.68		5.02		4.37

July Precipitation (in.)		August Precipitation (in.)		Sept. Precipitation (in.)		Oct. Precipitation (in.)		Nov. Precipitation (in.)		Dec. Precipitation (in.)	
1-Jul-97	0	1-Aug-97	0	1-Sep-97	0	1-Oct-97	0.01	1-Nov-97	0.04	1-Dec-97	0.14
2-Jul-97	0	2-Aug-97	0.14	2-Sep-97	0.18	2-Oct-97	0.02	2-Nov-97	0.54	2-Dec-97	0.11
3-Jul-97	0.16	3-Aug-97	0	3-Sep-97	0.53	3-Oct-97	0	3-Nov-97	0.02	3-Dec-97	0
4-Jul-97	0.83	4-Aug-97	0	4-Sep-97	0	4-Oct-97	0	4-Nov-97	0.15	4-Dec-97	0
5-Jul-97	0	5-Aug-97	0	5-Sep-97	0	5-Oct-97	0.22	5-Nov-97	0.29	5-Dec-97	0.15
6-Jul-97	0	6-Aug-97	0	6-Sep-97	0.01	6-Oct-97	0	6-Nov-97	0	6-Dec-97	0.75
7-Jul-97	0	7-Aug-97	0	7-Sep-97	0.05	7-Oct-97	0	7-Nov-97	0	7-Dec-97	0.13
8-Jul-97	0	8-Aug-97	0	8-Sep-97	0	8-Oct-97	0	8-Nov-97	0	8-Dec-97	0.01
9-Jul-97	0.47	9-Aug-97	0	9-Sep-97	0.14	9-Oct-97	0	9-Nov-97	0.24	9-Dec-97	0
10-Jul-97	0	10-Aug-97	0	10-Sep-97	0	10-Oct-97	0.02	10-Nov-97	0.02	10-Dec-97	0
11-Jul-97	0	11-Aug-97	0.69	11-Sep-97	0	11-Oct-97	0	11-Nov-97	0.04	11-Dec-97	0
12-Jul-97	0	12-Aug-97	0	12-Sep-97	0.04	12-Oct-97	0	12-Nov-97	0	12-Dec-97	0
13-Jul-97	0	13-Aug-97	0.18	13-Sep-97	0	13-Oct-97	0	13-Nov-97	0	13-Dec-97	0
14-Jul-97	0	14-Aug-97	0.1	14-Sep-97	0	14-Oct-97	0	14-Nov-97	0	14-Dec-97	0.02
15-Jul-97	0	15-Aug-97	0	15-Sep-97	0	15-Oct-97	0	15-Nov-97	0	15-Dec-97	0
16-Jul-97	0	16-Aug-97	0.78	16-Sep-97	0.01	16-Oct-97	0	16-Nov-97	0	16-Dec-97	0
17-Jul-97	0.1	17-Aug-97	0	17-Sep-97	0	17-Oct-97	0	17-Nov-97	0	17-Dec-97	0
18-Jul-97	0.08	18-Aug-97	0	18-Sep-97	0.07	18-Oct-97	0	18-Nov-97	0	18-Dec-97	0
19-Jul-97	0	19-Aug-97	0.02	19-Sep-97	0	19-Oct-97	0	19-Nov-97	0	19-Dec-97	0.04
20-Jul-97	0.01	20-Aug-97	0.16	20-Sep-97	0.45	20-Oct-97	0	20-Nov-97	0.01	20-Dec-97	0
21-Jul-97	0	21-Aug-97	0.01	21-Sep-97	0	21-Oct-97	0.06	21-Nov-97	0	21-Dec-97	0
22-Jul-97	0	22-Aug-97	0.61	22-Sep-97	0	22-Oct-97	0.1	22-Nov-97	0	22-Dec-97	0
23-Jul-97	0	23-Aug-97	0.17	23-Sep-97	0.23	23-Oct-97	0.03	23-Nov-97	0.03	23-Dec-97	0.03
24-Jul-97	0	24-Aug-97	0.04	24-Sep-97	0	24-Oct-97	0	24-Nov-97	0.32	24-Dec-97	0.04
25-Jul-97	0	25-Aug-97	0	25-Sep-97	0	25-Oct-97	0	25-Nov-97	0.05	25-Dec-97	0.67
26-Jul-97	0	26-Aug-97	0	26-Sep-97	0	26-Oct-97	0	26-Nov-97	0.01	26-Dec-97	0.1
27-Jul-97	0.32	27-Aug-97	0.24	27-Sep-97	0	27-Oct-97	0.78	27-Nov-97	0.32	27-Dec-97	0
28-Jul-97	0.13	28-Aug-97	0.37	28-Sep-97	0	28-Oct-97	0.07	28-Nov-97	0	28-Dec-97	0
29-Jul-97	0.04	29-Aug-97	0.61	29-Sep-97	0.89	29-Oct-97	0	29-Nov-97	0	29-Dec-97	0
30-Jul-97	0	30-Aug-97	0	30-Sep-97	0.07	30-Oct-97	0	30-Nov-97	0	30-Dec-97	0.62
31-Jul-97	0.5	31-Aug-97	0			31-Oct-97	0			31-Dec-97	0
	2.64		4.12		2.67		1.31		2.08		2.81

Source: National Oceanic Atmospheric Administration, National Weather Service, Caribou, Maine
Note: Reported "trace" amounts of rain were listed as zero precipitation.

Month	Monthly Rainfall				Cumulative Rainfall			
	Normal[1]	1995	1996	1997	Normal	1995	1996	1997
Jan	2.42	5.60	4.05	3.60	2.42	5.60	4.05	3.60
Feb	1.92	2.70	2.69	2.52	4.34	8.30	6.74	6.12
Mar	2.43	2.23	1.74	2.47	6.77	10.53	8.48	8.59
Apr	2.45	2.12	3.59	1.68	9.22	12.65	12.07	10.27
May	3.07	2.46	3.52	5.02	12.29	15.11	15.59	15.29
Jun	2.91	1.18	3.42	4.37	15.20	16.29	19.01	19.66
Jul	4.01	1.48	6.32	2.64	19.21	17.77	25.33	22.30
Aug	4.07	2.94	2.66	4.12	23.28	20.71	27.99	26.42
Sep	3.45	1.90	3.81	2.67	26.73	22.61	31.80	29.09
Oct	3.10	5.13	3.41	1.31	29.83	27.74	35.21	30.40
Nov	3.55	4.88	1.49	2.08	33.38	32.62	36.70	32.48
Dec	3.22	1.79	3.72	2.81	36.60	34.41	40.42	35.29

[1] Normal represents historical average for the month.

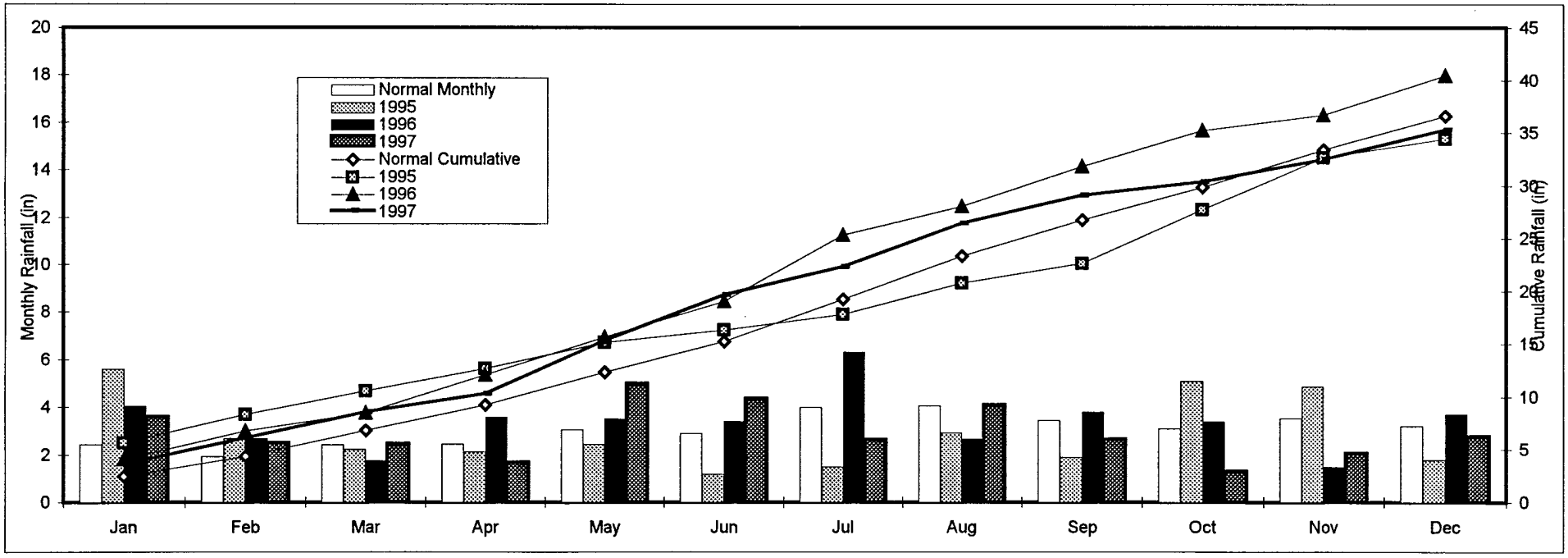


Figure 3-3 Daily and Cumulative Rainfall Amounts

4.0 AUTO HOBBY SHOP

4.1 OPERATIONS

Figure 4-1 presents the average flow at each AIW. In general, the AIWs located at the AHS operated per design throughout 1997 (Table 4-1).

4.2 CONCLUSIONS AND RECOMMENDATIONS

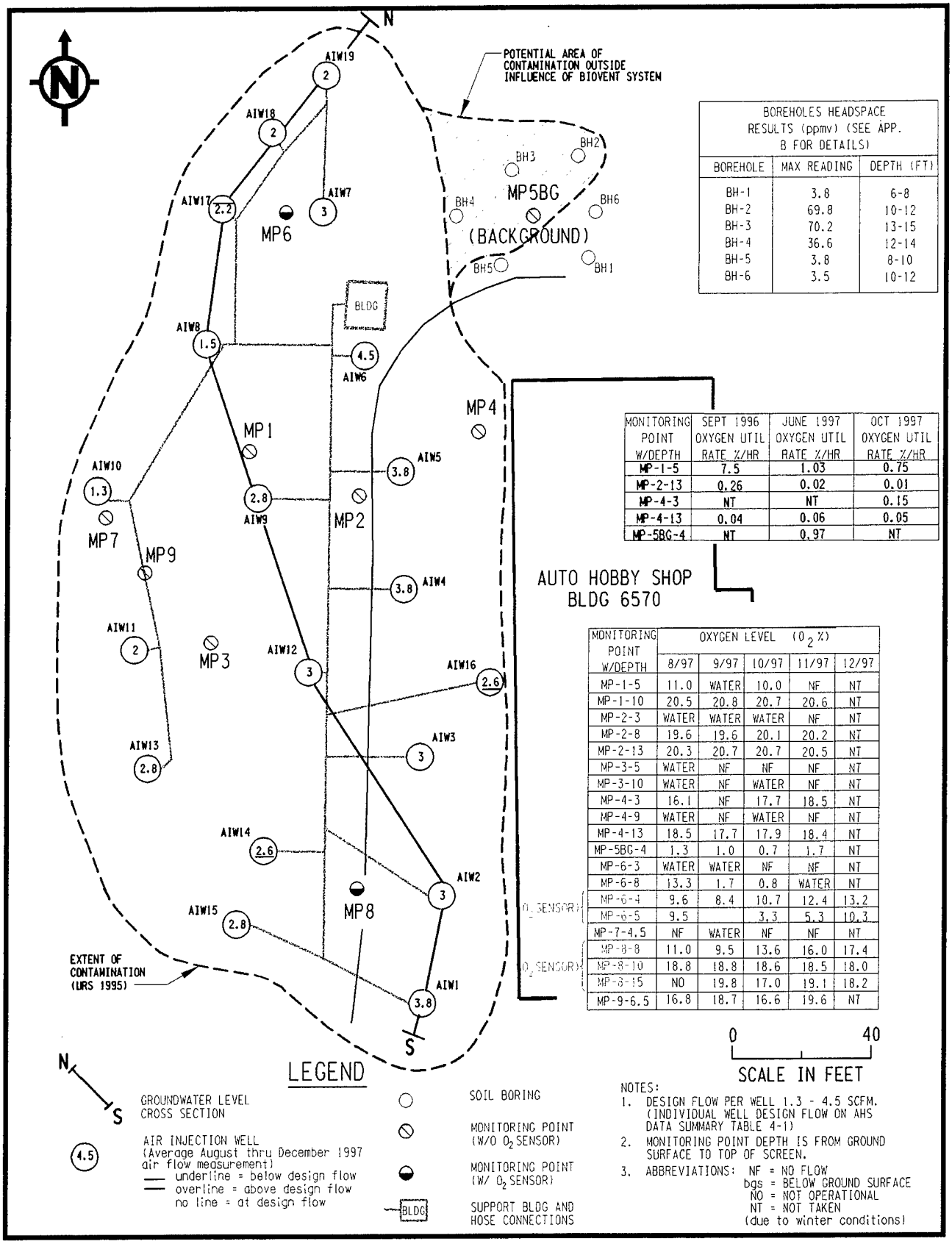
Table 4-2 presents the monthly AIW groundwater data including a graph showing the August, October, and December groundwater levels in the AIWs located along the north-south section identified on Figure 4-1. It is evident that groundwater saturation at the AHS was not a problem; only AIW-1 and AIW-2 had groundwater levels approaching the top of the screen. Figure 4-2 presents monthly groundwater levels and air injection rates along the north-south transect for 1997. Monthly and normal rainfall totals have been added for correlation with the water and air data. All screens remained fully open except AIW-1 and AIW-2, both located at the south end of the AHS.

Data presented in Table 4-1 indicate that active respiration is occurring at MPs 1, 5, and 6. MP 4 is likely situated in contaminated soil—the oxygen utilization rate is 0.15 percent/hour, oxygen levels are as low as 16.1 percent, and TVH levels are as high as 659 ppmv. Background location MP 5 continues to exhibit the greatest volatile readings (2400 ppmv) and the lowest oxygen readings (0.7 percent).

Respiration tests performed on October 22, 1997 included four MPs, one of which was a new location not previously tested. Respiration data and results for the respiration tests are shown on Figures A-1 and A-2 (Appendix A). MP 5, tested in the summer, was not tested this time. MPs 2-13 and 4-13 showed results similar to the summer respiration rates; both were at background levels, indicating that biodegradation may be complete. The oxygen utilization rate at MP 1-5 decreased from 1.03 percent/hour in June to 0.75 percent in October—a significant decrease, although still indicative of active biodegradation. An additional MP (MP-9-6.5) was constructed in August.

The biovent system had operated for a total of 406 days through December 31, 1997.

Overall Recommendation for AHS: Most of the site is operating per design, and most MPs are providing data. No significant operational changes to the air flow settings or improvements to MPs are recommended for the AHS site at this time. Oxygen levels are below 6 percent at MP-5 and MP-6, and the oxygen utilization rate at MP-1 is 0.75 percent/hour. Therefore, the system should remain in operation until all areas of the site reflect background conditions. The distance to the potentially contaminated soils near MP-5BG is beyond the radius of influence of the nearest AIWs; therefore, a new AIW is recommended to be added near boreholes 2, 3, and 4 (Figure 4-1).



BOREHOLES HEADSPACE RESULTS (ppmv) (SEE APP. B FOR DETAILS)		
BOREHOLE	MAX READING	DEPTH (FT)
BH-1	3.8	6-8
BH-2	69.8	10-12
BH-3	70.2	13-15
BH-4	36.6	12-14
BH-5	3.8	8-10
BH-6	3.5	10-12

MONITORING POINT W/DEPTH	SEPT 1996 OXYGEN UTIL RATE %/HR	JUNE 1997 OXYGEN UTIL RATE %/HR	OCT 1997 OXYGEN UTIL RATE %/HR
MP-1-5	7.5	1.03	0.75
MP-2-13	0.26	0.02	0.01
MP-4-3	NT	NT	0.15
MP-4-13	0.04	0.06	0.05
MP-5BG-4	NT	0.97	NT

MONITORING POINT W/DEPTH	OXYGEN LEVEL (O_2 %)				
	8/97	9/97	10/97	11/97	12/97
MP-1-5	11.0	WATER	10.0	NF	NT
MP-1-10	20.5	20.8	20.7	20.6	NT
MP-2-3	WATER	WATER	WATER	NF	NT
MP-2-8	19.6	19.6	20.1	20.2	NT
MP-2-13	20.3	20.7	20.7	20.5	NT
MP-3-5	WATER	NF	NF	NF	NT
MP-3-10	WATER	NF	WATER	NF	NT
MP-4-3	16.1	NF	17.7	18.5	NT
MP-4-9	WATER	NF	WATER	NF	NT
MP-4-13	18.5	17.7	17.9	18.4	NT
MP-5BG-4	1.3	1.0	0.7	1.7	NT
MP-6-3	WATER	WATER	NF	NF	NT
MP-6-8	13.3	1.7	0.8	WATER	NT
MP-6-4 (O_2 SENSOR)	9.6	8.4	10.7	12.4	13.2
MP-6-5 (O_2 SENSOR)	9.5		3.3	5.3	10.3
MP-7-4.5	NF	WATER	NF	NF	NT
MP-8-8	11.0	9.5	13.6	16.0	17.4
MP-8-10	18.8	18.8	18.6	18.5	18.0
MP-8-15	NO	19.8	17.0	19.1	18.2
MP-9-6.5	16.8	18.7	16.6	19.6	NT

NOTES:
1. DESIGN FLOW PER WELL 1.3 - 4.5 SCFM. (INDIVIDUAL WELL DESIGN FLOW ON AHS DATA SUMMARY TABLE 4-1)
2. MONITORING POINT DEPTH IS FROM GROUND SURFACE TO TOP OF SCREEN.
3. ABBREVIATIONS: NF = NO FLOW
bgs = BELOW GROUND SURFACE
NO = NOT OPERATIONAL
NT = NOT TAKEN
(due to winter conditions)

22784/043/FIG3-3.DGN

NO = NOT OPERATIONAL

Figure 4-1
AHS Biovent System Layout and Average Wellhead Flow

Table 4 - 1 AHS Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval top[3]	Screen Interval bottom[3]	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) August 1997	September 1997	October 1997	November 1997	12/97	Average Aug - Dec
AIW-1	14	21	9.7	3.8	3.8	3.8	3.8	3.8	3.8	3.8
AIW-2	15	22	10.4	3.0	3	3	3	3	3	3
AIW-3	15	22	10.4	3.0	3	3	3	3	3	3
AIW-4	14	22	9.7	3.8	3.8	3.8	3.8	3.8	3.8	3.8
AIW-5	13	21	9.0	3.8	3.8	3.8	3.8	3.8	3.8	3.8
AIW-6	13	20	9.0	4.5	4.5	4.5	4.5	4.5	4.5	4.5
AIW-7	8	15	5.6	3.0	3	3	3	3	3	3
AIW-8	6	13	4.2	1.5	1.5	1.5	1.5	1.5	1.5	1.5
AIW-9	10	17	6.9	2.8	2.8	2.8	2.8	2.8	2.8	2.8
AIW-10	6	10	4.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3
AIW-11	7	14	4.9	2.0	2	2	2	2	2	2
AIW-12	12	19	8.3	3.0	3	3	3	3	3	3
AIW-13	8	15	5.6	2.8	2.8	2.8	2.8	2.8	2.8	2.8
AIW-14	11	18	7.6	3.0	3	3	3	3	1	2.6
AIW-15	9	16	6.3	2.8	2.8	2.8	2.8	2.8	2.8	2.8
AIW-16	15	23	10.4	3.8	2.8	2	off	off	3	2.6
AIW-17	5	10	3.5	2.0	2	2	3	2	2	2.2
AIW-18	6	11	4.2	2.0	2	2	2	2	2	2
AIW-19	7	12	4.9	2.0	2	2	2	2	2	2
Total air flow:				53.9	52.9	52.1	51.1	50.1	51.1	
Pressure (psi):					2.6	3.2	3.1	3.4	3.5	

Monitoring Point	Screen Interval (ft bgs) top	bottom	Notes	Soil Gas Sampling Results August 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	September 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	October 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	November 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	December 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)
MP-1-5	5	5.5	O_2 Util. Rate = 0.75%/hr[4]	11.0	9.0	22		Water		10.0	9.9	nr		No flow			No Soil Gas	
MP-1-10	10	10.5		20.5	0.0	15	20.8	0.0	22.7	20.7	0.0	0	20.6	0.0	12.1		Samples Collected	
MP-2-3	3	3.5			Water			Water			Water			No flow			due to Winter Conditions	
MP-2-8	8	8.5		19.6	0.8	8	19.6	0.8	16.7	20.1	0.7	0	20.2	0.5	0			
MP2-13	13	13.5	O_2 Util. Rate = 0.04%/hr[4]	20.3	0.1	9	20.7	0.0	20.7	20.7	0.0	0	20.5	0.0	5.2			
MP-3-5	5	5.5			Water			No flow			No flow			No flow				
MP-3-10	10	10.5			Water			No flow			Water			No flow				
MP-4-3	3	3.5	O_2 Util. Rate = 0.15%/hr[4]	16.1	4.2	6		No flow		17.7	2.5	659	18.5	2.0	12.2			
MP-4-9	9	9.5			Water			No flow			Water			No flow				
MP4-13	13	13.5	O_2 Util. Rate = 0.05%/hr[4]	18.5	2.2	4	17.7	2.7	10.7	17.9	2.6	0	18.4	2.3	0			
MP-5BG-4	4	9		1.3	20.2	23	1.0	21.3	2400	0.7	19.5	nr	1.7	18.6	nr			
MP-6-3	3	3.5			Water			Water			No flow			No flow				
MP-6-8	8	8.5		13.3	6.2	24	1.7	10.0	nr	0.8	11.4	nr		Water				
MP-6-4	4	4.5	O_2 Sensor	9.6	na	na	8.4	na	na	10.7	na	na	12.4	na	na	13.2	na	na
MP-6-5	5	5.5	O_2 Sensor	9.5	na	na	nr	na	na	3.3	na	na	5.3	na	na	10.3	na	na
MP 7-4.5	4.5	5			No flow			Water			No flow			No flow				
MP-8-4	4	4.5	O_2 Sensor	11.0	na	na	no			13.6	na	na	16.0	na	na	17.4	na	na
MP-8-10	10	10.5	O_2 Sensor	18.8	na	na	no			18.6	na	na	18.5	na	na	18.0	na	na
MP-8-15	15	15.5	O_2 Sensor	no			no			17.0	na	na	19.1	na	na	18.2	na	na
MP-9-6.5	6.5	7	Installed 7/25/97	16.8	2.7	2	18.7	1.4	111	16.6	2.3	0	19.6	0.8	0			

[1] Maximum pressure before potential for fracturing of soil. Conservative value calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] The monthly O_2 sensor results is the average for month.
[3] Measured from top of casing.
[4] Test performed on 10/22/97.
bgs = below ground surface, nr = no reading, na = not applicable, no = not operational.

Table 4-2 AHS Groundwater Level Data

Auto Hobby Shop Groundwater Levels from August through December 1997

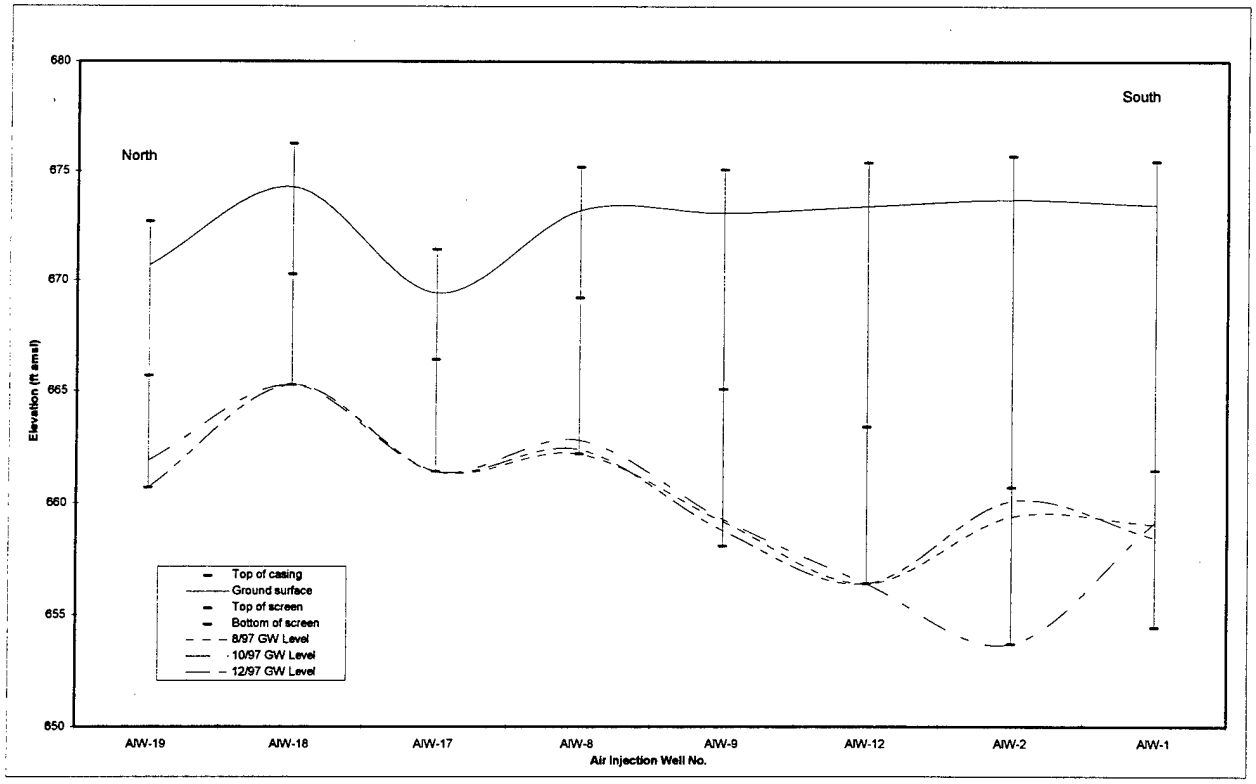
Well No.	Well Depth below TOC	Top of Screen below TOC	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97
AIW-1	21	14	16.4	15.4	16.3	16	17
AIW-2	22	15	16.3	**14.9**	22	16.1	15.6
AIW-3	22	15	22	16.5	22	16.2	17.3
AIW-4	22	14	16.4	15	16.3	15.9	17
AIW-5	21	13	21	15.1	21	21	22
AIW-6	20	13	18.1	17.1	18	17.6	21
AIW-7	15	8	14.3	14.5	14.2	12.9	14.7
AIW-8	13.5	6	13	12.75	12.4	12.2	12.8
AIW-9	17	10	15.9	15	15.8	15.5	16.3
AIW-10	10	6	10	10	10	10	10
AIW-11	14	7	14	14.4	14	14	14
AIW-12	19	12	19	19	19	19	19
AIW-13	15	8	15	15.4	15	15	15
AIW-14	18	11	17.8	17.6	17.7	17.7	17.5
AIW-15	16	9	16	15.8	16.2	16	16
AIW-16	23	15	16.7	15.3	23	16.3	18.5
AIW-17	10	5	10	9.7	10	9.8	10
AIW-18	11	6	11	11	11	11	11
AIW-19	12	7	12	10.4	10.8	12	12

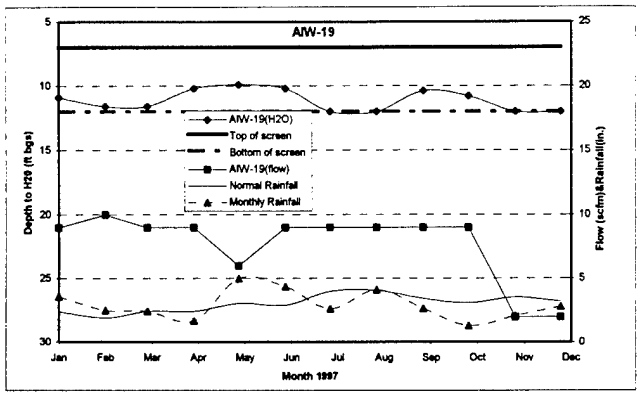
Boxed value indicates groundwater depth is at or above the top of screen.

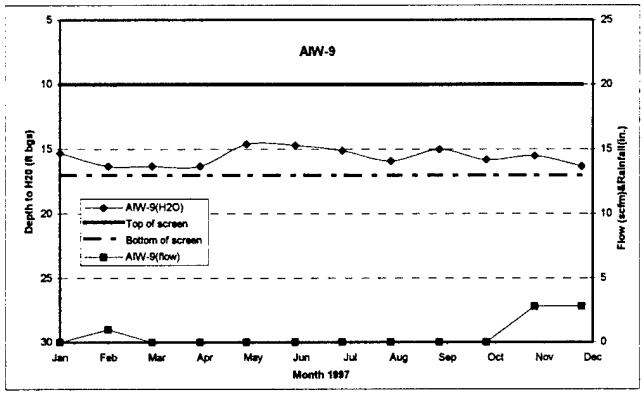
Groundwater Levels along North / South Transect at Auto Hobby Shop

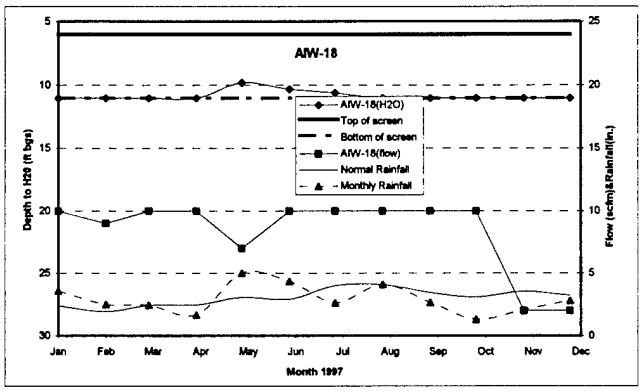
Well No.	Elevation at top of casing (ft amsl)	Approx elev. of ground (2 ft < TOC)	Elevation of water - AUG. (ft amsl)	Elevation of water - OCT. (ft amsl)	Elevation of water - DEC. (ft amsl)	Depth to top of screen (ft)	Elevation of TOS (ft amsl)	Depth to bottom of screen (ft)	Elevation of BOS (ft amsl)
AIW-19	672.89	670.69	660.69	661.89	660.69	7	665.69	12	660.69
AIW-18	676.27	674.27	665.27	665.27	665.27	6	670.27	11	665.27
AIW-17	671.41	669.41	661.41	661.41	661.41	5	666.41	10	661.41
AIW-8	675.20	673.20	662.20	662.80	662.40	6	669.20	13	662.20
AIW-9	675.09	673.09	659.19	659.29	658.79	10	665.09	17	658.09
AIW-12	675.41	673.41	656.41	656.41	656.41	12	663.41	19	656.41
AIW-2	675.70	673.70	659.40	653.70	660.10	15	660.70	22	653.70
AIW-1	675.45	673.45	659.05	659.15	658.45	14	661.45	21	654.45

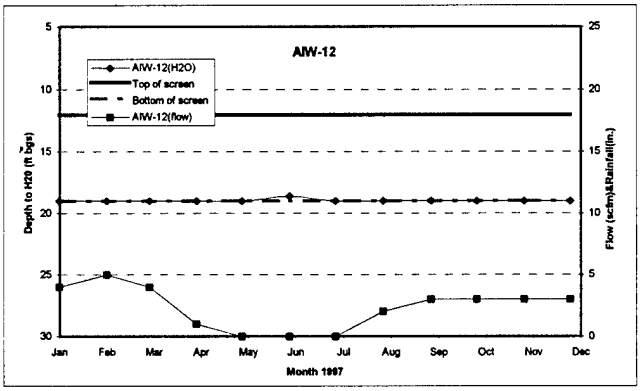
North / South Cross Section at Auto Hobby Shop

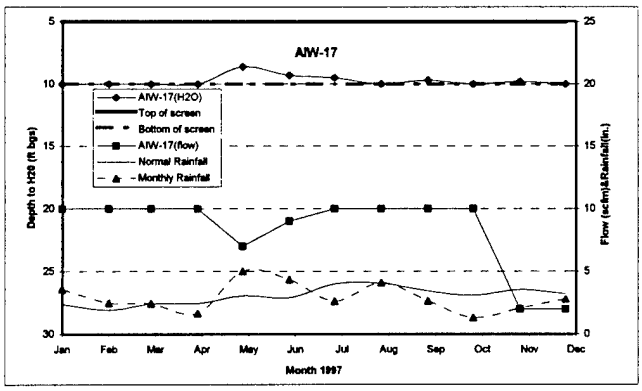


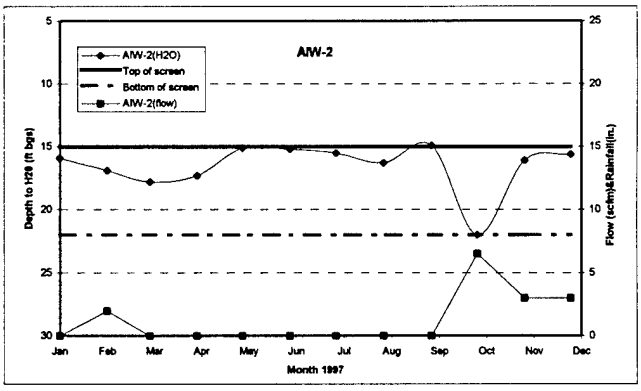


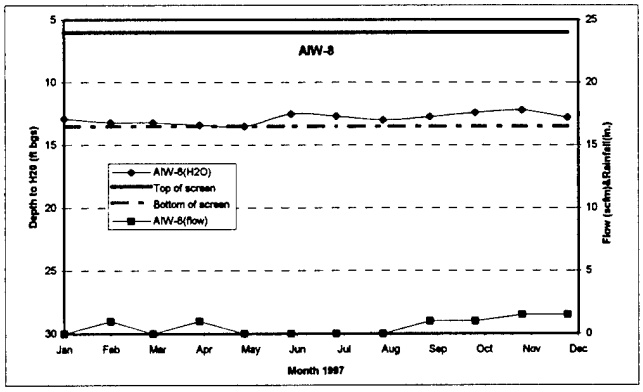












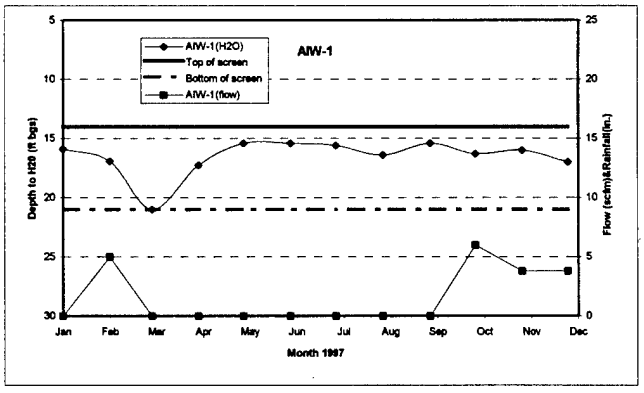


Figure 4-2 AHS Groundwater/Air Flow Relations Along North/South Section

5.0 BASE EXCHANGE SERVICE STATION

5.1 OPERATIONS

The BXSS, located in OU 5, consists of 7 AIWs and 12 MPs (Figure 5-1). The biovent system pilot test originally installed in the fall of 1993 (Earth Tech 1995) consisted of three AIWs (designated as biovent points, or BVs) and six MPs (designated as vapor monitoring points, or VMs). During the summer/fall of 1996, four additional AIWs and six MPs were installed to complete the system; the newly expanded system was started up in October 1996. BEI assumed O&M responsibilities in February 1995, and the BXSS system had operated 659 days through December 31, 1997.

Table 5-1 provides individual AIW air flow data for the BXSS bioventing system. The flow in the BV injection wells was reduced in November from 4 to 2 scfm to meet original design requirements. Soil gas samples were not collected in December due to winter conditions. During August and September, the lower screened interval (8 to 8.5 ft bgs) in the VM points did not produce air samples.

5.2 CONCLUSIONS AND RECOMMENDATIONS

Groundwater levels were collected from the BV wells beginning in October (Table 5-2). Previously only water levels had been collected from AIWs due to access problems with BV wells. Water levels in the AIWs and BVs were stable through the reporting period and had no affect on the air injection rates.

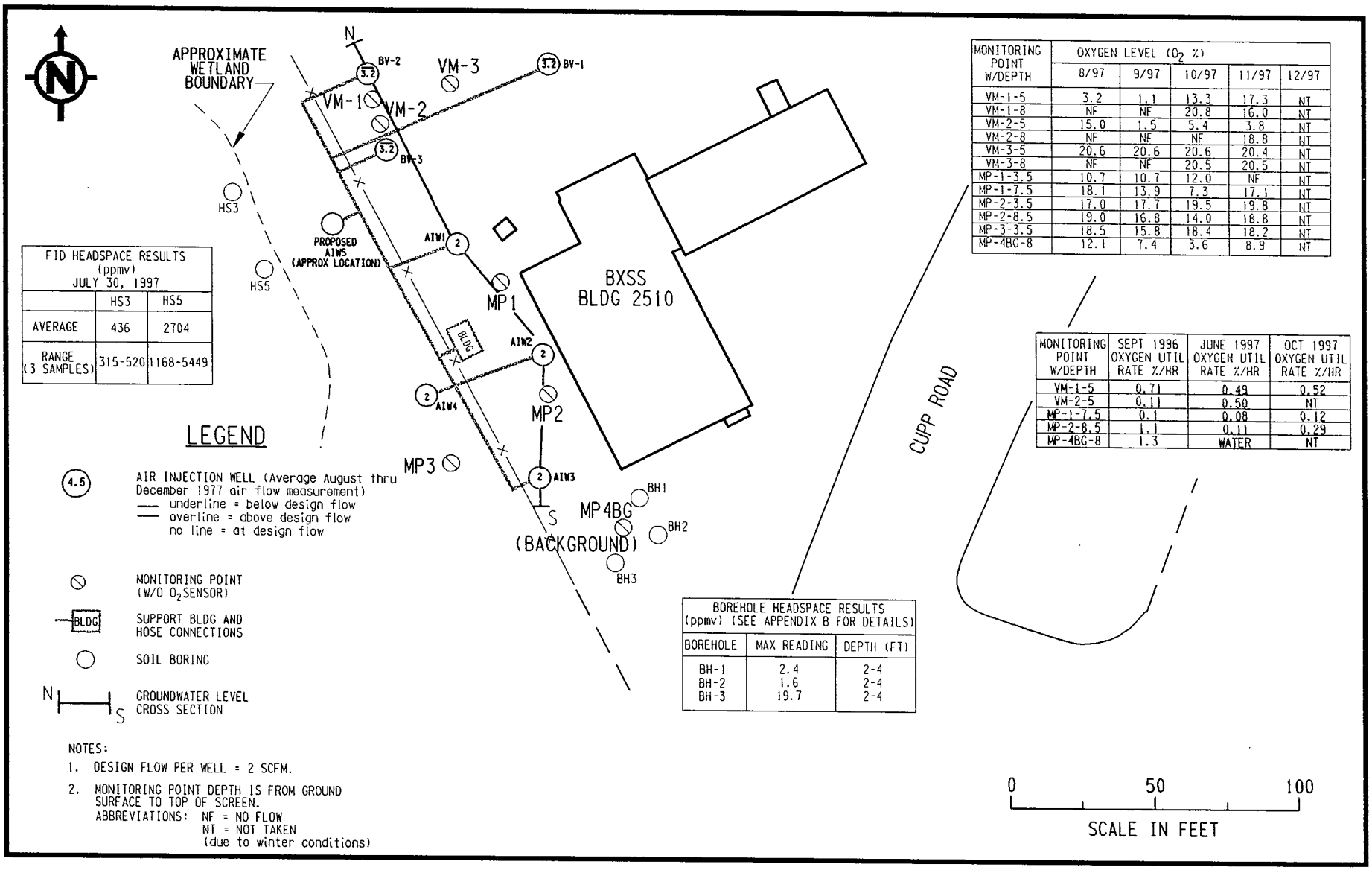
Respiration tests performed at MPs VM-1-5, MP-1-7.5, and MP-2-8.5 (Figures A-3 and A-4) showed that oxygen utilization rates ranged from 0.12 to 0.52 percent/hour. All three results were similar to those noted in June 1997 (Table 3-1).

In general, oxygen levels have increased in most MPs since samples were first taken in September 1996. VM-1-5 and VM-2-5 continue to indicate that enhanced biodegradation is occurring (i.e., low oxygen levels and high oxygen utilization rates). Oxygen levels of 3.2 and 1.1 percent were noted in VM-1-5 during operation in August and September, respectively (see Table 5-1). The oxygen utilization rate in VM-1-5 was 0.52 percent/hour, which is indicative of active respiration. In addition, VM-1-5 shows high TVH levels during August and October.

Oxygen utilization rates recorded in MP-1-7.5 and MP-2-8.5 were 0.12 and 0.29 percent/hour. The rate in MP-1-7.5 was similar to that recorded in June, but the MP-2-8.5 value of 0.29 percent/hour had increased from a June reading of 0.11 percent/hour. This increase is not significant and still supports the scenario that the MP-2-8.5 area is becoming cleaner when compared to 1996 values. Previous oxygen utilization rates at MP-2-8.5 were 1.3 and 1.1 percent/hour in the spring and fall of 1996, respectively (see Table 3-1). Typical background oxygen utilization rates are between 0.06 and 0.10 percent/hour.

A respiration rate of 0.5 percent/hour, corresponding to a total petroleum hydrocarbon (TPH) degradation rate of approximately 9 mg TPH/kg soil/day, suggests that the site should be at values near 500 mg/kg within one season (assuming initial concentrations around 1600 mg/kg). Since operation of the biovent system has been occurring at the BV wells for over 600 days and one full summer at the AIW area, the BXSS should have TPH values below preliminary remediation goals (PRGs).

Overall Recommendation for BXSS: During the winter months, the air injection rate should be kept at the design flow rate in the BV wells to maximize the potential for aeration of the deeper intervals. Soil samples should be collected in the early spring at locations to evaluate the cleanup. Include sampling locations near the BXSS Wetland (high headspace sampling sites; see Figure 5-1) and the background MP4BG area (obtain sample between 8.5 and 12 ft bgs). Compare the results to presystem concentrations to determine the effectiveness of the system. These samples will act as confirmation samples if concentrations are below the PRGs (cease bioventing). If the system has significantly decreased TPH concentrations (i.e., 70 percent or more) from initial levels but they are not below the PRGs, continue bioventing. If bioventing is continued, it is recommended that one AIW be added near the high headspace readings noted in the last semiannual report (see Figure 5-1 for the proposed location). If TPH concentrations have not declined significantly from initial conditions (i.e., less than 30 percent decrease), cease bioventing and evaluate other remedial options. A lack of a decrease in TPH concentrations is likely due to oxygen-limiting conditions (low-permeability soils) as indicated in VM-1 and VM-2.



FID HEADSPACE RESULTS (ppmv) JULY 30, 1997		
	HS3	HS5
AVERAGE	436	2704
RANGE (3 SAMPLES)	315-520	1168-5449

MONITORING POINT W/DEPTH	OXYGEN LEVEL (O_2 %) 8/97	9/97	10/97	11/97	12/97
VM-1-5	3.2	1.1	13.3	17.3	NT
VM-1-8	NF	NF	20.8	16.0	NT
VM-2-5	15.0	1.5	5.4	3.8	NT
VM-2-8	NF	NF	NF	18.8	NT
VM-3-5	20.6	20.6	20.6	20.4	NT
VM-3-8	NF	NF	20.5	20.5	NT
MP-1-3.5	10.7	10.7	12.0	NF	NT
MP-1-7.5	18.1	13.9	7.3	17.1	NT
MP-2-3.5	17.0	17.7	19.5	19.8	NT
MP-2-8.5	19.0	16.8	14.0	16.8	NT
MP-3-3.5	18.5	15.8	18.4	18.2	NT
MP-4BG-8	12.1	7.4	3.6	8.9	NT

MONITORING POINT W/DEPTH	SEPT 1996 OXYGEN UTIL RATE %/HR	JUNE 1997 OXYGEN UTIL RATE %/HR	OCT 1997 OXYGEN UTIL RATE %/HR
VM-1-5	0.71	0.49	0.52
VM-2-5	0.11	0.50	NT
MP-1-7.5	0.1	0.08	0.12
MP-2-8.5	1.1	0.11	0.29
MP-4BG-8	1.3	WATER	NT

BOREHOLE HEADSPACE RESULTS (ppmv) (SEE APPENDIX B FOR DETAILS)		
BOREHOLE	MAX READING	DEPTH (FT)
BH-1	2.4	2-4
BH-2	1.6	2-4
BH-3	19.7	2-4

NOTES:

1. DESIGN FLOW PER WELL = 2 SCFM.
2. MONITORING POINT DEPTH IS FROM GROUND SURFACE TO TOP OF SCREEN.
   ABBREVIATIONS: NF = NO FLOW
   NT = NOT TAKEN
   (due to winter conditions)

22784/043/FIG3-5.DGN

Figure 5-1
BXSS Biovent System Layout and Average Wellhead Flow

Table 5-1 BXSS Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval ft/bgs top[1]	bottom[1]	Overburden Pressure[2] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) August 1997	September 1997	October 1997	November 1997	12/97	Average Aug - Dec
BV-1	9.3	29.5	6.5	2	4	4	4	2	2	3.2
BV-2	8.3	28.4	5.8	2	4	4	4	2	2	3.2
BV-3	5.5	25.7	3.8	2	4	4	4	2	2	3.2
AIW-1	7	12	4.9	2	2	2	2	2	2	2
AIW-2	9	14	6.3	2	2	2	2	2	2	2
AIW-3	8	13	5.6	2	2	2	2	2	2	2
AIW-4	6	11	4.2	2	2	2	2	2	2	2
Total air flow:				14	20.0	20.0	20.0	14.0	14.0	
Pressure (psi):					2.75	2.7	2.3	2.4	2.7	

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results August 1997 O_2 (%)	CO_2 (%)	TVH (ppmv)	September 1997 O_2 (%)	CO_2 (%)	TVH (ppmv)	October 1997 O_2 (%)	CO_2 (%)	TVH (ppmv)	November 1997 O_2 (%)	CO_2 (%)	TVH (ppmv)	December 1997 O_2 (%)	CO_2 (%)	TVH (ppmv)
VM-1-5	5	5.5	O_2 Util. Rate = 0.46%/hr[3]	3.2	16.4	97	1.1	20.4	nr	13.3	9.7	1511	17.3	4.2	0	No Soil Gas		
VM-1-8	8	8.5			No flow			No flow		20.8	0.0	10.1	16.0	1.0	0	Samples Collected		
VM-2-5	5	5.5		15.0	8.3	458	1.5	22.0	nr	5.4	19.0	nr	3.8	18.5	nr	due to Winter Conditions		
VM-2-8	8	8.5			No flow			No flow			No flow		18.8	1.2	0			
VM-3-5	5	5.5		20.6	0.1	131	20.6	0.1	10	20.6	0.0	0.6	20.4	0.1	0			
VM-3-8	8	8.5			No flow			No flow		20.5	0.2	0	20.5	0.0	0			
MP-1-3.5	3.5	4		10.7	8.8	1006	10.7	6.5	25	12.0	6.2	0		No flow				
MP-1-7.5	7.5	8	O_2 Util. Rate = 0.12%/hr[3]	18.1	2.6	51	13.9	4.3	7.1	7.3	6.4	nr	17.1	3.0	0			
MP-2-3.5	3.5	4		17.0	1.9	93	17.7	1.8	10.3	19.5	0.5	0	19.8	0.5	0			
MP-2-8.5	8.5	9	O_2 Util. Rate = 0.25%/hr[3]	19.0	2.0	53	16.8	3.1	14.4	14.0	4.2	0	18.8	1.7	0			
MP-3-3.5	3.5	4		18.5	2.5	6	15.8	3.8	5.8	18.4	2.0	0	18.2	1.4	0			
MP-4BG-8	8	8.5		12.1	6.9	93	7.4	11.0	nr	3.6	12.9	nr	8.9	10.1	nr			

[1] Measured from top of casing in AIW wells only. MPs measured from ground surface.
[2] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[3] Test performed on 10/17/97.
bgs = below ground surface, nr = no reading

Table 5-2 BXSS Groundwater Level Data

Base Exchange Service Station Groundwater Levels from February through July 1997

Well No.	Well Depth below TOC[1]	Top of Screen below TOC[1]	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97
BV-1	29.5	9.3	nc	nc	9.8	9.4	9.7
BV-2	30	9.8	nc	nc	9.9	10	9
BV-3	25.7	5.5	nc	nc	10.1	9	9.4
AIW-1	15	7	11.1	11	11.6	11.2	11.6
AIW-2	17	9	11.2	12.6	12.9	13.1	13.5
AIW-3	16	8	11.8	11.95	12.6	12.1	12.8
AIW-4	14	6	14	14	14	14	14

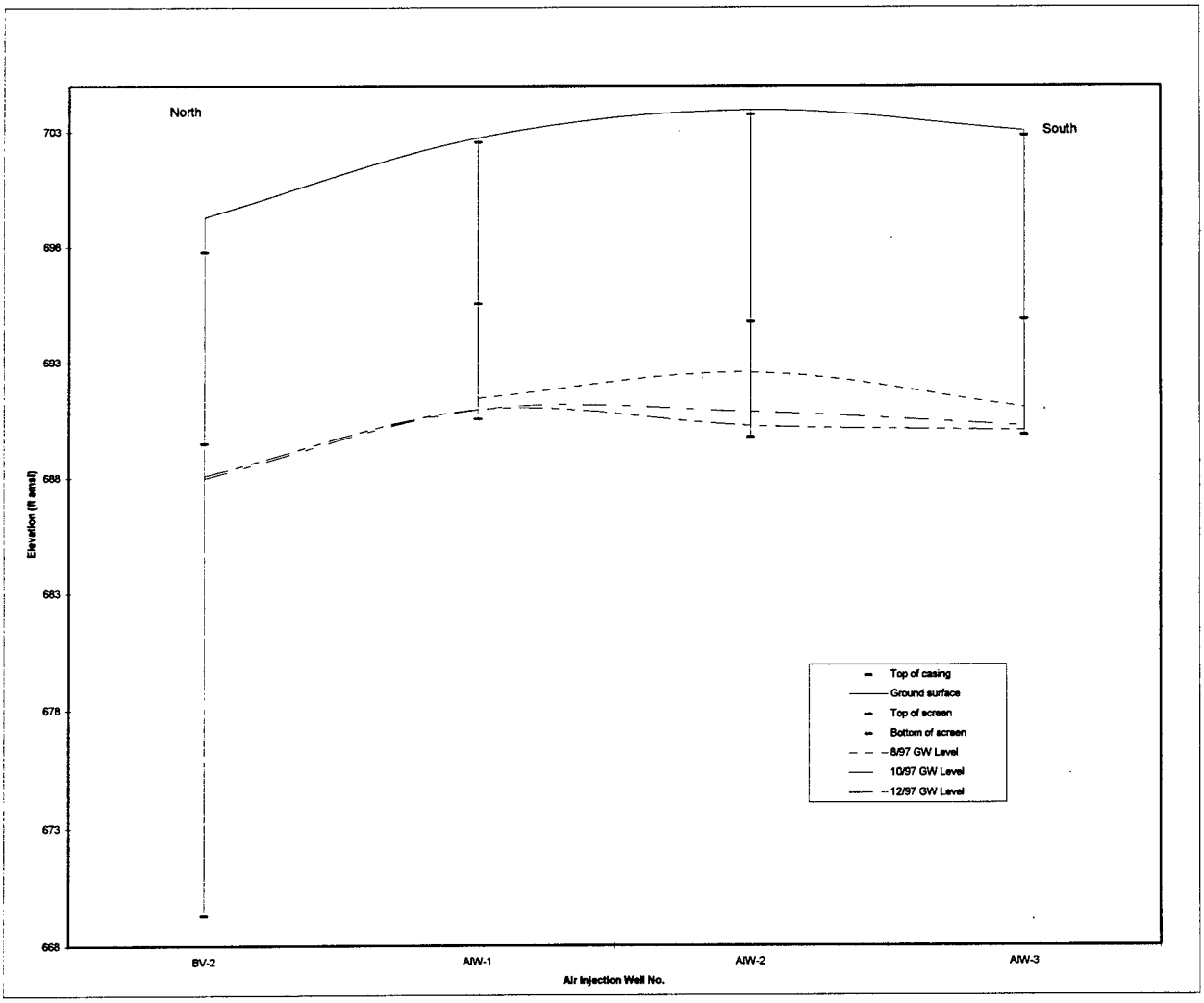
[1] Depth to BV wells are from ground surface. Depth to groundwater from TOC located approximately 1.5 ft bgs.
nc = not collected

Groundwater Levels along North / South Transect at BXSS

Well No.	Elevation at top of casing (ft amsl)	Approx elev. of ground (ft amsl)[2]	Elevation of water - AUG. (ft amsl)	Elevation of water - OCT. (ft amsl)	Elevation of water - DEC. (ft amsl)	Depth to top of screen (ft)	Elevation to TOS (ft amsl)	Depth to bottom of screen (ft)	Elevation to BOS (ft amsl)
BV-2	697.79	699.29		687.99	688.09	9.8	689.49	30	669.29
AIW-1	702.56	702.76	691.46	690.96	690.96	7	695.56	12	690.56
AIW-2	703.77	703.97	692.57	690.87	690.27	9	694.77	14	689.77
AIW-3	702.86	703.06	691.06	690.26	690.06	8	694.86	13	689.86

[2] Ground surface elevation estimated to be approximately 0.2 ft above the riser.

North / South Cross Section at BXSS



6.0 ENTOMOLOGY SHOP

6.1 OPERATIONS

The ES, located in OU 10, consists of 7 AIWs and 13 MPs (Figure 6-1). BEI installed the ES biovent system in the summer of 1996; startup was in September 1996, and O&M began in October 1996. Three new MPs were added to the system in July 1997 due to lack of monitoring data. The system operated a total of 443 days through December 31, 1997.

AIW-2 and AIW-3 are the only wells that continuously accepted air at or near the design flow rate (3 cfm) during the reporting period. AIW-5 and AIW-6 averaged approximately half of the design rate. As noted during the first half of 1997, AIWs-1, -4, and -7 had zero air injection flow rates. Only three MPs (MP-1-3, MP-2-14, and MP-5-9.5) were able to supply soil gas samples during May through July 1997 (Table 6-1). Oxygen sensor MP-6-8.5 came online at the beginning of October.

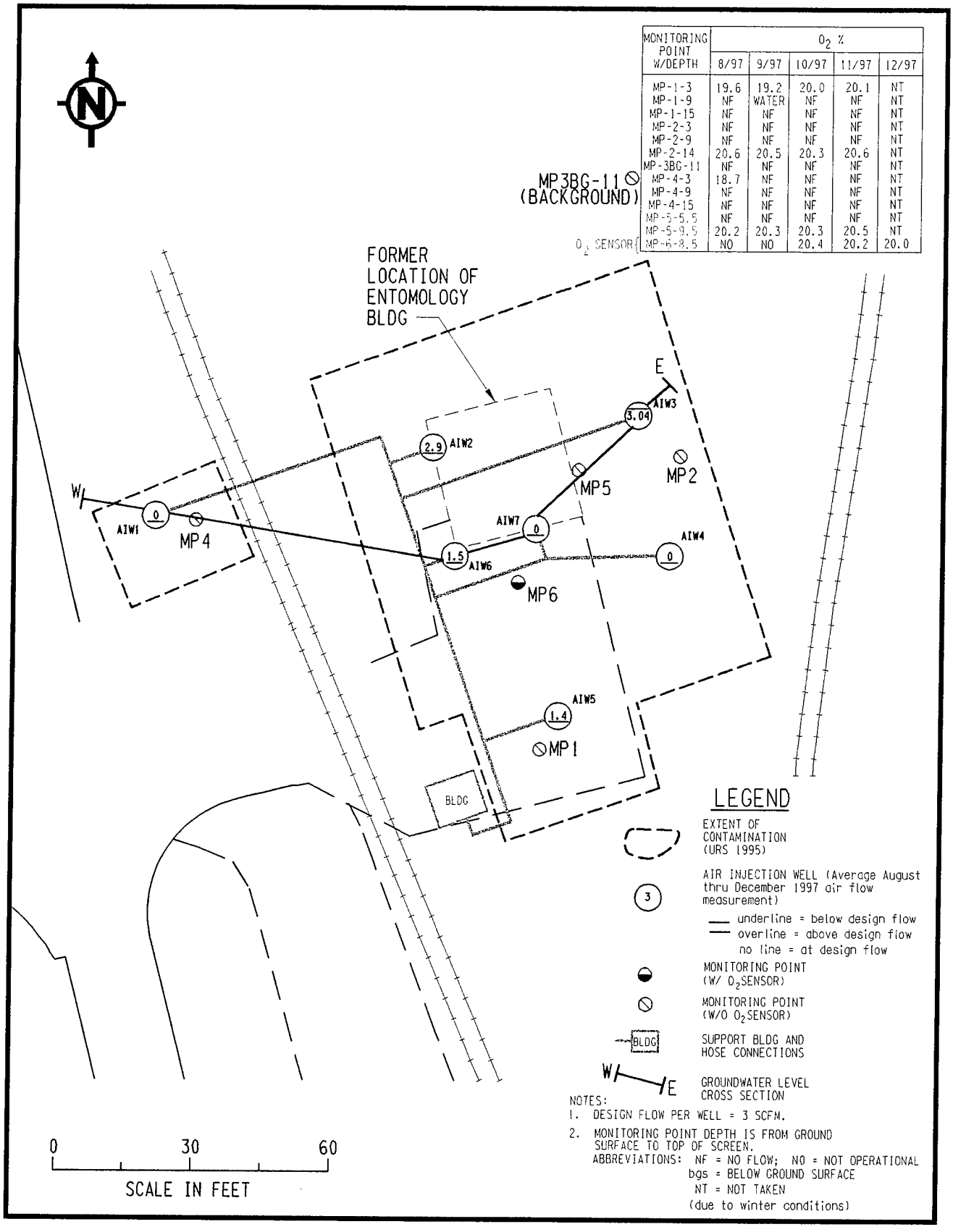
6.2 CONCLUSIONS AND RECOMMENDATIONS

Groundwater level measurements show that AIW-2 was fully inundated with water for the entire period from August through December (Table 6-2). It is not fully understood why AIW-2 continually takes air at the design rate (3 psi). AIW-3 was partially inundated from October through December; the remaining AIWs had no groundwater inundation. Figure 6-2 illustrates the air flow and groundwater level relationship along the west/east cross section identified on Figure 6-1. AIWs-1, -4, and -7 have not accepted air since operation began. Groundwater appears to remain at or below the bottom of the screen most of the time; therefore, extremely impermeable soils may surround the filter pack at each of these wells.

High oxygen levels were recorded at MP-1-3, MP-2-14, MP-4-3, MP-5-9.5, and MP-6-8.5 (18.7 to 20.6 percent) during the reporting period. Respiration tests were performed at MP-2-14 and MP-5-9.5 (Figure A-5). Both results were below background levels, 0.05 and 0.03, respectively. The fact that oxygen levels remain high, carbon dioxide levels remain low, and oxygen utilization rates are at background levels suggest that biodegradation has ceased and a majority of the site is clean. There is a lack of MP data for the deeper soil at MP-1 and MP-4 and shallow soil at MP-2.

Overall Recommendation for ES: It appears that biodegradation is not occurring in the vicinity of the MPs producing soil gas samples. High oxygen levels noted in these MPs may be indicating that the source of contaminants is depleted. New MPs (MP-5-5.5, MP-5-9.5, and MP-6-8.5) have provided information on soils immediately adjacent to the former ES. Although it appears these soils are not contaminated, it is still not known whether soils beneath the former basement have been affected by the air injection. It is recommended that air injection rates be increased during the remainder of the winter months, especially near the basement. Recommend spring soil sampling at several locations at the ES site, including the soils below the former basement if feasible. Suggest installing a polyvinyl chloride pipe (with perforations) in the borings following sampling to act as a temporary piezometer. Since saturated soils seem to be rendering some of

the MPs ineffective, a better understanding of the groundwater table is needed to evaluate any further remedial actions. If contamination still exists under the basement, the options of additional AIWs, excavation, or no action will be evaluated. Based on AIW oxygen levels, soils away from the former basement appear to be approaching cleanup goals. If soil sampling indicates PRGs have been achieved at the site, the bioventing system should be shut down.



22784/043/FIG3-10.DGN

Figure 6-1
ES Biovent System Layout and Average Wellhead Flow

Table 6 - 1 ES Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval ft/bgs top	bottom	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) August 1997	September 1997	October 1997	November 1997	12/97	Average Aug - Dec
AIW-1	10.3	15.3	7.2	3	0	0	0	0	0	0
AIW-2	10.1	15.1	7.0	3	3.2	3	3	2.3	3	2.9
AIW-3	7.5	12.5	5.2	3	3.2	3	3	3	3	3.04
AIW-4	10.1	15.1	7.0	3	0	0	0	0	0	0
AIW-5	13	18	9.0	3	1	1.2	1	2.3	1.5	1.4
AIW-6	11.4	16.4	7.9	3	1	1	1	2	2.5	1.5
AIW-7	10	15	6.9	3	0	0	0	0	0	0
Total air flow:				21	8.4	8.2	8.0	9.6	10	
Pressure (psi):					3.5	3.6	3.7	3.6	3.7	

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results August 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	September 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	October 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	November 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	December 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)
MP-1-3	3	3.5		19.6	1.0	22	19.2	0.8	39	20.0	0.6	16	20.1	0.5	9.1	No Soil Gas		
MP-1-9	9	9.5			No flow			Water			No flow			No flow		Samples Collected		
MP-1-15	15	15.5			No flow			No flow			No flow			No flow		due to Winter Conditions		
MP-2-3	3	3.5			No flow			No flow			No flow			No flow				
MP-2-9	9	9.5			No flow			No flow			No flow			No flow				
MP-2-14	14	14.5	O_2 Util. Rate = 0.04%/hr[3]	20.6	0.3	91	20.5	0.3	243	20.3	0.3	103	20.6	0.2	72			
MP-3BG-11	6.5	11.5	Background location		No flow			No flow			No flow			No flow				
MP-4-3	3	3.5		18.7	1.3	21		No flow			No flow			No flow				
MP-4-9	9	9.5			No flow			No flow			No flow			No flow				
MP-4-15	15	15.5			No flow			No flow			No flow			No flow				
MP-5-5.5	5.5	6			No flow			No flow			No flow			No flow				
MP-5-9.5	9.5	10	O_2 Util. Rate = 0.01%/hr[3]	20.2	0.5	2	20.3	0.3	17	20.3	0.2	0	20.5	0.1	0			
MP-6-8.5	8.5	9	O_2 Sensor	no		no				20.4	na	na	20.2	na	na	20.0	na	na

[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] The monthly O_2 sensor results is the average for month. See biovent monthly reports for daily values.
[3] Test performed on 10/15/97.
bgs = below ground surface, na = not applicable, no operational

Table 6-2 ES Groundwater Level Data

Entomology Shop Groundwater Levels from August through December 1997

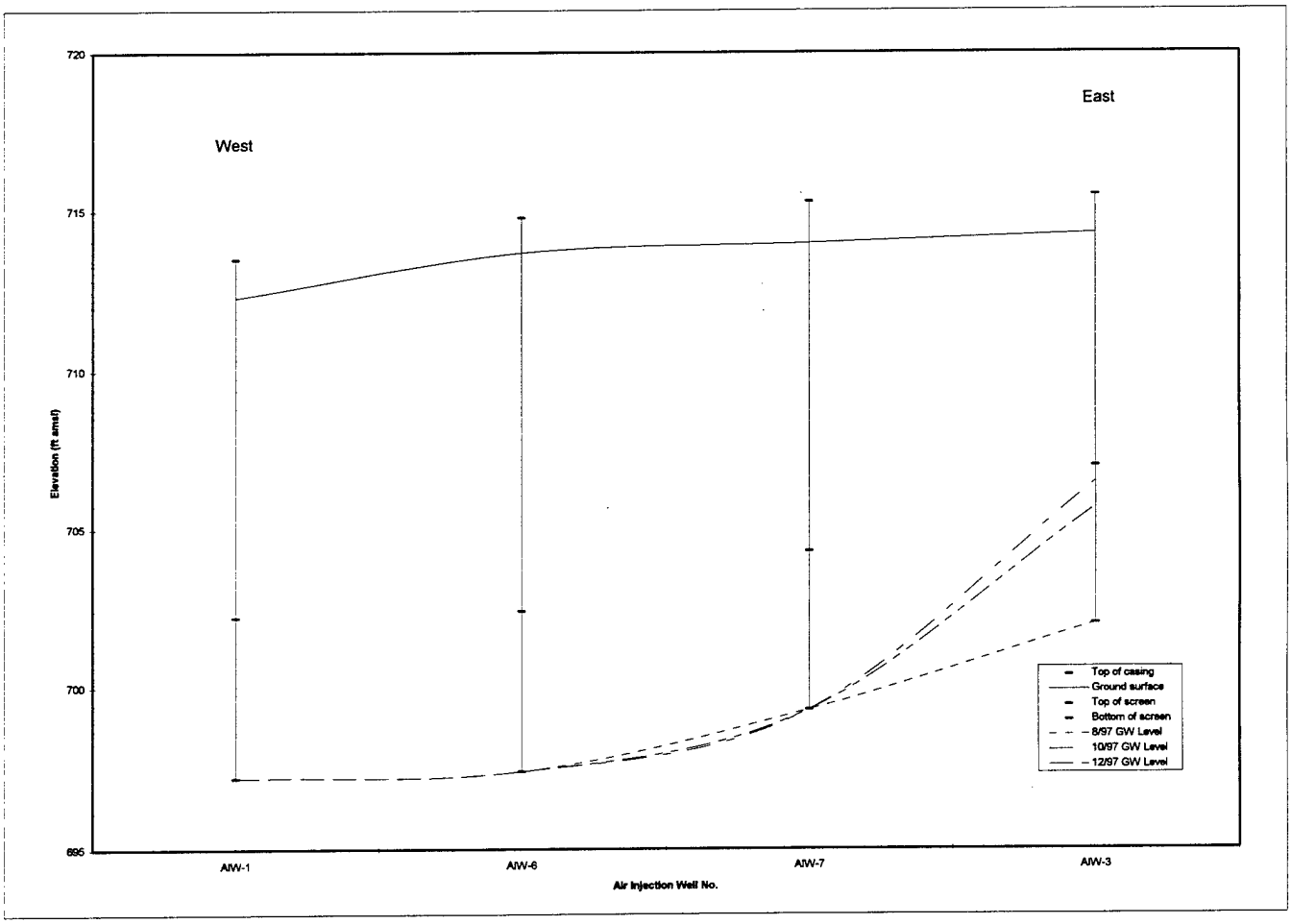
Well No.	Well Depth below TOC	Top of Screen below TOC	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97
AIW-1	16.3	11.3	16.3	16.3	16.3	16.3	16.3
AIW-2	16.1	11.1	8.3	7	7.1	6.8	7.5
AIW-3	13.5	8.5	13.5	9.5	9	8	9.8
AIW-4	16.1	11.1	16.1	16.1	16.1	16.1	16.1
AIW-5	19	14	19	19	19	19	19
AIW-6	17.4	12.4	17.4	17.4	17.4	17.4	17.4
AIW-7	16	11	16	16	16	15.8	16

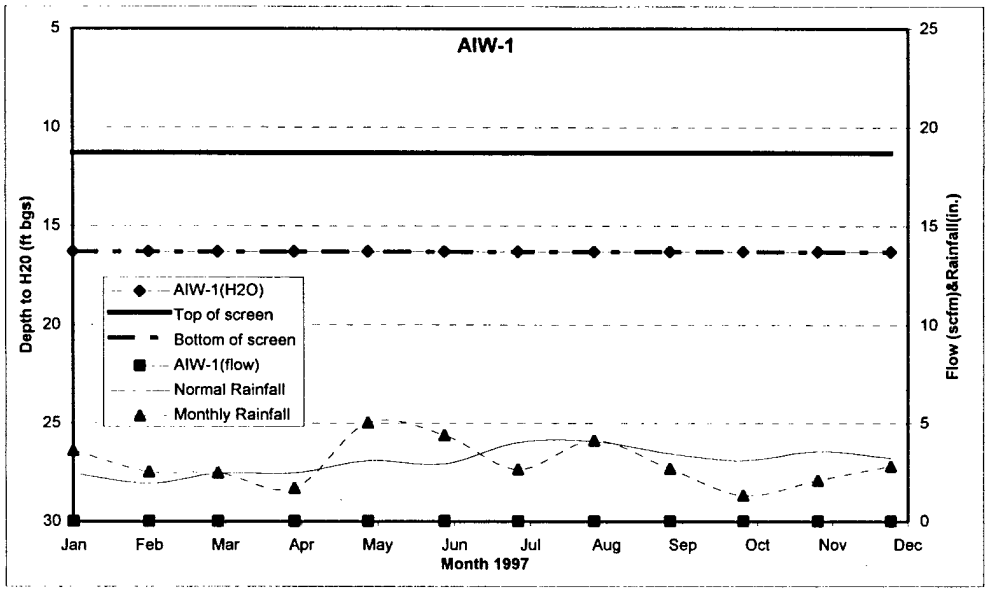
Boxed value indicates groundwater depth is at or above the top of screen.

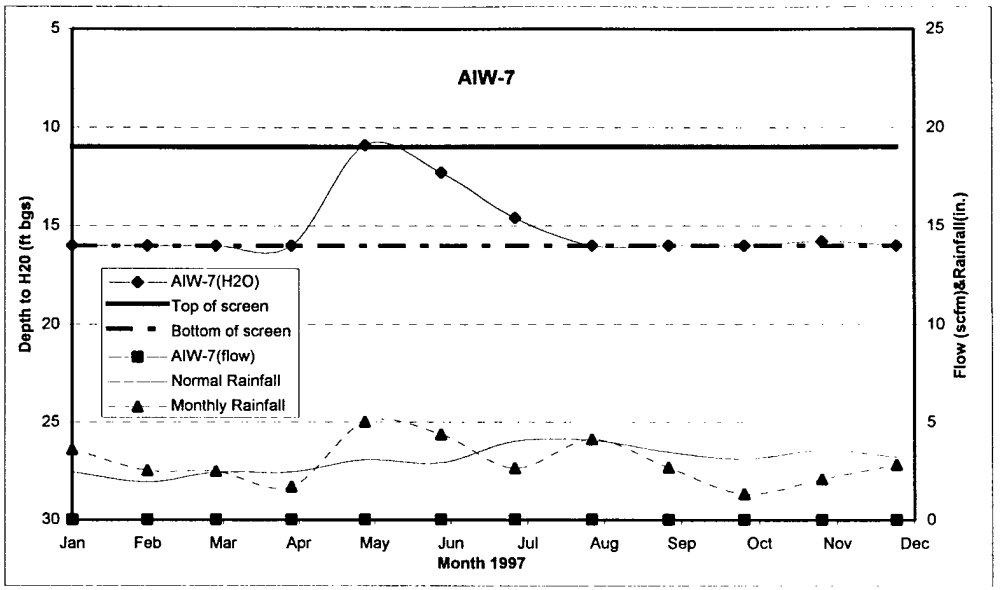
Groundwater Levels along West / East Transect at Entomology Shop

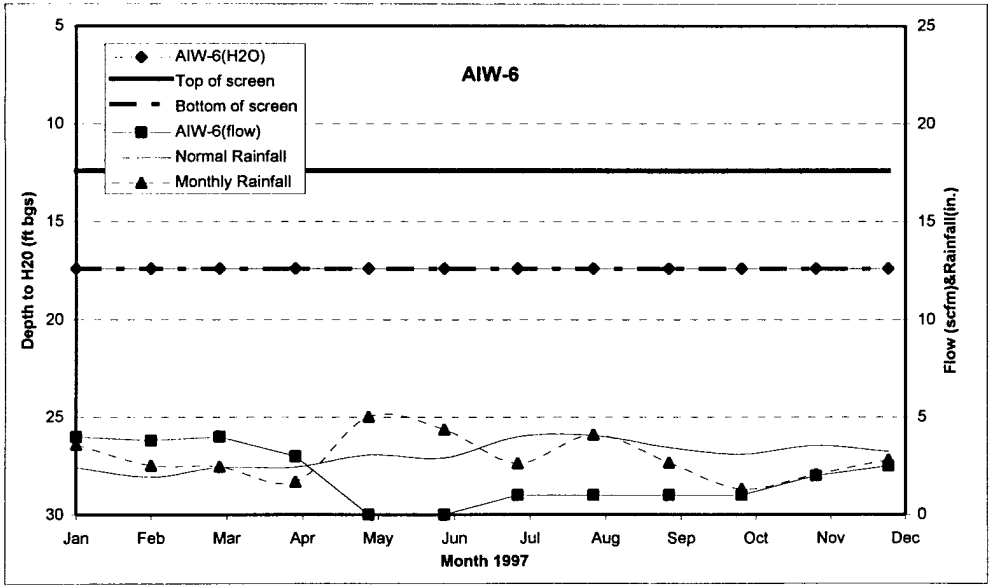
Well No.	Elevation at top of casing (ft amsl)	Elevation of ground surface	Elevation of water - AUG. (ft amsl)	Elevation of water - OCT. (ft amsl)	Elevation of water - DEC. (ft amsl)	Depth to top of screen (ft)	Elevation to TOS (ft amsl)	Depth to bottom of screen (ft)	Elevation to BOS (ft amsl)
AIW-1	713.5	712.3	697.2	697.2	697.2	11.3	702.2	16.3	697.2
AIW-6	714.8	713.7	697.4	697.4	697.4	12.4	702.4	17.4	697.4
AIW-7	715.3	714.0	699.3	699.3	699.3	11	704.3	16.0	699.3
AIW-3	715.5	714.3	702.0	706.5	705.7	8.5	707.0	13.5	702.0

West / East Cross Section at Entomology Shop









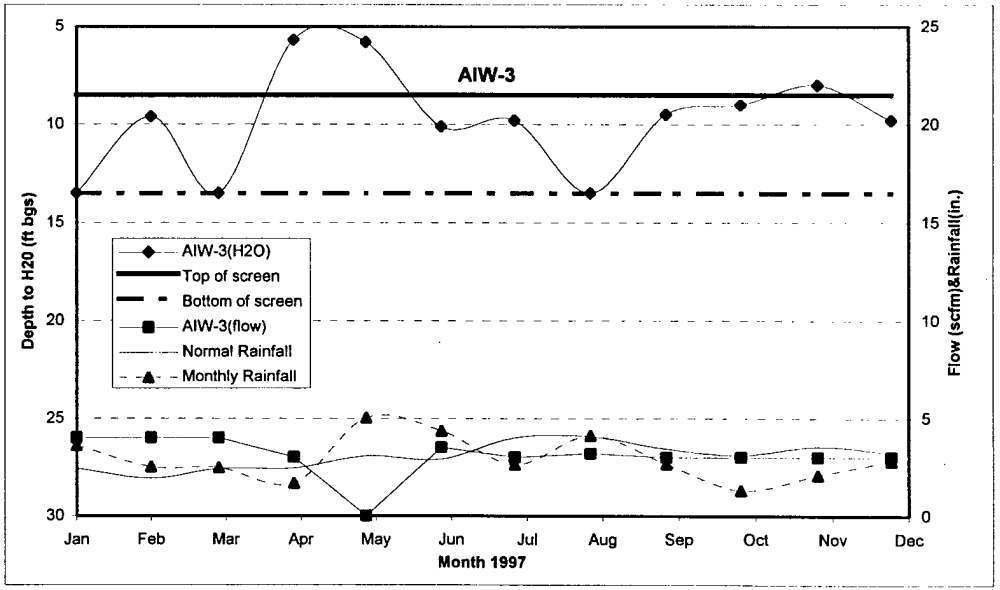


Figure 6-2 ES Groundwater/Air Flow Relations Along West/East Section

7.0 FORMER JET ENGINE TEST CELL

7.1 OPERATIONS

The FJETC, located in OU 5, consists of 13 AIWs and 8 MPs (Figure 7-1). BEI installed FJETC biovent system in the fall of 1995; MP-8, containing an oxygen sensor, was added to the system in July 1997. This oxygen sensor was added to the north-central portion of the site because of the lack of monitoring data in this area (as a result of inundated MPs) and the presence of fuel in nearby MP-1. Since BEI assumed responsibility for O&M, this biovent system has operated 522 days through December 31, 1997. The system was down during portions of the summer and early fall 1996 due to high groundwater levels and in May 1997 due to a malfunction of the high water level switch in the desiccant tank. During June and July 1997, most of the AIWs did not accept flow or were shut down due to high groundwater levels. Between August and December 1997, most of the AIWs accepted air at or near the design rate (Table 7-1). Table 7-2 illustrates August, October, and December water levels along two transects that are shown on Figure 7-1. Figures 7-2 and 7-3 present monthly groundwater levels and flow rates for each AIW located along the two transects.

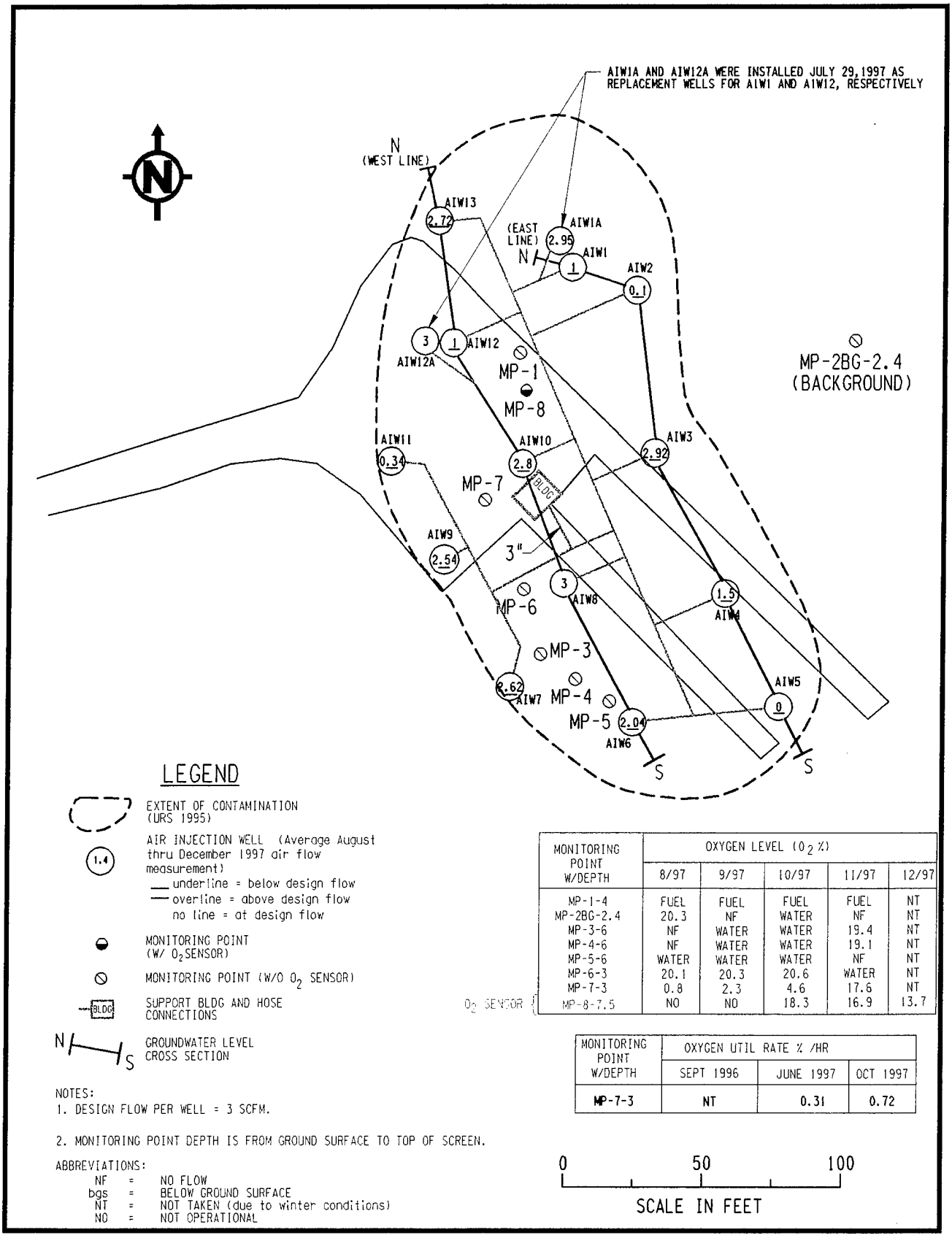
As observed in early summer of 1996 and July 1997, fuel was again encountered in MP-1-4 from August through November (sampling not performed in December). High water levels limited the collection of soil gas samples from MP-5 throughout the reporting period. MP-6 and MP-7 produced soil gas samples during the majority of the reporting period. A respiration test was performed at MP-7 in October as illustrated in Figure A-6.

7.2 CONCLUSIONS AND RECOMMENDATIONS

Two new replacement AIWs were drilled and installed (AIW-1A and AIW-12A) at the end of July 1997 (see Figure 7-1) to increase air flow in the northern end of FJETC. The two new AIWs have worked well since their startup in November. The new oxygen sensor (MP-8) in the south-central portion of the site contained oxygen levels as low as 16.9 percent, which may indicate that biodegradation is still in process. Contamination was identified in samples collected from the MP-8 boring (headspace results ranged from 156 to 294 ppm total volatiles).

Water levels in the center of the site (see Table 7-2) were elevated during much of the reporting period, which greatly reduced the amount of soil that could be treated. Treatment of shallow soils may be complete, assuming that MP-6-3 is representative of this zone. A respiration test at MP-7-3 has again produced a relatively high value for oxygen utilization (0.72 percent/hour; see Figure A-6); this rate is similar to that of a year ago. This unchanged rate along with a high TVH readings in MP-7-3 may support the possibility that a significantly contaminated source (i.e., fuel in free phase) may exist below the MP.

Overall Recommendation for FJETC: It is recommended that the system be allowed to run into the 1998 season since contamination is still believed to exist in the soils. Collect soil samples throughout FJETC beginning in late June 1998. Utilize the confirmation borings for monitoring purposes. In addition, perform respiration tests at all MPs that produce air samples. This information will be used to determine whether to continue or propose an alternative cleanup method (i.e., excavation or bioslurping).



MONITORING POINT W/DEPTH	OXYGEN LEVEL (O_2 %)				
	8/97	9/97	10/97	11/97	12/97
MP-1-4	FUEL	FUEL	FUEL	FUEL	NT
MP-2BG-2.4	20.3	NF	WATER	NF	NT
MP-3-6	NF	WATER	WATER	19.4	NT
MP-4-6	NF	WATER	WATER	19.1	NT
MP-5-6	WATER	WATER	WATER	NF	NT
MP-6-3	20.1	20.3	20.6	WATER	NT
MP-7-3	0.8	2.3	4.6	17.6	NT
MP-8-7.5	NO	NO	18.3	16.9	13.7

MONITORING POINT W/DEPTH	OXYGEN UTIL RATE % /HR		
	SEPT 1996	JUNE 1997	OCT 1997
MP-7-3	NT	0.31	0.72

NOTES:
1. DESIGN FLOW PER WELL = 3 SCFM.

2. MONITORING POINT DEPTH IS FROM GROUND SURFACE TO TOP OF SCREEN.

ABBREVIATIONS:
NF = NO FLOW
bgs = BELOW GROUND SURFACE
NT = NOT TAKEN (due to winter conditions)
NO = NOT OPERATIONAL

22784/043/FIG3-11.DGN

Figure 7-1
FJETC Biovent System Layout and Average Wellhead Flow

Table 7 - 1 FJETC Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval ft/bgs top	bottom	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) August 1997	September 1997	October 1997	November 1997	12/97	Average Aug - Dec
AIW-1	7.8	12.8	5.4	3	0	0	3	abandon	abandon	1
AIW-1A	4.8	15.2	3.3	3	offline	offline	offline	2.9	3	2.95
AIW-2	7.9	12.8	5.5	3	0	0	0	0	0.5	0.1
AIW-3	6.9	11.8	4.8	3	3	3	3	2.6	3	2.92
AIW-4	2	6	1.4	3	off	2	2	1	1	1.5
AIW-5	6.9	11.8	4.8	3	0	0	0	0	0	0
AIW-6	6.8	11.8	4.7	3	1.3	2.2	2.6	2	2.1	2.04
AIW-7	7.9	12.8	5.5	3	1.2	3	3	2.9	3	2.62
AIW-8	2	7	1.4	3	3	3	3	3	3	3
AIW-9	8.9	13.8	6.2	3	1.2	3	3	2.5	3	2.54
AIW-10	2	8.5	1.4	3	3	3	3	2	3	2.8
AIW-11	7.8	12.8	5.4	3	0	0	0	0.5	1.2	0.34
AIW-12	8.9	13.8	6.2	3	0	0	3	abandon	abandon	1
AIW-12A	4.6	15	3.2	3	offline	offline	offline	3	3	3
AIW-13	7.8	12.8	5.4	3	2.1	2.6	3	2.9	3	2.72
Total air flow:				39	14.8	21.8	28.6	25.3	28.8	
Pressure (psi):					2.6	3.2	3.6	3.8	3.4	

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results August 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	September 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	October 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	November 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	December 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)
MP-1-4	4	4.5			Fuel in MP			Fuel in MP			Fuel in MP			Fuel in MP			No Soil Gas	
MP-2BG-2.4	2.4	8	Background location	20.3	0.6	64		No flow			Water			No flow			Samples Collected	
MP-3-6	6	6.5			No flow			Water			Water		19.4	0.9	8062		due to Winter Conditions	
MP-4-6	6	6.5			No flow			Water			Water		19.1	1.2	2.18%			
MP-5-6	6	6.5			Water			Water			Water			No flow				
MP-6-3	3	3.5		20.1	0.4	115	20.3	0.2	9	20.6	0.0	2.4		Water				
MP-7-3	3	3.5	O_2 Util. Rate = 0.72%/hr[3]	0.8	15.3	680	2.3	14.4	nr	4.6	11.2	nr	17.6	2.7	0			
MP-8-7.5	7.5	8	O_2 sensor	no			no			18.3	na	na	16.9	na	na	13.7	na	na

[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] The monthly O_2 sensor results is the average for month. See biovent monthly reports for daily values.
[3] Test performed on 10/3/97.
nr = no reading, bgs = below ground surface, no = not operational.

Table 7-2 FJETC Groundwater Level Data

Former Jet Engine Test Cell Groundwater Levels from August through December 1997

Well No.	Well Depth below TOC	Top of Screen below TOC	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97
AIW-1	15.1	9.9	13.9	14	14.9	15.5	14.8
AIW-2	15.0	9.9	14	14	9.8	14	14
AIW-3	13.8	8.7	9	13	9.5	8.4	8.6
AIW-4	8.0	4.0	4.5	7	3.9	2.8	3.9
AIW-5	13.8	8.7	13	13	13	13	13
AIW-6	14.1	8.9	13	13	13	13	13
AIW-7	15.0	9.9	14	14	14	14	14
AIW-8	8.6	3.6	5.6	5.2	5	9.5	5.1
AIW-9	15.8	10.7	15	15	15	15	15
AIW-10	10.3	3.8	7	9.5	6.5	5.2	6.4
AIW-11	14.8	9.6	12.9	14	14	14	14
AIW-12	15.8	10.7	14.6	15	9.9	7.3	9.7
AIW-13	15.0	9.8	14	14	14	14	14

Boxed value: indicates water level is at or above the top of the screen.

Groundwater Levels along North / South (Westline) Transect at FJETC

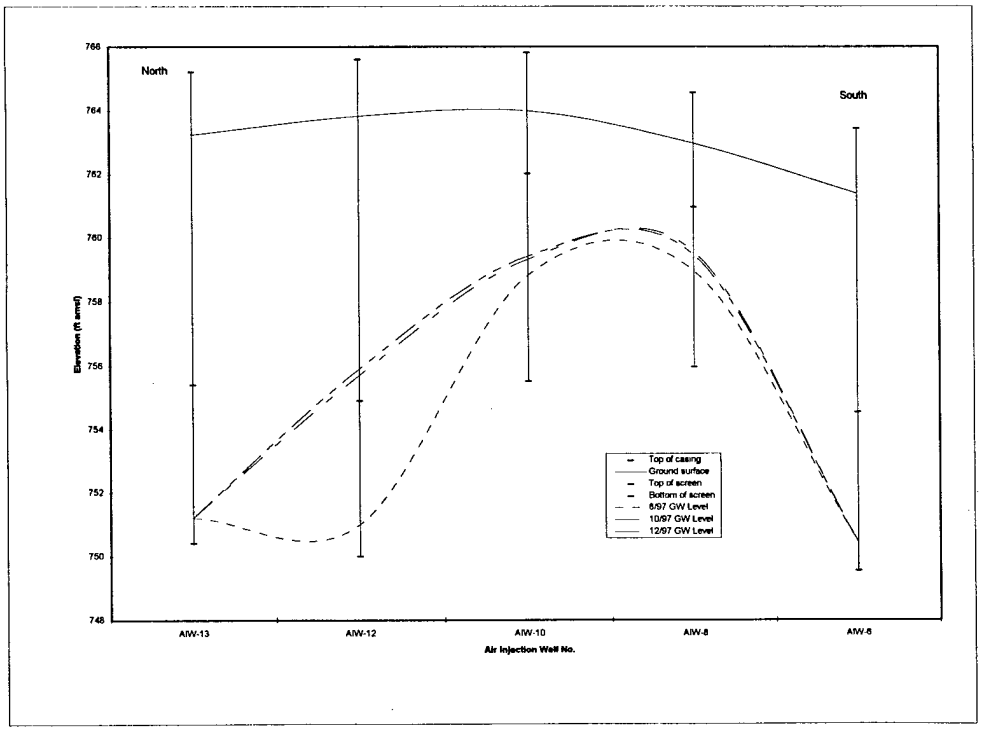
Well No.	Elevation at top of casing (ft amsl)	Elevation of ground (ft amsl)	Elevation of water - AUG. (ft amsl)	Elevation of water - OCT. (ft amsl)	Elevation of water - DEC. (ft amsl)	Depth to top of screen (ft)	Elevation to TOS (ft amsl)	Depth to bottom of screen (ft)	Elevation to BOS (ft amsl)
AIW-13	765.21	763.23	751.21	751.21	751.21	9.8	755.41	14.8	750.41
AIW-12	765.60	763.82	751.00	755.7	755.9	10.7	754.9	15.6	750
AIW-10	765.82	763.99	758.82	759.32	759.42	3.8	762.02	10.3	755.52
AIW-8	764.56	762.96	758.96	759.56	759.46	3.6	760.96	8.6	755.96
AIW-6	763.43	761.38	750.43	750.43	750.43	8.9	754.53	13.9	749.53

Groundwater Levels along North / South (Eastline) Transect at FJETC

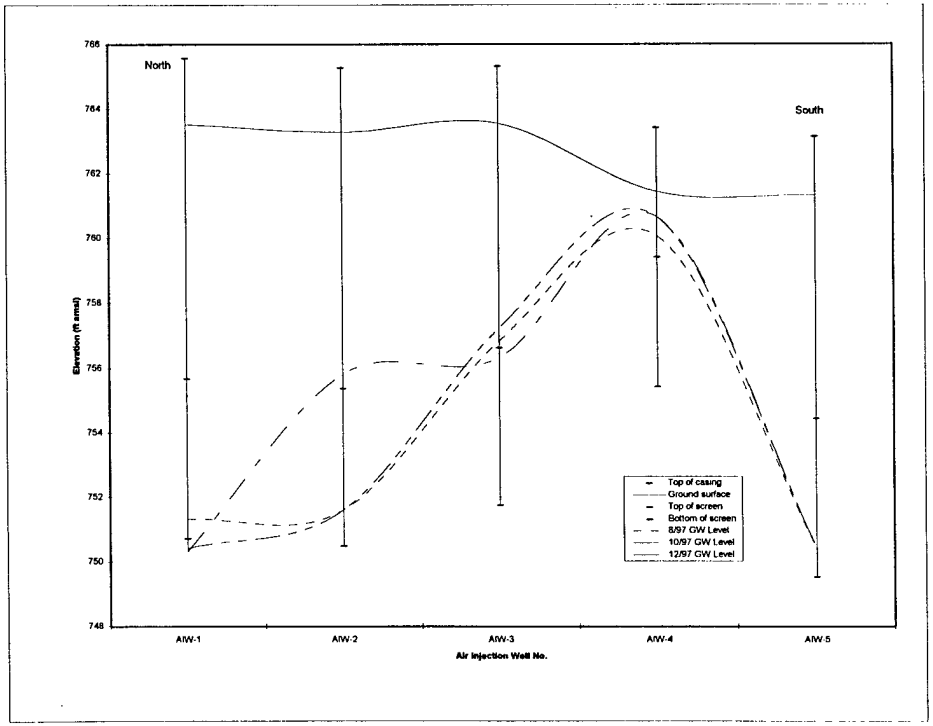
Well No.	Elevation at top of casing (ft amsl)	Elevation of ground (ft amsl)	Elevation of water - AUG. (ft amsl)	Elevation of water - OCT. (ft amsl)	Elevation of water - DEC. (ft amsl)	Depth to top of screen (ft)	Elevation to TOS (ft amsl)	Depth to bottom of screen (ft)	Elevation to BOS (ft amsl)
AIW-1	765.57	763.52	751.31	750.31	750.41	9.9	755.673	14.9	750.719
AIW-2	765.27	763.28	751.6	755.8	751.6	9.9	755.372	14.8	750.479
AIW-3	765.32	763.55	756.82	756.32	757.22	8.7	756.622	13.6	751.747
AIW-4	763.42	761.43	760.06	760.66	760.66	4	759.42	8.0	755.429
AIW-5	763.14	761.32	750.43	750.43	750.43	8.7	754.44	13.6	749.523

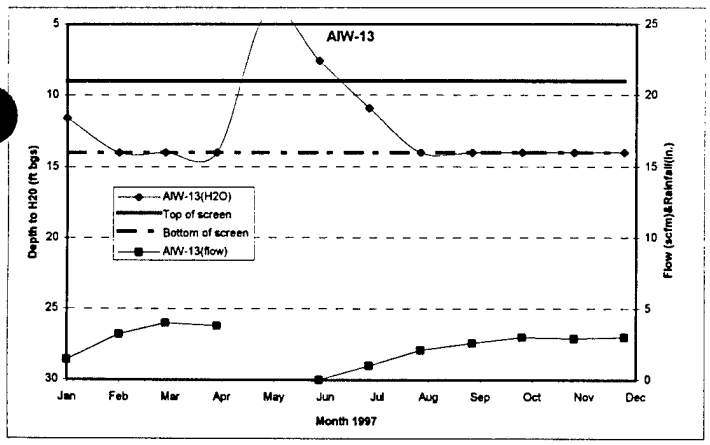
Boxed value: indicates water level is at or above the top of the screen.

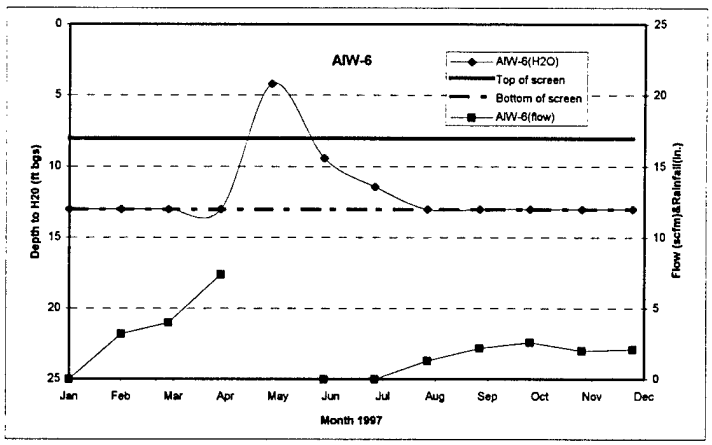
North / South Cross Section at FJETC - Westline

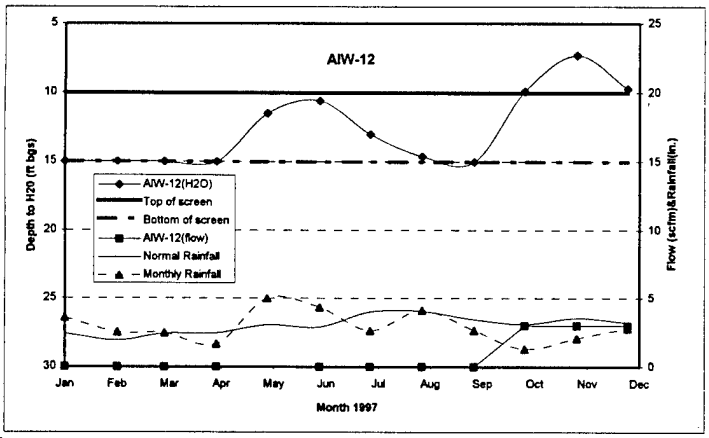


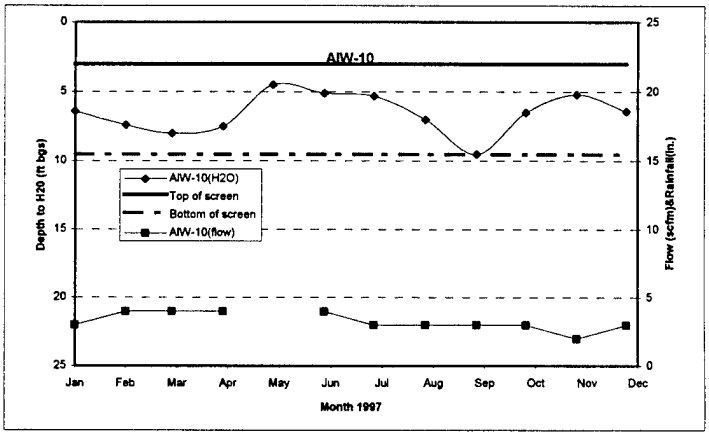
North / South Cross Section at FJETC - Eastline











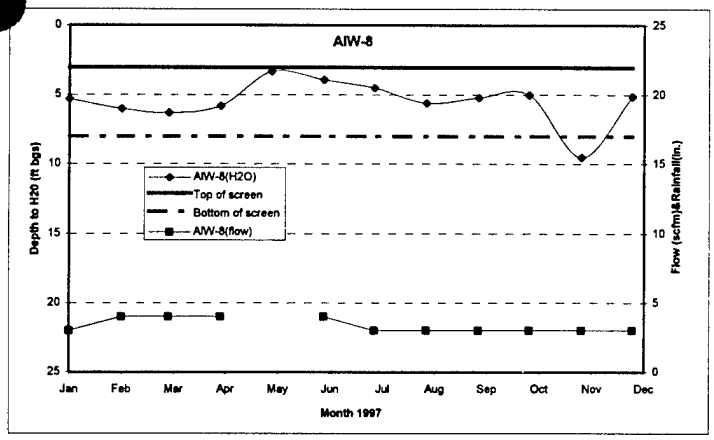
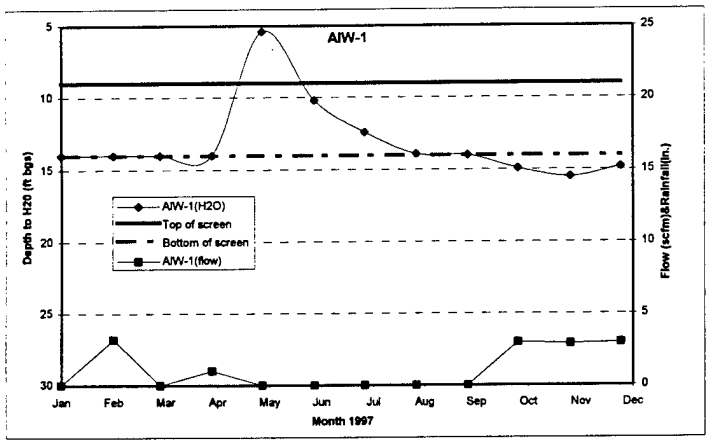
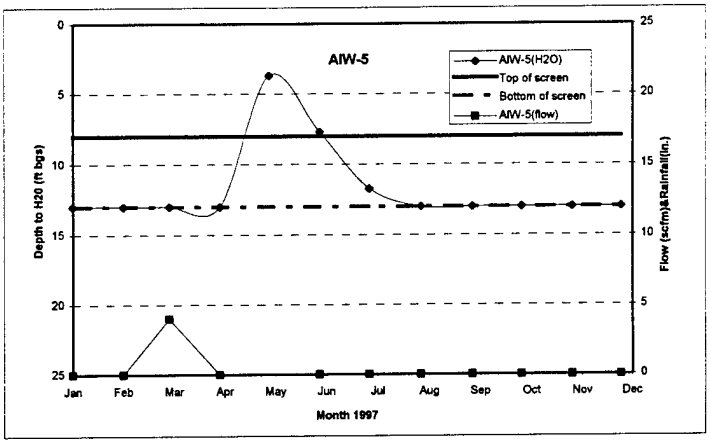
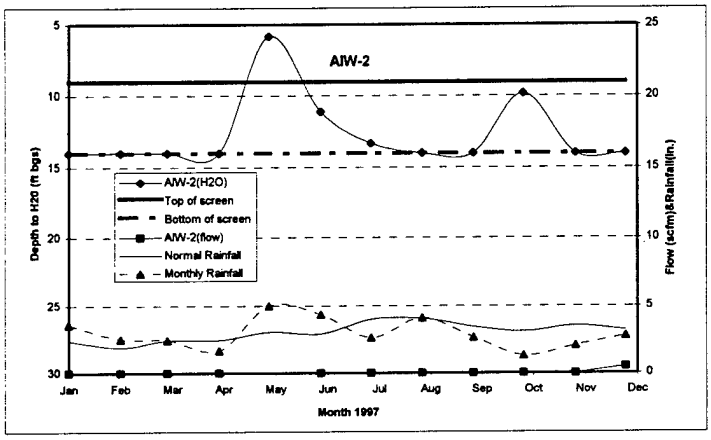
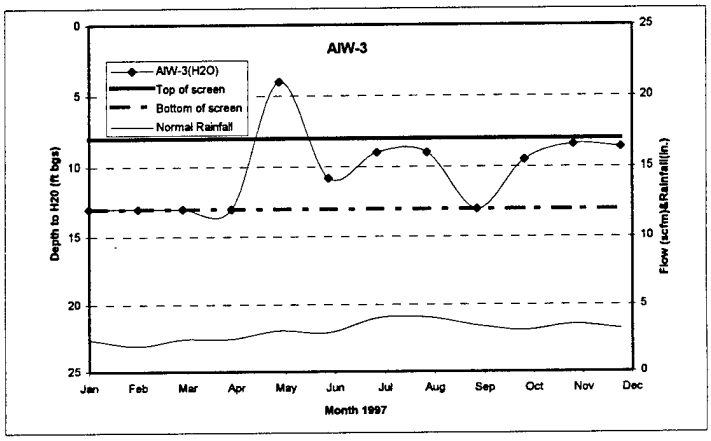


Figure 7-2 FJETC Groundwater/Air Flow Relations Along North/South Section (Westline)









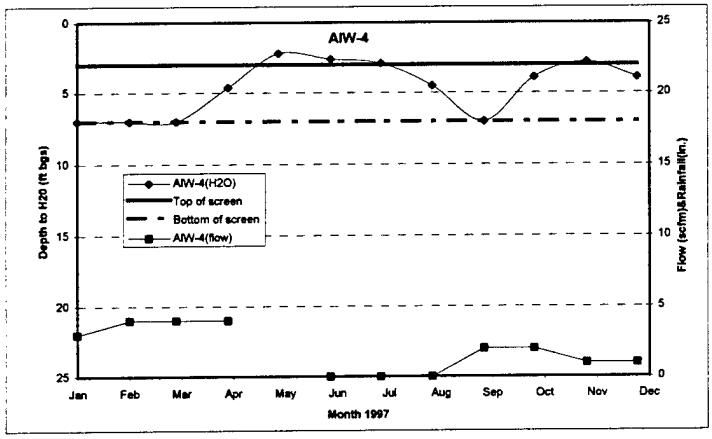


Figure 7-3 FJETC Groundwater/Air Flow Relations Along North/South Section (Eastline)

8.0 FIRE TRAINING AREA

8.1 OPERATIONS

The FTA, located in OU 8, consists of 16 AIWs and 38 MPs (Figure 8-1). BEI installed the FTA biovent system in the fall of 1995. Since BEI assumed responsibility for the bioventing O&M, the system had operated 648 days through December 31, 1997. The only oxygen sensor (MP-16) was installed in July 1997, as shown in Figure 8-1. Minor interruptions for respiration testing and general maintenance have occurred since startup. Several power outages have also occurred at this site, resulting in brief shutdowns.

Injection flows are typically held at or slightly above the design flow rate of 3 scfm in each AIW. AIW-2 has not accepted injected air since system startup. AIW-12 began accepting air during this reporting period, but at a very low rate of 0.5 to 1 scfm (design flow is 3 scfm). AIW-14 and AIW-16 are the only other AIWs with low flow. AIWs-12, -14, and -16 are all located in the southern end around the former fire pit; this area is also where most of the inundated MPs exist. The overall system injection pressure was held constant between 3.1 and 3.3 psi (Table 8-1) throughout the reporting period.

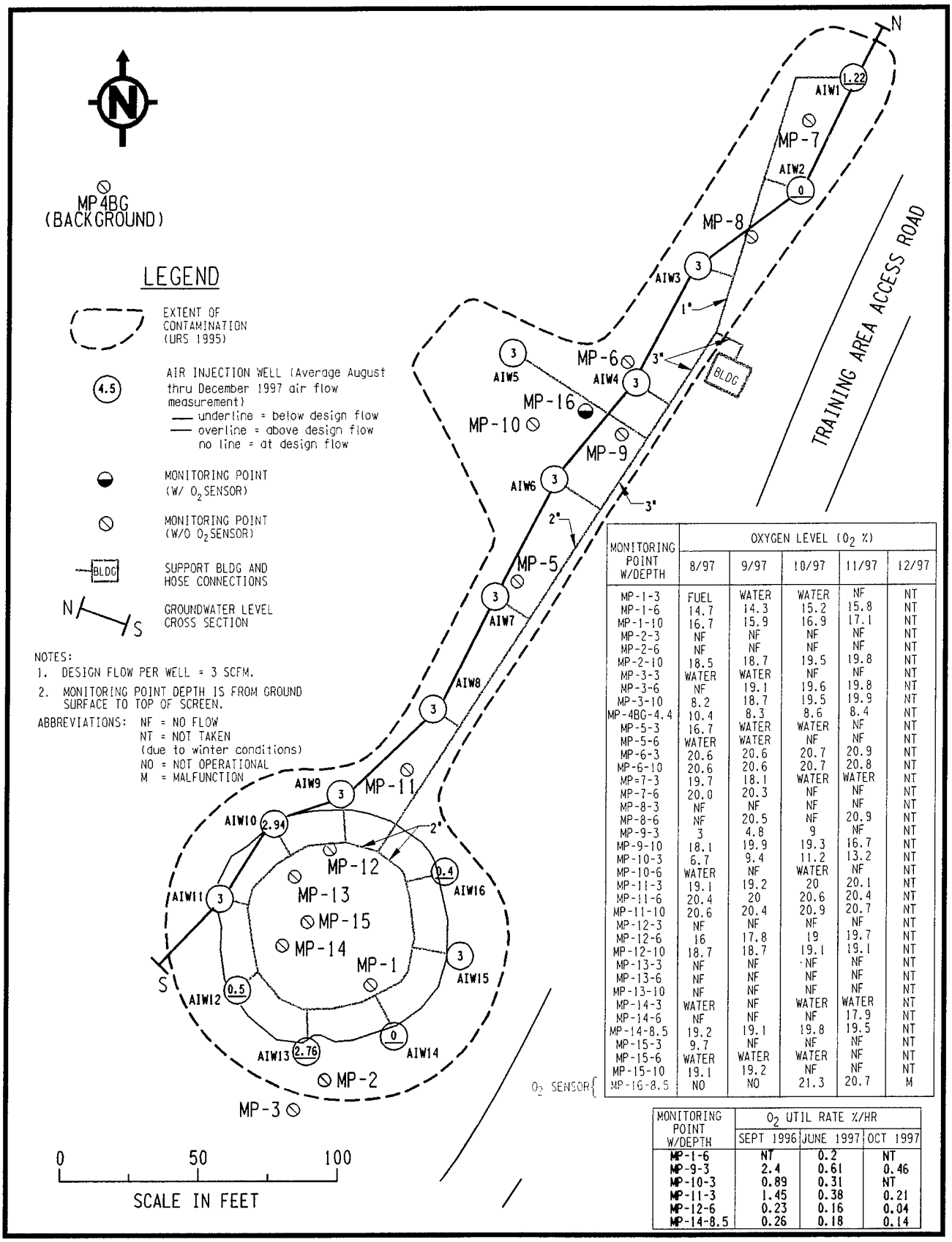
8.2 CONCLUSIONS AND RECOMMENDATIONS

Approximately 40 to 50 percent of the FTA MPs do not produce soil gas samples, although most of the AIWs allow air injection at design rates. Unexpectedly, most of the MPs that have no flow or saturated conditions are the 3- and 6-ft top of screen depths, not the deeper 8.5- and 10-ft depths (see Table 8-1). A perched clay/silt lens may be intersecting the shallow MPs. Table 8-2 presents groundwater levels in AIWs and a cross-sectional view of the generalized water table. It is clear that groundwater levels are not a problem at this site. On average, none of the AIWs had water greater than 1 ft above the bottom of the 5- and 6-ft screens. Figure 8-2 presents the groundwater levels and air flows per AIW along the north-south cross section on Figure 8-1. The average and normal monthly rainfall curve has been added to the first two AIW graphs for comparison to groundwater levels.

Four respiration tests were run in October; the pretest oxygen level ranged from 7.5 to 17.8 percent (Figures A-7 and A-8). Pretest oxygen levels are those measured after the system has been shut down for a minimum of 24 hours before helium and air are injected. All four oxygen utilization rates showed a slight decline, indicating that biodegradation is still occurring but at a slower rate (see Table 3-1 or Figure 8-1). This may be attributed to a depletion in the carbon source (i.e., fuel contaminants).

Overall Recommendation for FTA: No changes to the system are recommended; in general, the system appears to be working well. Comparison of the fall 1997 oxygen utilization rates with the previous reports shows that biodegradation is still occurring. Although there is a constant

decline in oxygen utilization rates, it is not clear when background rates will be obtained. Suggest collecting soil samples in June 1998 for evaluation in the next semiannual report. Delineation of contaminated soils should be made by mid-summer 1998. Any soils that remain above PRGs should be evaluated for another remedial alternative (i.e., excavation and disposal in LF-3).



MONITORING POINT W/DEPTH	OXYGEN LEVEL (O_2 %) 8/97	9/97	10/97	11/97	12/97
MP-1-3	FUEL	WATER	WATER	NF	NT
MP-1-6	14.7	14.3	15.2	15.8	NT
MP-1-10	16.7	15.9	16.9	17.1	NT
MP-2-3	NF	NF	NF	NF	NT
MP-2-6	NF	NF	NF	NF	NT
MP-2-10	18.5	18.7	19.5	19.8	NT
MP-3-3	WATER	WATER	NF	NF	NT
MP-3-6	NF	19.1	19.6	19.8	NT
MP-3-10	8.2	18.7	19.5	19.9	NT
MP-4BG-4.4	10.4	8.3	8.6	8.4	NT
MP-5-3	16.7	WATER	WATER	NF	NT
MP-5-6	WATER	WATER	NF	NF	NT
MP-6-3	20.6	20.6	20.7	20.9	NT
MP-6-10	20.6	20.6	20.7	20.8	NT
MP-7-3	19.7	18.1	WATER	WATER	NT
MP-7-6	20.0	20.3	NF	NF	NT
MP-8-3	NF	NF	NF	NF	NT
MP-8-6	NF	20.5	NF	20.9	NT
MP-9-3	3	4.8	9	NF	NT
MP-9-10	18.1	19.9	19.3	16.7	NT
MP-10-3	6.7	9.4	11.2	13.2	NT
MP-10-6	WATER	NF	WATER	NF	NT
MP-11-3	19.1	19.2	20	20.1	NT
MP-11-6	20.4	20	20.6	20.4	NT
MP-11-10	20.6	20.4	20.9	20.7	NT
MP-12-3	NF	NF	NF	NF	NT
MP-12-6	16	17.8	19	19.7	NT
MP-12-10	18.7	18.7	19.1	19.1	NT
MP-13-3	NF	NF	NF	NF	NT
MP-13-6	NF	NF	NF	NF	NT
MP-13-10	NF	NF	NF	NF	NT
MP-14-3	WATER	NF	WATER	WATER	NT
MP-14-6	NF	NF	NF	17.9	NT
MP-14-8.5	19.2	19.1	19.8	19.5	NT
MP-15-3	9.7	NF	NF	NF	NT
MP-15-6	WATER	WATER	WATER	NF	NT
MP-15-10	19.1	19.2	NF	NF	NT
MP-16-8.5	NO	NO	21.3	20.7	M

MONITORING POINT W/DEPTH	O_2 UTIL RATE %/HR SEPT 1996	JUNE 1997	OCT 1997
MP-1-6	NT	0.2	NT
MP-9-3	2.4	0.61	0.46
MP-10-3	0.89	0.31	NT
MP-11-3	1.45	0.38	0.21
MP-12-6	0.23	0.16	0.04
MP-14-8.5	0.26	0.18	0.14

22784/043/FIG3-12.DGN

Figure 8-1
FTA Biovent System Layout and Average Wellhead Flow

Table 8 - 1 FTA Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval ft/bgs top	bottom	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) August 1997	September 1997	October 1997	November 1997	12/97	Average Aug - Dec
AIW-1	6.9	11.8	4.8	3	1.4	1.7	2	0	1	1.22
AIW-2	6.4	11.3	4.4	3	0	0	0	0	0	0
AIW-3	6.9	11.8	4.8	3	3	3	3	3	3	3
AIW-4	6.1	11.1	4.2	3	3	3	3	3	3	3
AIW-5	7.4	12.3	5.1	3	3	3	3	3	3	3
AIW-6	7.2	12.1	5.0	3	3	3	3	3	3	3
AIW-7	6.4	11.3	4.4	3	3	3	3	3	3	3
AIW-8	6.9	11.8	4.8	3	3	3	3	3	3	3
AIW-9	4.1	9	2.8	3	3	3	3	3	3	3
AIW-10	4.9	9.8	3.4	3	2.7	3	3	3	3	2.94
AIW-11	3.9	8.8	2.7	3	3	3	3	3	3	3
AIW-12	4.6	9.5	3.2	3	0.5	0	0	1	1	0.5
AIW-13	2.8	8.8	1.9	3	2	3	2.8	3	3	2.76
AIW-14	4.4	9.3	3.1	3	0	0	0	0	0	0
AIW-15	7.4	12.3	5.1	3	3	3	3	3	3	3
AIW-16	4.9	9.8	3.4	3	0	0	0	1	1	0.4
Total air flow:				48	33.6	35.0	34.8	35.0	36.0	
Pressure (psi):					3.3	3.3	3.3	3.1	3.1	

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results August 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	September 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	October 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	November 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	December 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)
MP-1-3	3	3.5			Fuel in MP			Water			Water			No flow			No Soil Gas	
MP-1-6	6	6.5		14.7	5.5	313	14.3	6.0	1239	15.2	5.2	702	15.8	4.0	616		Samples Collected	
MP-1-10	10	10.5		16.7	3.8	211	15.9	4.1	835	16.9	3.1	595	17.1	2.4	680		due to Winter Conditions	
MP-2-3	3	3.5			No flow			No flow			No flow			No flow				
MP-2-6	6	6.5			No flow			No flow			No flow			No flow				
MP-2-10	10	10.5		18.5	1.7	156	18.7	1.4	336	19.5	1.1	1306	19.8	0.6	130			
MP-3-3	3	3.5			Water			Water			No flow			No flow				
MP-3-6	6	6.5			No flow		19.1	2.3	24.4	19.6	1.7	321	19.8	1.1	20			
MP-3-10	10	10.5		8.2	1.8	130	18.7	1.8	162	19.5	1.2	239	19.9	0.8	122			
MP-4BG-4.4	4.4	10	Background location	10.4	2.5	34	8.3	3.3	nr	8.6	3.0	nr	8.4	3.1	nr			
MP-5-3	3	3.5		16.7	5.6	143		Water			Water			No flow				
MP-5-6	6	6.5			Water			Water			No flow			No flow				
MP-6-3	3	3.5		20.6	0.0	22	20.6	0.0	1.7	20.7	0.0	43.8	20.9	0.0	5.1			
MP-6-10	10	10.5		20.6	0.2	15	20.6	0.3	0.9	20.7	0.1	29	20.8	0.0	15.1			
MP-7-3	3	3.5		19.7	1.5	14	18.1	2.0	2.8		Water			Water				
MP-7-6	6	6.5		20.0	1.2	27	20.3	0.8	10.6		No flow			No flow				
MP-8-3	3	3.5			No flow			No flow			No flow			No flow				
MP-8-6	6	6.5			No flow		20.5	0.2	7.4		No flow		20.9	0.0	14.6			
MP-9-3	3	3.5	O_2 Util. Rate = 0.46%/hr[3]	3.0	16.2	289	4.8	14.6	nr	9.0	11.4	nr		No flow				
MP-9-10	10	10.5		18.1	2.0	210	19.9	0.9	300	19.3	1.5	444	16.7	3.6	2407			
MP-10-3	3	3.5		6.7	13.8	77	9.4	11.8	nr	11.2	8.7	nr	13.2	6.1	160			
MP-10-6	6	6.5			Water			No flow			Water			No flow				
MP-11-3	3	3.5	O_2 Util. Rate = 0.21%/hr[3]	19.1	1.2	42	19.2	1.2	97	20.0	0.7	103	20.1	0.5	18.9			
MP-11-6	6	6.5		20.4	0.2	45	20.0	0.4	5	20.6	0.3	0	20.4	0.3	0			
MP-11-10	10	10.5		20.6	0.0	30	20.4	0.1	3.2	20.9	0.0	0	20.7	0.0	0.2			
MP-12-3	3	3.5			No flow			No flow			No flow			No flow				
MP-12-6	6	6.5	O_2 Util. Rate = 0.04%/hr[3]	16.0	4.3	58	17.8	2.5	9	19.0	1.7	0	19.7	0.9	0			
MP-12-10	8.5	9		18.7	1.8	51	18.7	1.9	9.3	19.1	1.8	0	19.1	1.4	0			
MP-13-3	3	3.5			No flow			No flow			No flow			No flow				
MP-13-6	6	6.5			No flow			No flow			No flow			No flow				
MP-13-10	7	7.5			No flow			No flow			No flow			No flow				
MP-14-3	3	3.5			Water			No flow			Water			Water				
MP-14-6	6	6.5			No flow			No flow			No flow		17.9	1.9	239			
MP-14-8.5	8.5	9	O_2 Util. Rate = 0.14%/hr[3]	19.2	1.1	111	19.1	1.1	104	19.8	0.8	40.8	19.5	0.7	38.3			
MP-15-3	3	3.5		9.7	12.0	521		No flow			No flow			No flow				
MP-15-6	6	6.5			Water			Water			Water			No flow				
MP-15-10	9	9.5		19.1	1.3	185	19.2	1.2	225		No flow			No flow				
MP-16-8.5	8.5	9	O_2 sensor							21.3	na	na	20.7	na	na	malf	na	na

[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] The monthly O_2 sensor results is the average for month. See biovent monthly reports for daily values.
[3] Test performed on 10/3/97.
malf = malfunctioned, no data, nr = no reading.

Table 8-2 FTA Groundwater Level Data

Fire Training Area Groundwater Levels from August through December 1997

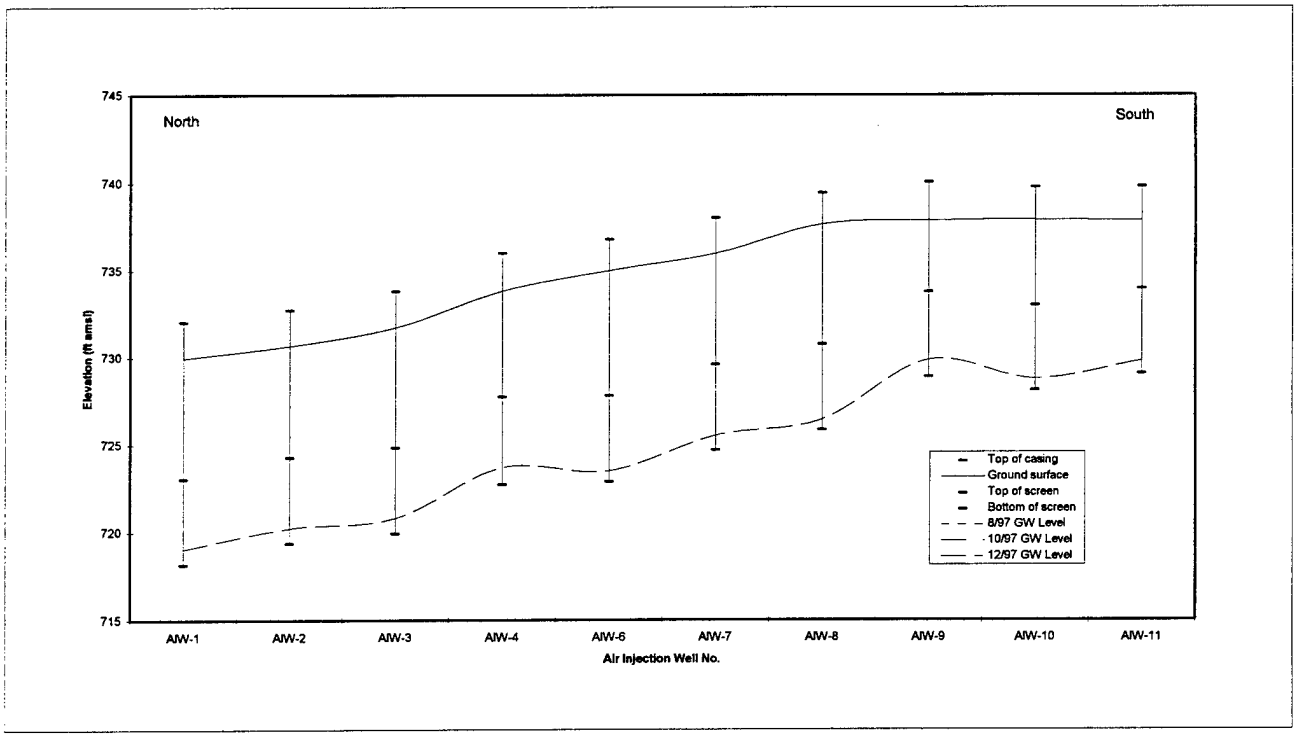
Well No.	Well Depth below TOC	Top of Screen below TOC	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97
AIW-1	14.1	9.0	13	13	13	13	13
AIW-2	13.6	8.5	12.5	12.5	12.5	12.5	12.5
AIW-3	14.1	9.0	13	13	13	13	13
AIW-4	13.5	8.3	12.3	12.3	12.3	12.3	12.3
AIW-5	14.2	9.1	13.5	13.5	13.5	13.5	13.5
AIW-6	14.1	9.0	13.3	13.3	13.3	13.3	13.3
AIW-7	13.5	8.4	12.5	12.5	12.5	12.5	12.5
AIW-8	13.8	8.7	13	13	13	13	13
AIW-9	11.4	6.3	10.2	10.2	10.2	10.2	10.2
AIW-10	11.9	6.8	11	11	11	11	11
AIW-11	10.9	5.8	10	10	10	10	10
AIW-12	11.5	6.4	10.7	10.7	10.7	10.7	10.7
AIW-13	10.6	4.4	9.5	10	10	10	10
AIW-14	11.4	6.3	10.5	10.5	10.5	10.5	10.5
AIW-15	14.3	9.2	13.5	13.5	13.5	13.5	13.5
AIW-16	12.0	6.9	11	11	11	11	11

Boxed value: indicates water level is at or above the top of the screen.

Groundwater Levels along North / South Transect at Fire Training Area

Well No.	Elevation at top of casing (ft amsl)	Elevation of ground surface	Elevation of water - AUG. (ft amsl)	Elevation of water - OCT. (ft amsl)	Elevation of water - DEC. (ft amsl)	Depth to top of screen (ft)	Elevation to TOS (ft amsl)	Depth to bottom of screen (ft)	Elevation to BOS (ft amsl)
AIW-1	732.05	729.96	719.05	719.05	719.05	9.0	723.06	13.9	718.16
AIW-2	732.75	730.69	720.25	720.25	720.25	8.5	724.29	13.4	719.39
AIW-3	733.83	731.75	720.83	720.83	720.83	9.0	724.85	13.9	719.95
AIW-4	736.02	733.85	723.72	723.72	723.72	8.3	727.75	13.3	722.75
AIW-6	736.82	735.02	723.52	723.52	723.52	9.0	727.82	13.9	722.92
AIW-7	738.04	736.01	725.54	725.54	725.54	8.4	729.61	13.3	724.71
AIW-8	739.45	737.67	726.45	726.45	726.45	8.7	730.77	13.6	725.87
AIW-9	740.07	737.90	729.87	729.87	729.87	6.3	733.80	11.2	728.90
AIW-10	739.79	737.93	728.79	728.79	728.79	6.8	733.03	11.7	728.13
AIW-11	739.82	737.88	729.82	729.82	729.82	5.8	733.98	10.7	729.08

North / South Cross Section at Fire Training Area



XSCT_F97.XLS

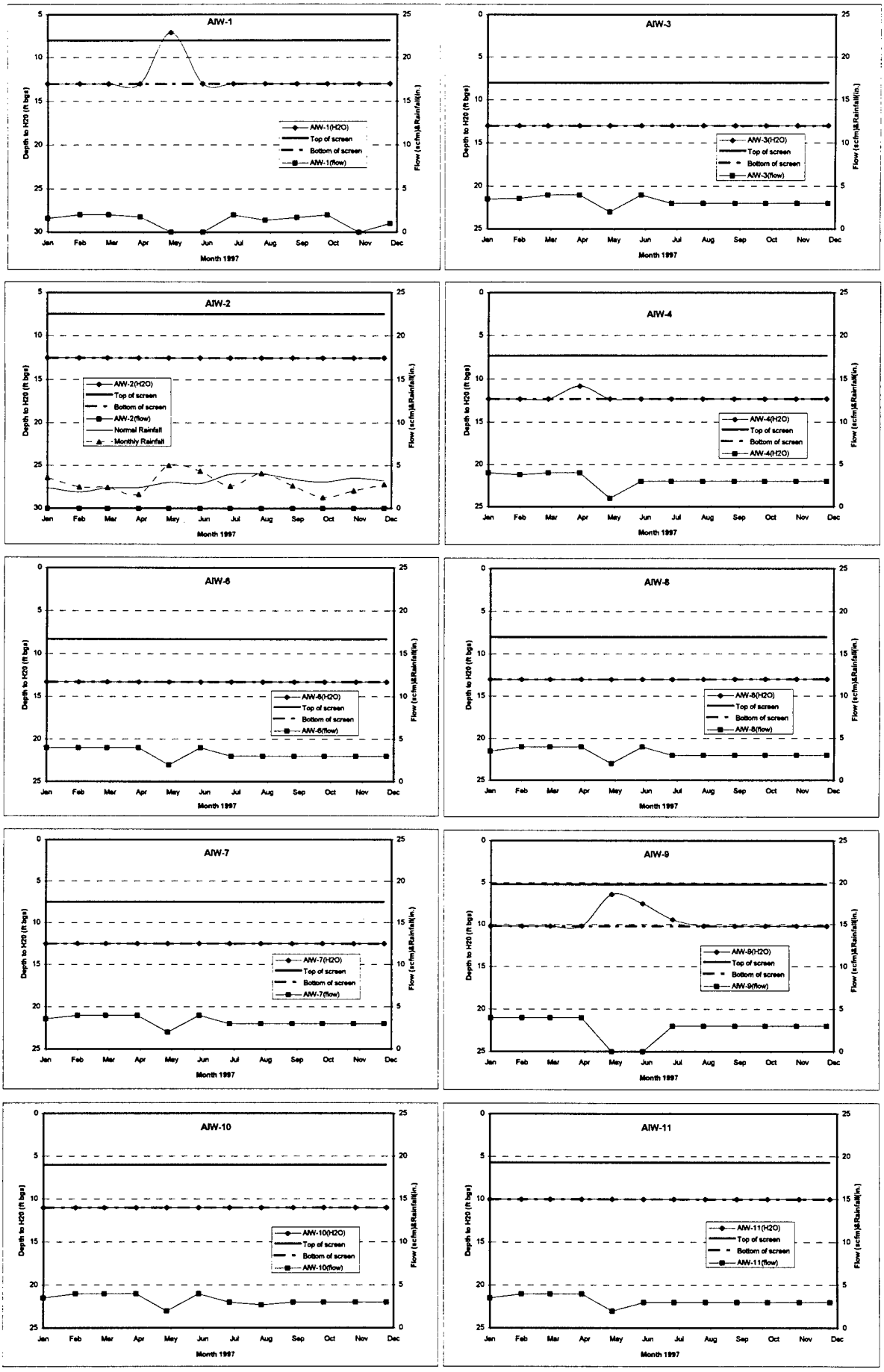


Figure 8-2 FTA Groundwater/Air Flow Relations Along North/South Section

GW_FLOW.XLS

9.0 FUEL TANK FARM BIOVENT/BIOSLURP

The FTF bioslurp/biovent system is installed in OU 11 and is made up of 17 bioslurp wells, 21 biovent wells, and 1 single-elevation and 7 dual-elevation MPs (15 MPs); 4 of the dual-elevation MPs have oxygen sensors. The FTF system ran from August 16 to August 23 in the bioslurp mode. Numerous mechanical problems occurred during this reporting period, but sediment breakthrough beyond the oil/water separator was the primary reason the system did not run properly. Two additional bag filters were added between the oil/water separator and the cartridge paper filter system. The system ran in a startup mode for only one week before the granular-activated carbon (GAC) barrels had to be changed and the volume meter replaced. Restartup of the system was delayed until Depot Roads (COE) excavation activities were completed; it was necessary to disconnect product recovery lines so that Depot Roads could perform its work. When Depot Roads completed work late in November and the system was changed back to the bioventing mode for winter operation, damage to the PLC boards in the control system was discovered. The cause for the damage could not be determined, but moisture leakage into the control panel was suspected. The system is scheduled to be repaired in January 1998, at which time it will be started up in the bioventing mode. Since BEI assumed responsibility for the bioventing O&M, the system had operated in bioventing mode 188 days through December 31, 1997. In order to make a decision on confirmation sampling, begin bioslurp as soon as possible this spring.

10.0 FUEL TANK FARM II

10.1 OPERATIONS

The FTF II, located in OU 11, consists of 37 AIWs and 24 MPs (6 with oxygen sensors) (Figure 10-1). BEI installed the FTA biovent system in the summer of 1997 and started operation on August 28, 1997. BEI assumed responsibility for the bioventing O&M in October 1997. The system operated until September 20; when it was shut down due to construction activities by Depot Roads, a subcontractor to the COE. The system was restarted on October 31, 1997 and has run continuously since that time. Through December 31, 1997 the system has operated for a total of 79 days.

The number of AIWs accepting air has steadily increased from 2 at startup to 24 in December. Injection flows are presently approximately half the design flow rate of 3 scfm in each AIW (Table 10-1). The overall system injection pressure was held constant between 3.4 and 3.5 psi throughout the reporting period.

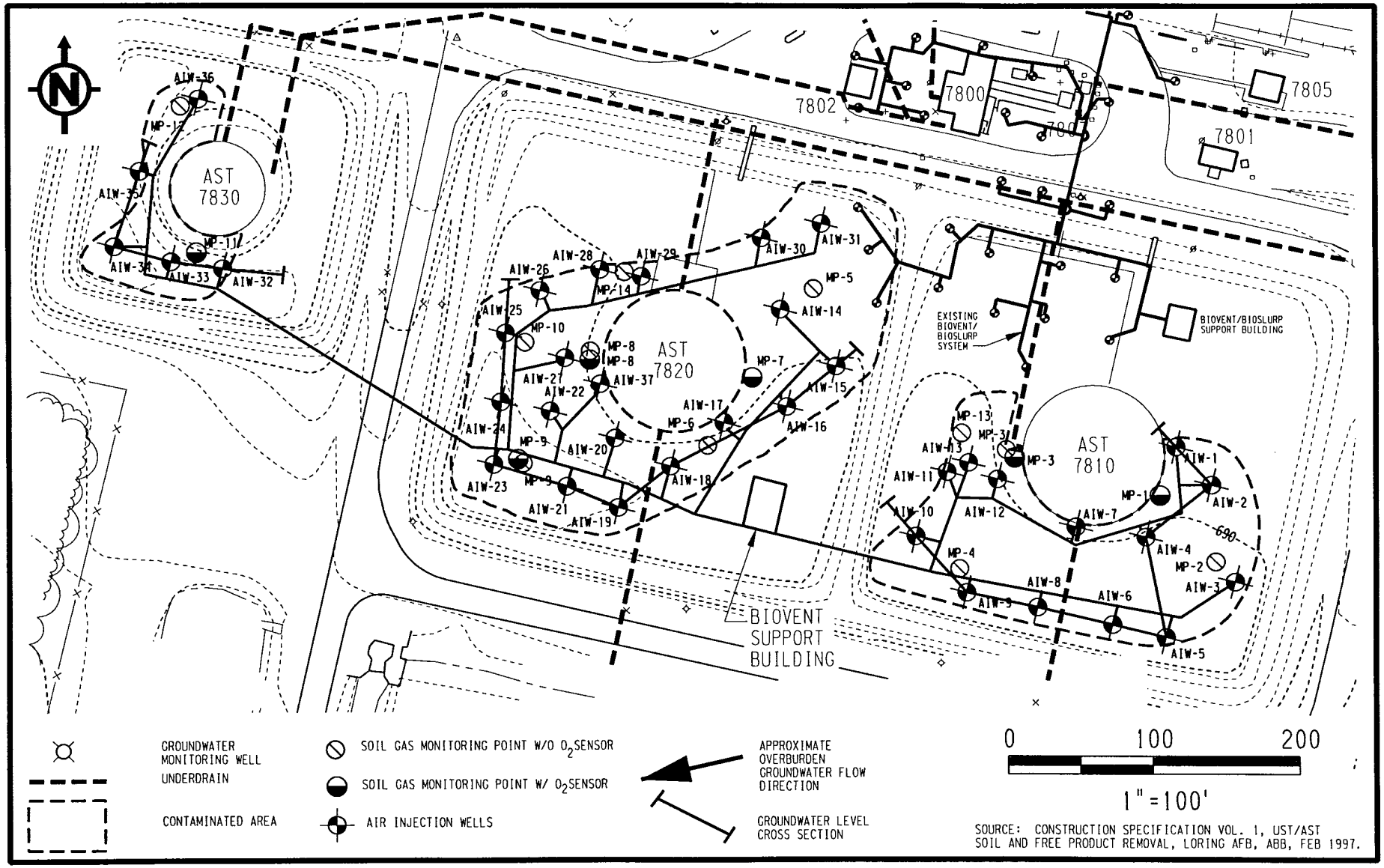
10.2 CONCLUSIONS AND RECOMMENDATIONS

Table 10-2 presents groundwater levels in AIWs and cross-sectional views of the generalized water table. By December the majority of AIW screens were above the water table. Figures 10-2 through 10-4 present the groundwater levels (data is limited) and air flows per AIW located along the cross sections on Figure 10-1. Initially, high groundwater levels were typical, but a general decline in the level can be inferred from these figures. As the water table dropped, air flow increased. The average and normal monthly rainfall curve has been added to the AIW graphs for comparison to groundwater levels.

By November, 10 of 24 MPs were yielding air samples or recorded data (oxygen sensors) (see Table 10-1). Oxygen levels ranged from a low 2.5 to a high of 20.9 percent in November. As on all biovent sites, only oxygen sensor data could be collected during winter months because standard MPs are inaccessible.

Two respiration tests were run on August 9, 1997 as part of the startup procedure. The pretest oxygen level ranged from 0.8 to 1.2 percent (Figure A-9). Pretest oxygen levels are those before helium and air are injected. Both oxygen utilization rates obtained from the testing (1.4 and 2.8 percent/hour) indicate that biodegradation was occurring at the site prior to startup and that this site was a good candidate for remediation by bioventing.

Overall Recommendation for FTF II: No changes to the system are recommended because it has been running for too short a period for detailed analysis. Respiration tests to be performed in the spring of 1998 and oxygen sensor data to be collected during the winter of 1997–1998 will be used to evaluate how the system is operating.



22784/043/FIG10-1.DGN

Figure 10-1
Air Injection Wells and Monitoring Points Location
Fuel Tank Farm II, LAFB

Table 10-1 FTF II Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval ft/bgs top	bottom	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) August 1997	September 1997	October 1997	November 1997	12/97	Average Aug - Dec
AIW-1	5.9	15.7	4.1	3	Not yet	3	no	3	3	3.0
AIW-2	6.5	16.3	4.5	3	operational	0	no	0	1	0.3
AIW-3	6.6	16.3	4.6	3		0	no	no	0.5	0.3
AIW-4	6.4	16.2	4.4	3		0	no	0	1	0.3
AIW-5	6.5	16.2	4.5	3		0	no	no	0	0.0
AIW-6	6.5	16.2	4.5	3		0	no	no	1.5	0.8
AIW-7	6.3	16.3	4.4	3		3	no	3	3	3.0
AIW-8	6.5	16.3	4.5	3		0	no	0	1.5	0.5
AIW-9	6.5	16.2	4.5	3		0	no	0	2	0.7
AIW-10	6.6	16.3	4.6	3		0	no	0	1	0.3
AIW-11	6.9	16.7	4.8	3		0	no	0	0	0.0
AIW-12	6.8	16.5	4.7	3		0	no	0	1	0.3
AIW-13	6.7	16.4	4.7	3		0	no	0	0	0.0
AIW-14	6.5	16.2	4.5	3		0	no	0	0	0.0
AIW-15	6.6	16.3	4.6	3		0	no	0	0	0.0
AIW-16	6.5	16.2	4.5	3		0	no	0	0.8	0.3
AIW-17	6.6	16.7	4.6	3		0	no	0	0	0.0
AIW-18	6.5	16.3	4.5	3		nf	no	0	0	0.0
AIW-19	6.6	16.3	4.6	3		nf	no	0	1.4	0.7
AIW-20	6.5	16.2	4.5	3		nf	no	0	0	0.0
AIW-21	6.6	16.3	4.6	3		nf	no	0	0	0.0
AIW-22	6.6	16.3	4.6	3		nf	no	0	1.1	0.6
AIW-23	6.5	16.3	4.5	3		0	no	0	1.5	0.5
AIW-24	6.6	16.3	4.6	3		nf	no	0	0	0.0
AIW-25	6.5	16.3	4.5	3		0	no	3	3	2.0
AIW-26	6.6	16.3	4.6	3		0	no	3	3	2.0
AIW-27	6.6	16.3	4.6	3		0	no	0	0	0.0
AIW-28	6.6	16.3	4.6	3		0	no	3	3	2.0
AIW-29	6.6	16.4	4.6	3		0	no	0	0	0.0
AIW-30	6.6	16.3	4.6	3		0	no	no	0	0.0
AIW-31	6.5	16.2	4.5	3		0	no	no	1.2	0.6
AIW-32	6.5	16.3	4.5	3		nf	no	0	1.2	0.6
AIW-33	6.3	16.3	4.4	3		nf	no	0	1.2	0.6
AIW-34	6.5	16.5	4.5	3		nf	no	0	2	1.0
AIW-35	6.4	16.7	4.4	3		nf	no	0	1	0.5
AIW-36	6.4	16.5	4.4	3		nf	no	1.2	1.2	1.2
AIW-37	6.6	16.3	4.6	3		nf	no	0	1.7	0.9
Total air flow:				111		6.0		16.2	38.8	
Pressure (psi):						2.5		3.5	3.4	

Monitoring Point	Screen Interval top	bottom		Soil Gas Sampling Results August 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	September 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	October 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	November 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	December 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)
MP-1-5	5	5.5	O_2 Sensor	System			no			Water covering sensor			Water covering sensor			Water covering sensor		
MP-2-4.5	4.5	5		not yet				No flow						Water				
MP-2-8.5	8.5	9		operational				Water						Water				
MP-3-5.5	5.5	6	O_2 Util. Rate = 2.83%/hr[3]				17.3	2.0	12.20%					Water				
MP-3-6	6	6.5	O_2 Sensor							Water covering sensor			7.1	na	na	9.2	na	na
MP-4-5.5	5.5	6						No flow					19.9	1.4	213			
MP-4-9.5	9.5	10						No flow						Water			No Soil Gas	
MP-5-5.0	5.5	6						No flow						No flow			Samples Collected	
MP-5-9.5	9.5	10						Water						No flow			due to Winter Conditions	
MP-6-3.5	3.5	4						No flow						Water				
MP-6-9.5	9.5	10						No flow						Water				
MP-7-6	6	6.5	O_2 Sensor				no			7.8	na	na	4.6	na	na	2.4	na	na
MP-8-9	9	9.5	O_2 Sensor				no			19.1	na	na	8.4	na	na	Water covering sensor		
MP-8-5.5	5.5	6					16.2	2.6	12.20%					No flow				
MP-8-12.5	12.5	13						Water						No flow				
MP-9-4.5	4.5	5					7.8	10.7	No reading				16.4	3.4	3.46%			
MP-9-6	6	6.5	O_2 Sensor				no			17.1			18.7	na	na	19.0	na	na
MP-10-7.5	7.5	8						Water						No flow				
MP-10-11.5	11.5	12						Water					18.4	0.4	14%			
MP-11-6	6	6.5	O_2 Sensor				no			19.9	na	na	15.9	na	na	19.1	na	na
MP-12-4.5	4.5	5						No flow						No flow				
MP-12-8.5	8.5	9					20.6	0.0	8.1				20.9	0.0	7			
MP-13-5.5	5.5	6	O_2 Util. Rate = 1.43%/hr[3]					No flow					2.5	12.5	nr			
MP-14-5.5	5.5	6						No flow						No flow				

[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] O_2 result represents daily average for month.
[3] Test performed on 8/9/97.
na = not applicable, no = not operational, nf = flow meter not hooked up for reading, nr = no reading.

Fuel Tank Farm Groundwater Levels from February through July 1997

Well No.	Well Depth below TOC	Top of Screen below TOC	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97
AW-1	15.7	5.9	10.8	11.8		12.9	12
AW-2	16.3	6.5	8.85	11.7		16.3	16.3
AW-3	16.3	6.6	4.3	7.8		6.1	14
AW-4	16.2	6.4	8.7	11.6		16.2	16.6
AW-5	16.2	6.5	6.3	9		7.2	14.9
AW-6	16.2	6.5	11.55	10.7		7.7	14.2
AW-7	16.3	6.3	10.2	11.3		6.6	6.6
AW-8	16.3	6.5	7.35	10.8		13.6	13.9
AW-9	16.2	6.5	7.05	10.5		13.2	13.3
AW-10	16.3	6.6	6.95	10.4		13.5	16.3
AW-11	16.7	6.9	9.9	13.2		16.7	16.7
AW-12	16.5	6.8	9.95	12.7		16.5	16.5
AW-13	16.4	6.7	10.5	12.4		16.4	16.4
AW-14	16.2	6.5	10.3	13.1		16.2	16.2
AW-15	16.3	6.6	11.95	13.2		16.3	16.3
AW-16	16.2	6.5	8.55	11.4		16	16.2
AW-17	16.7	6.6	10	13		16	16.7
AW-18	16.3	6.5	8.15	11.2		13.1	16.3
AW-19	16.3	6.6	10.1	15.15		16.3	16.3
AW-20	16.2	6.5	9.35	12.15		11.6	12
AW-21	16.3	6.6	8.8	10		16.2	16.3
AW-22	16.3	6.6	10.65	14.2		15.3	14
AW-23	16.3	6.5	7	10.9		13.5	16.3
AW-24	16.3	6.6	7.8	10.5		14.7	16.3
AW-25	16.3	6.5	11.3	14.4		16.3	16.3
AW-26	16.3	6.6	13.7	16.3		16.3	16.3
AW-27	16.3	6.6	10.15	13.7		16.3	16.3
AW-28	16.3	6.6	11.95	16.4		16.3	16.3
AW-29	16.4	6.6	9.3	11.25		15.2	16.4
AW-30	16.3	6.6	11.05	13.7		12.2	16.3
AW-31	16.2	6.5	11.85	15.2		7.6	16.2
AW-32	16.3	6.5	11.3	12.5		14.6	16.3
AW-33	16.3	6.3	10.9	12.9		15.6	16.3
AW-34	16.5	6.5	9.2	12.7		15	16.5
AW-35	16.7	6.4	10.9	19.35		16.3	16.7
AW-36	16.5	6.4	15.6	16.3		16.5	16.5
AW-37	16.3	6.6	9.7	11.3		5.3	6.7

No readings in October 1997 due to construction in the area.

Boxed value: indicates water level is at or above the top of the screen.

1997 Groundwater Levels along East/West Transect at FTF II - AST 7810

Well No.	Elevation at top of casing (ft amsl)	Elevation at ground (ft amsl)	Elevation of water - AUG (ft amsl)	Elevation of water - SEP (ft amsl)	Elevation of water - DEC (ft amsl)	Depth to top of screen (ft)	Elevation to TOS (ft amsl)	Depth to bottom of screen (ft)	Elevation to BOS (ft amsl)
AW-1	893.22	891.73	881.13	880.13	879.73	5.9	885.83	15.7	878.03
AW-2	891.25	889.58	880.73	877.88	873.28	6.5	883.08	16.3	873.28
AW-4	890.89	889.12	880.42	877.52	872.32	6.4	882.72	16.2	872.92
AW-5	890.49	888.75	882.45	879.75	873.85	6.5	882.25	16.2	872.55
AW-6	890.5	888.84	877.29	878.14	874.64	6.5	882.34	16.2	872.64
AW-8	890.28	888.6	881.25	877.8	874.7	6.5	882.1	16.3	872.3
AW-9	889.92	888.1	881.05	877.6	874.8	6.5	881.6	16.2	871.9
AW-10	889.41	887.71	880.76	877.31	871.41	6.6	881.11	16.3	871.41

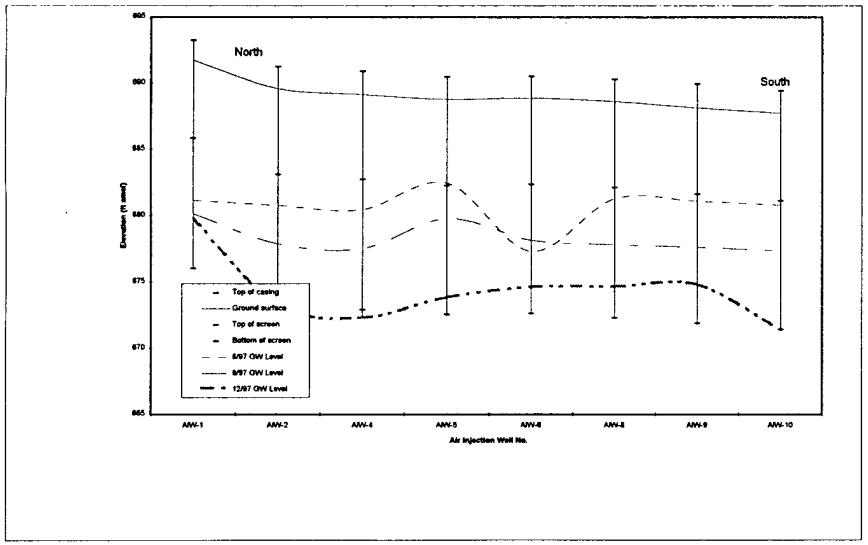
Boxed value: indicates water level is at or above the top of the screen.

1997 Groundwater Levels along East/West Transect at FTF II - AST 7820

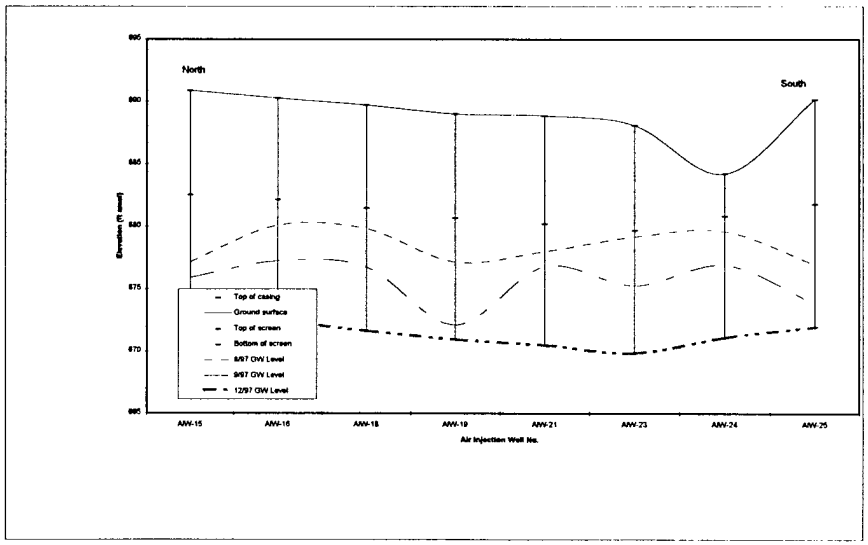
Well No.	Elevation at top of casing (ft amsl)	Elevation of ground (ft amsl)	Elevation of water - AUG (ft amsl)	Elevation of water - SEP (ft amsl)	Elevation of water - DEC (ft amsl)	Depth to top of screen (ft)	Elevation to TOS (ft amsl)	Depth to bottom of screen (ft)	Elevation to BOS (ft amsl)
AW-15	890.86	888.09	877.14	875.89	872.79	6.6	882.49	16.3	872.6
AW-16	890.25	888.62	880.07	877.22	872.42	6.5	882.12	16.2	872.4
AW-18	888.68	887.93	879.78	878.73	871.83	6.5	881.43	16.3	871.6
AW-19	888.96	887.25	877.15	872.1	870.95	6.6	880.65	16.3	871.0
AW-21	888.83	886.79	877.99	878.79	870.49	6.6	880.19	16.3	870.5
AW-23	888.07	886.18	879.18	875.28	869.86	6.5	879.66	16.3	869.9
AW-24	884.17	887.39	879.59	878.89	871.09	6.6	880.79	16.3	871.1
AW-25	890.14	888.27	878.97	873.67	871.97	6.5	881.77	16.3	872.0

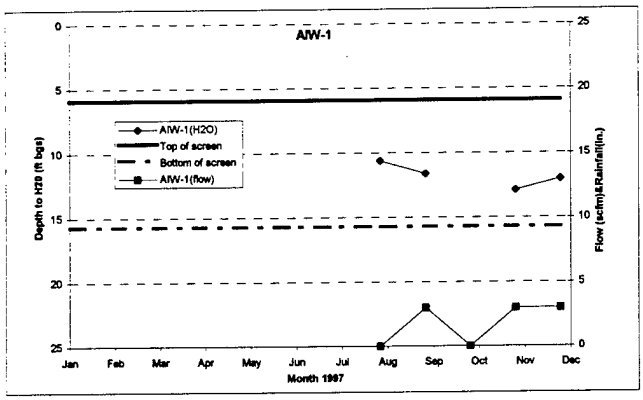
Boxed value: indicates water level is at or above the top of the screen.

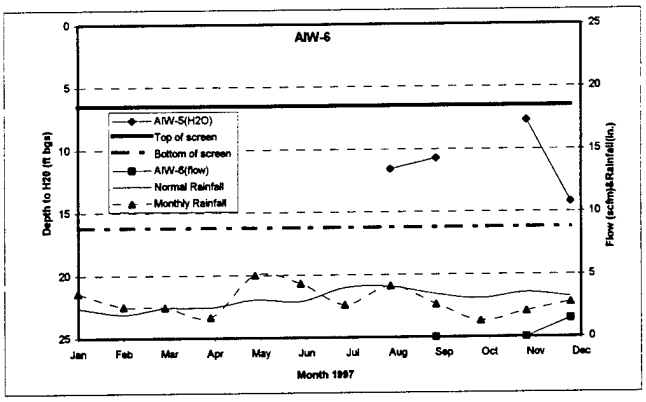
East/West Cross Section at FTF - AST 7810

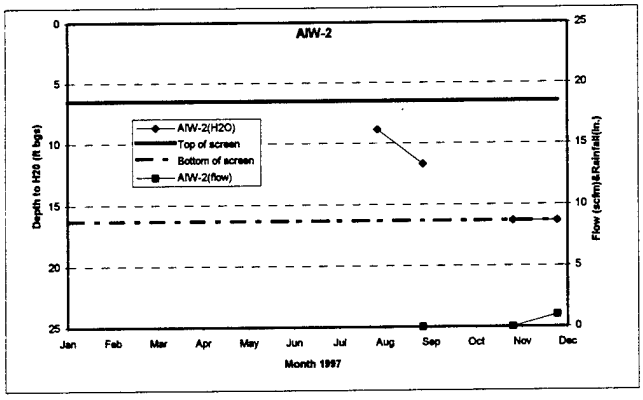


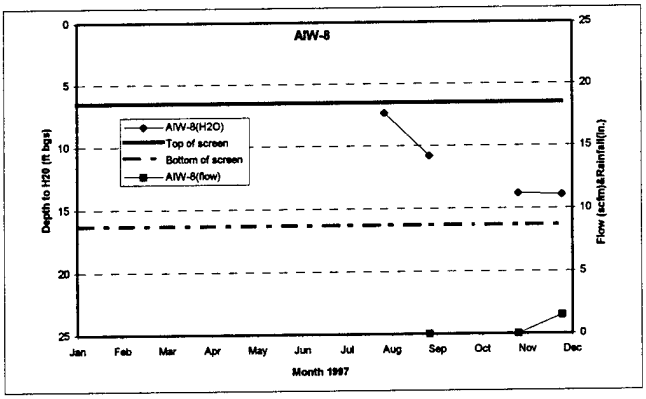
East/West Cross Section at FTF - AST 7820

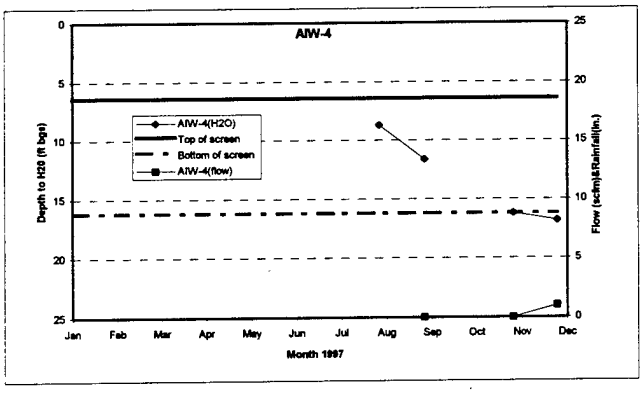


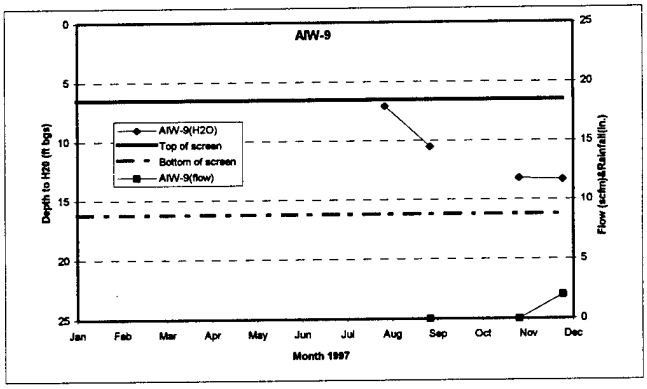


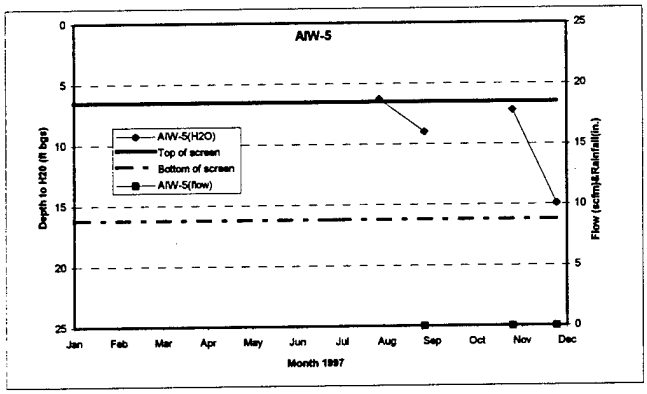












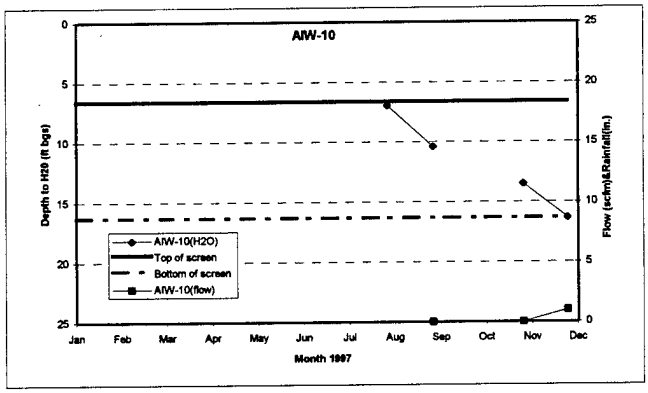


Figure 10-2 FTF II Groundwater/Air Flow Relations - AST 7810 Area

GW_FLOW.XLS

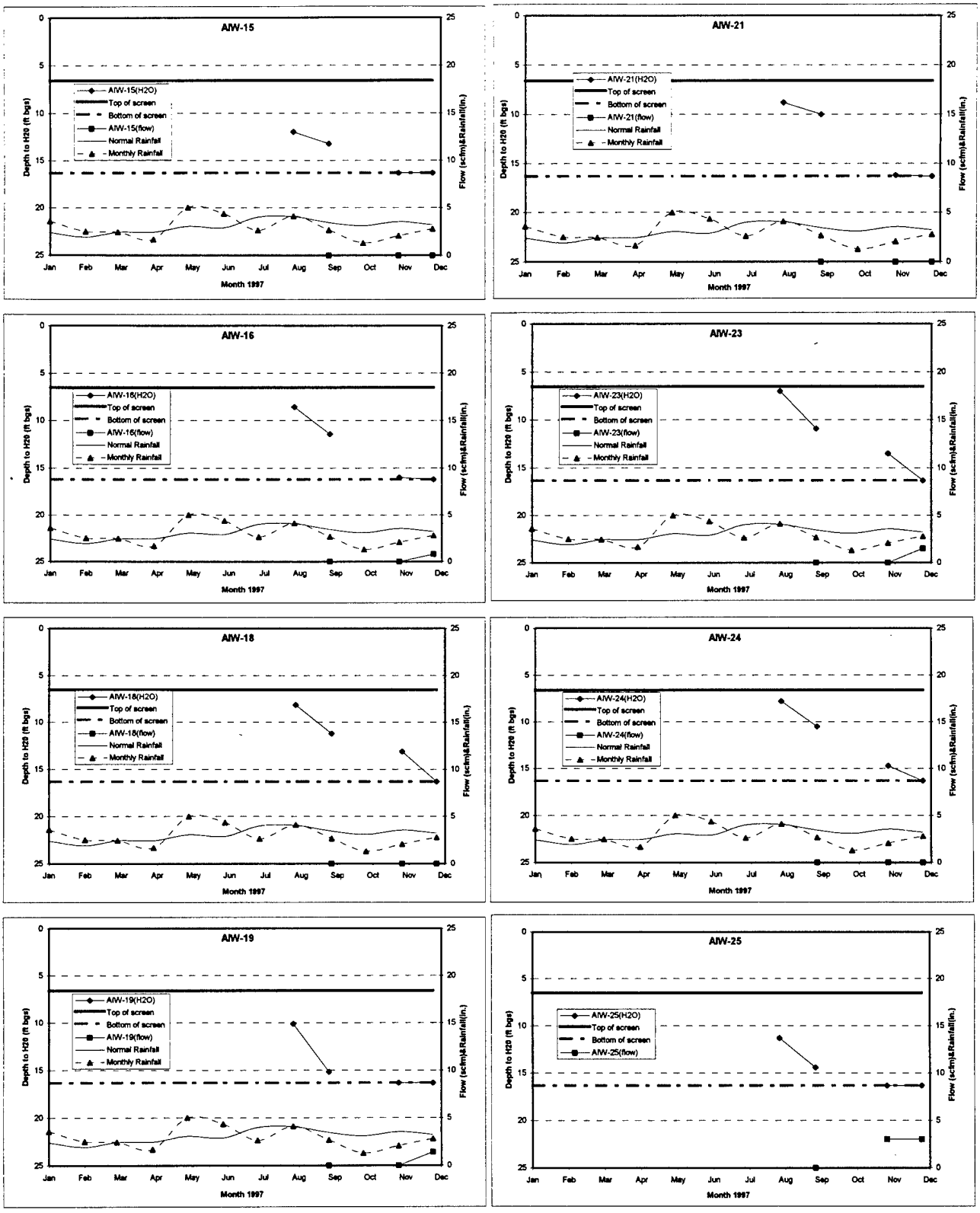
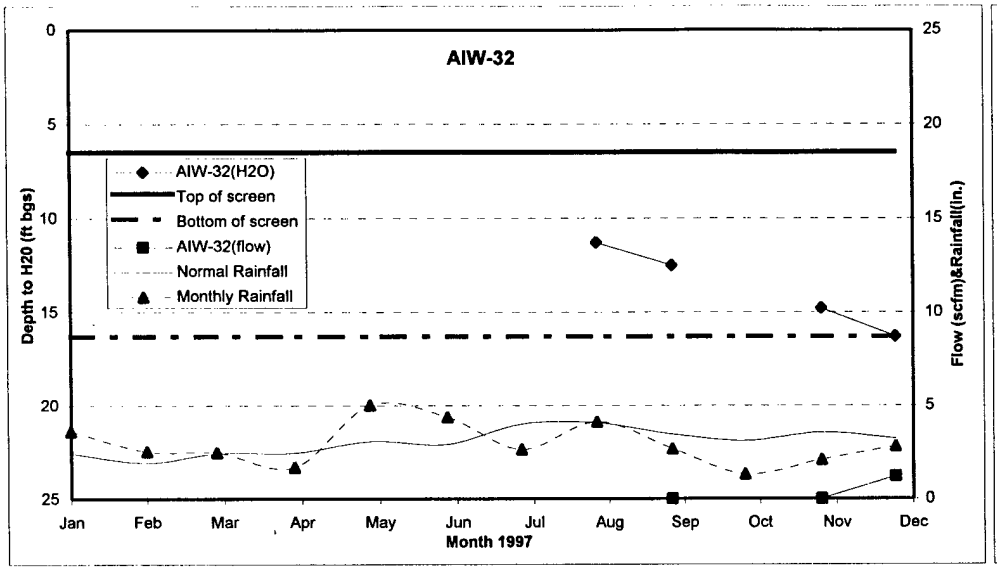
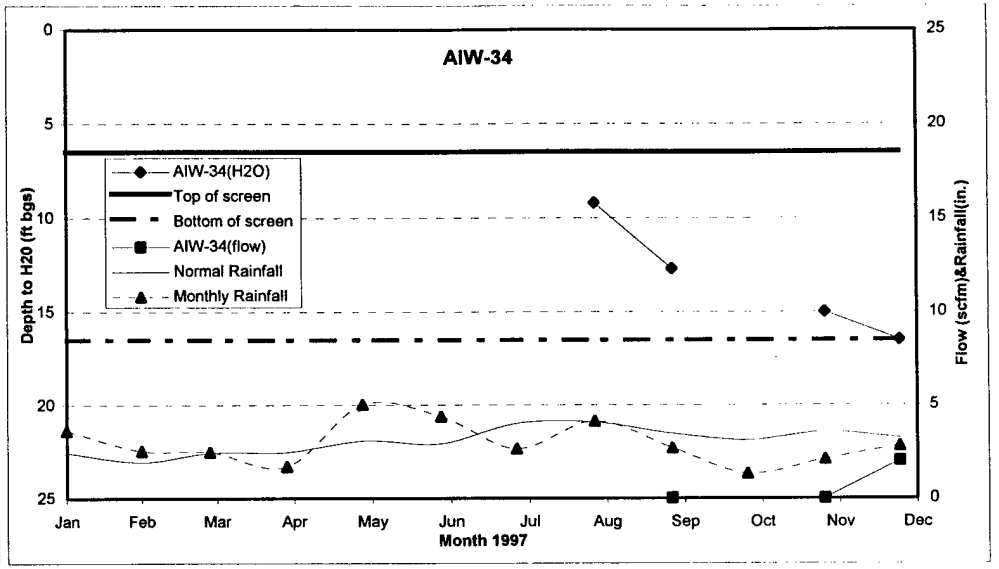
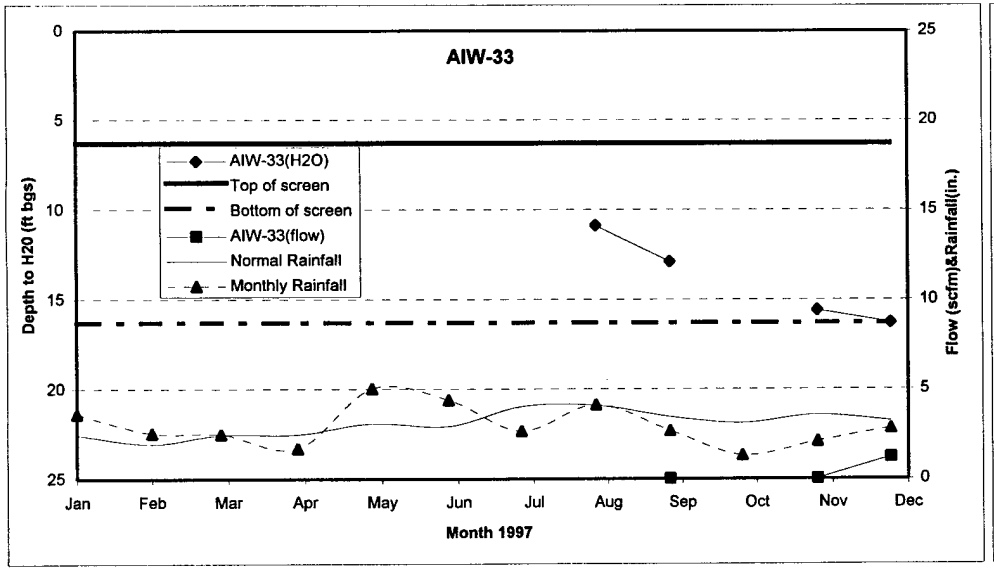


Figure 10-3 FTF II Groundwater/Air Flow Relations - AST 7820 Area







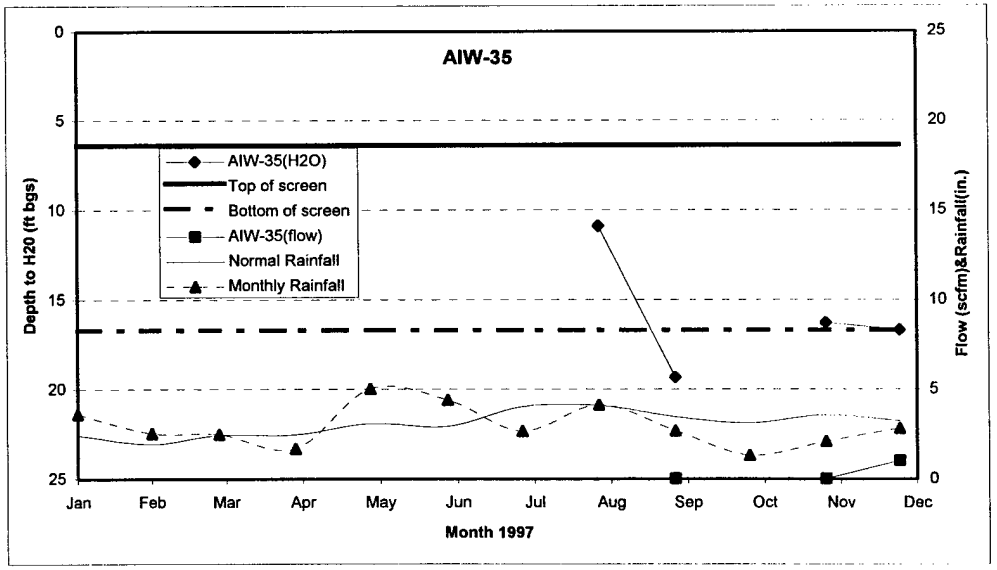


Figure 10-4 FTF II Groundwater/Air Flow Relations - AST 7830

11.0 NOSE DOCK AREA #1

11.1 OPERATIONS

The COE installed the NDA biovent systems in OU 5 during the fall of 1996 and initiated system startup in October and November. The COE biovent removal action report for these systems presents relevant data. BEI began formal O&M on December 1, 1996. Since BEI assumed responsibility for O&M, this biovent system had operated 443 days through December 31, 1997.

11.2 CONCLUSIONS AND RECOMMENDATIONS

Individual wellhead flow has been monitored since December 1996, allowing long-term performance to be evaluated. Figure 11-1 (foldout) presents the biovent system AIW and MP layouts for all of the NDAs. Table 11-1 presents the wellhead flow measurements and soil gas results for NDA-1. For comparison, Figure 11-1 presents the average air flow rate per well over the reporting period along with MP oxygen data. Water levels measured at individual NDA-1 wellheads are provided on Table 11-2.

As depicted on Figure 11-1, most AIWs were operating near or at the design flows; only AIWs-3, 5, 21, 22, and 24 did not allow air during the reporting period. This condition is a significant improvement from the spring and early summer (last semiannual reporting period), when approximately 75 percent of the wells would not accept air. A major contributor to this turnaround is the drying of the soils since the end of July. Figure 11-2 includes graphs that illustrate the fluctuating groundwater levels and air flow at specific wells identified along the cross section on Figure 11-1. These graphs further show how the groundwater has subsided since the May–July period.

The deep zones of MPs-1, 3, and 4 remain inundated with water. The shallow zone at MP-3 and 4 show oxygen and carbon dioxide levels typical of active biodegradation. The lowest oxygen levels at NDA-1 were noted at MP-6. Unfortunately, the highest groundwater levels were noted in wells adjacent to MP-6, therefore limiting air flow to this contaminated area. AIWs-21, 22, and 24, which lie just north of MP-6, all had zero air flow and nearby AIWs-9, 10, and 18 had fully inundated well screens between April and December. In fact, AIWs-9 and 10 were turned off during October and November due to the high water.

Respiration testing was performed only on MP-1-6-5 and -1-6-8 (Figure A-10). Both results, 0.34 and 0.76 percent/hour, respectively, were much lower than noted during the fall of 1996 (Table 1-3 or Figure 11-1). Both results indicate that biodegradation is still occurring.

Overall Recommendation for NDA-1: Recommend an increase in air flow near MP-6, primarily through AIWs-6, 4, and 2. Connect systems NDA-1 and NDA-3 together and run with one blower to save operations costs; the total flow presently accepted by both systems is less than the

capacity of a single blower. Use the blower from NDA-1 for this hookup. The current system design allows for easy interconnection of these two sytems because a hose with a closed valve already connects the two areas. Collect soil samples throughout NDA-1 beginning in June 1998.

Table 11-1 NDA-1 Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval top[1]	Screen Interval bottom[1]	Overburden Pressure[2] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) August 1997	September 1997	October 1997	November 1997	12/97	Average Aug - Dec
AIW-1	12	22	8.3	15.0	9	6	7	9.5	8	7.9
AIW-2	6	21	4.2	14.0	9	12.5	14	5	11.5	10.4
AIW-3	13	24	9.0	13.0	0	0	0	0	0	0.0
AIW-4	7	18	4.9	13.0	12	13	13	13	13	12.8
AIW-5	11.3	21.3	7.8	13.0	0	0	0	0	0	0.0
AIW-6	18.75	29.75	13.0	13.0	13	13	13	13	13	13.0
AIW-7	15	30	10.4	13.0	0	2	4	1	4	2.2
AIW-8	16	26	11.1	13.0	9.5	13	13	13	12	12.1
AIW-9	12	23	8.3	10.0	10	10	no	no	8	9.3
AIW-10	12	23	8.3	10.0	9	10	no	no	10	9.7
AIW-11	17	28	11.8	12.0	1	9.5	10	9.5	9	7.8
AIW-12	16	27	11.1	12.0	0	5.5	5	3.5	0	2.8
AIW-13	16	27	11.1	12.0	9	12	12	12	11.5	11.3
AIW-14	15	26	10.4	12.0	10	12	12	12	12	11.6
AIW-15	10	21	6.9	11.0	9	11	11	11	11	10.6
AIW-16	13	24	9.0	11.0	11	11	11	11	11	11.0
AIW-17	14	25	9.7	11.0	0	11	11	11	11	8.8
AIW-18	14	24	9.7	11.0	9	11	11	11	11	10.6
AIW-19	14	25	9.7	11.0	4	11	11	11	11	9.6
AIW-20	12.5	23.5	8.7	11.0	6	6	6	9.5	7	6.9
AIW-21	12	23	8.3	10.0	0	0	0	0	0	0.0
AIW-22	13	24	9.0	10.0	0	0	0	0	0	0.0
AIW-23	13	24	9.0	10.0	0	8	10	10	10	7.6
AIW-24	13	24	9.0	10.0	0	0	0	0	0	0.0
Total air flow:				281.0	130.5	187.5	174.0	166.0	184.0	
Pressure (psi):					2.4	3.3	3.2	3.2	2.8	

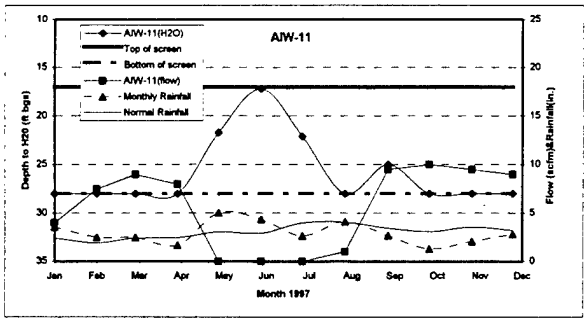
Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results August 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	September 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	October 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	November 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	December 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)
MP 1-1-6.5	6.5	7		20.7	0.0	13.3	20.2	0.3	391	20.2	0.4	8	No flow					
MP 1-1-13.5	13.5	14		No flow			No flow			No flow			No flow					
MP 1-2-7-L	7	7	O_2 Sensor	no			no			16.6	na	na	17.0	na	na	16.9	na	na
MP 1-3-5.5	5.5	6		14.9	3.1	457	20.6	0.1	203	20.6	0.0	3	20.7	0.0	2.5	No Soil Gas		
MP 1-3-11.5	11.5	12		No flow			No flow			No flow			Water			Samples Collected		
MP 1-4-8	8	8.5		Water			Water			3.2	12.7	nr	4.1	10.4	nr	due to Winter Conditions		
MP 1-4-13	13	13.5		Water			Water			No flow			Water					
MP 1-5BG-7	7	7.5	Background location	12.9	15.5	13.4	15.9	15.3	356	17.6	10.4	47	17.0	8.9	147			
MP 1-6-5	5	5.5	O_2 Util. Rate = 0.34%/hr[4]	18.5	1.5	259	19.0	1.3	123	0.5	5.9	nr	1.9	10.3	nr			
MP 1-6-8	8	8.5	O_2 Util. Rate = 0.76%/hr[4]	10.5	6.4	241	8.6	7.2	1.20%	0.9	10.3	nr	No flow					

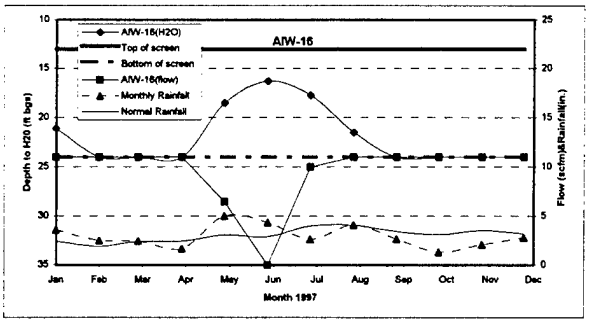
[1] Measured from top of casing.
[2] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[3] O_2 result represents daily average for month.
[4] Test performed on 10/7/97.
na = not applicable, nr = no reading.

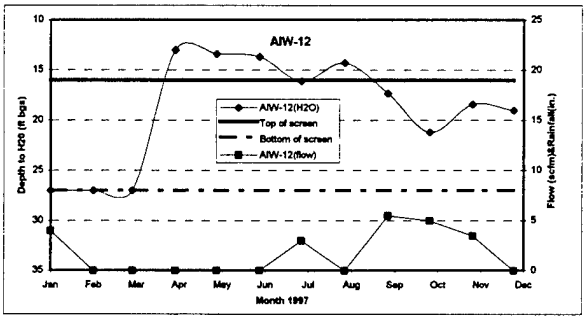
Table 11-2 NDA-1 Groundwater Level Data

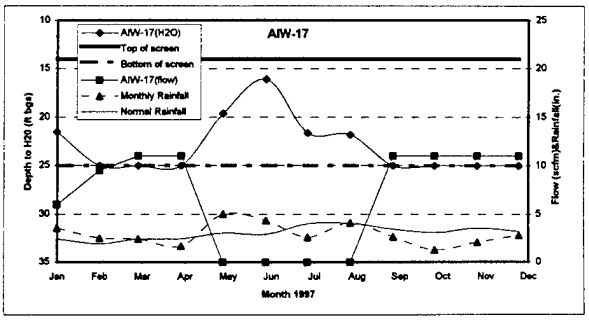
WELL NO	Well Depth below TOC (ft)	Top of Screen below TOC (ft)	Groundwater Depth Below TOC (ft)											
			Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97
AIW-1	22	12	22	22	22	22	22	22	22.4	22	22	22	22	22
AIW-2	21	6	9.3	11.5	21	17.2	6.9	8.3	8.6	9.9	14.1	11.7	8.2	9.7
AIW-3	24	13	24	24	24	24	24	20.8	19.9	19.3	24	24	21.5	24
AIW-4	18	7	13.8	15.2	18	17.3	9.5	10.2	10.8	12.8	10.25	18	10.1	13
AIW-5	21.3	11.3	15.6	15.6	21.3	16.7	15.1	13.8	14.7	12.9	16.2	16.7	14.9	15.3
AIW-6	29.75	18.75	25	29.75	29.75	29.75	22.9	19.5	22.9	25.9	29.75	29.75	29.75	29.75
AIW-7	30	15	27.8	30	30	30	17.7	30	30	25.8	30	30	30	30
AIW-8	26	16	26	26	26	26	26	21.9	26	26	26	26	26	26
AIW-9	23	12	23	23	23	10.1	10.5	11.1	11	11.5	11.1	off	off	11.3
AIW-10	23	12	23	23	23	9.9	11.2	12.1	12.4	11.6	11.4	off	off	11.8
AIW-11	28	17	28	28	28	28	21.7	17.2	22.1	28	25	28	28	28
AIW-12	27	16	27	27	27	13	13.4	13.7	16.1	14.3	17.3	21.2	18.4	19
AIW-13	27	16	17.4	16.6	27	27	19.3	16.6	20.2	23.9	18.8	27	27	20.6
AIW-14	26	15	26	26	26	26	26	17.9	21.7	26	26	26	26	26
AIW-15	21	10	21	21	21	21	21	18.7	21.5	21	21	21	21	21
AIW-16	24	13	21.1	24	24	24	18.5	16.3	17.7	21.5	24	24	24	24
AIW-17	25	14	21.5	25	25	25	19.6	16.1	21.6	21.8	25	25	25	25
AIW-18	24	14	18	24	24	24	17	24	10.3	24	24	24	24	24
AIW-19	25	14	21.7	25	25	25	21.6	17.9	23.3	23.6	25	25	25	25
AIW-20	23.5	12.5	23.5	23.5	23.5	23.5	13	12.8	19.9	21.4	23.5	23.5	23.5	21.7
AIW-21	23	12	23	23	23	13.7	23	23	23	23	23	23	23	23
AIW-22	24	13	22.6	24	24	24	24	19.5	15.6	20.1	24	24	24	24
AIW-23	24	13	24	24	24	24	19.9	16.1	20.9	21.9	24	24	24	24
AIW-24	24	13	24	24	24	24	24	18.4	23	23.1	24	24	24	24

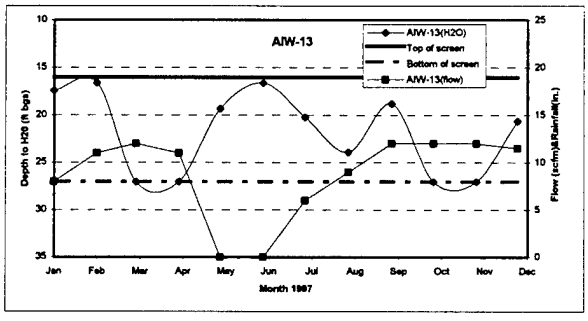
Boxed value indicates water level is at or above the top of the screen.
TOC = top of casing.

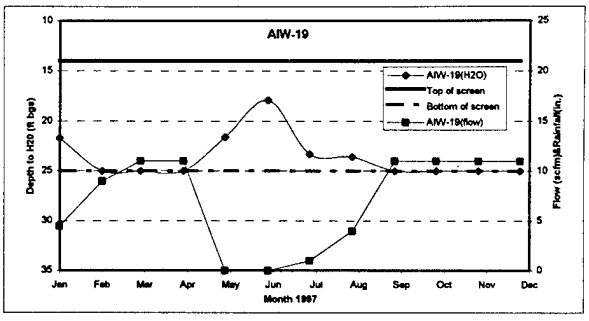


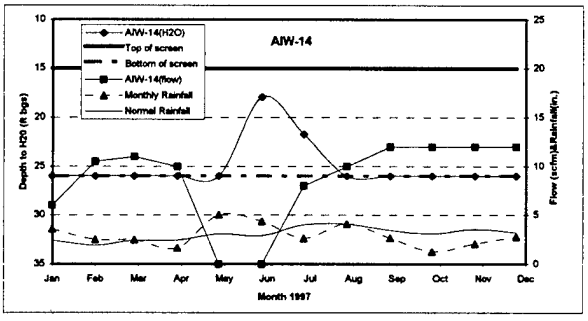


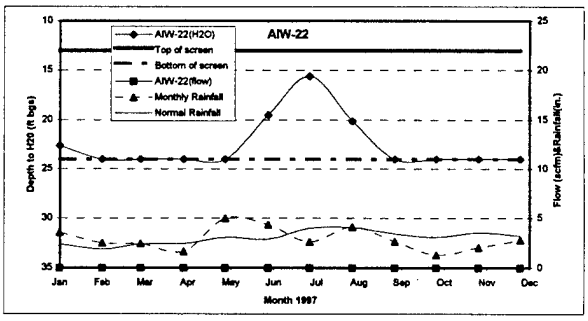


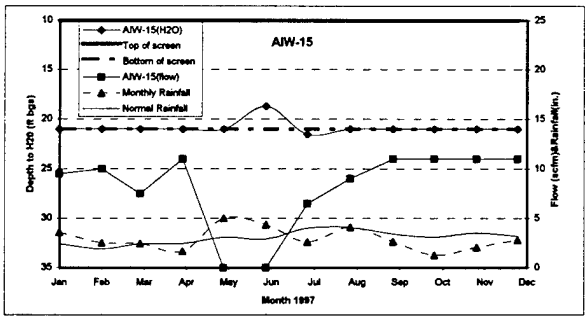












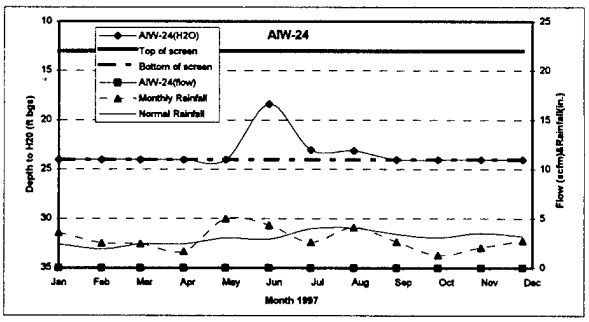


Figure 11-2 Air Flow vs. Depth to Groundwater at NDA-1

12.0 NOSE DOCK AREA #2

12.1 OPERATIONS

The COE installed the NDA biovent systems in OU 5 during the fall of 1996 and initiated system startup in October and November. The COE biovent removal action report for these systems presents relevant data. BEI began formal O&M on December 1, 1996. Since BEI assumed responsibility for O&M, this biovent system had operated 398 days through December 31, 1997.

12.2 CONCLUSIONS AND RECOMMENDATIONS

MP-2 continues to exhibit high oxygen and low carbon dioxide levels; suggesting either that contamination does not exist or that the MPs may be short-circuiting via permeable zones (Table 12-1). Either of these scenarios are possible due the fact that the oxygen levels, when measurable, have always been above 20 percent. MP-2 lies approximately 100 ft to the west of MP-6, which had the lowest oxygen levels in NDA-1 (see Figure 11-1). This difference in oxygen levels supports the conceptual model (Figure 1-2) that perched lenses may be avenues to the movement of injected air. All other MPs except the oxygen sensor at MP-11 had no flow or water; therefore, no data could be collected from these points. Water levels are listed on Table 12-2. The oxygen levels at the MP-11 oxygen sensor dropped slightly from initiation levels in October through December (19.8 to 18.5 percent).

Respiration tests could not be performed due to saturated MPs.

Overall Recommendation for NDA-2: Recommend adding MPs to areas not being monitored, such as the MP-8 and 10 areas. Get a true in situ air reading at MP-2 and MP-11 with the system shut off to help determine whether contamination exists. High oxygen levels may indicate that cleanup is complete in these areas. Collect soil samples throughout NDA-2 beginning in June 1998.

Table 12-1 NDA-2 Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval top[1]	Screen Interval bottom[1]	Overburden Pressure[2] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) August 1997	September 1997	October 1997	November 1997	12/97	Average Aug - Dec
AIW-1	14	25	9.7	11.0	10	11	0	11	11	8.6
AIW-2	11	22	7.6	9.0	8	9	9	9	8.5	8.7
AIW-3	7	18	4.9	11.0	7	10	9	7	8	8.2
AIW-4	11	22	7.6	9.0	0	0	0	0	0	0.0
AIW-5	13.5	23.5	9.4	11.0	10.5	11	11	11	11	10.9
AIW-6	10	21	6.9	9.0	7	9	9	8.5	9	8.5
AIW-7	13	24	9.0	10.0	8	10	10	10	10	9.6
AIW-8	10.5	21.5	7.3	10.0	10	10	10	10	10	10.0
AIW-9	6	13	4.2	12.0	0	0	0	0	0	0.0
AIW-10	11	22	7.6	9.0	9	9	9	9	9	9.0
AIW-11	4	15	2.8	9.0	9	9	8.5	0	0	5.3
AIW-12	8	19	5.6	10.0	7	10	10	10	10	9.4
AIW-13	12	23	8.3	10.0	10	10	10	10	10	10.0
AIW-14	11	22	7.6	9.0	9	9	9	9	9	9.0
AIW-15	9	19	6.3	12.0	11.5	12	12	12	12	11.9
AIW-16	10	20	6.9	12.0	0	0	0	0	0	0.0
AIW-17	9	20	6.3	8.0	8	8	8	8	8	8.0
AIW-18	9	20	6.3	8.0	8	8	8	8	8	8.0
AIW-19	6	15	4.2	10.0	10	10	10	10	10	10.0
AIW-20	9.5	20.5	6.6	10.0	10	10	10	10	10	10.0
AIW-21	9	20	6.3	10.0	8	10	9	8.5	9	8.9
AIW-22	8	19	5.6	8.0	8	8	8	8	8	8.0
AIW-23	7	18	4.9	7.0	7	7	7	7	7	7.0
Total air flow:				224.0	175.0	190.0	176.5	176.0	177.5	
Pressure (psi):					2.1	3.3	2.5	2.5	2.5	

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results August 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	September 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	October 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	November 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	December 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)
MP 2-1-8	8	8.5		No flow			No flow			Water			Water			No Soil Gas		
MP 2-1-13	13	13.5		No flow			No flow			No flow			No flow			Samples Collected		
MP 2-2-5	5	5.5		21.0	0.0	7	20.6	0.0	30.4	21.0	0.0	6.4	20.7	0.0	5.1	due to Winter Conditions		
MP 2-2-8	8	8.5		21.0	0.0	3	20.6	0.0	3	20.7	0.1	15.2	20.7	0.0	3.8			
MP 2-8-8	8	8.5		No flow			No flow			No flow			No flow					
MP 2-8-15	15	15.5		No flow			No flow			No flow			No flow					
MP 2-9-6	6	6.5		Water			No flow			No flow			No flow					
MP 2-9-12	12	12.5		No flow			No flow			Water			Water					
MP 2-10-8	8	8.5		No flow			No flow			No flow			No flow					
MP 2-11-14.5	14.5	15	O_2 Sensor	no			19.8	na	na	18.9	na	na	18.2	na	na	18.0	na	na

[1] Measured from top of casing.
[2] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[3] O_2 result represents daily average for month.
na = not applicable, no = not operational.

Table 12-2 NDA-2 Groundwater Level Data

WELL NO	Well Depth below TOC (ft)	Top of Screen below TOC (ft)	Groundwater Depth Below TOC (ft)											
			Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97
AIW-1	25	14	25	25	25	25	19.8	17.1	19	21.8	23.5	25	25	25
AIW-2	22	11	22	17	22	11.4	12	13.7	13.9	16.9	14.5	16	14.1	15.1
AIW-3	18	7	18	18	18	17.4	14.1	16.8	19.9	20.5	20.35	20.4	20.2	20.2
AIW-4	22	11	22	16	22	16.7	11.9	14.5	13.3	13.6	14.6	13.7	13	14.9
AIW-5	23.5	13.5	23.5	23.5	23.5	23.5	22.6	16.1	18.3	22.6	23.5	23.5	23.5	23.5
AIW-6	21	10	20	21	21	21.6	19	15.7	18.3	21	21	21	21	21
AIW-7	24	13	24	24	24	24	23.2	21.4	23.2	24	24	24	24	24
AIW-8	21.5	10.5	21.5	21.5	21.5	21.5	20.3	17	20.2	21.5	21.5	21.5	21.5	21.5
AIW-9	13	6	13	13	13	13	13	13	13	13	13	13	13	13
AIW-10	22	11	22	22	22	22	20.6	17.4	20	22	22	22	22	22
AIW-11	15	4	15	15	15	15	15	5.8	6.2	15	8.1	16	13.6	15
AIW-12	19	8	19	19	19	19	19	19	19	19	19	19	19	19
AIW-13	23	12	23	23	23	23	19.5	16.6	17.7	23	23	23	23	23
AIW-14	22	11	22	22	22	22	22	20.9	22.1	22	22	22	22	22
AIW-15	19	9	19	19	19	19	19	19	19	19	19	19	19	19
AIW-16	20	10	20	20	20	20	20	20	20	20	20	20	20	20
AIW-17	20	9	20	20	20	20	18	17.5	18.5	20	20	20	20	20
AIW-18	20	9	20	20	20	20	21	14.5	18.4	20	20	20	20	20
AIW-19	15	6	15	15	15	15	15.9	12	12.3	12.5	13.4	11.1	8.9	9.7
AIW-20	20.5	9.5	20.5	20.5	20.5	20.5	19.9	15.8	19.9	20.5	20.5	20.5	20.5	20.5
AIW-21	20	9	20	20	20	20	20	20	20	20	20	20	20	20
AIW-22	19	8	19	19	19	19	19	17.5	19	19	19	19	19	19
AIW-23	18	7	18	18	18	18	18	18	18	18	18	18	18	18

TOC = top of casing.

13.0 NOSE DOCK AREA #3

13.1 OPERATIONS

The COE installed the NDA biovent systems in OU 5 during the fall of 1996 and initiated system startup in October and November. The COE biovent removal action report for these systems presents relevant data. BEI began formal O&M on December 1, 1996. Since BEI assumed responsibility for O&M, this biovent system had operated 438 days through December 31, 1997.

13.2 CONCLUSIONS AND RECOMMENDATIONS

As during the last reporting period, no MP data could be collected; saturated soils around the screens (Table 13-1) prevented respiration tests from being performed. AIWs-2, 3, 4, 6, 7, 8, and 10 showed notable improvement relative to the first half of 1997. As shown on Figures 13-1 and 13-2, these AIWs were partially inundated or dry; Table 13-2 lists the 1997 groundwater levels. Most of the air flow rates were at or near the design rates. AIWs-1, 5, 9, and 11 through 21 did not show improvement from the last reporting period (first half of 1997), typically allowing zero air flow (Figure 11-1). AIWs-1, 14, and 21 were fully inundated with water during several months of 1997. Other AIWs not allowing air had minimal inundation, possibly attributable to low-permeability or saturated soils surrounding the screens. Figure 13-1 includes graphs that illustrate the fluctuating groundwater levels and air flow at all wells along the cross section presented in Figure 11-1.

Overall Recommendation for NDA-3: Recommend removing AIWs-11 through 21 from the system and evaluating another remedial approach. Connect AIWs-1 through 10 with the NDA-1 system utilizing the blower from NDA-1. The NDA-3 blower and ancillary system components will remain shut down until it can be used at another site. Collect soil samples in the AIW-11 through AIW-21 area as soon as possible this spring and throughout the remainder of NDA-3 beginning in June 1998.

Table 13-1 NDA-3 Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval top[1]	Screen Interval bottom[1]	Overburden Pressure[2] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) August 1997	September 1997	October 1997	November 1997	12/97	Average Aug - Dec
AIW-1	18	28	12.5	11	off	off	off	off	2	2.0
AIW-2	18	28	12.5	11	0	7	8	4.5	8.5	5.6
AIW-3	18	28	12.5	11	1	11	11	11	11	9.0
AIW-4	11	21	7.6	5	11	5	5	5	5	6.2
AIW-5	13	23	9.0	5	5	0	0	0	0	1.0
AIW-6	9	19	6.3	6	0	6	6	6	6	4.8
AIW-7	8	18	5.6	5	6	5	5	5	5	5.2
AIW-8	6.5	16.5	4.5	9	5	9	9	9	9	8.2
AIW-9	14	24	9.7	10	9	0	0	0	0	1.8
AIW-10	16	26	11.1	10	0	5	6	6.5	7.5	5.0
AIW-11	7	25.5	4.9	10	6.5	0	0	0	0	1.3
AIW-12	16	26	11.1	10	0	0	0	0	0	0.0
AIW-13	16	26	11.1	10	0	0	0	0	0	0.0
AIW-14	15	25	10.4	9	off	off	off	off	8.5	8.5
AIW-15	15	25	10.4	9	0	0	0	0	0	0.0
AIW-16	15	25	10.4	9	0	0	0	0	0	0.0
AIW-17	14	25	9.7	9	0	0	0	0	0	0.0
AIW-18	15	25	10.4	9	0	0	0	0	0	0.0
AIW-19	15	25	10.4	9	0	0	0	0	0	0.0
AIW-20	18	28	12.5	6	0	0	0	0	0	0.0
AIW-21	18	28	12.5	6	0	0	0	0	0	0.0
Total air flow:				179	43.5	48.0	50.0	47.0	62.5	
Pressure (psi):					3.7	3.7	3.5	3.8	3.7	

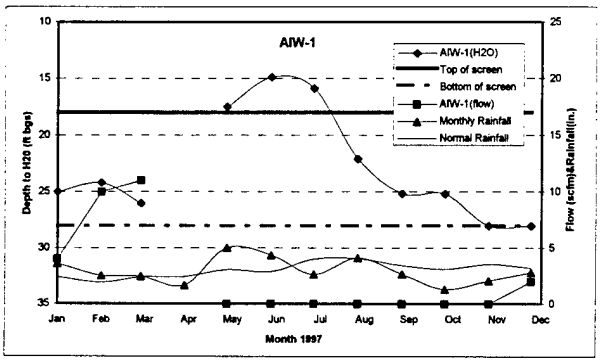
Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results August 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	September 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	October 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	November 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	December 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)
MP 3-1-5.5	5.5	6		No flow			No flow			No flow			No flow			No Soil Gas		
MP 3-1-11.5	11.5	12		Water			Water			Water			Water			Samples Collected		
MP 3-2-8.0	8	8.5		No flow			Water			Water			Water			due to Winter Conditions		
MP3-2-14.0	14	14.5		No flow			No flow			No flow			No flow					
MP 3-3-11.5	11.5	12	O_2 Sensor	no			19.4	na	na	19.6	na	na	18.7	na	na	17.0	na	na

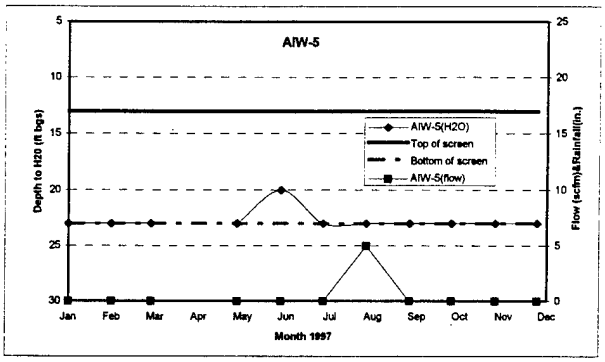
[1] Measured from top of casing.

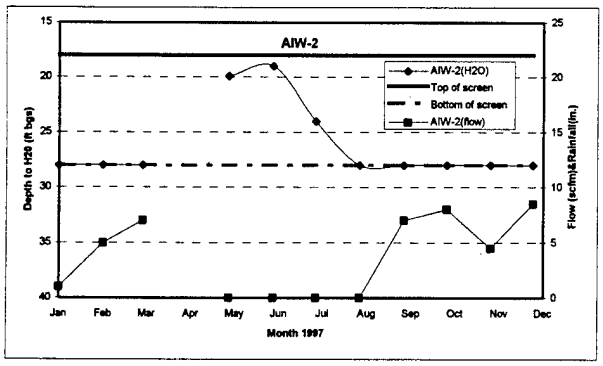
[2] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.

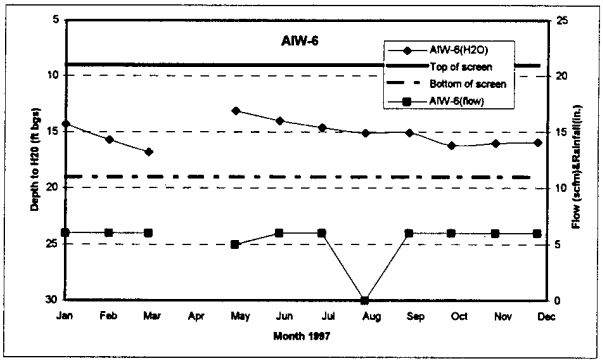
[3] O_2 result represents daily average for month.

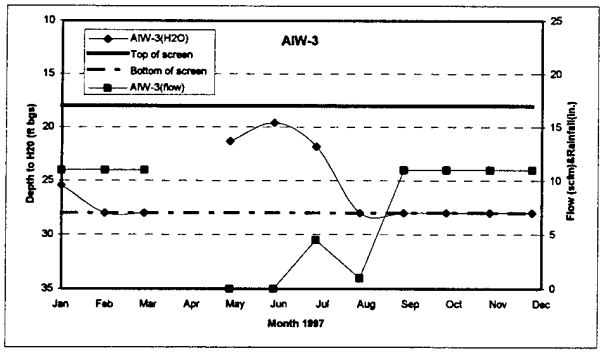
no = not operational, na = not applicable.

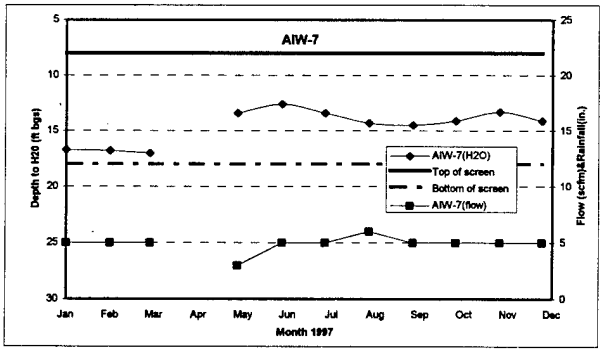


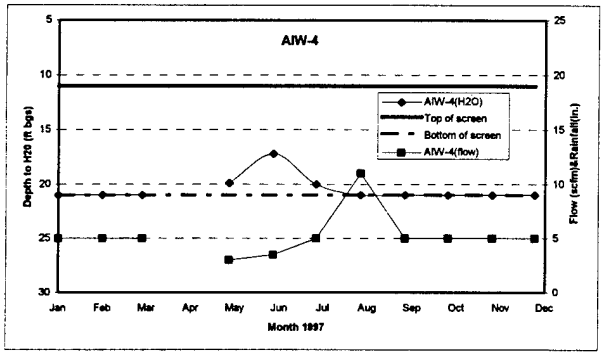












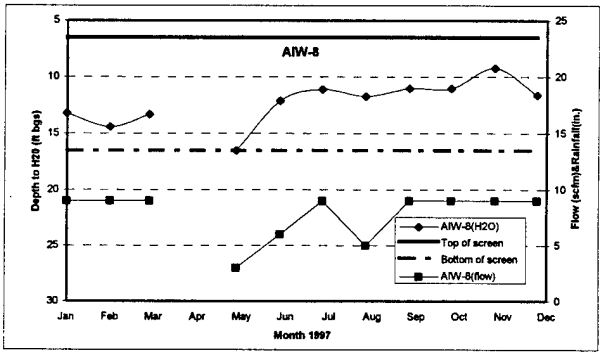
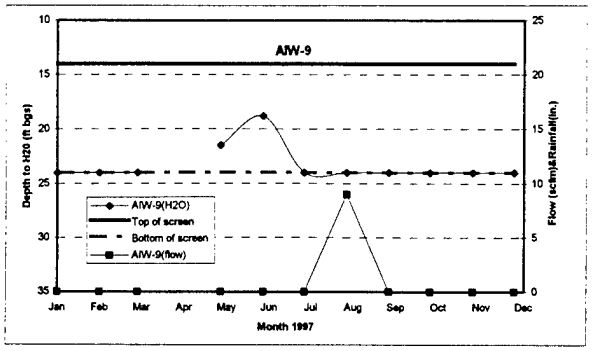
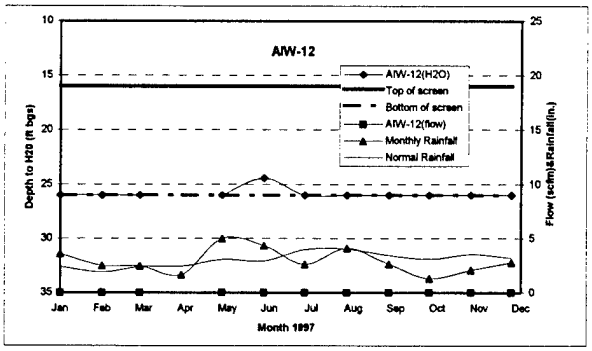
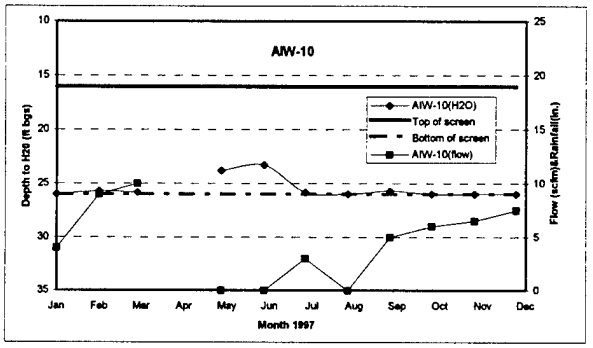
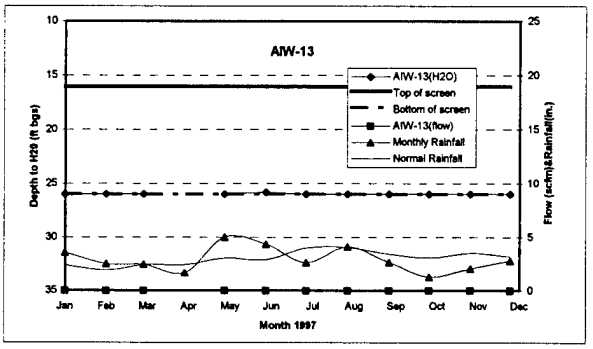


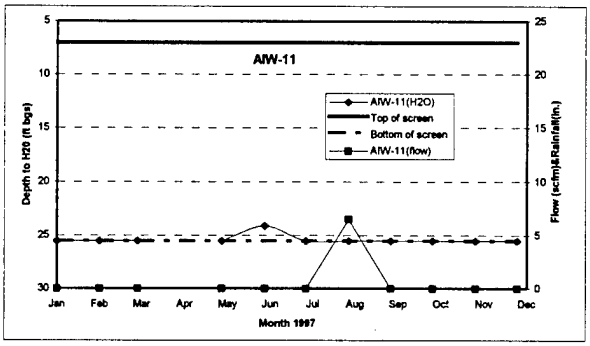
Figure 13-1 Air Flow vs. Depth to Groundwater at NDA-3











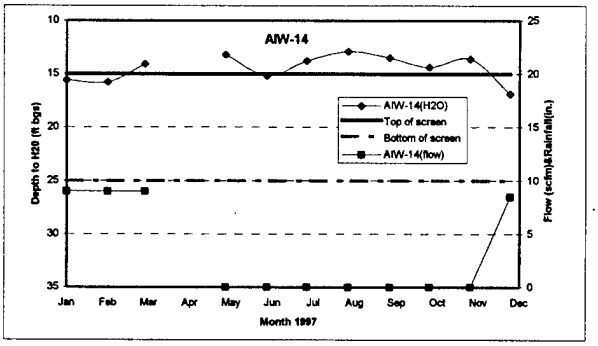


Figure 13-2 Air Flow vs. Depth to Groundwater at NDA-3

Table 13-2 NDA-3 Groundwater Level Data

WELL NO	Well Depth below TOC (ft)	Top of Screen below TOC (ft)	Groundwater Depth Below TOC (ft)											
			Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97
AIW-1	28	18	25	24.2	26	NR	17.5	14.9	15.9	22.1	25.15	25.2	28	28
AIW-2	28	18	28	28	28	NR	19.9	19	24	28	28	28	28	28
AIW-3	28	18	25.4	28	28	NR	21.3	19.6	21.8	28	28	28	28	28
AIW-4	21	11	21	21	21	NR	19.9	17.2	20	21	21	21	21	21
AIW-5	23	13	23	23	23	NR	23	20	23	23	23	23	23	23
AIW-6	19	9	14.3	15.7	16.8	NR	13.1	14	14.6	15.1	15.05	16.2	16	15.9
AIW-7	18	8	16.7	16.8	17	NR	13.4	12.6	13.4	14.3	14.5	14.1	13.3	14.1
AIW-8	16.5	6.5	13.2	14.4	13.3	NR	16.5	12.1	11.1	11.7	11	11	9.2	11.6
AIW-9	24	14	24	24	24	NR	21.5	18.8	24	24	24	24	24	24
AIW-10	26	16	26	25.7	25.8	NR	23.8	23.3	25.8	26	25.7	26	26	26
AIW-11	25.5	7	25.5	25.5	25.5	NR	25.5	24.1	25.5	25.5	25.5	25.5	25.5	25.5
AIW-12	26	16	26	26	26	NR	26	24.4	26	26	26	26	26	26
AIW-13	26	16	26	26	26	NR	26	25.8	26	26	26	26	26	26
AIW-14	25	15	15.6	15.8	14.1	NR	13.2	15.2	13.8	12.9	13.5	14.4	13.6	16.9
AIW-15	25	15	25	25	25	NR	25	22.5	25	25	25	25	25	25
AIW-16	25	15	25	25	25	NR	25	20.3	23.7	25	25	25	25	25
AIW-17	25	14	23.2	24	24.8	NR	19.9	15.9	19.2	21.1	23.7	24.3	25	24.5
AIW-18	25	15	21.8	23.6	22.7	NR	16.3	13.6	17.5	21	22.8	22.1	21.7	22.1
AIW-19	25	15	21.8	23.8	25	NR	16.6	13.7	17.7	20.6	22.25	21.4	21.1	22.2
AIW-20	28	18	28	28	28	NR	26	21.9	28	28	28	28	28	28
AIW-21	28	18	13.9	13.3	16	NR	13.9	12.3	12.6	15	12.9	14.2	13.5	14

NR = not recorded because system down March 21, 1997 to April 15, 1997 with electrical problems.
Boxed value indicates water level is at or above the top of the screen.
TOC = top of casing.

14.0 NOSE DOCK AREA #4

14.1 OPERATIONS

The COE installed the NDA biovent systems in OU 5 during the fall of 1996 and initiated system startup in October and November. The COE biovent removal action report for these systems presents relevant data. BEI began formal O&M on December 1, 1996. Since BEI assumed responsibility for O&M, this biovent system had operated 364 days through December 31, 1997. The entire system was shut down during October and November because nearby construction had damaged the air hoses.

14.2 CONCLUSIONS AND RECOMMENDATIONS

Half of the 36 AIWs averaged 0 scfm throughout the reporting period (Table 14-1). Although this number decreased during May through July 1997, there remain distinct areas within NDA-4 where air injection has not occurred. After a year of operation, the western boundary and northeast arm have not accepted air (see Figure 11-1). The east side of the western arm and the area just east of the support building accepted air at or below the design rate for most of August, September, and December. As shown on Figure 11-1, elevated groundwater levels in the AIWs were common during the reporting period but only a few wells were fully inundated (i.e., AIW 4-4, -11, -23, -24, and -29). Saturated conditions are shown along the AIW east arm groundwater cross section presented on Figure 11-1. Figures 14-1 and 14-2 includes graphs that illustrate the fluctuating groundwater and air flow at all wells along the cross section. Table 14-2 provides 1997 groundwater depths at each AIW.

Prior to this report, the only monitoring data available at NDA-4 were the oxygen data from MP 4-6-15. Beginning in August 1997, soil gas samples became available at three MPs (MPs 4-2BG-5, 4-3-4, and 4-5-5) and another MP starting in July (MP 4-1-16) (Table 14-1 and Figure 11-1).

Respiration tests had not been performed at any NDA-4 MPs prior to October 1997. Respiration tests were performed at MP 4-2BG and MP 4-4 beginning on October 7, 1997 (Figure A-11). Background location MP 4-2BG had an oxygen utilization rate of 0.05 percent/hour, similar to expected background levels. MP 4-4, located at 10 ft bgs, had an oxygen utilization rate of 0.77 percent/hour, indicative of active biodegradation. MP 4-4 is over 60 ft from AIWs 4-7 and 4-9, which had been receiving air in August and September but were turned off during the week ending September 27, approximately 10 days before the respiration test. Adjacent AIW 4-32 and AIW 4-8 have never accepted air.

Overall Recommendation for NDA-4: It is recommended that bioventing be discontinued at the two areas of NDA-4 noted in the first paragraph above (identified on Figure 11-1). Other alternatives need to be evaluated at these locations. Contaminated soils remain above the groundwater table in these areas, although partially saturated conditions are likely to exist. Connect systems NDA-4 and NDA-5 together and run with one blower to save operations costs;

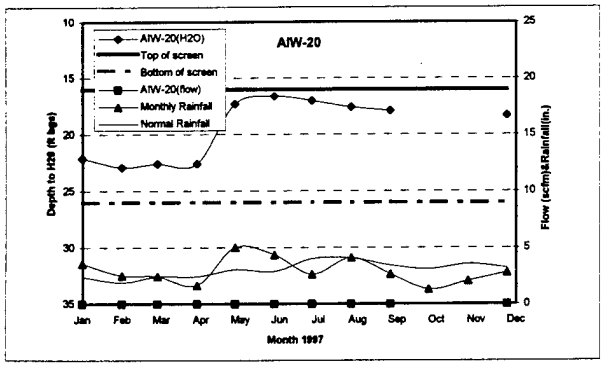
the total flow presently accepted by both systems is less than the capacity of a single blower. Use the blower from NDA-5 for this hookup. The current system design allows for easy interconnection of these two sytems because a hose with a closed valve already connects the two areas. Collect soil samples in the two ineffective areas noted above as soon as possible this spring and throughout the remainder of NDA-4 beginning in June 1998.

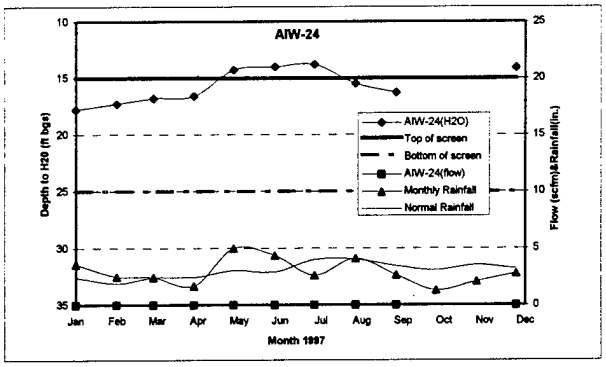
Table 14-1 NDA-4 Air Flow and Monitoring Point Data

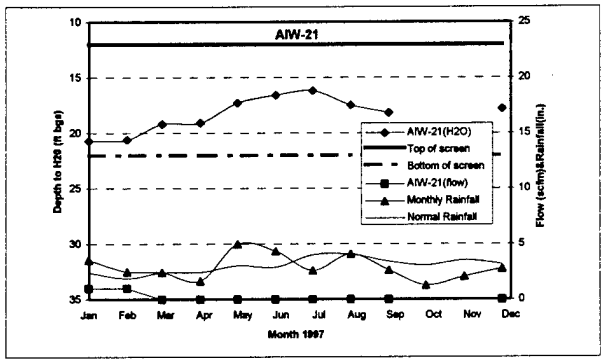
Air Injection Well	Screen Interval top[1]	Screen Interval bottom[1]	Overburden Pressure[2] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) August 1997	September 1997	October 1997	November 1997	12/97	Average Aug - Dec
AIW-1	14	24	9.7	10	10	10	Shut down	Shut down	10	10.0
AIW-2	8	18	5.6	9	0	0	due to	due to	0	0.0
AIW-3	6	16	4.2	9	9	9	Construction	Construction	9	9.0
AIW-4	11	21	7.6	9	0	0	in Area	in Area	0	0.0
AIW-5	11	21	7.6	9	6	9			9	8.0
AIW-6	8	18	5.6	9	8	8			8	8.0
AIW-7	11	21	7.6	9	3.5	6			7	5.5
AIW-8	9	19	6.3	9	0	0			0	0.0
AIW-9	8	18	5.6	9	6	3.5			6	5.2
AIW-10	8	18	5.6	9	0	0			0	0.0
AIW-11	7	17	4.9	8	7	0			2	3.0
AIW-12	6	12	4.2	5	0	0			0	0.0
AIW-13	6	12	4.2	5	4	4			3.5	3.8
AIW-14	6	13	4.2	5	0	0			1	0.3
AIW-15	6	11	4.2	4	2	4			4	3.3
AIW-16	6	12	4.2	5	5	4.5			5	4.8
AIW-17	6	11	4.2	4	4	2			4	3.3
AIW-18	6	12	4.2	5	0	0			0	0.0
AIW-19	6	12	4.2	5	0	0			0	0.0
AIW-20	16	26	11.1	11	0	0			0	0.0
AIW-21	12	22	8.3	11	0	0			0	0.0
AIW-22	15	25	10.4	10	0	0			0	0.0
AIW-23	15	25	10.4	10	0	0			0	0.0
AIW-24	15	25	10.4	10	0	0			0	0.0
AIW-25	15	25	10.4	10	0	0			0	0.0
AIW-26	7	15	4.9	10	10	10			10	10.0
AIW-27	6	14	4.2	6	0	0			0	0.0
AIW-28	8	16	5.6	7	1	0			1	0.7
AIW-29	6	14	4.2	6	5.5	6			6	5.8
AIW-30	6	13	4.2	5	5	4			5	4.7
AIW-31	6	13	4.2	5	5	5			5	5.0
AIW-32	12	22	8.3	5	0	0			0	0.0
AIW-33	16	26	11.1	5	0	0			0	0.0
AIW-34	16	26	11.1	5	0	0			0	0.0
AIW-35	16	26	11.1	5	0	0			0	0.0
AIW-36	5	8	3.5	5	9	9			10	
Total air flow:				263	100.0	94.0			105.5	
Pressure (psi):					2.2	2.2			1.7	

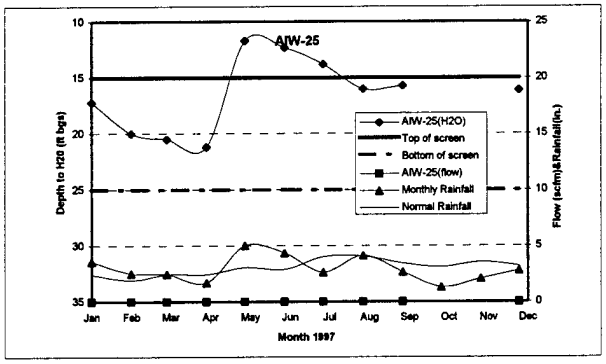
Monitoring Point	Screen Interval top	Screen Interval bottom		Soil Gas Sampling Results August 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	September 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	October 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	November 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	December 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)
MP 4-1-7.0	6.5	7			Water			Water			Water							
MP 4-1-16.0	15.5	16			Water		2.9	8.0	1.72%	8.1	5.7	nr		No Soil Gas Samples Collected			No Soil Gas Samples Collected	
MP 4-2BG-5.0	5	10	O_2 Util. Rate = 0.05%/hr[4]	16.3	6.5	14.7		Water		7.9	6.5	nr					due to Winter Conditions	
MP 4-3-4.0	3.5	4		19.3	1.1	8.5		Water			No flow							
MP 4-4-10.0	9.5	10	O_2 Util. Rate = 0.77%/hr[4]		Water			No flow		3.0	38.0	nr						
MP 4-5-5.0	4.5	5		4.0	31.3	16.5		No flow			No flow							
MP 4-6-15	15	15	O_2 Sensor	14.5	na	na	16.0	na	na	16.9	na	na	17.3	na	na	17.7	na	na
MP 4-7-8.0	7.5	8			Water			Water			Water							
MP 4-7-15.0	14.5	15			No flow			No flow			No flow							
MP 4-8-8.0	7.5	8			Water			Water			No flow							
MP 4-8-15.0	14.5	15			Water			No flow			No flow							
MP 4-9-8.5	8	8.5			Water			No flow			No flow							
MP 4-9-16.0	15.5	16			Water			Water			No flow							
MP 4-10-8.0	7.5	8			No flow			No flow			No flow							
MP4-10-15.0	14.5	15			Water			No flow			No flow							

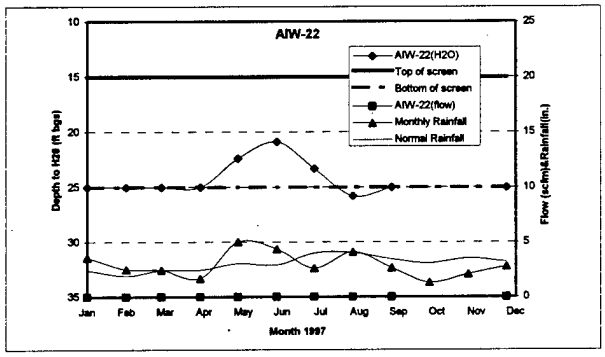
[1] Measured from top of casing.
[2] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[3] O_2 result represents daily average for month.
[4] Test performed on 10/7/97.
na = not applicable, nr = no reading.

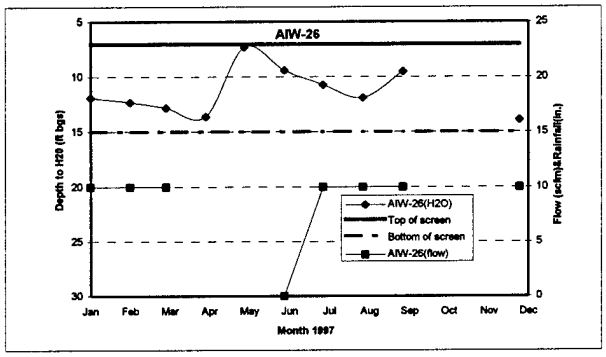


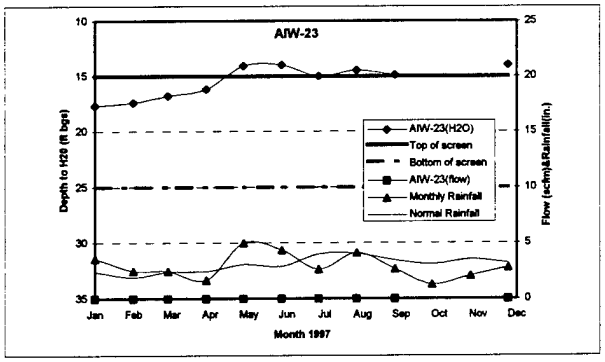












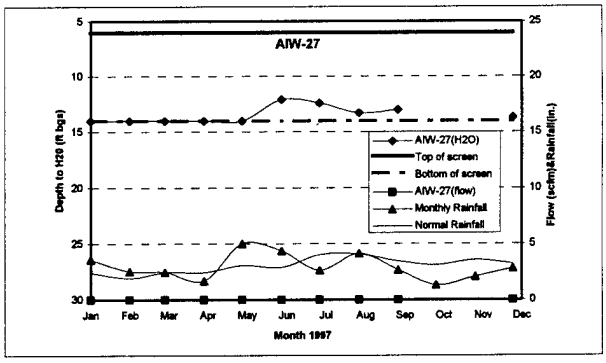
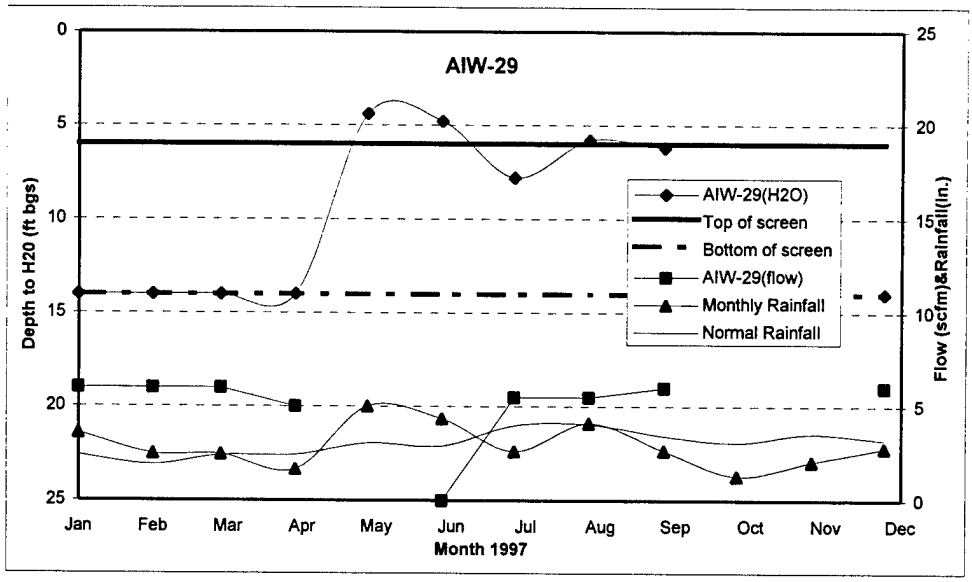
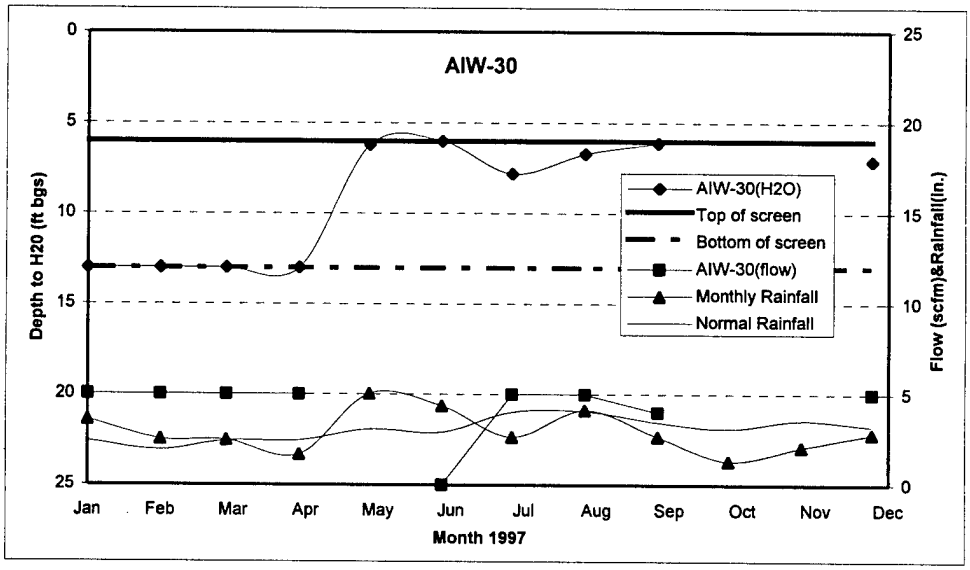


Figure 14-1 Air Flow vs. Depth to Groundwater at NDA-4





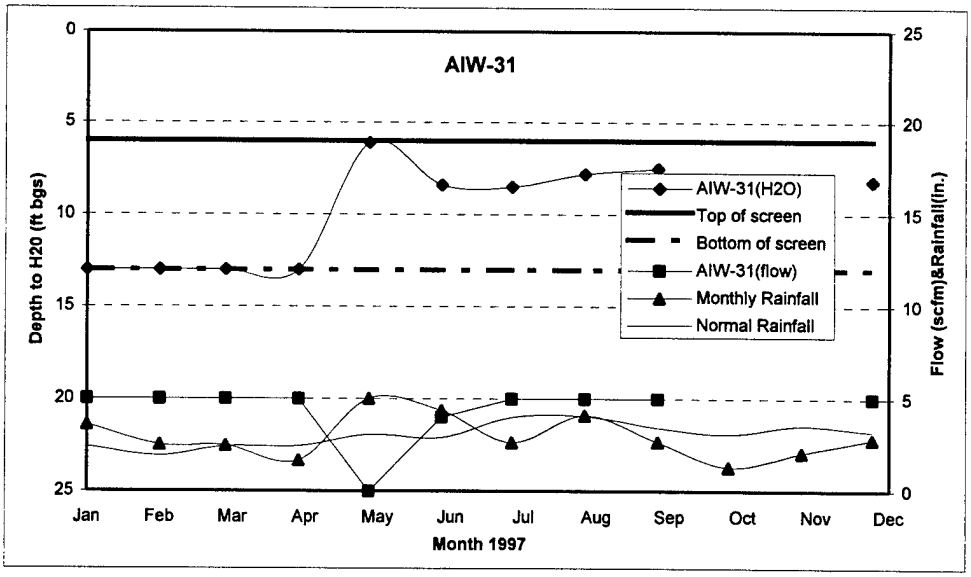


Figure 14-2 Air Flow vs. Depth to Groundwater at NDA-4

Table 14-2 NDA-4 Groundwater Level Data

WELL NO	Well Depth below TOC (ft)	Top of Screen below TOC (ft)	Groundwater Depth Below TOC (ft)											
			Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97
AIW-1	24	14	24	24	24	24	20.4	20	22.2	24	24	NR	NR	24
AIW-2	18	8	18	18	18	18	18	18	13.2	17.5	18	NR	NR	16.2
AIW-3	16	6	16	16	16	16	8.1	11.9	11	14.3	14.5	NR	NR	14.2
AIW-4	21	11	6.4	21	21	21	2.9	4.4	9.8	12.4	10.35	NR	NR	15.1
AIW-5	21	11	16.3	21	21	21	13.5	12.3	17.3	21	19.2	NR	NR	21
AIW-6	18	8	18	18	18	18	18	18	18	18	18	NR	NR	18
AIW-7	21	11	21	21	21	21	21.8	17	20.6	20.8	21	NR	NR	21
AIW-8	19	9	19	19	19	19	19	19	19	19	19	NR	NR	21.8
AIW-9	18	8	18	18	18	18	6.7	11.4	18	18	12.2	NR	NR	9.2
AIW-10	18	8	12.6	16.9	17.5	17.7	16.7	9.9	12.4	16.3	17.7	NR	NR	15.9
AIW-11	17	7	9.7	11.2	13	12.8	3.5	5.1	12.3	13.8	6.6	NR	NR	13.3
AIW-12	12	6	12	12	12	12	7	5.3	5.5	8.5	9.2	NR	NR	12
AIW-13	12	6	12	12	12	12	1.9	3.8	8	8.7	9.9	NR	NR	12
AIW-14	13	6	13	13	13	13	8.1	8.9	10.3	13	13.7	NR	NR	11.1
AIW-15	11	6	11	11	11	11	5.2	5.2	8.9	10.2	10.1	NR	NR	9.5
AIW-16	12	6	8	8.6	8.6	12	3.8	5	7.9	7.6	7.2	NR	NR	8.7
AIW-17	11	6	9.6	9.8	10.6	11	4.4	5.3	7.6	9	7.2	NR	NR	8.6
AIW-18	12	6	12.2	12.6	9.6	8.3	6.1	5.1	8.7	10.7	9.5	NR	NR	10.5
AIW-19	12	6	12.2	12.2	12.2	12.2	5.9	4.9	9	11.5	11.4	NR	NR	10.9
AIW-20	26	16	22.1	22.9	22.6	22.6	17.3	16.6	17	17.6	17.9	NR	NR	18.3
AIW-21	22	12	20.7	20.6	19.2	19.1	17.3	16.6	16.2	17.5	18.2	NR	NR	17.8
AIW-22	25	15	25	25	25	25	22.4	20.9	23.3	25.8	25	NR	NR	25
AIW-23	25	15	17.7	17.4	16.8	16.2	14.1	14	15	14.5	14.9	NR	NR	14
AIW-24	25	15	17.8	17.3	16.8	16.6	14.3	14	13.8	15.5	16.3	NR	NR	14.1
AIW-25	25	15	17.2	20	20.5	21.2	11.7	12.3	13.8	16	15.7	NR	NR	16.1
AIW-26	15	7	11.9	12.3	12.8	13.6	7.3	9.4	10.7	11.9	9.5	NR	NR	13.9
AIW-27	14	6	14	14	14	14	14	12.1	12.4	13.3	13	NR	NR	13.7
AIW-28	16	8	16	16	16	16	15.3	14.7	12.5	14	12.6	NR	NR	13.6
AIW-29	14	6	14	14	14	14	4.4	4.8	7.8	5.8	6.2	NR	NR	14
AIW-30	13	6	13	13	13	13	6.2	6	7.8	6.7	6.1	NR	NR	7.1
AIW-31	13	6	13	13	13	13	6.1	8.4	8.5	7.8	7.5	NR	NR	8.2
AIW-32	22	12	22	22	22	22	22	22	22	22	22	NR	NR	22
AIW-33	26	16	26	26	26	26	20.1	18.3	22	23.3	26	NR	NR	26
AIW-34	26	16	26	26	26	26	19.9	17.8	21.8	22.7	25	NR	NR	26
AIW-35	26	16	26	26	25	26	19.5	18	21.6	22.6	23.9	NR	NR	24.9
AIW-36	8	5	8	8	8	8	3	5.1	6.3	5.9	5.9	NR	NR	8

Boxed value indicates water level is at or above the top of the screen.
NR = not recorded because system down October and November due to construction in area.
TOC = top of casing.

15.0 NOSE DOCK AREA #5

15.1 OPERATIONS

The COE installed the NDA biovent systems in OU 5 during the fall of 1996 and initiated system startup in October and November. The COE biovent removal action report for these systems presents relevant data. BEI began formal O&M on December 1, 1996. Since BEI assumed responsibility for O&M, this biovent system had operated 363 days through December 31, 1997. The entire system was shut down during October and November because nearby construction had damaged the air hoses.

15.2 CONCLUSIONS AND RECOMMENDATIONS

During August, September, and December 1997, the air injection rates for most AIWs were at or slightly less than the design rate (Table 15-1). AIWs 5-2, -5, and -20 have not accepted air since startup in December 1996. Only two other AIWs remain significantly below the design rate (AIW 5-6 and 5-21). Since these wells are scattered throughout NDA-5, there are no significant areas not receiving air. Table 15-2 provides 1997 AIW groundwater levels. Partially saturated AIWs were predominantly located in the northern end of NDA-5, in close proximity to NDA-4. Figures 15-1 and 15-2 includes graphs that illustrate the fluctuating groundwater levels and air flow at all wells along the cross section.

In August, only two of six MPs could not be sampled for soil gas; MP 5-5 and 5-6 have never been able to produce samples. By October, only one of the six MPs could be sampled. Oxygen sensor readings began in October at MP 5-3. All oxygen data derived from soil gas samples to date indicate that oxygen levels are fairly high (i.e., 18.3 to 20.8 percent). The oxygen sensor (MP 5-3) has shown lower levels in the range of 15.9 to 16 percent, which may be an indication that biodegradation is occurring. No respiration tests were performed due to high oxygen levels (MP-5-4) or no flow or saturated conditions (all other MPs).

Overall Recommendation for NDA-5: Oxygen levels should be collected from MPs after the system has been shut down for 48 hours to determine whether biodegradation is occurring. If oxygen levels remain high; soil samples should be collected throughout NDA-5 to determine whether contamination still exists. If contamination does exist, additional MPs should be installed and the system left running for another 6 to 12 months. Connect systems NDA-4 and NDA-5 together and run with one blower to save operations costs; the total flow presently accepted by both systems is less than the capacity of a single blower. Use the blower from NDA-5 for this hookup. The NDA-5 blower and ancillary system components will remain shut down until it can be used at another site. The current system design allows for easy interconnection of these two systems because a hose with a closed valve already connects the two areas. Collect soil samples throughout NDA-5 beginning in June 1998.

Table 15-1 NDA-5 Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval top[1]	Screen Interval bottom[1]	Overburden Pressure[2] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) August 1997	September 1997	October 1997	November 1997	12/97	Average Aug - Dec
AIW-1	5	8	3.5	9	0	2	Shut down	Shut down	3	1.7
AIW-2	5	8	3.5	9	0	0	due to	due to	0	0.0
AIW-3	6	9	4.2	9	0	0	Construction	Construction	1	0.3
AIW-4	6	11	4.2	5	5	5	in Area	in Area	5	5.0
AIW-5	8	14	5.6	6	0	0			0	0.0
AIW-6	7	13	4.9	6	0	0			6	2.0
AIW-7	7	13	4.9	6	6	5.5			6	5.8
AIW-8	7	13	4.9	6	6	6			6	6.0
AIW-9	7	13	4.9	7	7	7			7	7.0
AIW-10	7	13	4.9	7	7	3			7	5.7
AIW-11	6	12	4.2	6	6	6			6	6.0
AIW-12	7	13	4.9	7	5	7			7	6.3
AIW-13	6	11	4.2	6	6	6			6	6.0
AIW-14	6	11	4.2	6	1	2			3	2.0
AIW-15	6	10	4.2	7	7	6.5			7	6.8
AIW-16	6	10	4.2	7	7	7			7	7.0
AIW-17	6	11	4.2	7	7	7			7	7.0
AIW-18	6	10	4.2	7	7	7			7	7.0
AIW-19	6	10	4.2	7	7	7			7	7.0
AIW-20	6	10	4.2	7	0	0			0	0.0
AIW-21	6	9	4.2	6	0	0			0	0.0
AIW-22	6	10	4.2	7	7	7			7	7.0
AIW-23	6	11	4.2	6	0	0			0	0.0
AIW-24	5	8	3.5	6	1	3			4	2.7
AIW-25	6	9	4.2	6	6	off			1	3.5
AIW-26	5	8	3.5	6	6	6			6	6.0
AIW-27	4	7	2.8	5	5	off			1	3.0
AIW-28	4	7	2.8	5	0	5			0	1.7
AIW-29	4	6	2.8	5	0	0			0	0.0
Total air flow:				189	109.0	105.0			117.0	
Pressure (psi):					2.2	2.4			3.5	

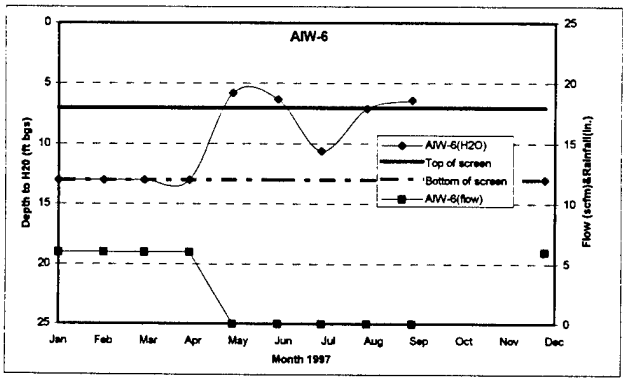
Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results August 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	September 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	October 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	November 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	December 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)
MP 5-1-9.5	9.5	10		18.4	2.0	40.1	18.4	2.0	40.1		No flow							
MP 5-2-3.5	3.5	4		18.3	4.5	47.5		No flow			No flow							
MP 5-3-7	7	7	O_2 Sensor[4]	no			no			16.0	na	na	15.9	na	na	18.6	na	na
MP 5-4-7.0	7	7.5		20.8	0.0	nr	20.6	0.0	111	20.1	0.0	0.0				No Soil Gas		
MP 5-5-7.0	7	7.5			No flow			Water			Water					Samples Collected		
MP 5-6-5.5	5.5	6			No flow			Water			Water					due to Winter Conditions		
MP 5-8-3.0	3	3.5		20.7	0.0	4.6	-	Water			No flow							

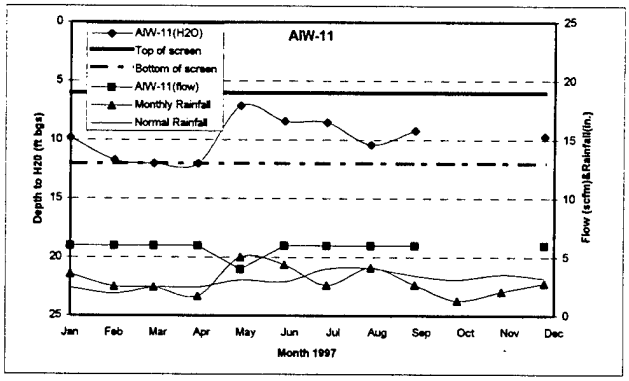
[1] Measured from top of casing.
[2] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[3] O_2 result represents daily average for month.
nr = no reading, no = not operational.

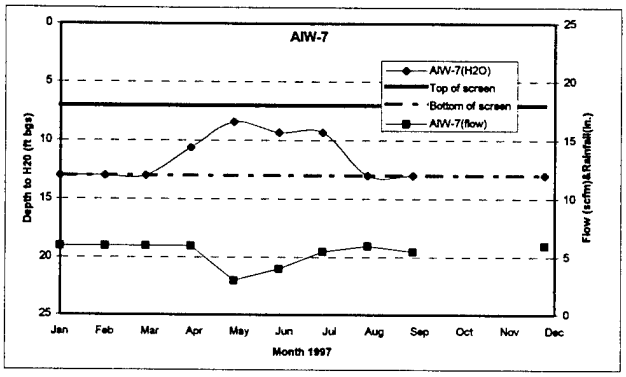
Table 15-2 NDA-5 Groundwater Level Data

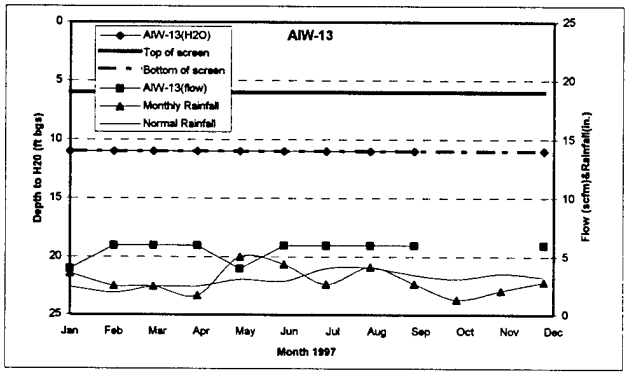
WELL NO	Well Depth below TOC (ft)	Top of Screen below TOC (ft)	Groundwater Depth Below TOC (ft)											
			Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97
AIW-1	8	5	8	8	8	8	5	5.4	7.3	8	8	NR	NR	8
AIW-2	8	5	8	8	8	8	8	8	8	8	8	NR	NR	8
AIW-3	9	6	9	9	9	9	10.5	8.4	8.8	9	9	NR	NR	9
AIW-4	11	6	9.3	10.1	11	11	10.5	8	8.6	11	8.3	NR	NR	11
AIW-5	14	8	14	14	14	14	13.2	7.8	8.7	13.3	13.9	NR	NR	12.1
AIW-6	13	7	13	13	13	13	5.8	6.3	10.6	7.1	6.4	NR	NR	13
AIW-7	13	7	13	13	13	10.6	8.4	9.3	9.3	13	13	NR	NR	13
AIW-8	13	7	11.8	13	13	13	8.1	10.6	11	11.9	13	NR	NR	11.6
AIW-9	13	7	10.6	11.8	12.5	13	9.1	10.7	10.9	12	13.9	NR	NR	11.4
AIW-10	13	7	13	9.8	13	13	5.6	5.1	7.8	11.7	13	NR	NR	11.2
AIW-11	12	6	9.8	11.7	12	12	7.1	8.4	8.5	10.4	9.2	NR	NR	9.7
AIW-12	13	7	9.2	11.4	13	12.8	9.3	10	10.4	13	13	NR	NR	13
AIW-13	11	6	11	11	11	11	11	11	11	11	11	NR	NR	11
AIW-14	11	6	11	11	11	8.8	3.9	5.6	10.6	11	11.3	NR	NR	11
AIW-15	10	6	10	10	10	10	10	10	10	10	10	NR	NR	10
AIW-16	10	6	10	10	10	10	10	10	10	10	10	NR	NR	10
AIW-17	11	6	10.1	10.25	11	11	7.8	8.8	8.7	9.5	11	NR	NR	9.4
AIW-18	10	6	10	10	10	10	10	10	10	10	10	NR	NR	10
AIW-19	10	6	10	10	10	10	10	10	10	10	10	NR	NR	10
AIW-20	10	6	10	10	10	10	10	10	9.3	10	10	NR	NR	10
AIW-21	9	6	9	9	9	9	7.9	8	9	9	9	NR	NR	9
AIW-22	10	6	10	10	10	10	10	10	10	10	10	NR	NR	10
AIW-23	11	6	11	11	11	11	11	11	8.3	11	11	NR	NR	11
AIW-24	8	5	8	8	8	8	8	8	8	8	8	NR	NR	8
AIW-25	9	6	9	9	9	9	9	6.7	9	9	9	NR	NR	9
AIW-26	8	5	8	8	8	8	8	8	8	8	8	NR	NR	8
AIW-27	7	4	7	7	7	7	8.4	4.9	7	7	7	NR	NR	7
AIW-28	7	4	7	7	7	7	7	7	7	7	7	NR	NR	7
AIW-29	6	4	6	6	6	6	2.3	4	5.7	6	6	NR	NR	6

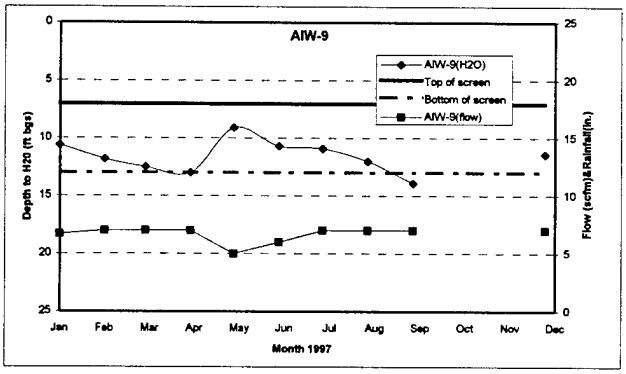
Boxed value indicates water level is at or above the top of the screen.
TOC = top of casing.











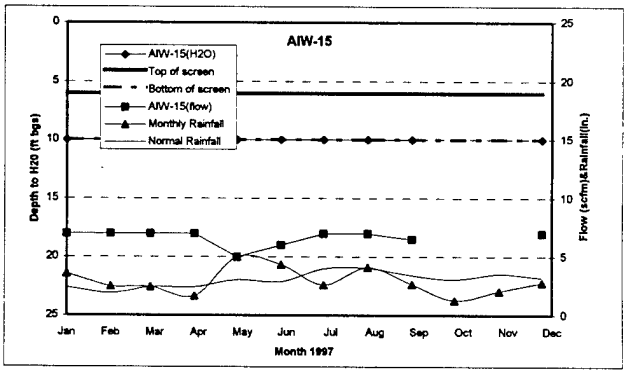
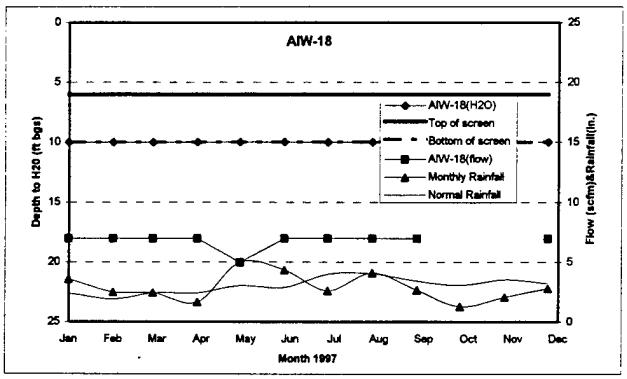
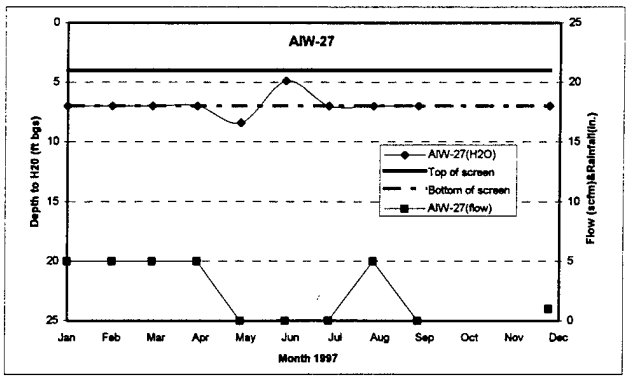
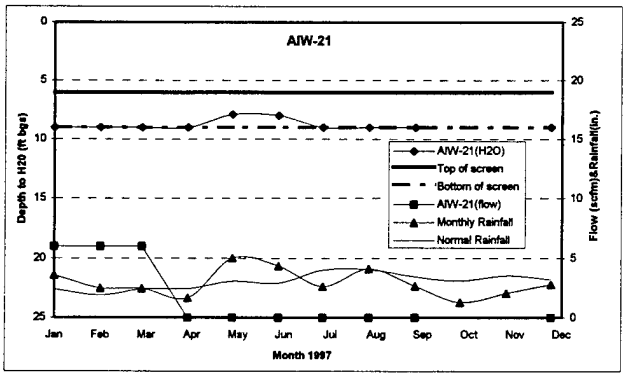
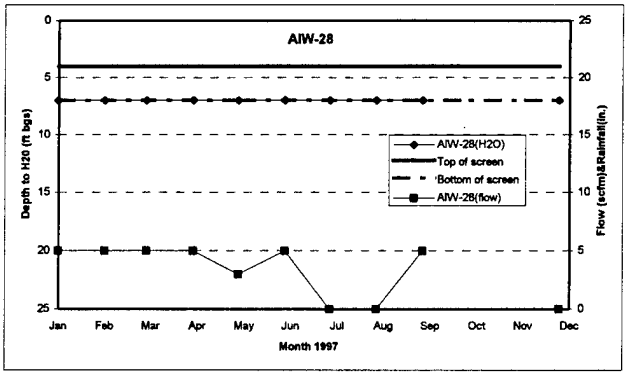


Figure 15-1 Air Flow vs. Depth to Groundwater at NDA-5









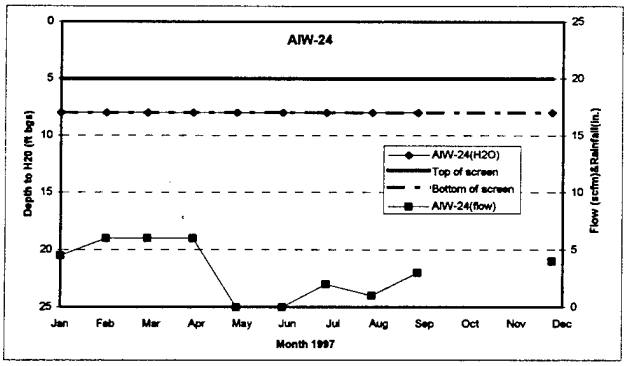


Figure 15-2 Air Flow vs. Depth to Groundwater at NDA-5

16.0 NOSE DOCK AREA #6

16.1 OPERATIONS

The COE installed the NDA biovent systems in OU 5 during the fall of 1996 and initiated system startup in October and November. The COE biovent removal action report for these systems presents relevant data. BEI began formal O&M on December 1, 1996. Since BEI assumed responsibility for O&M, this biovent system had operated 428 days through December 31, 1997.

16.2 CONCLUSIONS AND RECOMMENDATIONS

Only one of the four AIWs is operating (AIW-2); the other three were turned off at the request of researchers at the University of Maine at Orono (Table 16-1). Currently, a graduate student writing a master's thesis on bioventing has been granted use of NDA #6 for research purposes. Operation, therefore, is conducted in conjunction with research activities at the site. No modifications are anticipated to occur to this system. Monthly air flow readings and MP data are presented on Table 16-1. AIW-2 operated per design through this reporting period. Water levels for the AIWs are presented on Table 16-2.

During a respiration test at MP-6-2BG-7 in October, the oxygen utilization rate was determined to be 0.06 percent/hour, which is representative of background levels (Figure A-12). A new oxygen sensor (MP-6-4-5.5) was installed near AIW-6-2 (Figure 11-1, foldout) on July 29, 1997. The new oxygen sensor added to NDA-6 produced monthly oxygen readings of 19.1, 16.3, 17.3, and 16.9 percent from October through December. These levels may be indicative of biodegradation. As noted in the last semiannual report, the background location appears to be within contaminated soils; the oxygen levels are unusually low (11.5 and 12.9 percent). No volatiles were noted, and carbon dioxide levels are relatively low.

Overall Recommendation for NDA-6: Recommendation to return all AIWs to operation as soon as possible. Collect soil samples throughout NDA-6 beginning in June 1998.

Table 16-1 NDA-6 Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval top[1]	Screen Interval bottom[1]	Overburden Pressure[2] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) August 1997	September 1997	October 1997	November 1997	12/97	Average Aug - Dec
AIW-1	8	18	5.6	7						
AIW-2	8	18	5.6	7	8.0	7.0	7.0	7.0	7.0	7
AIW-3	8	18	5.6	7						
AIW-4	8	18	5.6	7						
Total air flow:				28	8.0	7.0	7.0	7.0	7.0	
Pressure (psi):					2.1	2.1	2.2	2.2	2	

Monitoring Point	Screen Interval top	Screen Interval bottom		Soil Gas Sampling Results August 1997 O_2 (%)[3]	August 1997 CO_2 (%)	August 1997 TVH (ppmv)	September 1997 O_2 (%)[3]	September 1997 CO_2 (%)	September 1997 TVH (ppmv)	October 1997 O_2 (%)[3]	October 1997 CO_2 (%)	October 1997 TVH (ppmv)	November 1997 O_2 (%)[3]	November 1997 CO_2 (%)	November 1997 TVH (ppmv)	December 1997 O_2 (%)[3]	December 1997 CO_2 (%)	December 1997 TVH (ppmv)
MP 6-1-4	4	4	O_2 Sensor							Water covering sensor			Water covering sensor			No Soil Gas		
MP 6-2BG-7.0	7	12	O_2 Util. Rate = 0.06%/hr[4]	19.5	0.5	1.8	12.9	4.2	-0.7	11.5	3.6	3.7	19.0	0.7	0	Samples Collected		
MP 6-3-8	8	8.5		Water			Water			Water			No flow			due to Winter Conditions		
MP 6-4-5.5	5.5	6	O_2 Sensor	no			19.1	na	na	16.3	na	na	17.3	na	na	16.9	na	na

[1] Measured from top of casing.
[2] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[3] O_2 result represents daily average for month.
[4] Test performed on 10/13/97.
na = not applicable, no = not operational.

Table 16-2 NDA-6 Groundwater Level Data

WELL NO	Well Depth below TOC (ft)	Top of Screen below TOC (ft)	Groundwater Depth Below TOC (ft)											
			Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97
AIW-1	18	8	7.3	18	18	NR	6	7.6	7.3	7.4	7.2	7.7	7.6	8
AIW-2	18	8	11.5	18	12.3	12.1	11.6	11.6	11.6	11.8	11.55	11.6	11.3	11
AIW-3	18	8	7.3	18	18	NR	7.6	6.2	5.9	6.45	6.2	6.6	8.5	8.8
AIW-4	18	8	9.6	18	18	NR	12.1	9.4	9.7	10.2	11.5	11.5	11.4	11.4

Boxed value indicates water level is at or above the top of the screen.
TOC = top of casing.

17.0 NOSE DOCK AREA #7

17.1 OPERATIONS

The COE installed the NDA biovent systems in OU 5 during the fall of 1996 and initiated system startup in October and November. The COE biovent removal action report for these systems presents relevant data. BEI began formal O&M on December 1, 1996. Since BEI assumed responsibility for O&M, this biovent system had operated 432 days through December 31, 1997.

17.2 CONCLUSIONS AND RECOMMENDATIONS

Table 17-1 presents the flow at each of the four AIWs since startup. Also included is the design flow rate per AIW, the depth to groundwater in the AIWs noted each month, rainfall data, and oxygen monitoring results. No samples have been collected from MP 7-1 since startup due to no flow or saturated conditions, only 3 month's worth of oxygen data are currently available at oxygen sensor MP 7-2.

All four AIWs have been partially inundated with groundwater from February through December 1997 (Figure 17-1). Table 17-2 contains the depths to groundwater at each of the four AIWs. Between May and August, all of the AIW screens were, on average, 70 percent inundated with groundwater. The AIW-7-3 graph on Figure 17-1 shows that the monthly rainfall for May and June 1997 was well above the normal monthly precipitation totals. In general, air flow at all of the AIWs was affected at the onset of or during high groundwater levels. Both AIW-7-1 and AIW-7-2 accepted air during the warmer spring/summer months; although both had problems from July thereafter (AIW-7-2 actually recovered by October). At MP 7-2, the October and November oxygen sensor readings were 16.9 and 14.4 percent, respectively, which indicates that enhanced respiration was occurring.

Overall Recommendation for NDA-7: Although NDA-7 has operated below design flow capacity most of the time, the potential for more ideal conditions exists. Because there is less than one year's worth of flow data available and the newly available oxygen sensor data indicate that respiration is occurring, it is not recommended to abandon the bioventing effort at this time. The system should be allowed to run through the winter, when air flows are typically at design rates, and continue into the spring of 1998. There is a chance that the greater-than-normal elevated rainfall in May and June 1997 will not be repeated in 1998. If at this time (~June 1998) groundwater levels begin to show similar trends to 1997 and the air flow begins to decrease, other cleanup processes should be evaluated. Providing a surface seal (i.e., polypropylene) should be considered if above normal precipitation occurs. In contrast, if saturation in the wells is minimal and air flow appears not to be affected, operation should be continued into the summer. Collect soil samples throughout NDA-7 beginning in June 1998.

Table 17-1 NDA-7 Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval top[1]	Screen Interval bottom[1]	Overburden Pressure[2] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) August 1997	September 1997	October 1997	November 1997	12/97	Average Aug - Dec
AIW-1	6	21	4.2	9	0	0	0	0	0	0.0
AIW-2	6	21	4.2	9	1	5	8	9	9	6.4
AIW-3	6	21	4.2	9	0	7	9	9	9	6.8
AIW-4	6	21	4.2	9	0	1	0	0	0	0.2
Total air flow:				36	1.0	13.0	17.0	18.0	18.0	13.4
Pressure (psi):					2.2	2.9	2.9	2.4	2.5	

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results August 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	September 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	October 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	November 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	December 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)
MP 7-1-7.0	7	7.5		Water			Water			Water			No flow			nt	nt	nt
MP 7-2-4.5	4.5	5	O_2 Sensor	no			no			16.9	na	na	14.4	na	na	13.8	na	na

[1] Measured from top of casing.
[2] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[3] O_2 result represents daily average for month.
no = not operational, na = not applicable, nt = not collected due to winter conditions.

Table 17-2 NDA-7 Groundwater Level Data

WELL NO	Well Depth below TOC (ft)	Top of Screen below TOC (ft)	Groundwater Depth Below TOC (ft)											
			Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97
AIW-1	21	6	21	21	18.5	18.1	12.4	9.8	9.5	15.6	19.2	19.7	18.5	18.5
AIW-2	21	6	20.8	21	13.8	14.2	10.6	10.1	10	15	16.8	16.3	10.3	14.3
AIW-3	21	6	20.2	21	17.8	15.5	11	8.8	9	14.7	10.1	10.2	14.4	10.6
AIW-4	21	6	20.9	21	17.4	17.2	13	8.6	9	15.1	17.85	18.5	17.9	18.3

TOC = top of casing.

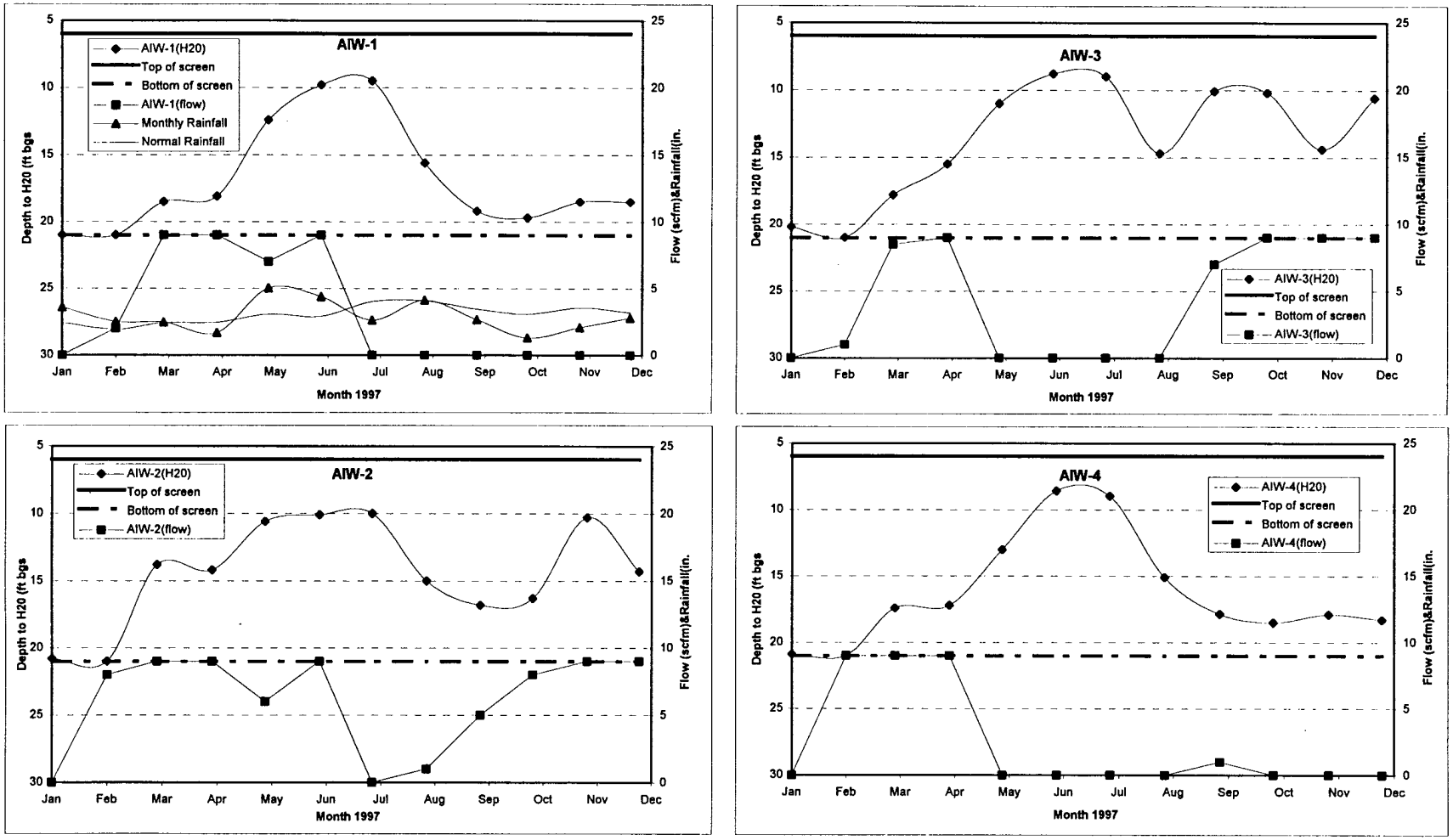


Figure 17-1 Air Flow vs. Depth to Groundwater at NDA-7

18.0 NOSE DOCK AREA #8

18.1 OPERATIONS

The COE installed the NDA biovent systems in OU 5 during the fall of 1996 and initiated system startup in October and November. The COE biovent removal action report for these systems presents relevant data. BEI began formal O&M on December 1, 1996. Since BEI assumed responsibility for O&M, this biovent system had operated 328 days through December 31, 1997. Monthly air flow and MP soil gas sampling results are presented on Table 18-1.

18.2 CONCLUSIONS AND RECOMMENDATIONS

The majority of the AIWs to the north of the support building have remained unable to accept air (Figures 11-1, 18-1 and 18-2). The shaded area on Figure 11-1 indicates the area of NDA-8 where the average air flow was zero, including most of the first half of 1997. The total flow entering the AIWs located south of the support building has increased from the first half of 1997. As shown on Figures 11-1, 18-1 and 18-2, the AIWs south of the support building (AIW 8-11 and above) were inundated with groundwater to levels typically greater than half of the screen throughout the year. Table 18-2 provides depths to groundwater in each AIW during 1997.

Oxygen levels in MPs 3 and 4 indicate that oxygen is abundant (19.4 to 20.7 percent), possibly at levels representing clean conditions. The MPs are located at depths of 8 and 9.5 ft, respectively. MP 2 continues to be unusable because saturated soils surround the screen (i.e., no flow or water in MP). It is unclear why MP 4 indicates high levels of oxygen with none of the surrounding AIWs accepting air; it is possible that the soils surrounding this MP may not be contaminated. The high oxygen levels at MP 3 may indicate that shallow soils (8 to 10 ft) may have been remediated and are approaching cleanup levels.

No respiration tests were performed due to no flow and water in the MPs.

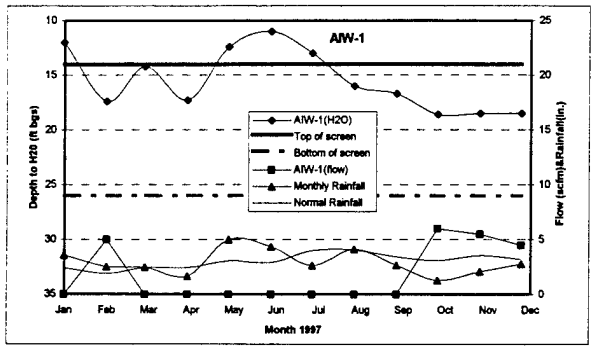
Overall Recommendation for NDA-8: The recommendation is to evaluate another remedial technology applicable to the entire site because of the lack of air injection in the northern end and the high water levels in the southern end of NDA 8. Shallow soils (i.e., upper 10 ft) in the southern end may have been remediated, so soil sampling will be necessary to determine the extent of any remaining contamination. Collect soil samples throughout NDA-8 as soon as possible in spring 1998.

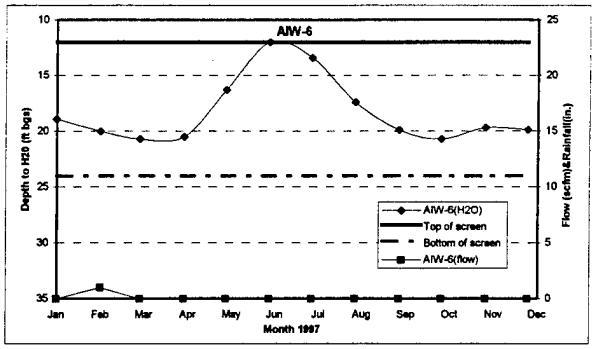
Table 18-1 NDA-8 Air Flow and Monitoring Point Data

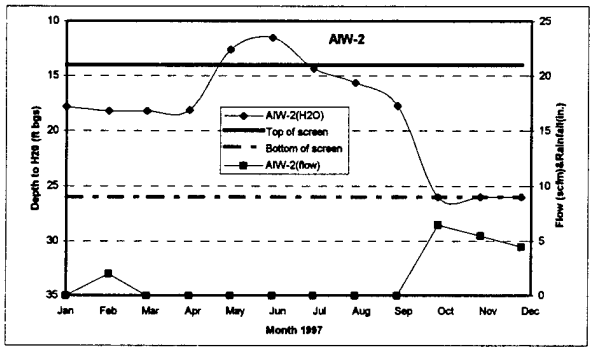
Air Injection Well	Screen Interval top[1]	Screen Interval bottom[1]	Overburden Pressure[2] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) August 1997	September 1997	October 1997	November 1997	12/97	Average Aug - Dec
AIW-1	14	26	9.7	10	0	0	6	5.5	4.5	3.2
AIW-2	14	26	9.7	10	0	0	6.5	5.5	4.5	3.3
AIW-3	13	25	9.0	10	0	0	0	0	0	0.0
AIW-4	13	25	9.0	10	0	0	0	0	0	0.0
AIW-5	12	24	8.3	10	0	0	0	0	0	0.0
AIW-6	12	24	8.3	10	0	0	0	0	0	0.0
AIW-7	11	23	7.6	9	0	0	0	0	0	0.0
AIW-8	10	22	6.9	8	0	1	1	0	1	0.6
AIW-9	11	23	7.6	7	0	0	0	0	0	0.0
AIW-10	10	22	6.9	6	6	6	6	5.5	6	5.9
AIW-11	9	21	6.3	7	7	7	7	7	7	7.0
AIW-12	8	20	5.6	7	2	3	3	2	3	2.6
AIW-13	9	21	6.3	7	7	7	7	6.5	7	6.9
AIW-14	7	19	4.9	8	6	7	7	6	7	6.6
AIW-15	7	19	4.9	9	9	9	9	9	9	9.0
AIW-16	7	19	4.9	10	10	10	10	10	10	10.0
AIW-17	6	18	4.2	10	10	10	10	10	10	10.0
AIW-18	6	18	4.2	10	10	10	10	10	10	10.0
AIW-19	11	23	7.6	9	9	9	9	9	9	9.0
AIW-20	11	23	7.6	8	8	8	8	4	6	6.8
AIW-21	9	21	6.3	8	2	3	2.5	1	2	2.1
AIW-22	10	22	6.9	7	0	0	0	0	0	0.0
AIW-23	12	24	8.3	7	0	0	0	0	0	0.0
Total air flow:				197	86.0	90.0	102.0	91.0	96.0	
Pressure (psi):					3.4	3.7	3.3	3.7	3.3	

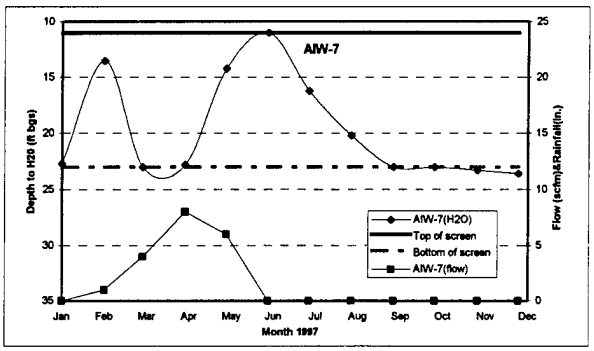
Monitoring Point	Screen Interval top	Screen Interval bottom		Soil Gas Sampling Results August 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	September 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	October 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	November 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)	December 1997 O_2 (%)[3]	CO_2 (%)	TVH (ppmv)
MP 8-2-8.0	8	8.5		Water			No flow			Water			No flow			Not collected due		
MP 8-3-8.0	8	8.5		20.6	0.0	75	20.6	0.0	1.0	20.5	0.0	10.7	20.7	0.0	5.0	to Winter Conditions		
MP 8-4-9.5	9.5	10	O_2 Sensor	no			no			20.4	na	na	19.4	na	na	18.3	na	na

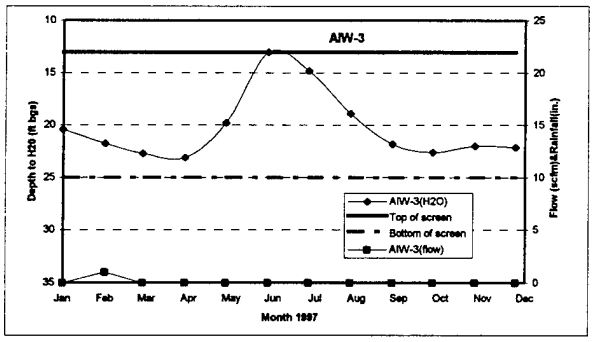
[1] Measured from top of casing.
[2] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[3] O_2 result represents daily average for month.
na = not applicable, no = not operational.

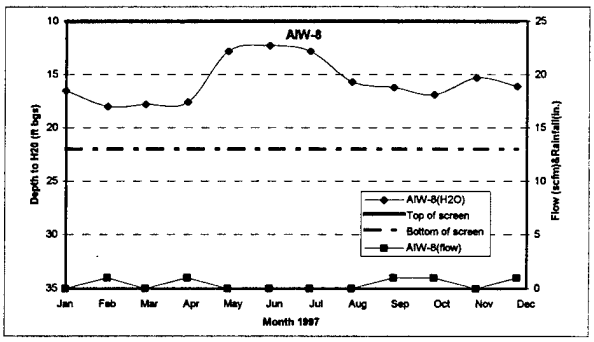


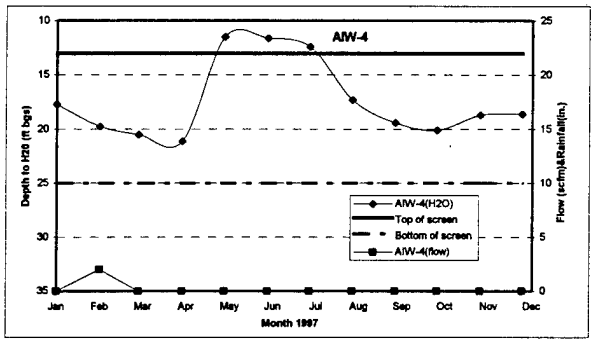


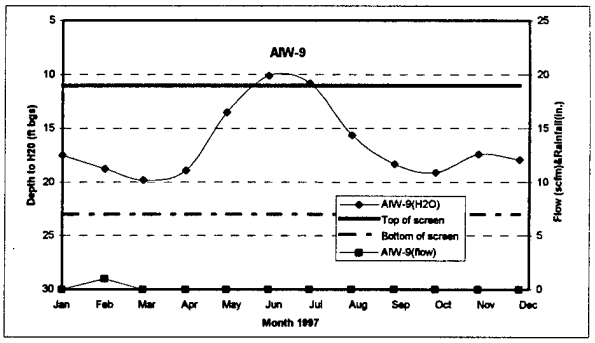


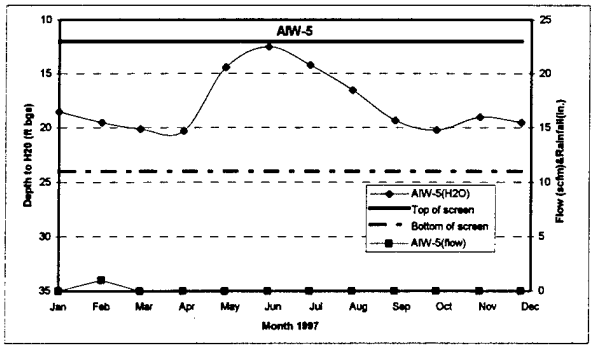












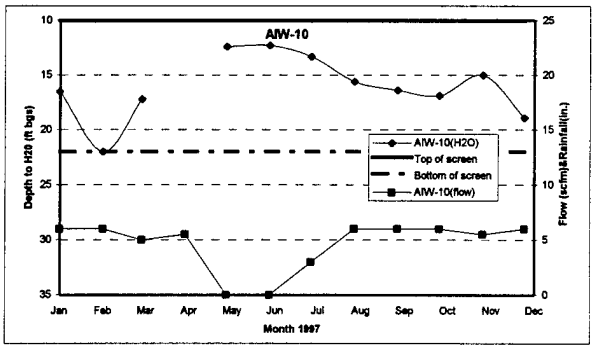


Figure 18-1 Air Flow vs. Depth to Groundwater at NDA-8

GW_FLOW.XLS

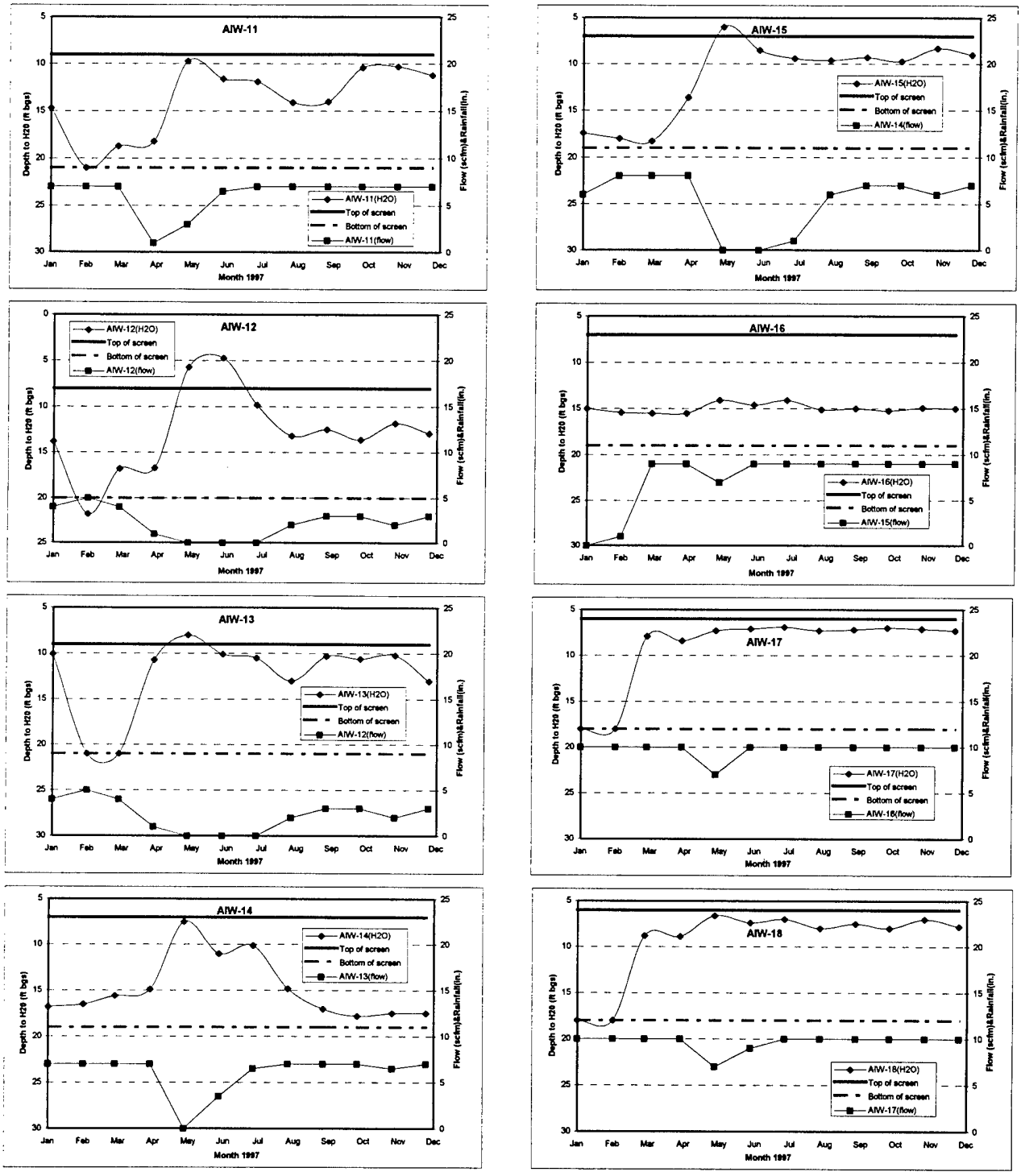


Figure 18-2 Air Flow vs. Depth to Groundwater at NDA-8

Table 18-2 NDA-8 Groundwater Level Data

WELL NO	Well Depth below TOC (ft)	Top of Screen below TOC (ft)	Groundwater Depth Below TOC (ft)											
			Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97
AIW-1	26	14	12	17.4	14.2	17.3	12.4	11	13	16	16.7	18.6	18.5	18.5
AIW-2	26	14	17.8	18.2	18.2	18.1	12.6	11.5	14.3	15.6	17.7	26	26	26
AIW-3	25	13	20.4	21.75	22.7	23.1	19.8	13	14.8	18.9	21.8	22.6	22	22.1
AIW-4	25	13	17.7	19.75	20.5	21.1	11.5	11.6	12.4	17.3	19.4	20.1	18.7	18.6
AIW-5	24	12	18.5	19.5	20.1	20.3	14.4	12.5	14.2	16.5	19.3	20.2	19	19.5
AIW-6	24	12	18.9	20	20.7	20.5	16.3	12	13.4	17.4	19.9	20.7	19.7	19.9
AIW-7	23	11	22.7	13.5	23	22.8	14.2	11	16.2	20.2	23	23	23.3	23.6
AIW-8	22	10	16.5	18	17.8	17.6	12.8	12.3	12.8	15.7	16.2	16.9	15.3	16.1
AIW-9	23	11	17.5	18.75	19.8	18.9	13.5	10.1	10.8	15.6	18.3	19.1	17.4	17.9
AIW-10	22	10	16.5	22	17.2	NR	12.4	12.3	13.3	15.6	16.4	16.9	15	18.9
AIW-11	21	9	14.7	21	18.7	18.2	9.7	11.6	11.9	14.1	14	10.4	10.3	11.2
AIW-12	20	8	13.8	21.8	16.8	16.7	5.7	4.7	9.8	13.2	12.5	13.6	11.8	12.9
AIW-13	21	9	10.1	21	21	10.7	8	10.1	10.5	13	10.3	10.6	10.2	13
AIW-14	19	7	16.8	16.5	15.6	14.9	7.5	11	10.1	14.8	17	17.8	17.5	17.5
AIW-15	19	7	17.4	18	18.3	13.6	6	8.5	9.4	9.6	9.3	9.7	8.3	9
AIW-16	19	7	15	15.4	15.5	15.5	14.1	14.6	14.1	15.1	15	15.2	14.9	15
AIW-17	18	6	18	18	7.9	8.4	7.3	7.1	6.9	7.3	7.2	7	7.1	7.3
AIW-18	18	6	18	18	8.8	8.9	6.6	7.4	7	8	7.5	8	7	7.8
AIW-19	23	11	23	23	23	12.9	12.3	12.3	12.4	12.6	12.4	12.6	12.4	12.5
AIW-20	23	11	13	12.75	13	13.1	8.5	10	12	13.6	10.9	10.8	10.1	12.9
AIW-21	21	9	14.2	16.3	18.4	21	6.3	7.6	10.6	14.1	13.9	14.8	13	14
AIW-22	22	10	15.1	17.5	18.2	18.4	6.8	7.8	9.7	14.2	14.3	15.25	13.4	14.4
AIW-23	24	12	17.1	21	22.7	23.2	7.4	6.1	10.6	16.9	20.6	21.3	18.3	19.6

Boxed value indicates water level is at or above the top of the screen.
TOC = top of casing.

19.0 POWER PLANT DRAINAGE PIPE

19.1 OPERATIONS

The PPDP, located in OU 9, consists of 18 AIWs and 24 MPs (Figure 19-1). BEI installed the PPDP biovent system in the fall of 1995. During July 1997 three new MPs—one (MP-10) with oxygen sensors and two (MP-9-3.5 and MP-9-8.5) without an oxygen sensor—were installed in accordance with the recommendations made in the previous semiannual report. These areas did not contain sufficient soil gas data to evaluate biodegradation activity. Since BEI assumed responsibility for the bioventing O&M, the system had operated 621 days as of December 31, 1997. This system was down during portions of the summer of 1996 due to high water levels but has since operated continuously then with only minor interruptions for respiration testing and general maintenance.

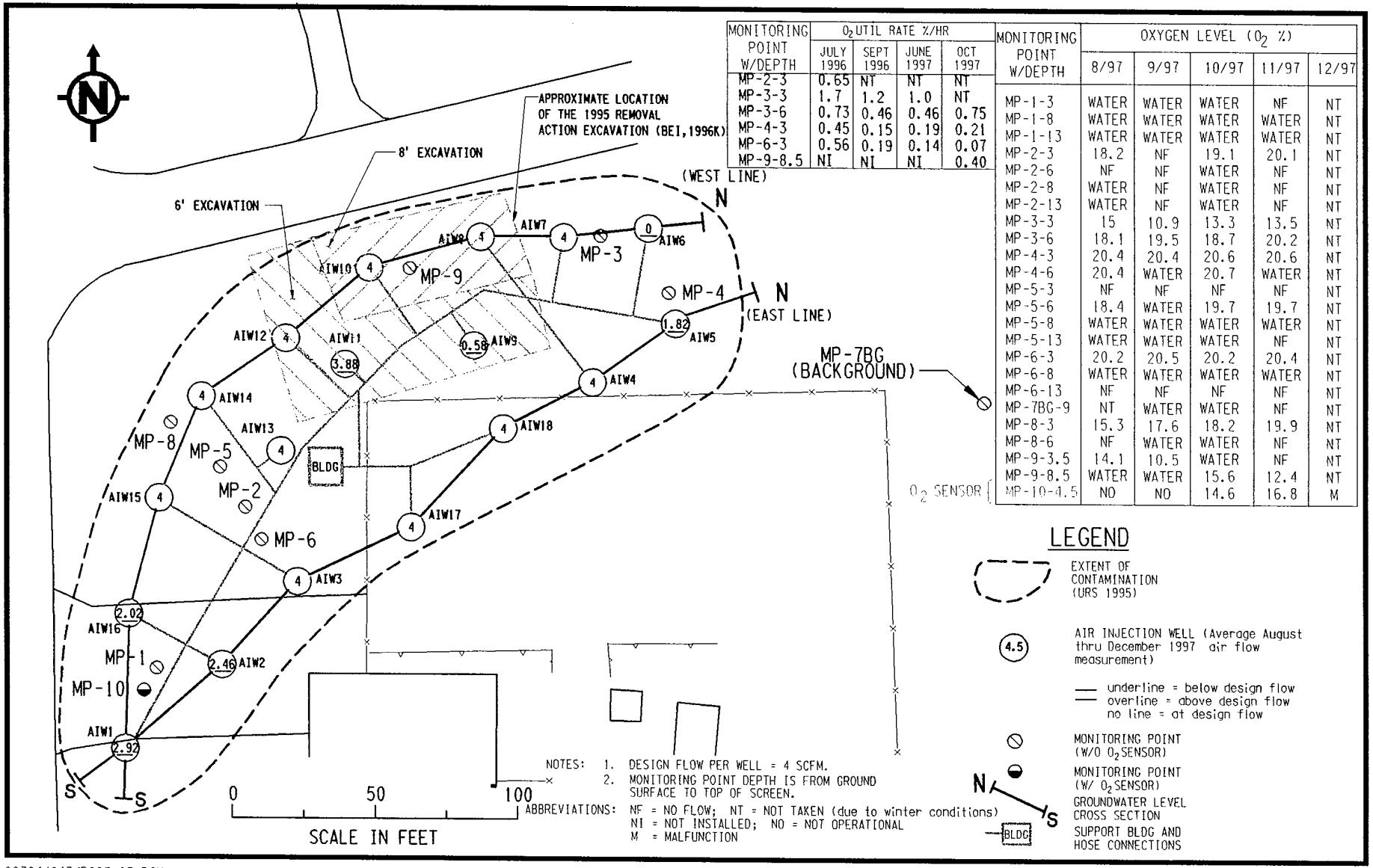
System flows were typically at the design flow rate of 4 scfm (Table 19-1). Groundwater levels shown in Table 19-2 confirm that the screens were not fully inundated. System injection pressures were not raised above 3.5 psi.

19.2 CONCLUSIONS AND RECOMMENDATIONS

In general, the contaminated area is being aerated at air flow rates equal to or below the 4 scfm design rate. AIW-6 has not accepted air since startup (except 1 scfm in April 1997). As mentioned above, air flow has not been impeded by partial inundations as illustrated on Figures 19-2 and 19-3. Low oxygen levels were recorded in MPs-3-3, MP-8-3, MP-9-3.5, MP-9-8.5, and MP-10, the only MPs with indications of active respiration (low readings of 10.9, 15.3, 10.5, 12.4, and 14.6 percent oxygen, respectively). The remaining MPs either had oxygen readings greater than 18 percent or yielded no data because of saturation/no flow.

Respiration tests were run at three of the same locations where fall respiration tests were performed including a different MP (Figures A-13 and A-14). Test results from MP 3-6 indicate an increase in the rate to the fall 1996 level (0.75 and 0.73, respectively); these levels are those expected with active biodegradation. Active biodegradation is also indicated at MP-4-3 and MP-9-8.5. Oxygen utilization at MP-6-3 has reached typical background levels (0.07 percent/hour). Elevated TVH readings were noted in MP-9-8.5 during the respiration tests (see Figure 19-3) and the monthly monitoring event (see Table 19-1). It appears that approximately 3 ft of unsaturated contaminated soils (located below the 1995 removal; see Figure 19-1) are the probable source of the volatiles. Contaminated saturated soils may exist below these unsaturated soils, thus continually providing elevated soil gas.

Overall Recommendation for PPDP: No changes are recommended since the AIWs are working as planned and contaminated soils still are believed to remain, based on low oxygen readings and elevated carbon dioxide and TVH readings. Oxygen utilization rates show a general decline, likely attributable to the ongoing biodegradation. Collect soil samples throughout the PPDP beginning in June 1998.



MONITORING POINT W/DEPTH	O_2 UTIL RATE %/HR			
	JULY 1996	SEPT 1996	JUNE 1997	OCT 1997
MP-2-3	0.65	NT	NT	NT
MP-3-3	1.7	1.2	1.0	NT
MP-3-6	0.73	0.46	0.46	0.75
MP-4-3	0.45	0.15	0.19	0.21
MP-6-3	0.56	0.19	0.14	0.07
MP-9-8.5	NI	NI	NI	0.40

MONITORING POINT W/DEPTH	OXYGEN LEVEL (O_2 %)				
	8/97	9/97	10/97	11/97	12/97
MP-1-3	WATER	WATER	WATER	NF	NT
MP-1-8	WATER	WATER	WATER	WATER	NT
MP-1-13	WATER	WATER	WATER	WATER	NT
MP-2-3	18.2	NF	19.1	20.1	NT
MP-2-6	NF	NF	WATER	NF	NT
MP-2-8	WATER	NF	WATER	NF	NT
MP-2-13	WATER	NF	WATER	NF	NT
MP-3-3	15	10.9	13.3	13.5	NT
MP-3-6	18.1	19.5	18.7	20.2	NT
MP-4-3	20.4	20.4	20.6	20.6	NT
MP-4-6	20.4	WATER	20.7	WATER	NT
MP-5-3	NF	NF	NF	NF	NT
MP-5-6	18.4	WATER	19.7	19.7	NT
MP-5-8	WATER	WATER	WATER	WATER	NT
MP-5-13	WATER	WATER	WATER	NF	NT
MP-6-3	20.2	20.5	20.2	20.4	NT
MP-6-8	WATER	WATER	WATER	WATER	NT
MP-6-13	NF	NF	NF	NF	NT
MP-7BG-9	NT	WATER	WATER	NF	NT
MP-8-3	15.3	17.6	18.2	19.9	NT
MP-8-6	NF	WATER	WATER	NF	NT
MP-9-3.5	14.1	10.5	WATER	NF	NT
MP-9-8.5	WATER	WATER	15.6	12.4	NT
MP-10-4.5	NO	NO	14.6	16.8	M

22784/043/FIG3-23.DGN

Figure 19-1
PPDP Biovent System Layout and Average Wellhead Flow

Table 19-1 PPDP Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval ft/bgs top	bottom	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) August 1997	September 1997	October 1997	November 1997	12/97	Average Aug - Dec
AIW-1	8.9	13.8	6.2	4	3	2.2	2.9	3	3.5	2.92
AIW-2	8.9	13.8	6.2	4	2	1.9	2.5	2.9	3	2.46
AIW-3	6.8	11.8	4.7	4	4	4	4	4	4	4
AIW-4	4.6	9.5	3.2	4	4	4	4	4	4	4
AIW-5	6.9	11.8	4.8	4	1.6	1.5	2	2	2	1.82
AIW-6	6.9	11.8	4.8	4	0	0	0	0	0	0
AIW-7	3.2	8.1	2.2	4	4	4	4	4	4	4
AIW-8	7.8	11.8	5.4	4	4	4	4	4	4	4
AIW-9	7.8	11.8	5.4	4	0.6	0	0.5	1	0.8	0.58
AIW-10	7.8	11.8	5.4	4	4	4	4	4	4	4
AIW-11	6.9	11.8	4.8	4	4	4	4	3.8	4	3.88
AIW-12	6.9	11.8	4.8	4	4	4	4	4	4	4
AIW-13	6.9	11.8	4.8	4	4	4	4	4	4	4
AIW-14	4.9	9.8	3.4	4	4	4	4	4	4	4
AIW-15	5.5	10.5	3.8	4	4	4	4	4	4	4
AIW-16	8.9	13.8	6.2	4	2.5	1.1	1.7	2	2.8	2.02
AIW-17	6.9	11.8	4.8	4	4	4	4	4	4	4
AIW-18	4.7	9.7	3.3	4	4	4	4	4	4	4
Total air flow:				72	57.7	54.7	57.4	58.9	59.7	
Pressure (psi):					3.3	3.5	3.4	3.5	3.4	

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results August 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	September 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	October 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	November 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)	December 1997 O_2 (%)[2]	CO_2 (%)	TVH (ppmv)
MP-1-3	3	3.5			Water			Water			Water			No flow			No Soil Gas	
MP-1-8	8	8.5			Water			Water			Water			Water			Samples Collected	
MP-1-13	13	13.5			Water			Water			Water			Water			due to Winter Conditions	
MP-2-3	3	3.5		18.2	1.3	5		No flow		19.1	1.4	6.8	20.1	0.5	41.5			
MP-2-6	6	6.5			No flow			No flow			Water			No flow				
MP-2-8	8	8.5			Water			No flow			Water			No flow				
MP-2-13	13	13.5			Water			No flow			Water			No flow				
MP-3-3	3	3.5		15.0	4.6	40	10.9	8.9	nr	13.3	7.6	164	13.5	6.1	118			
MP-3-6	6	6.5	O_2 Util. Rate = 0.65%/hr[3]	18.1	1.3	22.4	19.5	0.7	75	18.7	1.2	37	20.2	0.2	39			
MP-4-3	3	3.5	O_2 Util. Rate = 0.22%/hr[3]	20.4	0.0	8	20.4	0.2	12.4	20.6	0.1	0	20.6	0.0	21.1			
MP-4-6	6	6.5		20.4	0.0	7		Water		20.7	0.0	0		Water				
MP-5-3	3	3.5			No flow			No flow			No flow			No flow				
MP-5-6	6	6.5		18.4	2.2	7		Water		19.7	1.0	67.4	19.7	1.0	67.4			
MP-5-8	8	8.5			Water			Water			Water			Water				
MP-5-13	13	13.5			Water			Water			Water			No flow				
MP-6-3	3	3.5	O_2 Util. Rate = 0.09%/hr[3]	20.2	0.2	3	20.5	0.0	3.2	20.2	0.3	0	20.4	0.3	10.2			
MP-6-8	8	8.5			Water			Water			Water			Water				
MP-6-13	13	13.5			No flow			No flow			No flow			No flow				
MP-7BG-9	9	14.5	Background location		nr			Water			Water			No flow				
MP-8-3	3	3.5		15.3	5.7	8	17.6	1.5	8.2	18.2	2.2	0	19.9	1.1	5.4			
MP-8-6	6	6.5			No flow			Water			Water			No flow				
MP-9-3.5	3.5	4		14.1	7.5	72	10.5	10.4	nr		Water			No flow				
MP-9-8.5	8.5	9	O_2 Util. Rate = 0.40%/hr[3]		Water			Water		15.6	5.3	1205	12.4	5.1	1.7			
MP-10-4.5	4.5	5	O_2 Sensor							14.6	na	na	16.8	na	na	malf	na	na

[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] The monthly O_2 sensor results is the average for month. See biovent monthly reports for daily values.
[3] Test performed on 10/16/97.
nr = no reading, bgs = below ground surface, malf = malfunctioned.

Table 19-2 PPDP Groundwater Level Data

Power Plant Discharge Pipe Groundwater Levels from August through December 1997

Well No	Well Depth below TOC	Top of Screen below TOC	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97
AIW-1	15.9	10.8	15	15	15	15.5	15
AIW-2	15.9	10.8	15	15	15	15	15
AIW-3	13.9	8.7	13	13	13	13	13
AIW-4	11.3	6.4	9.2	7.35	8.7	7.7	9.1
AIW-5	13.9	8.8	13	13	13	13	13
AIW-6	13.9	8.8	13	13	13	13	13
AIW-7	10.3	5.0	9.5	8.6	8.9	8.6	8.9
AIW-8	13.7	9.5	11	11	10.9	10.9	10.9
AIW-9	13.8	9.6	13	13	13	13	13
AIW-10	13.9	9.7	11.5	11.05	11.6	11	11.5
AIW-11	13.9	8.8	13	13	13	13	13
AIW-12	13.8	8.7	11.4	9.5	10.4	9.7	11.6
AIW-13	13.7	8.6	11.5	9.6	10	10.2	11
AIW-14	11.8	6.7	9.1	8	8.6	8	9
AIW-15	12.7	7.5	9.4	7.4	8.2	7.75	9.2
AIW-16	16.0	10.9	15	15	15	15	15
AIW-17	13.7	8.6	12.1	11.9	11.7	11.9	11.9
AIW-18	11.7	6.4	8.5	7	8.1	7.2	8.5

Shaded/boxed value: indicates water level is at or above the top of the screen.

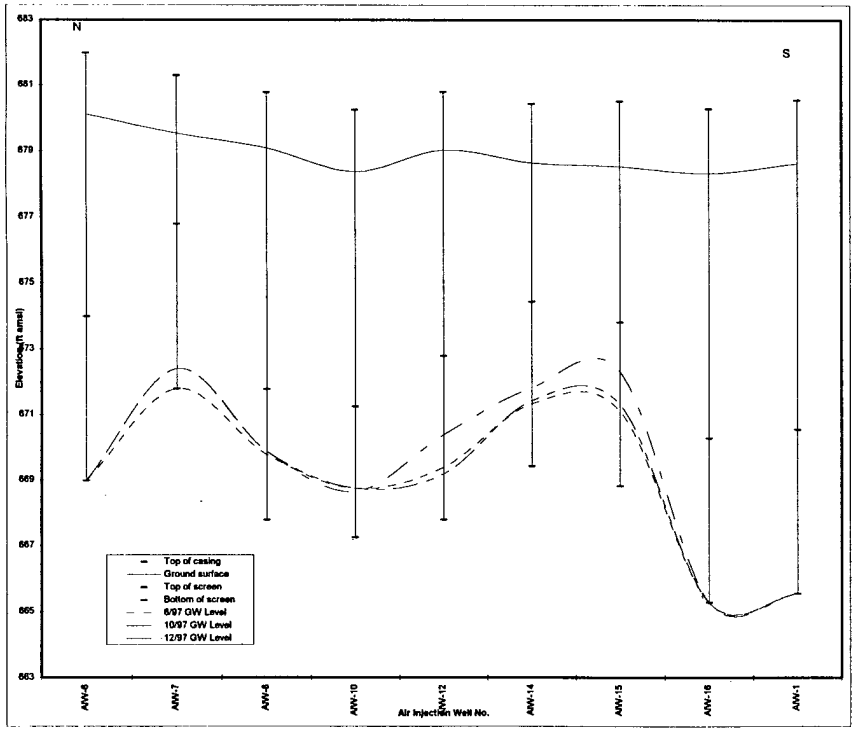
Groundwater Levels along North / South (Westline) Transect at PPDP

Well No.	Elevation at top of casing (ft amsl)	Elevation of ground (ft msl)	Elevation of water - AUG. (ft amsl)	Elevation of water - OCT. (ft amsl)	Elevation of water - DEC. (ft amsl)	Depth to top of screen (ft)	Elevation to TOS (ft amsl)	Depth to bottom of screen (ft)	Elevation to BOS (ft amsl)
AIW-6	681.98	680.11	668.98	668.98	668.98	8	673.981	13	668.981
AIW-7	681.29	679.53	671.79	672.39	672.39	4.5	676.792	9.5	671.792
AIW-8	680.78	679.09	669.78	669.88	669.88	9	671.78	13	667.78
AIW-10	680.25	678.37	668.75	668.65	668.75	9	671.25	13	667.25
AIW-12	680.79	679.03	669.39	670.39	669.19	8	672.79	13	667.79
AIW-14	680.43	678.64	671.33	671.83	671.43	6	674.43	11	669.43
AIW-15	680.51	678.53	671.11	672.31	671.31	6.7	673.81	11.7	668.81
AIW-16	680.28	678.33	665.28	665.28	665.28	10	670.28	15	665.28
AIW-1	680.55	678.63	665.55	665.55	665.55	10	670.55	15	665.55

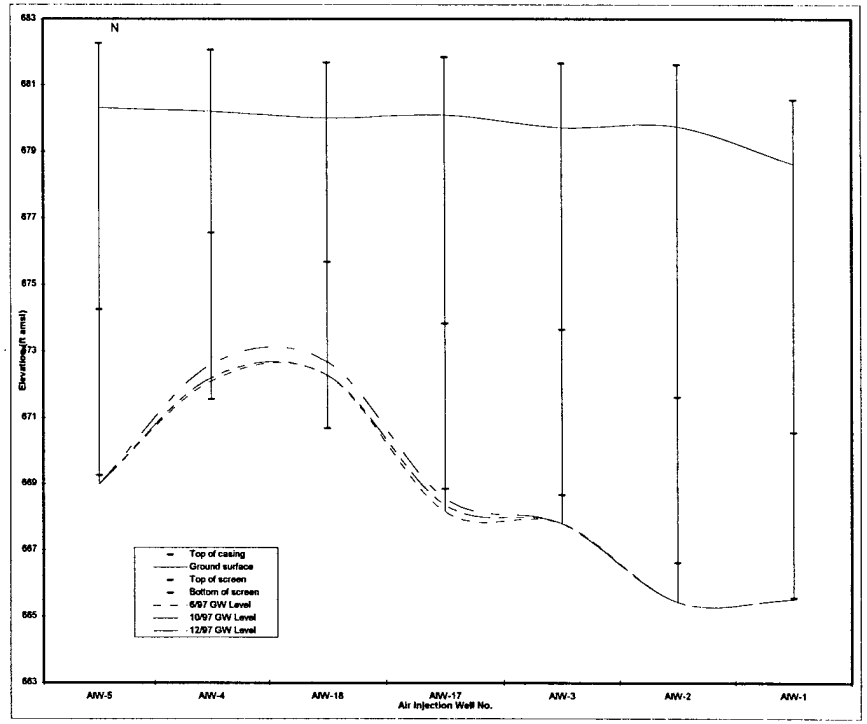
Groundwater Levels along North / South (Eastline) Transect at PPDP

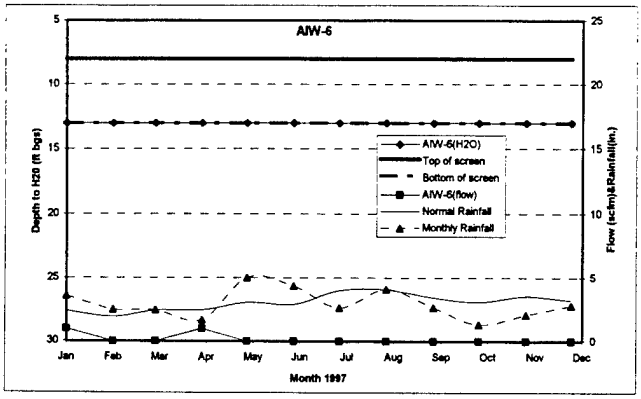
Well No.	Elevation at top of casing (ft amsl)	Elevation of ground (ft amsl)	Elevation of water - AUG. (ft amsl)	Elevation of water - OCT. (ft amsl)	Elevation of water - DEC. (ft amsl)	Depth to top of screen (ft)	Elevation to TOS (ft amsl)	Depth to bottom of screen (ft)	Elevation to BOS (ft amsl)
AIW-5	682.25	680.31	668.98	668.98	668.98	8	674.25	13.0	669.25
AIW-4	682.05	680.2	672.09	672.59	672.19	5.5	676.55	10.5	671.55
AIW-18	681.67	680.01	672.28	672.68	672.28	6	675.67	11.0	670.67
AIW-17	681.83	680.09	668.15	668.55	668.35	8	673.83	13.0	668.83
AIW-3	681.65	679.72	667.79	667.79	667.79	8	673.65	13.0	668.65
AIW-2	681.61	679.75	665.43	665.43	665.43	10	671.61	15.0	666.61
AIW-1	680.55	678.63	665.51	665.51	665.51	10	670.55	15.0	665.55

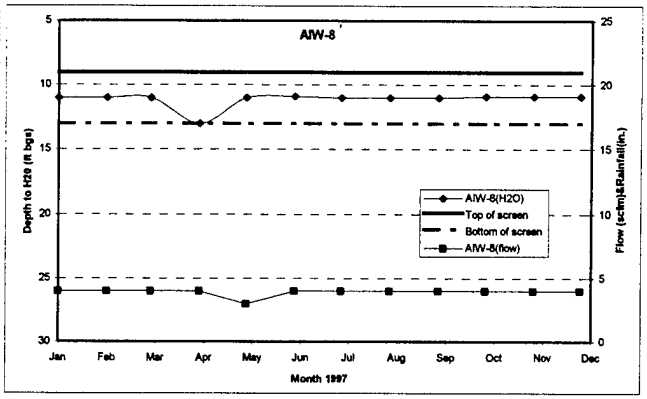
North / South Cross Section at PPDP - Westline

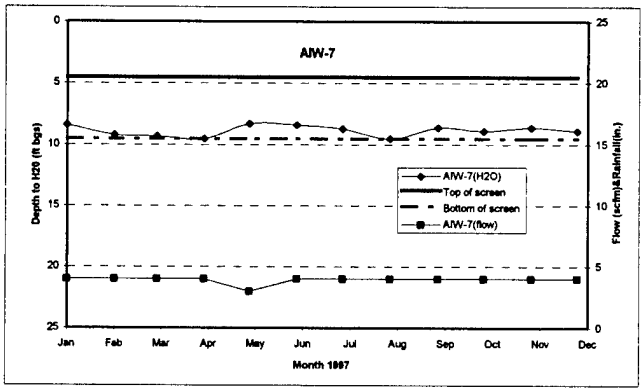


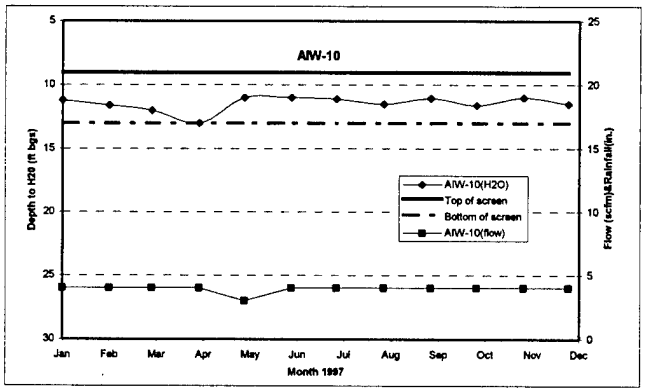
North / South Cross Section at PPDP - Eastline

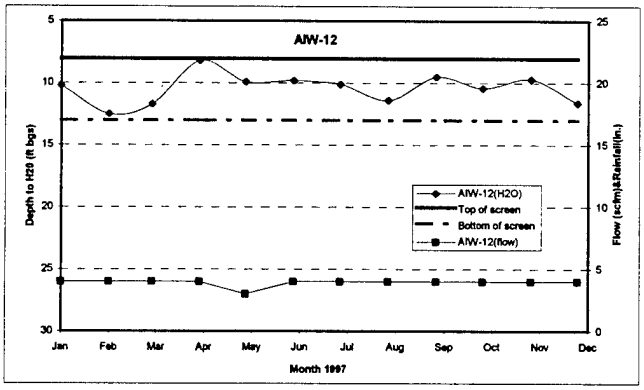


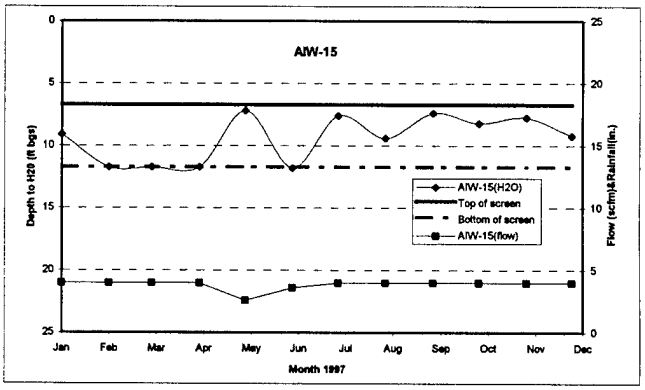


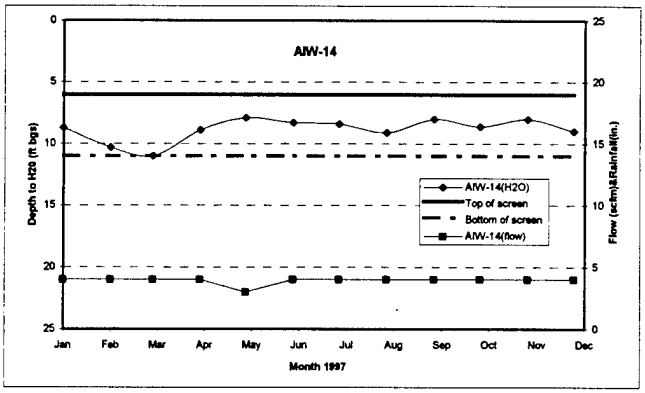












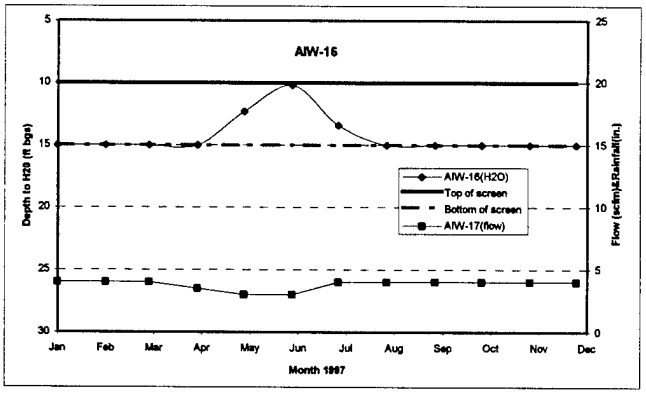
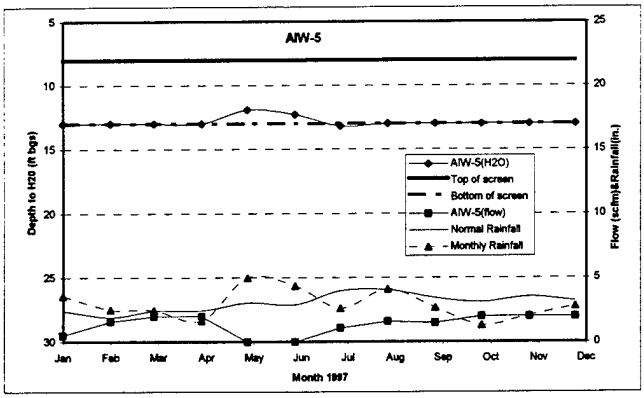
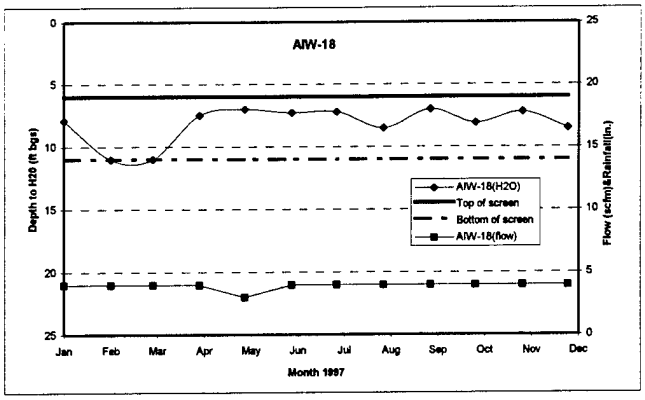
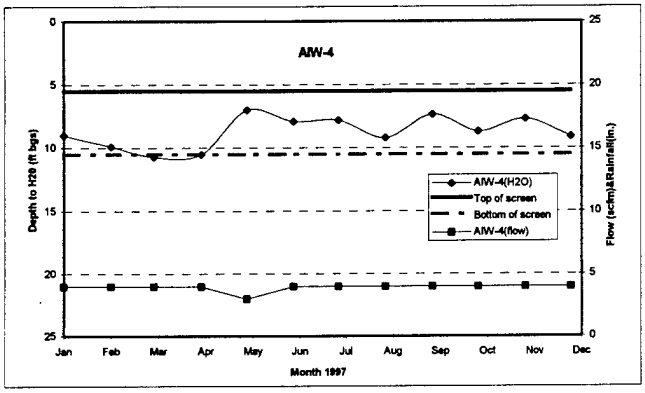
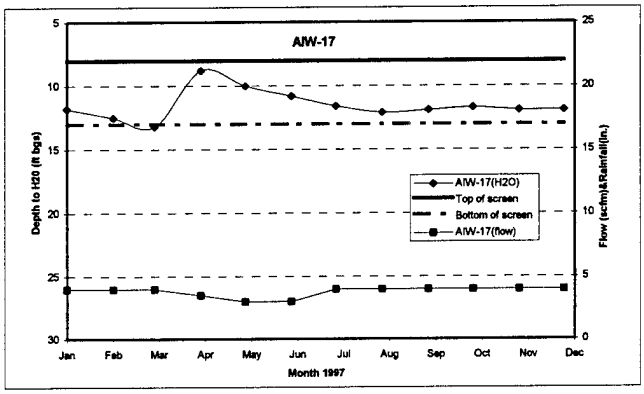


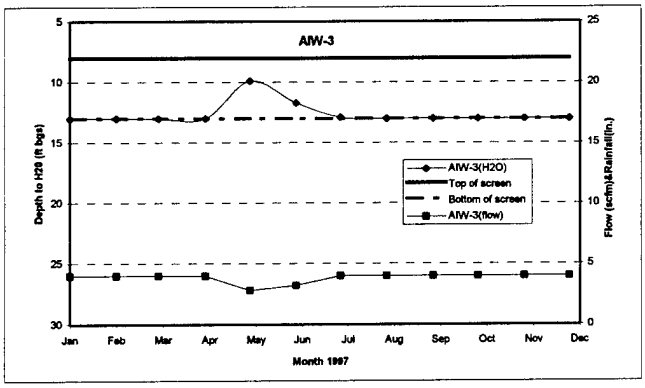
Figure 19-2 PPDP Groundwater/Air Flow Relations - Westline

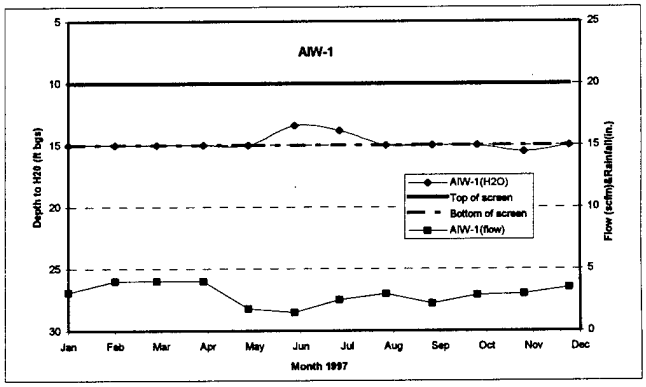












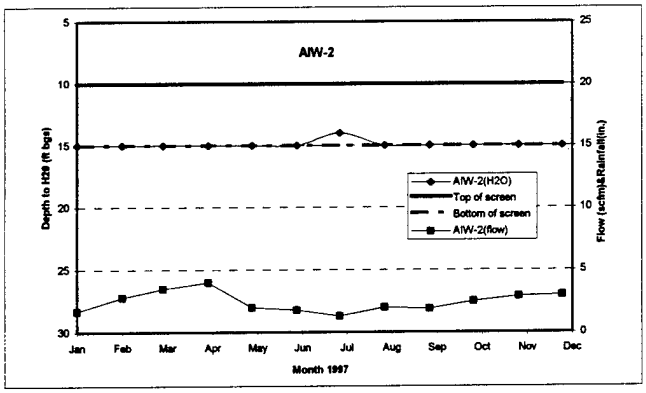


Figure 19-3 PPDP Groundwater/Air Flow Relations - Eastline

GW_FLOW.XLS

REFERENCES

ABB-ES (ABB-Environmental Services, Inc.), 1994. *Final Remedial Investigation Report, OU-10.* Installation Restoration Program. Loring AFB. August.

ABB-ES, 1995a. *Final Remedial Investigation Report, OU-8.* Installation Restoration Program. Loring AFB. February.

ABB-ES, 1995b. *Remedial Investigation Report, OU-9.* Installation Restoration Program. Loring AFB. January.

ABB-ES, 1996. *Final Remedial Investigation Report, OU-11.* Installation Restoration Program. Loring AFB. February.

AFCEE (Air Force Center for Environmental Excellence), 1992. *Test Plan and Technical Protocol for a Field Treatability Test for Bioventing.* May.

BEI (Bechtel Environmental, Inc.), 1996a. *Bioventing at OUs 5, 8, 9, 10, and 11 Removal Action Report.* Final, April.

BEI, 1996b. *Operation and Maintenance Plan for Bioventing at OUs 5, 8, 9, 10, and 11.* Final, January.

BEI, 1996c. *Excavations in OUs 5, 8, 9, 10, and 11 Removal Action Report.* Final, February.

BEI, 1996d. *Bioventing at OUs 5, 8, 9, 10, and 11 Removal Action Work Plan,* Addendum No. 1. November.

BEI, 1996e. *Bioventing Semiannual Report.* October.

BEI, 1996f. *Bioventing Alternatives Technical Memorandum.* October.

BEI, 1996g - j. *Monthly Bioventing Reports.* September through December.

BEI, 1997a. *Bioventing Semiannual Report,* Final. August.

BEI, 1997b. Addendum No. 1 to *Bioventing Removal Action Report,* Final. May.

BEI, 1997c. *Expansion of the OU 11 Bioventing System,* Addendum No. 2 to the *RAWP Bioventing at Operable Units 5, 8, 9, 10, and 11,* Final. September.

BEI, 1997d. *Bioventing Semiannual Report,* Draft. December.

BEI, 1997e - p. *Monthly Bioventing Reports.* January through December.

CDM (Camp Dresser McKee), 1996. *Final Remedial Investigation Report, OU-5.* Installation Restoration Report. Loring AFB. February.

Earth Tech, 1995. *Long-Term Bioventing Treatability Study,* Technical Report, Loring AFB, Base Exchange Service Station. Final, August.

Patrick St. Peter & Sons Inc., 1997. *Operation and Maintenance Manuals for Nose Dock Area & Service Station.*

URS (URS Consultants, Inc.), 1995a. *Design Analysis Report, OUs 5, 9, 10, and 11.* Final, June.

URS, 1995b. *Bioventing and Excavation Specifications for Former Jet Engine Test Cell, Fuel Tank Farm, Vehicle Maintenance Building, Power Plant Drainage Pipe, and Entomology Shop.* Final, June.

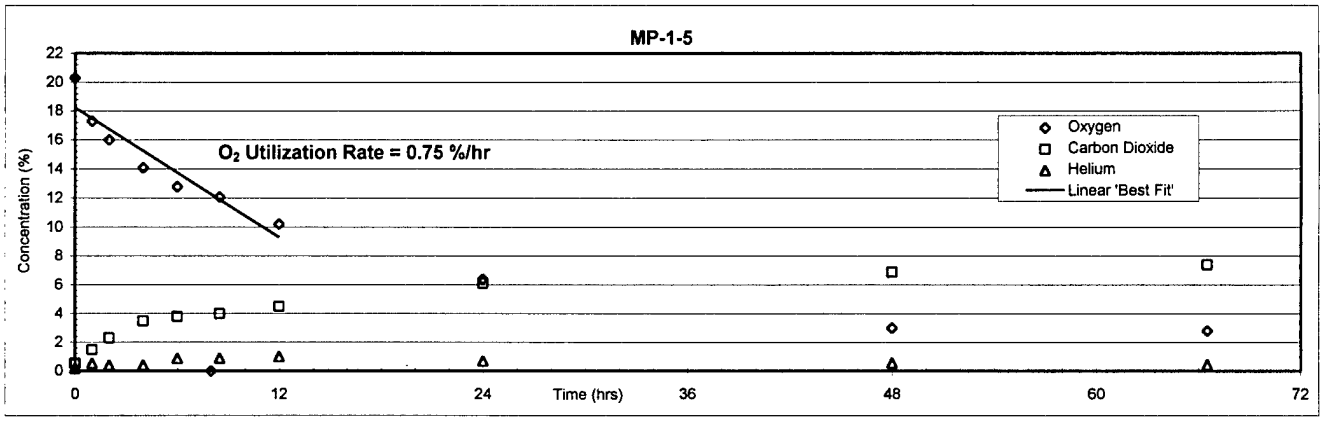
APPENDIX A

Time[1] (hrs)	MP-1-5					MP-2-13				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	PID	Helium (%)
Pretest[2]	5.1	11.1	fo	1	-	19.7	0	0	0.5	-
0.0	20.3	0.5	65	1.9	0.19	20.6	0	2.3	1.9	0.36
1.0	17.3	1.5	154	1.5	0.54	20.1	0	1.3	1.8	0.6
2.0	16	2.3	169	1.3	0.42	19.9	0	0	1.7	0.61
4.0	14.1	3.5	204	1	0.41	19.5	0	2.4	1.5	1
6.0	12.8	3.8	190	1.1	0.87	20	0	0	1	1.3
8.0			bag leaked			20	0	0	0.7	0.47
8.5	12.1	4	fo	0.8	0.9			not collected		
12.0	10.2	4.5	fo	0.7	1	19.8	0	0	0.4	1.1
24.0	6.4	6.1	fo	1.4	0.71	20.2	0	0	0.3	0.65
48.0	3	6.9	fo	0.3	0.58	19.6	0	0	1	0.67
66.5	2.8	7.4	fo	0.3	0.47	19	0	0	1.5	0.59
			End of test					End of test		

[1] Test began on 10/23/97 at 1100 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system is shutdown for a minimum of 24 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



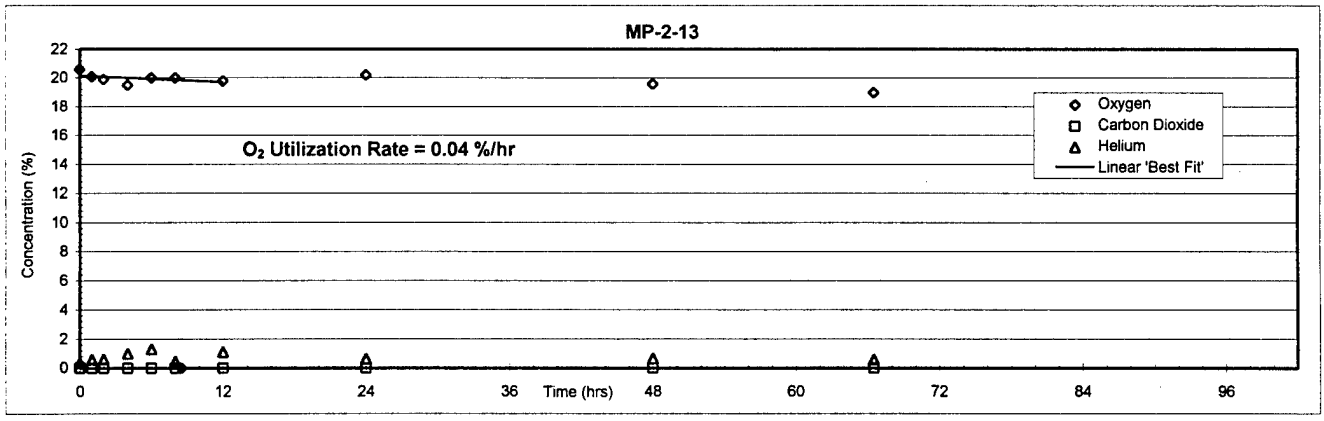


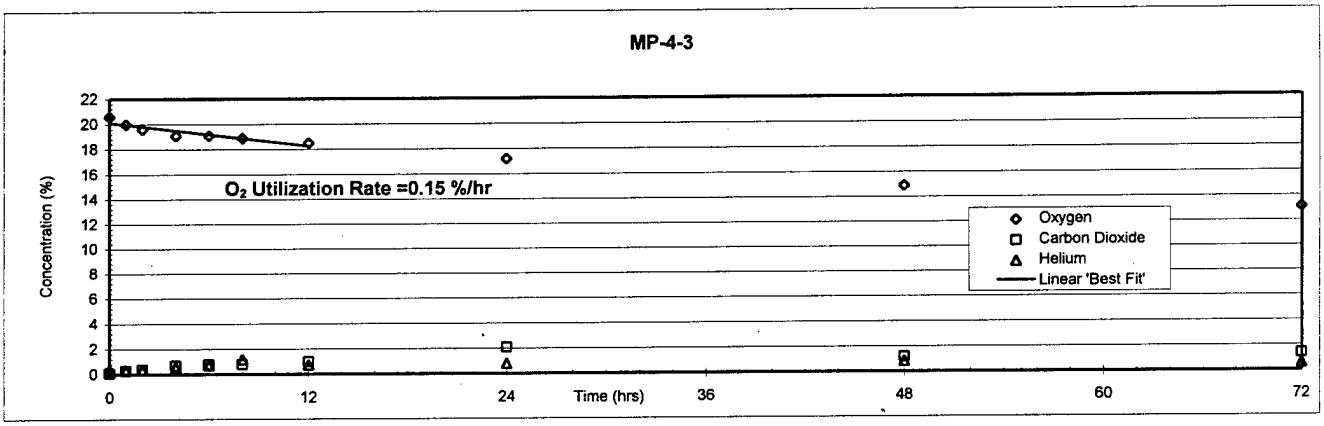
Figure A-1 Fall 1997 Respiration Test Results for MP-1-5 and MP-2-13 at the AHS

Time[1] (hrs)	MP-4-3					MP-4-13				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	14	2.8	16	1.2	-	16.5	2.8	0	0.7	-
0.0	20.6	0.1	11.5	2.1	0.37	20.6	0	2.5	1.9	0.31
1.0	20	0.3	9.2	1.7	0.36	20.2	0.1	0.6	1.8	0.71
2.0	19.6	0.4	9.7	1.5	0.38	19.8	0.2	0	1.7	0.61
4.0	19.1	0.7	13.3	1	0.58	19.5	0.3	0	1.1	0.58
6.0	19.1	0.8	0.7	0.2	0.72	19.7	0.4	0	0.1	1.2
8.0	18.9	0.8	0	0.4	1.2	19.7	0.4	0	0.7	0.96
12.0	18.5	1	0	0.2	0.76	19.5	0.5	0	0.5	0.8
24.0	17.2	2.1	0	1	0.8	19.1	0.7	0	0.7	0.95
48.0	14.9	1.2	0	1.2	0.85	17.9	1.1	0	1	0.82
72.0	13.1	1.4	0	1.7	0.61	16.4	1.3	0	1.3	0.74
	End of Test					End of Test				

[1] Test began on 10/22/97 at 1100 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system is shutdown for a minimum of 24 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



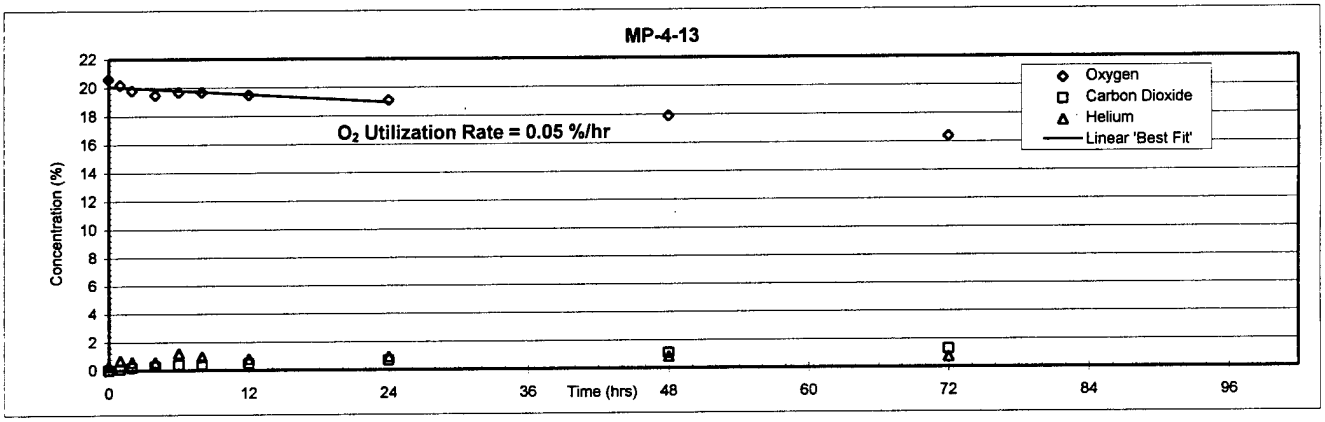


Figure A-2 Fall 1997 Respiration Test Results for MP-4-3 and MP-4-13 at the AHS

Time[1] (hrs)	VM-1-5				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	9.1	7	1194/fo	157	-
0.0	19.3	0.8	462	72.1	1.4
1.0	18.4	1.1	463	74.2	1.1
2.0	17	2	540	93.8	1.2
4.0	16.9	2.7	942	178	1.8
6.0	15.9	2.8	666	166	2
8.0	14.9	3.4	590	164	1.5
12.0	13.4	4	530	154	1.6
24.0	12.4	5	154	73	2.2
48.0	9.9	6	fo	14.8	1.6
72.0	5.9	5.4	fo	184	1.6

[1] Test began on 10/17/97 at 1200 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system is shutdown for a minimum of 24 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.

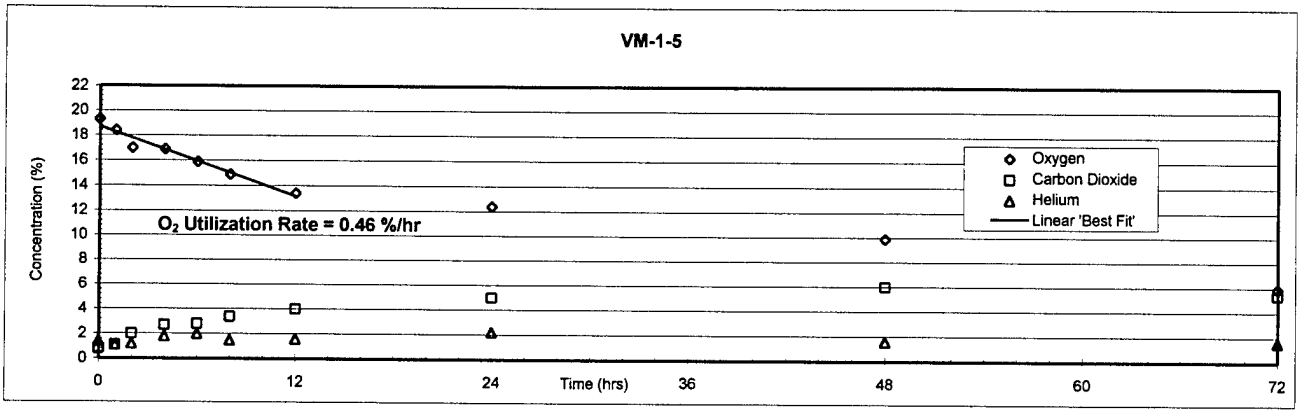


Figure A-3 Fall 1997 Respiration Test Results for VM-1-5 at the BXSS

Time[1] (hrs)	MP-1-7.5					MP-2-8.5				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	2.3	7.2	fo	0.6	-	6.3	5.4	fo	1.2	-
0.0	19.9	0.3	0	0.8	1.5	19.9	0.2	0	1.2	1.7
1.0	19.7	0.6	0	1.1	1.6	19.5	0.6	0	1.1	1.3
2.0	19.4	1	0	1.2	0.96	19.3	0.8	0	1.3	1.2
4.0	18.9	1.3	0	1.6	1.7	18.7	1.2	0	2.1	1.9
6.0	18.8	1.5	0	2.2	1.7	18.4	1.3	0	1.8	1.6
8.0	18.4	1.9	0	1.6	1.7	20	0.3	0	1.4	0.5
12.0	18.1	2.2	0	0.6	1.5	20	0.4	0	0.8	0.5
24.0	16.8	2.6	0	2	1.9	19.6	0.4	0	1.1	0.33
48.0	14.5	3.5	0	2	2.1	19.6	0.3	0	0.9	0.37
72.0	12	4.1	0	0.9	0.04	10.4	2.8	fo	0.9	1.4

[1] Test began on 10/17/97 at 1200 hrs.
[2] Pretest sample is collected before air/helium injection and after system is shutdown for a minimum of 24 hrs.
Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.

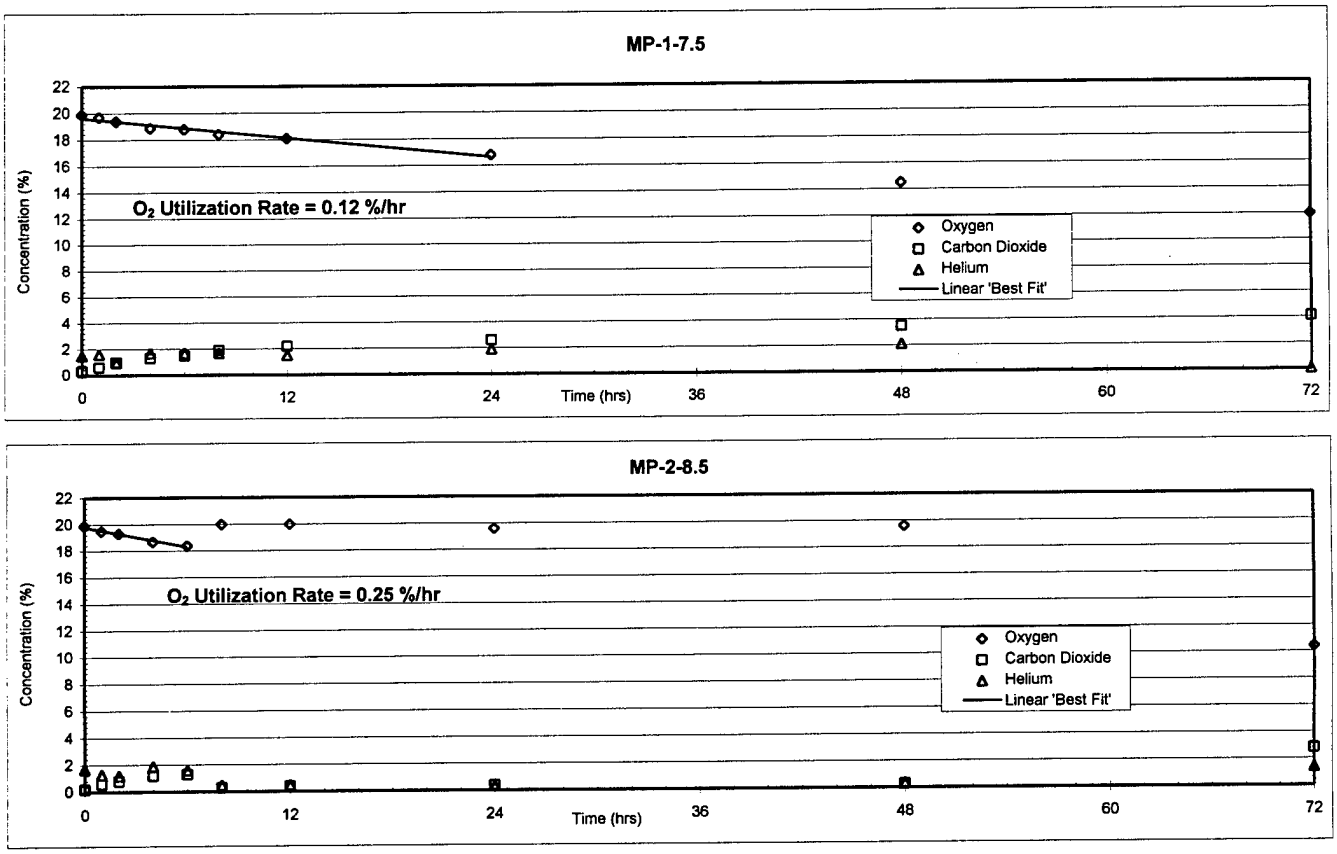


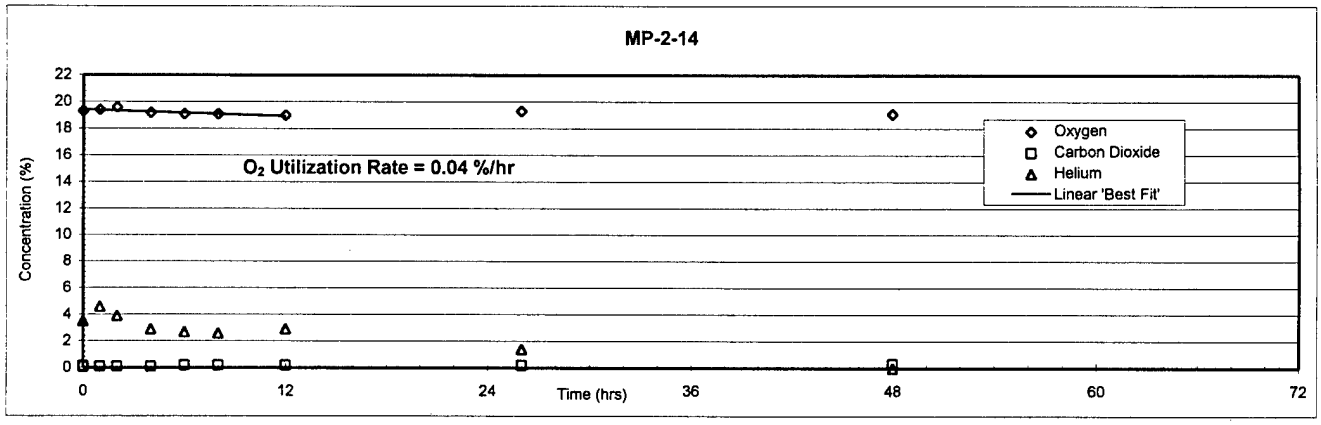
Figure A-4 Fall 1997 Respiration Test Results for MP-1-7.5 and MP-2-8.5 at the BXSS

Time[1]	MP-2-14					MP-5-9.5				
(hrs)	O_2	CO_2	TVH (ppmv)		Helium	O_2	CO_2	TVH (ppmv)		Helium
	(%)	(%)	FID	PID	(%)	(%)	(%)	FID	PID	(%)
Pretest[2]	19.2	0.4	320	201	-	19.3	0.3	0	0.9	-
0.0	19.3	0.1	20.8	42.6	3.5	19.5	0	0	0.8	2.7
1.0	19.4	0.1	38.8	66.1	4.6	19.6	0.1	0	0.8	2.2
2.0	19.6	0.1	41.2	65.8	3.9	19.9	0.1	0	0.6	2.7
4.0	19.2	0.1	61.4	71.6	2.9	19.6	0.1	0	0.9	2.4
6.0	19.1	0.2	72.2	82.2	2.7	19.4	0.1	0	0.6	1.4
8.0	19.1	0.2	94	100	2.6	19.7	0	0	0.7	
12.0	19	0.2	114	111	2.9	19.4	0.1	0	1	2
26.0	19.3	0.2	168	100	1.4	19.4	0.2	0	1.1	0.86
48.0	19.1	0.3	280	147	nr	19.1	0.3	0	1.6	0.34

[1] Test began on 10/15/97 at 1000 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system is shutdown for a minimum of 24 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



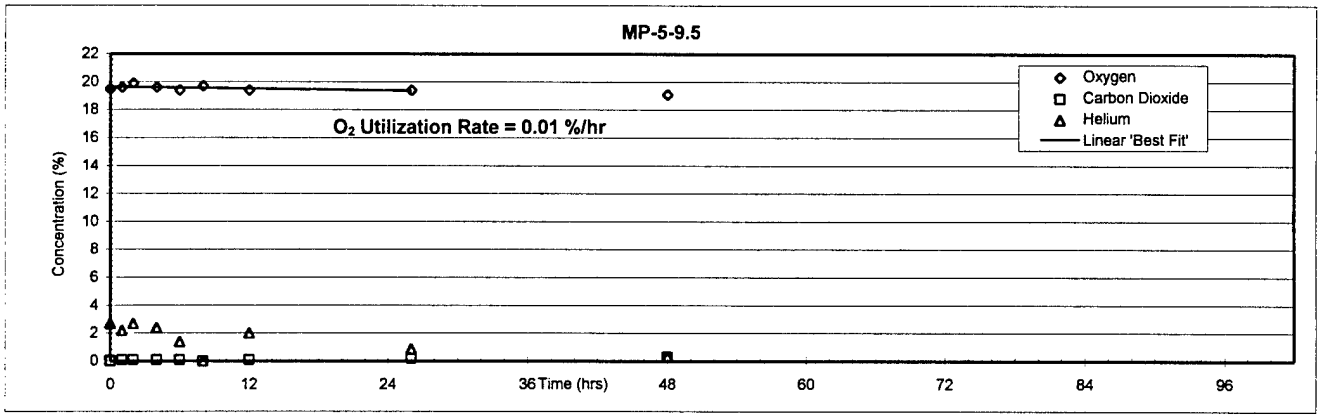


Figure A-5 Fall 1997 Respiration Test Results for MP-2-14 and MP-5-9.5 at the ES

Time[1] (hrs)	MP-7-3				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	0.9	13	fo	313	-
0.0	18.9	0.1	3.1	8.2	5.5
2.0	17	1	111	51.1	1.8
4.0	16.8	1	32.6	20.7	3.5
6.0	13.8	1.9	48.7	34.7	4
8.0	13.3	2.2	59.4	42	2.7
12.0	7.3	4.4	fo	75	2.7
25.0	2.3	7.1	fo	120	2
31.0	1.4	9.4	fo	425	0.89
75.0	0.7	11	fo	449	0.52

[1] Test began on 10/3/97 at 0945 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system is shutdown for a minimum of 24 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.

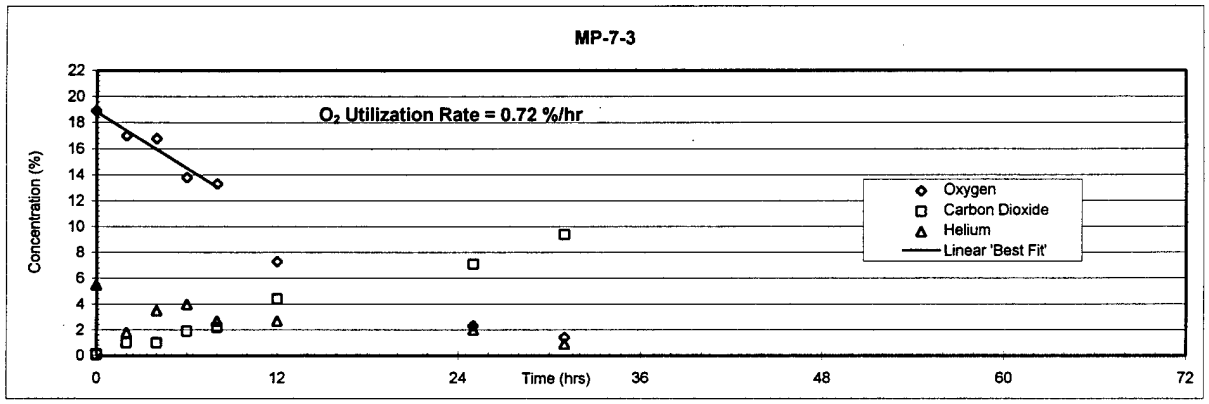


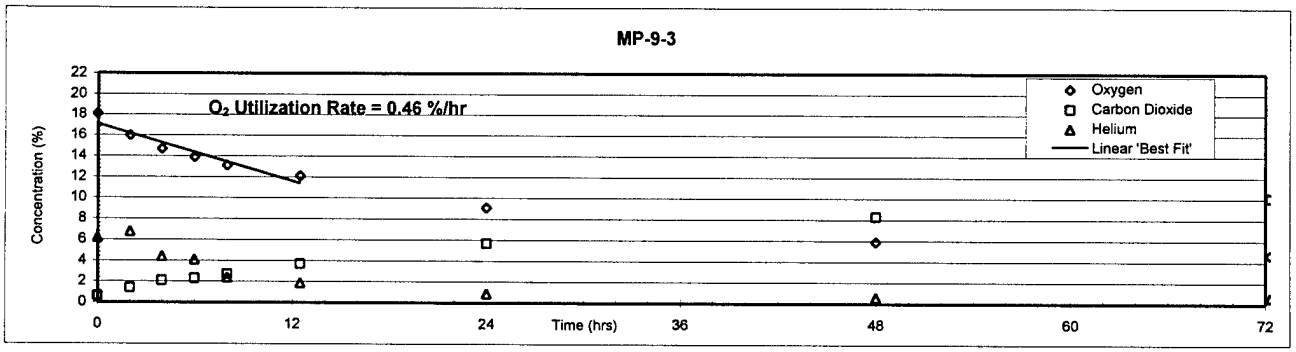
Figure A-6 Fall 1997 Respiration Test Results for MP-7-3 at the FJETC

Time[1] (hrs)	MP-9-3					MP-11-3				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	7.5	11.4			-	14.3	1.9			-
0.0	18.1	0.6	256	86	6.2	18.9	0	0	4.9	5.8
2.0	16	1.4	161	69.9	6.8	18.4	0.2	0	5.1	4.6
4.0	14.7	2.1	137	66.5	4.4	18.6	0.6	3	5.3	3.4
6.0	13.9	2.3	54	30	4.1	18	0.6	2.4	0	1.2
8.0	13.1	2.7	38	30	2.4	17.3	0.5	3	3.1	1.8
12.5	12.1	3.7	50	43	1.9	16.3	0.8	8	4	1.2
24.0	9.1	5.7	fo	74	0.89	14.9	1.3	0	5.5	0.71
48.0	5.9	8.3	fo	270	0.6	13.6	2	32	9	0.42
72.3	4.7	10.1	fo	305	0.64	11.8	2.6	38	9.1	0.36

[1] Test began on 10/3/97 at 1300 hrs. nt = not taken fo = flame out

[2] Pretest sample is collected before air/helium injection and after system is shutdown for a minimum of 24 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



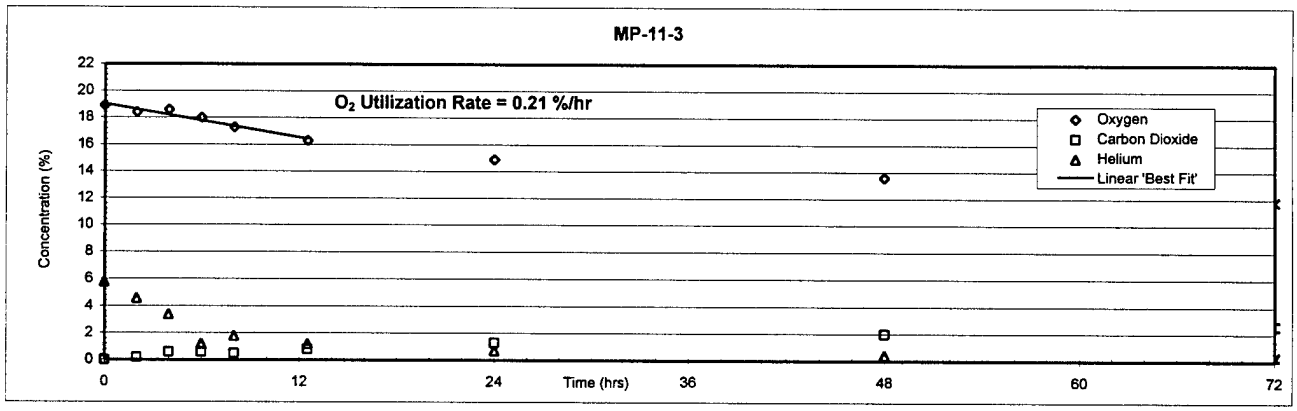


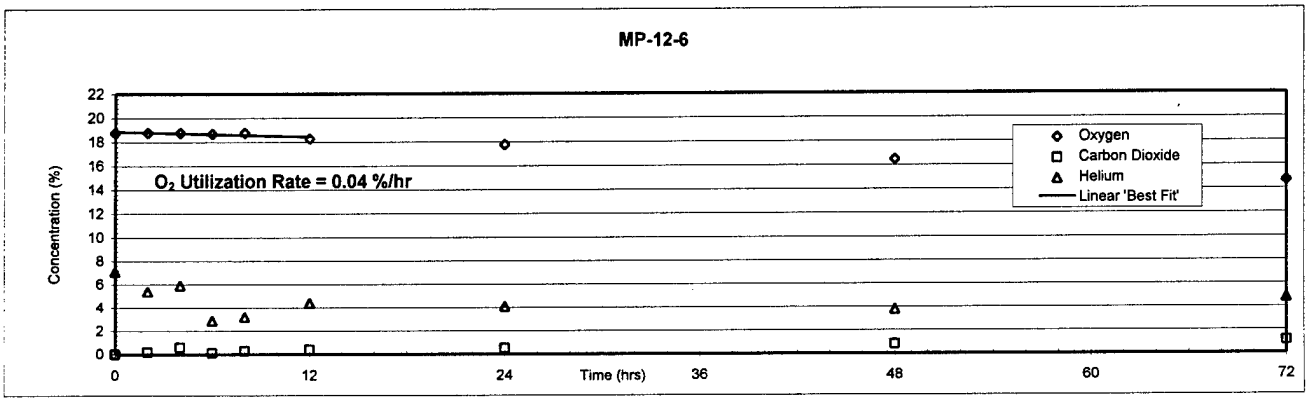
Figure A-7 Fall 1997 Respiration Test Results for MP-9-3, and MP-11-3 at the FTA

Time[1] (hrs)	MP-12-6					MP-14-10				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	17.8	1.9			-	16.7	1			-
0.0	18.8	0	0	3.7	7.1	18.8	0.1	0	4.9	5.8
2.0	18.8	0.2	0	4.1	5.4	18.7	0.2	0	6.7	6.7
4.0	18.8	0.6	0	4.8	5.9	18.4	0.2	3.1	8.1	5.1
6.0	18.7	0.1	0	3	2.9	16.3	0.1	2.1	6.2	5.4
8.0	18.8	0.3	0	3.4	3.2	17.6	0.2	3.5	8.4	4.9
12.0	18.3	0.4	0	3.1	4.4	17.4	0.2	5.1	9.5	4
24.0	17.8	0.5	0	5.2	4.1	15	0.4	0	13	3.8
48.0	16.5	0.8	0	8	3.8	10.9	0.5	fo	19	3.6
72.0	14.7	1.1	0	7.3	4.8	6.5	0.6	fo	27.2	5.2

[1] Test began on 10/3/97 at 1300 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system is shutdown for a minimum of 24 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



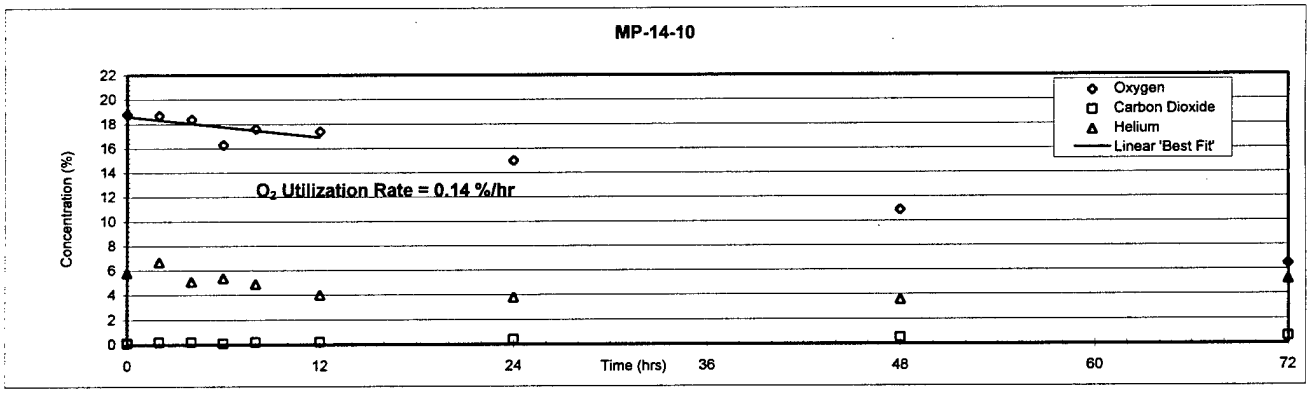


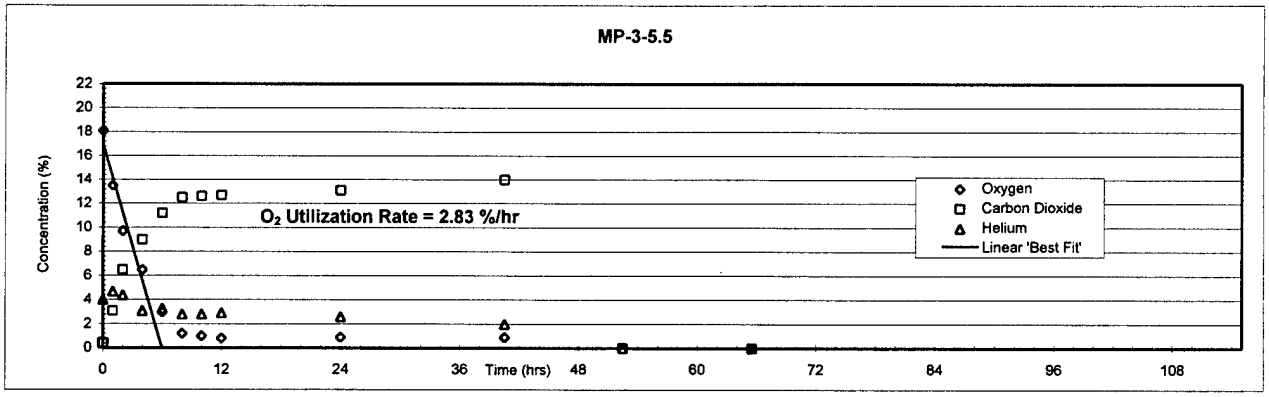
Figure A-8 Fall 1997 Respiration Test Results for MP-12-6 and MP-14-10 at the FTA

Time[1] (hrs)	MP-3-5.5 O_2 (%)	CO_2 (%)	TVH (ppmv) FID	PID	Helium (%)	MP-13-5.5 O_2 (%)	CO_2 (%)	TVH (ppmv) FID	PID	Helium (%)
Pretest[2]	0.8	15.4	na	248	-	1.2	19.4	na	490	-
0.0	18.1	0.4	na	470	4	17.8	0.5	na	100	4.2
1.0	13.5	3.1	na	469	4.7	14.3	0.9	na	175	4.5
2.0	9.7	6.5	na	429	4.4	12.1	1.1	na	270	4.2
4.0	6.5	9	na	349	3.1	8.6	1.9	na	350	3.6
6.0	3	11.2	na	333	3.3	7.2	2.1	na	390	3.5
8.0	1.2	12.5	na	362	2.8	6	2.3	na	430	3.4
10.0	1	12.6	na	348	2.8	5.6	2.6	na	450	3.4
12.0	0.8	12.7	na	350	2.9	5	3.1	na	480	3.2
24.0	0.9	13.1	na	325	2.6	3	3.8	na	505	2.4
40.5	0.9	14	na	310	2	2.1	4.5	na	588	2.1
52.5						1.5	5.6	na	595	1.6
65.5						1.5	6	na	580	1.3

[1] Test began on 8/9/97 at 1430 hrs. fo = flame out na = not available

[2] Pretest sample is collected before air/helium injection and after system is shutdown for a minimum of 24 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



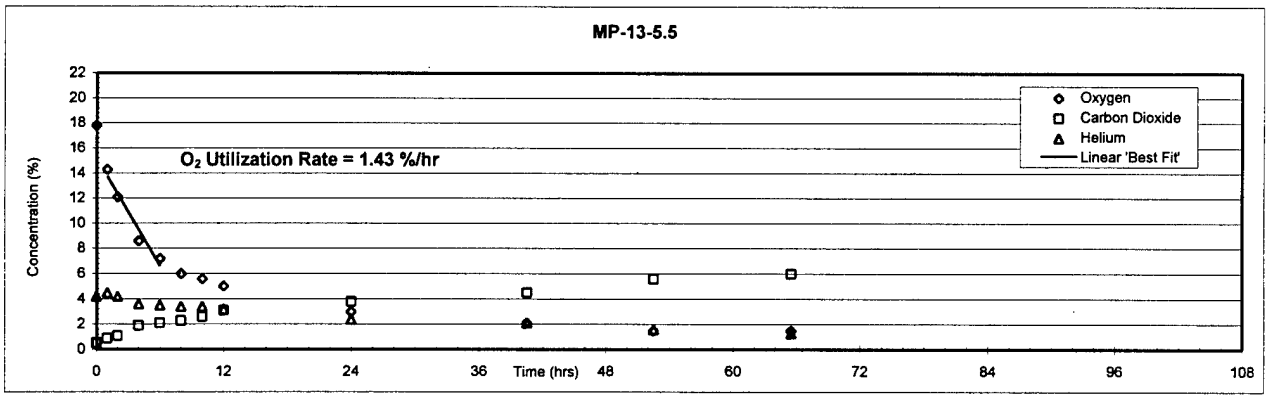


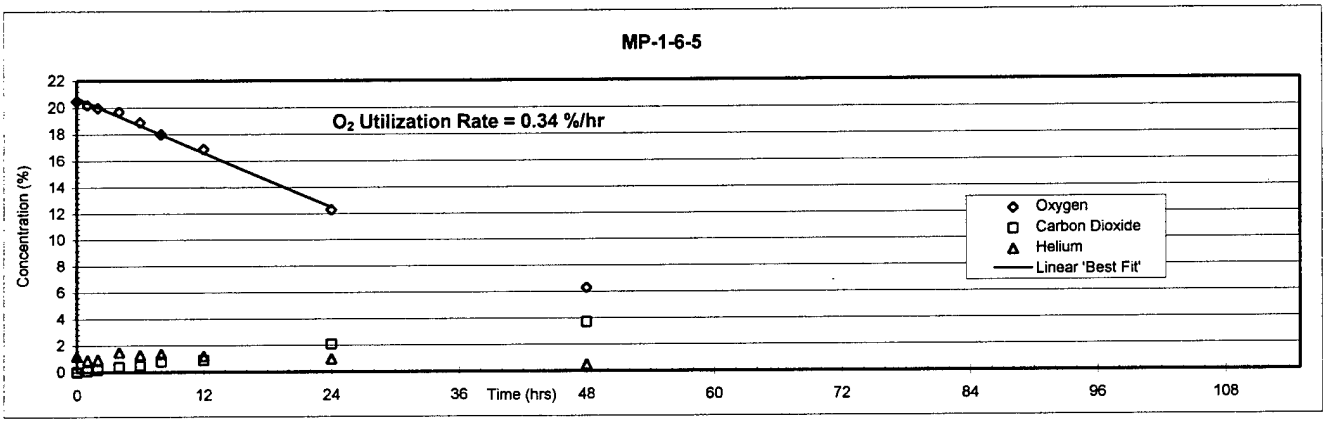
Figure A-9 Fall 1997 Respiration Test Results for MP-3-5.5 and MP-13-5.5 at FTF II

Time[1] (hrs)	MP-1-6-5					MP-1-6-8				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	1.7	5.5	fo	4	-	0.8	9.5	fo	206	-
0.0	20.5	0	0	1.6	1.2	19.9	0.4	1.62	532	1.7
1.0	20.2	0.1	19.3	7.1	0.91	17.4	1.2	2.61	393	1.1
2.0	20	0.2	34.9	8.3	0.97	16.4	1.4	2.88	454	1.1
4.0	19.7	0.4	28.7	5.2	1.5	12.8	2.6	fo	391	1.3
6.0	18.9	0.5	31	2.7	1.3	12.8	2.5	fo	490	1.1
8.0	18	0.8	81	8	1.4	11.7	2.7	fo	500	1.1
12.0	16.9	0.9	111	11.6	1.2	10.1	3.1	fo	511	10
24.0	12.3	2.1	24.1	4.9	0.98	6.4	4.6	fo	385	0.79
48.0	6.3	3.7	fo	4.9	0.51	3.3	5.8	fo	387	1.1

[1] Test began on 10/8/97 at 1100 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system is shutdown for a minimum of 24 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



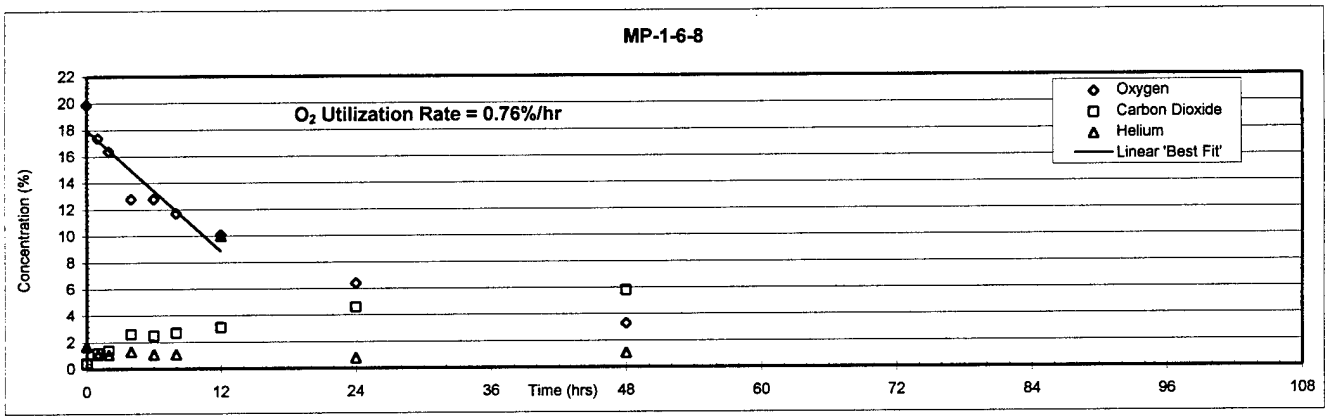


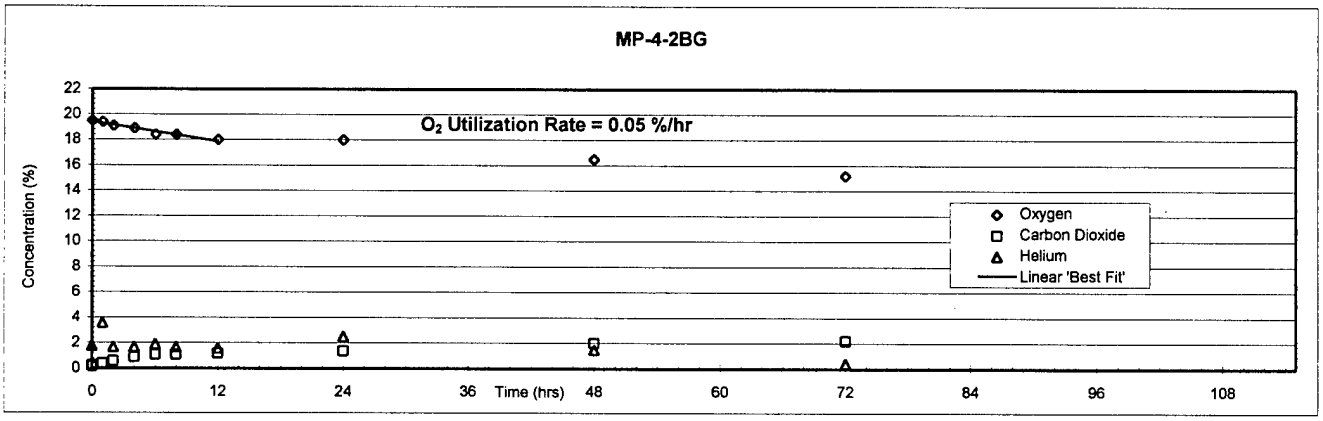
Figure A-10 Fall 1997 Respiration Test Results for MP-1-6-5 and MP-1-6-8 at NDA-1

Time[1]	MP-4-2BG					MP-4-4				
(hrs)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	7.7	6.5	fo	5.1	-	4.7	35.1	fo	549	-
0.0	19.5	0.2	7.8	6.1	1.8	16.7	3.6	1213	118	2.3
1.0	19.4	0.4	8.2	2.6	3.6	15.7	5.5	1600	164	1.5
2.0	19.1	0.6	17.5	4.4	1.7	15.5	6.1	1540	183	1.6
4.0	18.9	0.9	17.1	3	1.7	13.7	7.5	1581	224	1.4
6.0	18.4	1.1	6.7	1.7	1.9	11.7	9	1635	284	1.1
8.0	18.4	1.1	6.4	2.6	1.7	10.7	10.6	fo	292	2
12.0	18	1.2	1.5	2.2	1.6	8	11.7	fo	339	1.6
24.0	18	1.4	13.5	3.1	2.5	10.2	11.8	fo	322	1.9
48.0	16.5	2	14.3	6.7	1.5	6	14.9	fo	371	0.65
72.0	15.2	2.2	118	4.3	0.42	8	15.7	fo	361	1.7

[1] Test began on 10/7/97 at 1000 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system is shutdown for a minimum of 24 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



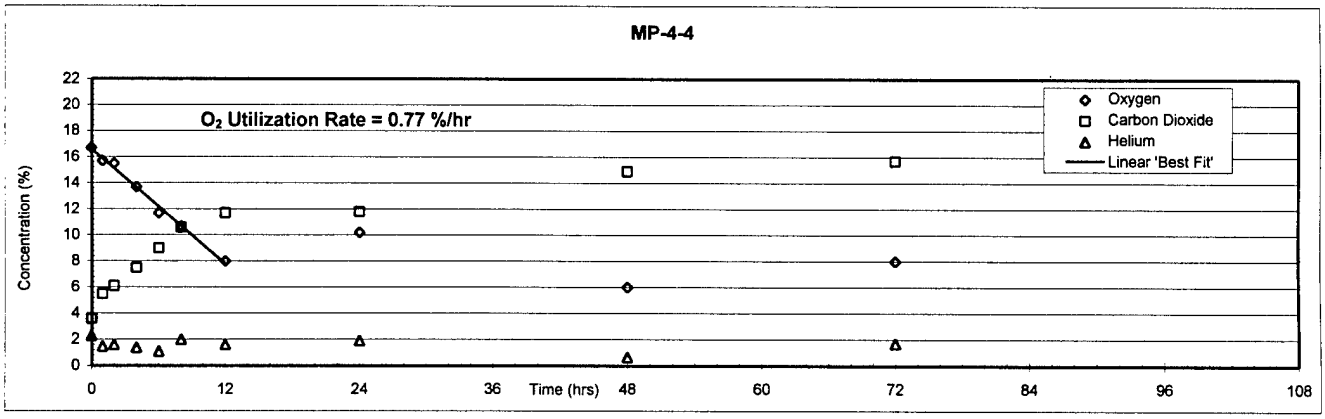


Figure A-11 Fall 1997 Respiration Test Results for MP-4-2BG and MP-4-4 at NDA-4

Time[1] (hrs)	MP-6-2BG				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	PID	Helium (%)
Pretest[2]	11.3	3.5	fo	0.6	-
0.0	19.8	0.1	0	1.4	2
1.0	19.7	0.4	0	1	1.4
2.0	19.6	0.5	0	1	2.1
4.0	19.2	0.8	0	1.4	1.1
6.0	19.2	0.8	0	1.3	1.3
8.0	19.1	1	0	2.2	1
12.0	19	1.1	0	1.3	1.9
24.0	18.2	1.3	0	1.6	1
48.0	17.3	1.7	0	0.8	0.85
72.5	16.9	1.8	0	1	0.88

[1] Test began on 10/13/97 at 1200 hrs.

[2] Pretest sample is collected before air/helium injection and after system is shutdown for a minimum of 24 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.

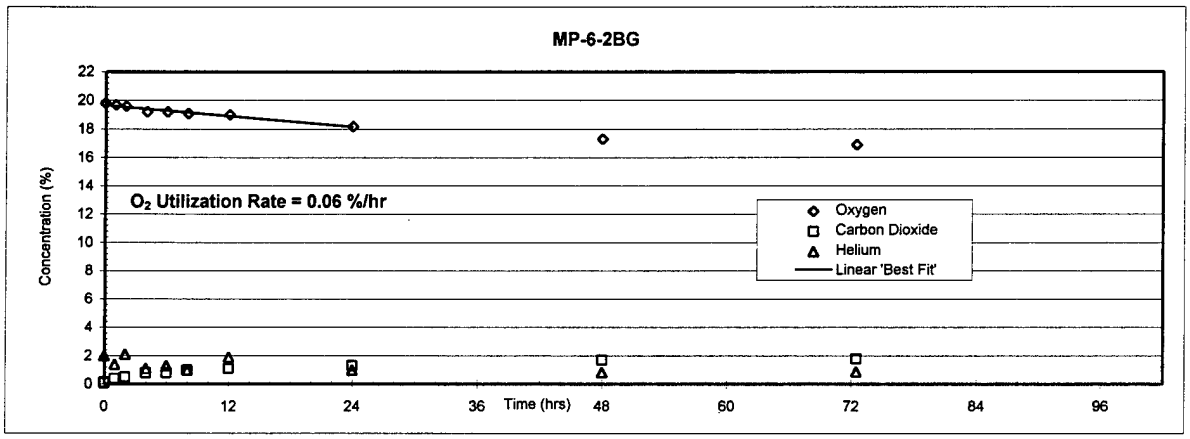


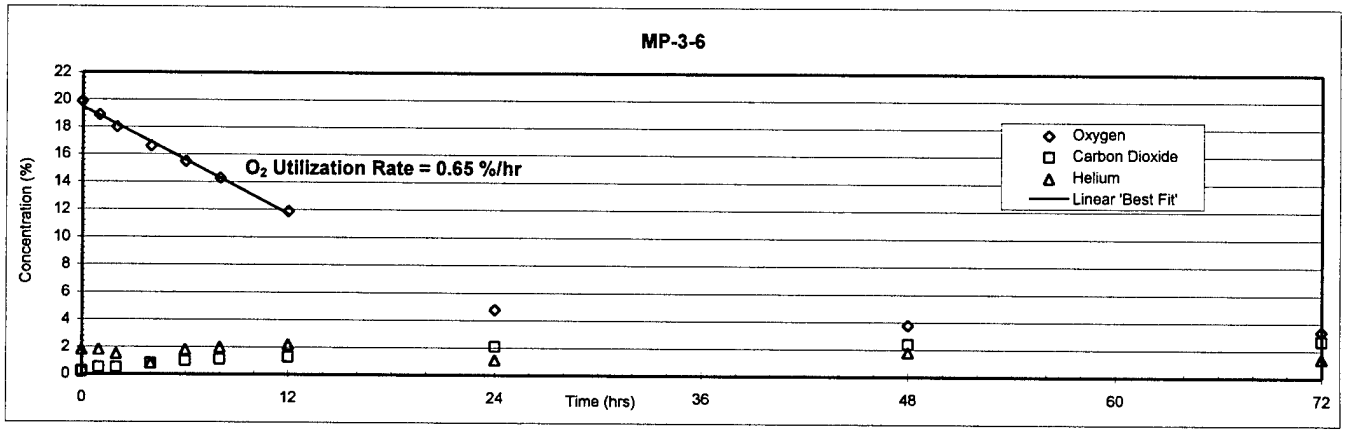
Figure A-12 Fall 1997 Respiration Test Results for MP-6-2BG at NDA-6

Time[1] (hrs)	MP-3-6					MP-4-3				
	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	3.9	2.6	fo	15.1	-	12.1	0.9	0	0.6	-
0.0	19.9	0.2	4	1.6	1.8	20	0	0	0.6	1.6
1.0	18.9	0.5	19.1	3.6	1.8	19.9	0.1	0	0.7	1.2
2.0	18	0.5	25.8	4.2	1.5	19.6	0.1	0	0.7	1.1
4.0	16.6	0.8	28.2	5.3	0.82	19.1	0.2	0	0.9	1.3
6.0	15.5	1	28	5.1	1.8	18.8	0.3	0	0.7	1.2
8.0	14.3	1.1	24	6.2	2	18.2	0.4	0	0.6	1.2
12.0	11.9	1.3	20	6.8	2.2	17.3	0.4	0	0.6	1.3
24.0	4.8	2.1	fo	9.2	1.1	14.9	0.8	0	1.3	1.4
48.0	3.8	2.4	fo	10.1	1.8	11.1	1.1	0	1.9	1.5
72.0	3.4	2.7	fo	11.1	1.4	8.3	1.3	0	1.7	1

[1] Test began on 10/16/97 at 1130 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system is shutdown for a minimum of 24 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



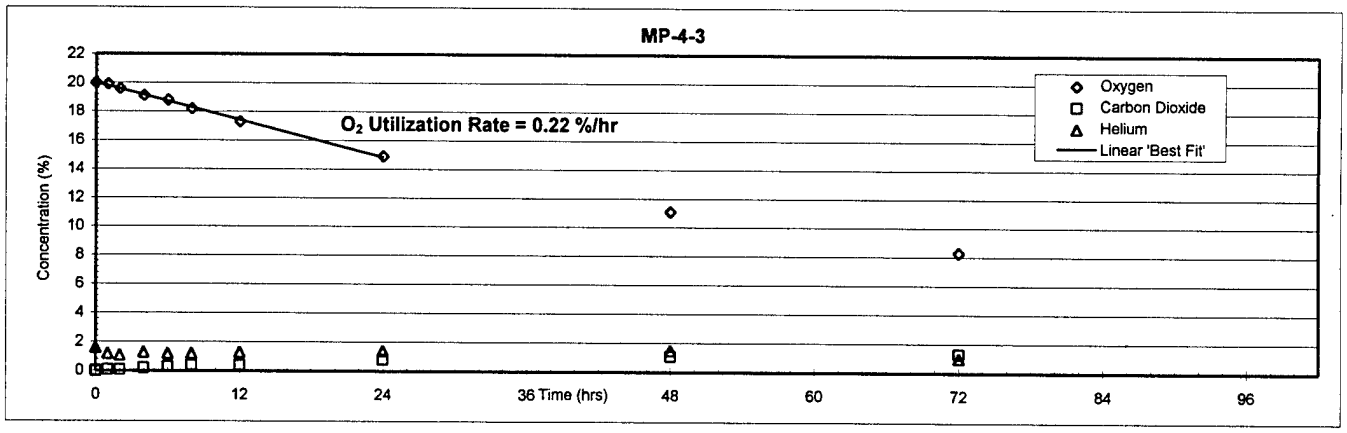


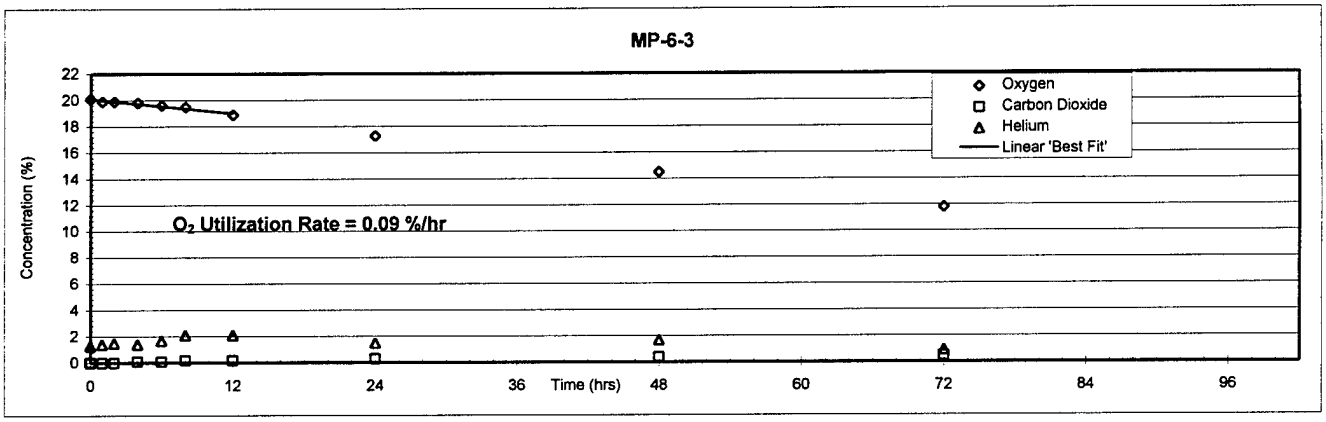
Figure A-13 Fall 1997 Respiration Test Results for MP-3-6 and MP-4-3 at the PPDP

Time[1]	MP-6-3					MP-9-8.5				
(hrs)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)	O_2 (%)	CO_2 (%)	TVH (ppmv) FID	TVH (ppmv) PID	Helium (%)
Pretest[2]	14.8	0.5	0	0.4	-	11	6.6	fo	21.6	-
0.0	20.1	0	0	0.5	1.3	20.3	0	14.1	1.2	1.1
1.0	19.9	0	0	0.6	1.4	19.8	0.3	94	4.2	0.69
2.0	19.9	0	0	0.7	1.5	19.4	0.5	152	5.8	0.74
4.0	19.8	0.1	0	0.7	1.4	18.5	0.8	166	7.8	0.75
6.0	19.6	0.1	0	0.6	1.7	17.9	1.1	220	9	0.77
8.0	19.5	0.2	0	0.5	2.1	17.7	1.2	227	9.5	0.65
12.0	18.9	0.2	0	0.4	2.1	16.9	1.4	270	11	1
24.0	17.3	0.3	0	1.1	1.5	15.6	2.4	306	12.1	0.65
48.0	14.5	0.4	0	1.5	1.7	14.3	3	400	12	0.48
72.0	11.8	0.5	0	1.3	0.94	14.2	3.4	560	13	0.43

[1] Test began on 10/16/97 at 1130 hrs. fo = flame out

[2] Pretest sample is collected before air/helium injection and after system is shutdown for a minimum of 24 hrs.

Note: Typical background oxygen utilization rates = 0.06 - 0.10 %/hr.



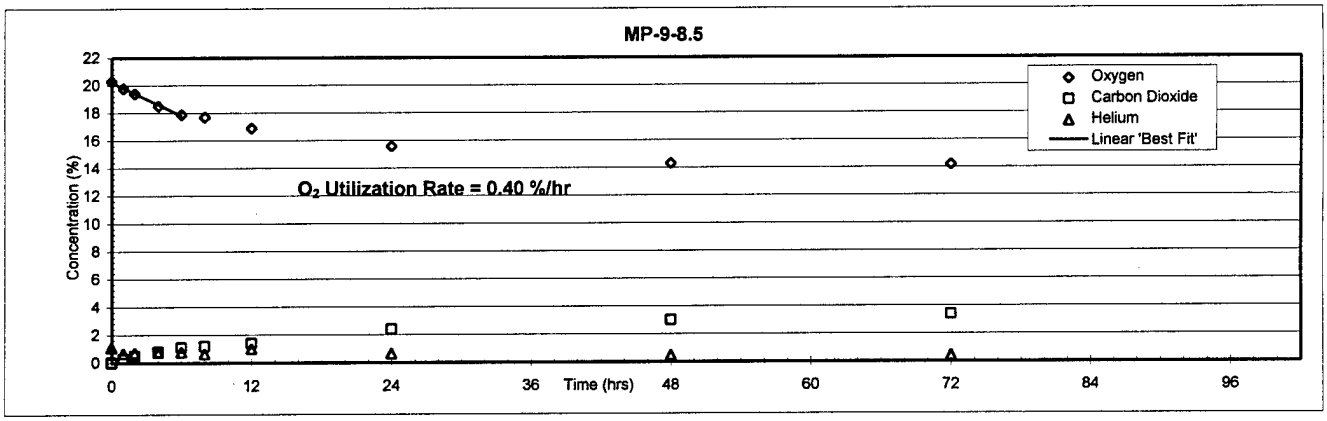


Figure A-14 Fall 1997 Respiration Test Results for MP-6-3 and MP-9-8.5 at the PPDP

Loring Air Force Base
Comments/Responses
Draft (Revision A) Bioventing Semiannual Report - Second Half 1997
January 1998

Reviewer: Mark E. Lucas (210) 321-5126 - Comments Received 2/24/98

Comments	Response
1. Clarity and Organization The document is clear and well organized with the exception of the graphs showing the well screen intervals, the ground-water levels, rain amounts (monthly and normal), and air flow rates. These graphs are small and somewhat hard to read, and the inclusion of the normal rainfall amounts makes the graph more cluttered than necessary. Plotting the monthly rain amounts on the same graph with the ground-water elevations also seems to be unnecessary, since it seems reasonable that the ground-water table will rise after a rain event. This information migh also be conveyed in a paragraph stating that the rise in ground water can be directly attributed to rain events. The most pertinent information contained in these graphs appears to be the correlation of air flow into the ground relative to the water level in the well. WPI feels that this should be the focus of the graphs. The other data could be presented separately, or discussed in a paragraph. Alternatively, the graphs could be presented individually (rather than 10 to a page as in Figure 8.2) so they would be easier to read.	Comment noted, no major changes to the document needed. Some of the rainfall curves will be removed.
2. Completeness The document contains the necessary information to adequately document the activities and findings associated with the various bioventing systems except as noted in the specific comments.	No response required.

Comments/Responses
Draft (Revision A) Bioventing Semiannual Report - Second Half 1997

Comments	Response
3. Technical Issues No general technical issues were noted.	No response required.
Item 1, Page 6, Paragraph 2, Line 3: WPI recommends including a sentence indicating when the malfunctioning programmable logic control (PLC) boards will be repaired or replaced.	Added to text.
Item 2, Page 7, Paragraph 4, Line 1: WPI recommends including a sentence explaining that a discussion of the corrective measures for repairing/replacing non-functional air injection wells is included in the site specific sections presented later in the text.	Added to text.
Item 3, Page 9, Paragraph 1, Line 3: WPI recommends further discussion of the background oxygen utilization rate be included in this paragraph. The fact that some rates are well below the 0.1 %/hour rate mentioned in this paragraph is not fully addressed. Is 0.1 %/hour the rate at a specific site? Is it an average rate? Possibly another column in Table 3-1 showing the site specific background oxygen utilization rate would be helpful.	This paragraph is a generalization of data. Specific sites and respiration results are discussed in site specific sections presented later in this report. No changes were made to this section.

Comments/Responses
Draft (Revision A) Bioventing Semiannual Report - Second Half 1997

Comments	Response
Item 4, Page 9, Paragraph 3, Line 5: WPI recommends clarifying this sentence. It is not clear if the design pressure is 5 psi, or if that is a limit imposed during winter operation. Also, it is not clear what "...maximum pressure was kept close.." means. Was the maximum pressure allowed to exceed design pressure? Was it always less? How close is "close"?	Sentence was clarified and questions answered with clarification.
Item 5, Page 9, Paragraph 5, Lines 3 & 5: These sentences appear to be in disagreement with each other. Sentence three states that air will eventually make its way to the subsurface if constant pressure is applied even if the well is inundated. Sentence five states the wells will be turned off when the wells are inundated. WPI recommends resolving this conflict.	Further explanation was added to text.
Item 6, Page 12, Paragraph 1, Line 4: WPI recommends that the "unexplained improvements" be explained. Are the improvements in the ability to collect the sample, or are the improvements in the performance of the bioventing system?	Sentence was removed from text.

Comments/Responses
Draft (Revision A) Bioventing Semiannual Report - Second Half 1997

Comments	Response
Item 7, Page 12, Paragraph 1, Line 10: If the depth to ground water is going to be determined prior to installation of a new monitoring point, WPI recommends that the historic range of ground-water depth (if known) rather than a single measurement be used to determine the screened interval.	No modification to the text is necessary, recommendation noted.
Item 8, Page 13, Paragraph 3, Line 1: Table 3-1 indicates the oxygen utilization rates are far below the "defined" background rates. This would seem to indicate that no benefit is gained from continuing to operate the system at this site. WPI recommends that the bioventing system at site ES be shut down, or provide an explanation of why it should continue to run (without providing a measurable benefit) either in this section or elsewhere in the text.	No change to text. MP data is scarce. Will keep system running until recommended sampling is performed.
Item 9, Page 38, Paragraph 1 & 3: The first paragraph indicates the bioventing system at the FTA site was shut down in the summer due to high ground-water levels. It states in paragraph 3, line 6 that ground-water levels are not a problem at this site. WPI recommends resolving this conflict.	The reference in the first paragraph to the high water levels in 1996 has been removed from the text.

Comments/Responses
Draft (Revision A) Bioventing Semiannual Report - Second Half 1997

Comments	Response
Item 10, Page 44, Paragraph 1, Line 6: It is not clear whether two bag filters were installed downstream from the oil/water separator and again just upstream from the cartridge filters, or if just two bag filters were installed between the two. WPI recommends clarifying this sentence.	Sentence was clarified.
Item 11, Page 52, Paragraph 1, Line 4: The number of days of operation is inconsistent with the time period indicated. A total of 396 days are available between December 1, 1996 and December 31, 1997. However, the sentence states that the system operated for 443 days during this period. WPI recommends correcting this discrepancy.	No correction necessary. The December 1 date is the start of O&M. The system was started previous to this data.
Item 12, Page 61, Paragraph 1, Line 4: The number of days of operation is stated as 438, when only 396 are available. See comment 11.	No correction necessary. The December 1 date is the start of O&M. The system was started previous to this data.
Item 13, Page 61, Paragraph 2, Line 7: The document states that high water levels can only be attributed to the lack of air injection. WPI recommends changing the sentence to include the fact that high ground-water levels, large amounts of rain, incorrect air injection well placement, etc. are possibly responsible for the high water levels in the well. Lack of air injection by itself cannot be the only reason for high water levels.	The text has been clarified.

Comments/Responses
Draft (Revision A) Bioventing Semiannual Report - Second Half 1997

Comments	Response
Item 14, Page 77, Paragraph 1, Line 4: The number of days of operation is stated as 428, when only 396 are available. See comment 11.	No correction necessary. The December 1 date is the start of O&M. The system was started previous to this data.
Item 15, Page 80, Paragraph 1, Line 4: The number of days of operation is stated as 432, when only 396 are available. See comment 11.	No correction necessary. The December 1 date is the start of O&M. the system was started previous to this data.

Comments/Responses
Draft (Revision A) Bioventing Semiannual Report - Second Half 1997

Reviewer: Peter Forbes - Comments Received 3/9/98

Comments	Response
General Comments *Item 1:* Expand the title of the report to reflect the focus on evaluation of system performance and to include the period of performance. *"Semi-Annual Bioventing Performance Report, August - December 1997".*	Title has been modified.
Specific Comments: *Item 2. Figure 1-2:* Correct the spelling of *"Injection".*	Comment incorporated.
Item 3. Figure 1-2: Add a label for the well screen.	Label has been added in parenthesis next to screen dimension.
Item 4. Section 3.1.3, Page 7: Delete *"January 1998".*	Comment incorporated.
Item 5. Section 4: No changes. I agree with the recommendations.	No response required.
Item 6. Section 5: I agree with the recommendation to add an injection well in the proposed location.	No response required.

Comments/Responses
Draft (Revision A) Bioventing Semiannual Report - Second Half 1997

Comments	Response
Item 7. Section 5: According to Figure 5-1, there is low oxygen in MP-4BG-8 along with a high respiration rate in 1996. Although the nearby borings and jar headspace readings taken in 1997 revealed low VOCs, there is room to argue that the borings did not advance deeply enough to delineate the subsurface petroleum contamination. I recommend this area be included in the confirmation sampling program and an additional injection well be planned for this area if bioventing is to continue at this site.	The paragraph has been modified to identify the background area as a confirmation sampling site including a sampling depth interval below the depth of MP-4BG (8.5 ft). The soil gas samples were collected to a depth of 10 ft bgs. Wet conditions were noted in the 8 - 10 ft bgs samples therefore the borings were halted since headspace analysis is not effective in saturated soils.
Item 8. Section 6, Figure 6-1: The circle for AIW 5 should be underlined.	Good eye. AIW 5 has been underlined.
Item 9. Section 6.2: Are we not actually referring to soils rather than sediment at MP-1, MP-4, and MP-2?	Comment incorporated.
Item 10. Section 6.2: I agree with the recommendation. Please delete the phrase "risk assessment" which is used to describe the no action alternative. The last sentence should be rewritten. If soil sampling indicates PRGs have been achieved at the site, the bioventing system should be shut down.	Comments incorporated.

Comments/Responses
Draft (Revision A) Bioventing Semiannual Report - Second Half 1997

Comments	Response
Item 11. Section 6.2: Any ideas why so many of these monitoring points do not work, even though the screens are not under water?	Good question. We can only speculate that either the soils immediately surrounding the monitoring point screens are very impermeable and therefore have retained moisture throughout the bioventing period or that the permeability of the soils have been affected during the installation process (e.g., smearing, grout infiltration resulting in sealing of the borehole wall).
Item 12. Section 7, Figure 7-1: The label for AIW 8 is missing from the figure.	Label has been added.
Item 13. Section 7, Figures for Table 7-2: It looks like the two rubble zones at this site are acting like infiltration galleries and are the cause of the water level mounding. Can these be covered with plastic to prevent this from occurring?	As illustrated on Table 7-2, the central portion of the FJETC does have high groundwater levels. Just under one-half of this area is paved although the rubble areas exist from the edge of the pavement to the southeast. Potential mounding of the water table could be occurring due to the rubble acting as an infiltration gallery. Suggest that water levels are evaluated in April and May before the decision is made to place plastic over this area.
Item 14. Section 7: This site has evidence that a significant source of contamination still exists near MP-1 and MP-7. There are high TVH readings at MP-3 and MP-4 also, even though the oxygen levels were high. Perhaps they are getting too much air. Could a respiration test be performed at one of these locations next summer? We should also consider installing some sort of product recovery system at the site to accelerate cleanup. This would probably involve some shallow wells and some sort of system to reduce the water mounding close to the area we suspect to be contaminated.	Agree that there is some evidence on a source near MP-1 and MP-7 due to the presence of fuel and very low oxygen levels, respectively. One thing to note is that fuel has not been noted in any of the AIWs therefore a large pool of fuel oil is not suspected. Respiration tests at these two MPs are a good idea and this will be added to the recommendations. Some of the confirmation sampling borings to be drilled in 1998 will be placed within the suspected contamination areas and left open or completed as wells for monitoring any free product. At this time the decision should be made to add fuel oil recovery systems. See response to #13 to controlling the water mounding.

Comments/Responses
Draft (Revision A) Bioventing Semiannual Report - Second Half 1997

Comments	Response
Item 15. Section 8: I agree with the recommendation.	No response required.
Item 16. Section 9: I agree with the recommendations. Please edit the last two sentences to read more smoothly.	Content from both sentences have been rewritten into one sentence.
Item 17. Section 10.2, second paragraph: It is stated that oxygen levels range from 4.6% in November, yet Table 10-1 indicates MP 13-5.5 has an oxygen level of 2.5%. Please edit the text or table as appropriate. Also edit the last sentence in this paragraph. It seems to imply that oxygen sensor data are collected only in December and not other months. I think we mean to communicate that data are collected only from the oxygen sensors and not from the standard MPs in the winter months.	The table is correct, the text has been changed. Statements on oxygen sensors have been clarified.
Item 18, Section 10: I agree with the recommendation to continue running the system until more data are available to evaluate performance.	No response required.
Item 19. Section 11: I agree with the recommendations.	No response required.

Comments/Responses
Draft (Revision A) Bioventing Semiannual Report - Second Half 1997

Comments	Response
Item 20. Section 12: I generally agree with the recommendations. We need to know how this system is working. We know it is contaminated. We should also consider expanding this system to include the area affected by the free product removal now in progress.	Based on the fact that water levels in AIWs 20 through 22 are typically greater than 10 ft below the bottom of the screens in MPs 2-9 and 2-10, it is clear that either the construction of the MP or a saturated perched lense may be contributing to the no flow conditions in both MPs. May be best to wait and get soil sample results before making the decision on installing new MPs. It is probably too early to include the new area of contamination in the NDA-2 biovent system. It is not recommended until the magnitude of the source is better defined.
Item 21. Section 13: It appears that the equipment shed for this system could be shut down, if these recommendations are followed. I think we should recommend the equipment be taken completely out of service and be made available for some other site.	Comment incorporated.
Item 22. Section 14: I agree with the recommendations, and would add a statement about whether the equipment could be shut down permanently and used at another site.	The blower at NDA-4 is recommended for the combination of NDAs-4 and 5. A statement will be added regarding the use at another site in the NDA-5 section.
Item 23. Section 15: I agree with the recommendations.	See response to comment #22. No response required.
Item 24. Section 16: I agree with the recommendations.	No response required.

Comments/Responses
Draft (Revision A) Bioventing Semiannual Report - Second Half 1997

Comments	Response
Item 25. Section 17: I generally agree with the recommendation. Since this is such a small site, is it feasible to cover the ground with a poly cover to reduce surface water infiltration and keep the AIWs from becoming inundated?	Covering an area of approximately 100 by 100 ft may not be that expensive as long as the edges can be sealed to the taxiway (assuming the taxiway surface drainage does not slope to the NDA-7 area). Keep in mind that a perched water table may be to blame. Sentence has been added to consider adding a polypropylene surface seal.
Item 26. Section 18, NDA-8: I agree with the recommendation.	No response required.
Item 27. Section 19, PPDP: I agree with the recommendation.	No response required.