1162208 - R8 SDMS

Golder Associates

TECHNICAL MEMORANDUM

Date: June 22, 2010

Project No.: 073-81526

To: Fran Costanzi, Remedial Project Manager

Company: U.S. EPA

From: Walter Weinig and Sarah Doyle

Email: WWeinig@golder.com

cc: D. White-KMI, J. Francis-DEQ

RE: SUMMARY OF REMEDIATION ACTIONS RELATED TO OPERABLE UNIT 2 (OU2) AT THE CASPER COMPRESSOR STATION

This technical memorandum presents a summary of the Superfund remediation activities related to source areas at the Kinder Morgan, Inc. (KMI) Casper Compressor Station (Site), formerly owned by KN Energy. This summary was prepared on behalf of KMI by Golder Associates Inc. (Golder).

Since 1965, KN Energy (KN) and later KMI and its affiliates have operated a natural gas compression station at the Site located in Natrona County, northeast of Casper, Wyoming.

The site is divided into two Operable Units. Operable Unit 1 (OU1) includes the groundwater contaminant plumes and OU2 includes the sources for groundwater contamination. This memorandum presents information primarily related to OU2, source areas.

BACKGROUND

In 1987, groundwater under and immediately north of the Site was found to contain trace amounts of dissolved hydrocarbons that were suspected to have originated, in part, from the Site. After completion of site investigations in 1986 and 1987, KN, Dow, Dowell, and LARCO were notified as potentially responsible parties. Removal and Remedial Actions were conducted at the Site from 1989 through 1996 and consisted of groundwater pump-and treat, air sparging, soil-vapor extraction, and free product removal. A timeline of activities related to the Site, specifically related to OU2, is presented in Table 1.

REMEDIATION ACTIONS FOR OU2

In December 1987, KN entered into Administrative Order on Consent (AOC) to perform removal actions requiring that they take immediate action to control suspected sources of groundwater contamination and prevent future migration of contaminated groundwater. In accordance with the AOC, KN prepared an Engineering Evaluation/Cost Assessment (EE/CA) which included an investigation for removal actions (Adrian Brown Consultants, Inc. 1989). In November 1989, removal actions designed to remove BTEX contaminants from groundwater and soil beneath the KN facility began. The remediation system included groundwater pump-and-treat with air stripping, air sparging, and soil vapor extraction.

Golder Associates Inc.
44 Union Blvd., Suite 300
Lakewood, CO 80228 USA
Tel: (303) 980-0540 Fax: (303) 985-2080 www.golder.com

Golder Associates: Operations in Africa, Asia, Australasia, Europe, North America and South America

Remediation actions specific to OU2 were presented in the OU2 Phase 1 Report, prepared by Adrian Brown Consultants (ABC) in June 1995. Objectives, methods, and results of the Phase 1 program are summarized in the sections below.

Objectives

The overall objective of the OU2 Phase 1 work was to "ensure long-term effectiveness and permanence of OU-1 remediation by eliminating the sources of groundwater contamination at the site, such as contaminated subsurface soils or free product (excluding sources associated with the groundwater plume extending from the LARCO property into the Brookhurst Subdivision), so that the concentration in groundwater of contaminants originating from these sources never exceed the Maximum Contaminant Levels (MCLs) or proposed MCLs" (EPA 1991). More specifically, the objectives of the program were as follows (ABC 1995):

1. Evaluate the remedial action;
2. Confirm soil conditions;
3. Enhance the ongoing remedial action by implementing a full-scale air sparging system;
4. Update existing applicable or relevant and appropriate requirements (ARARs), if necessary;
5. After completing the air sparging operations, identify any remaining source areas, if any;
6. Address remaining source areas, if necessary.

Methods

To achieve and maintain final cleanup standards, air sparging was selected as remediation technology for OU2. The levels of benzene, toluene, ethylbenzene, and xylenes (BTEX) existing at the Site prior to implementing the air sparging system were already low due to the cleanup efforts for OU1. Pre-air sparging conditions are summarized in Tables 2 and 3. Remediation of OU1 consisted of three technologies: pump-and-treat, soil vapor extraction, and product recovery. Therefore, air sparging acted primarily as a final polishing step to the remedial action (ABC 1995).

Between July 1993 and September 1993, fifty-four air sparging wells were installed at the Site. On October 28, 1993, the air sparging program began and operated for 495 days until March 9, 1995. The average injection rate per air sparging well during the air sparging program was 6.7 standard cubic feet per minute (scfm), with the total air injection maintained at flow rates between approximately 50 scfm and 100 scfm, depending on the number of air sparging wells in operation at any given time (typically between 4 to 15 wells). A total of 58 million cubic feet of air was injected into the subsurface during the air sparging program. Extraction flow rates were maintained above the air injection flow rates at

approximately 115 scfm to ensure that all air injected was recovered. A total of 78 million cubic feet of soil gas was extracted from the vadose zone. (ABC 1995).

Results

To determine when air sparging was complete, soil gas measurements of volatile organic vapors were measured with a portable photoionization detector (PID). Groundwater and soil gas samples were collected to confirm the results from the PID. The soil gas results after completion of air sparging are presented in Table 4. As shown in Tables 2 and 4, benzene and toluene were below detection in the pre-sparging period, and remained below detection limits after air sparging was completed. Ethylbenzene and xylenes concentrations, which accounted for the majority of BTEX in the soil, were reduced during air sparging. The average BTEX reduction during the air sparging program was 9,915 micrograms per kilogram (μg/kg). (ABC 1995)

SUMMARY OF OU2 REMEDATION

Based on the results of the Phase 1 OU2 remediation, ABC (1995) concluded that the air sparging program was successful in achieving the goal to "ensure long-term effectiveness and permanence of OU-1 remediation by eliminating the sources of groundwater contamination at the site..." Additionally, ABC (1995) concluded that "no identifiable source areas remain at the KN Facility and no further action is considered necessary at this time."

In 1998, KN Energy provided a Certification of Completion for OU2 in conformance with the Administrative Order for Removal Action on Consent (KN Energy 1998). In an unsigned letter from June 1998, EPA indicated approval of the certification by KN Energy (EPA 1998). Both documents are attached to this memorandum

REFERENCES

ABC, 1995, OU2 Phase 1 Report, KN Energy Gas Compressor Station, Casper Wyoming, Report 1125J/950627, June 27, 1995.

EPA, 1991, Work to be Performed by KN Energy, Inc. for the Conduct of the OU2 RI/FS Mystery Bridge Road/U.S. Highway 20 Superfund Site Natrona County, Wyoming, Denver, Colorado, December 1991.

EPA, 1998, Letter from Dale Vodehnal (Program Director, EPA Office of Ecosystem Protection and Remediation) to Mr. Hayden Truscott (Environmental Manager, KN Energy, Inc.) regarding: Termination of Administrative Order on Consent (Docket No. CERCLA VII-88-01, and all its amendments) for Mystery Bridge Rd./U.S. Highway 20, letter without date, last initialed June 22, 1998.

KN Energy, 1998, Letter from Hayden Truscott (Environmental Manager, KN Energy, Inc.) to Ms. Lloyd and Mr. Jaramillo (EPA) regarding: Operable Unit 2 Completion Certification, April 24, 1998.

ATTACHMENTS

Table 1 – Timeline of Activities Related to OU2 at the Casper Compressor Station
Table 2 – Soil BTEX Concentrations before Air Sparging
Table 3 – Soil Gas BTEX Concentrations before Air Sparging
Table 4 – Soil BTEX Concentrations after Air Sparging
1998 KN Energy letter certifying completion of OU2 activities
1998 EPA letter approving certification of completion of OU2 activities and terminating Administrative Order on Consent
1995 Adrian Brown Consultants OU2 Phase 1 Report, KN Energy Gas Compressor Station, Casper Wyoming, Report 1125J/950627, June 27, 1995

TABLES

TABLE 1
TIMELINE OF ACTIVITIES RELATED TO OU2 AT THE CASPER COMPRESSOR STATION

Date	Activity
Summer 1986	USEPA and Wyoming Department of Environmental Quality (WDEQ) begin investigation of the area in and around the Brookhurst subdivision. Three monitoring wells installed on the property by KN.
Early-mid 1987	Ecology and Environment performs Expanded Site Investigation of Brookhurst subdivision and surrounding facilities.
Summer 1987	KN, Dow, Dowell, and LARCO notified of status as Potentially Responsible Parties (PRPs).
Dec-87	KN enters into Administrative Order on Consent to perform EE/CA of its property. Dow/Dowell and KN enter into Administrative Order on Consent to perform an RI/FS of the Brookhurst Subdivision site (sites later known as Mystery Bridge Superfund Site). LARCO facility work performed under RCRA 3008(h) order.
Jan-88	Removal activities begin at Dow/DSI site, including excavation of 440 cubic yards of contaminated soil from chlorinated sump area and removal of other inactive facilities. SVE systems installed and operated.
March 1988 – June 1990	O'Brien & Gere performs RI/FS activities for Brookhurst subdivision.
Early-mid 1988	ERT performs Phase I and Phase II studies under contract to KN, focusing on area around flare pit. 2 feet of floating product found in piezometer KNP-2.
Mid-late 1988	ABC performs Phase III study to identify extent of free product at KN facility. Study expanded to include information necessary for EE/CA.
Jan-89	Brookhurst subdivision connected to Evansville public water supply system.
Mar-89	EE/CA report completed and submitted to USEPA.
14-Aug-91	Consent Decree for Mystery Bridge Superfund Site
October – November 1992	Air sparging pilot test to address OU2 (source areas) at the KN facility. Sparging shown to have little effect on groundwater levels.
October 28, 1993 – March 9, 1995	Full-scale air sparging system operated to address OU2 soils. Approximately 1,600 pounds of BTEX estimated to have been removed.
24-Apr-98	KN certifies completion of OU2 remediation.
22-Jun-98	USEPA approves certification of completion for OU2 remediation and terminates Administrative Order on Consent
Nov-98	5-year review conducted.
11-Feb-99	USEPA issues letter certifying completion of 5-year review. Letter includes statement that "OU2 remedial action objectives have been fully achieved."
Sep-04	SVE/air-sparging system and groundwater infiltration gallery decommissioned and removed from site per approved work plan.
21-Aug-09	Site visit for 2009 5-year review. Site visit included Fran Costanzi from USEPA and Jane Francis from WDEQ.
30-Sep-09	Five-year review report for Mystery Bridge issued by USEPA. Review concluded that the remedy as implemented is protective of human health and the environment.

TABLE 2
SOIL BTEX CONCENTRATIONS BEFORE AIR SPARGING

Sample ID	Concentration (μg/kg), July 1993				Notes
	Benzene	Ethylbenzene	Toluene	Xylenes	
SB-01	<10.00	810	<9.75	5500	North of KNABC-09
SB-02	<10.00	660	<9.75	4900	Center of old pond
SB-03	<10.00	2000	<9.75	11000	Near flare pit
SB-04	<10.00	5900	<9.75	22000	West of KNABC-27
SB-05	<10.00	1400	<9.75	5300	Completed as KNABC-91

TABLE 3
SOIL GAS BTEX CONCENTRATIONS BEFORE AIR SPARGING

Sample ID	Concentration (ppm), August 1993			
	Benzene	Ethylbenzene	Toluene	Xylenes
KNSVE-63	0.12	0.1	0.94	0.68
KNSVE-64	1.56	0.1	0.74	0.58
KNSVE-65	0.2	0.1	0.76	0.52
KNSVE-66	0.2	0.22	0.94	1.74
KNSVE-67	<0.08	0.32	1.52	1.26
KNSVE-68	0.12	0.12	0.82	0.64
KNSVE-69	0.14	0.08	0.84	0.7
KNSVE-80	3.34	0.58	2.2	1.96
KNSVE-81	<0.08	<0.06	1.94	0.52
KNSVE-82	0.12	0.1	0.9	0.74
Field Blank	<0.08	0.5	1.26	1.54

NOTES:

Sampling was conducted on August 24, 1993 after the Soil Vapor Extraction system had been shut off for 114 days to see if a rebound of soil gas concentrations occurred and to establish pre-air sparging soil gas concentrations.

TABLE 4
SOIL BTEX CONCENTRATIONS AFTER AIR SPARGING

Sample ID	Concentration (µg/kg), February 1995				Notes
	Benzene	Ethylbenzene	Toluene	Xylenes	
SB-01A	<8	570	<8	2900	North of KNABC-09
SB-02A	<8	280	<8	260	Center of old pond
SB-03A	<8	93	<8	400	Near flare pit
SB-04A	<8	1700	<8	3000	West of KNABC-27
SB-05A	<8	280	<8	430	Completed as KNABC-91

1998 KN ENERGY LETTER CERTIFYING COMPLETION OF OU2 ACTIVITIES

K N Energy, Inc.
370 Van Gordon Street
P.O. Box 281304
Lakewood, CO 80228-8304
(303) 989-1740

510254

April 24, 1998

SUPERFUND BRANCH

Lisa Lloyd
United States Environmental Protection Agency
999 18th Street Suite 500
Denver, CO 80202
Mailcode EPR-SR

RE: Operable Unit 2 Completion Certification

Dear Ms. Lloyd and Mr. Jaramillo:

KN Energy (KN) is pleased to provide this Certification of Completion for Operable Unit 2 (OU-2) at the Brookhurst site in conformance with the Administrative Order for Removal Action on Consent (Removal Order) dated December 15, 1987 and the subsequent two amendments.

KN certifies that it has completed all the requirements of the Removal Order and its amendments. The following paragraph conforms to typical standards for work completion certification.

> *I certify under penalty of law that all work, as defined in the Removal Order, was completed under my direction or supervision in accordance with a system designed to assure that personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information KN has submitted is, to the best of my belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.*

KN continues to appreciate the cooperation and comprehension of the EPA in regards to complicated environmental issues. We look forward to your closure response.

Sincerely,
KN Energy, Inc.

Hayden Truscott
Environmental Manager

cc: JK, SA

File:1125A:980423

1998 EPA LETTER APPROVING CERTIFICATION OF COMPLETION OF OU2 ACTIVITIES AND TERMINATING ADMINISTRATIVE ORDER ON CONSENT

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2466

510256

Ref: 8 EPR-SR

Hayden Truscott
Environmental Manager
KN Energy Inc.
370 Van Gordon Street
PO Box 281304
Lakewood Co 80228-2466

RE: Termination of Administrative Order on Consent (Docket No CERCLA VIII-88-01, and all its amendments) for Mystery Bridge Rd. / U.S. Highway 20

Dear Mr. Truscott :

The Environmental Protection Agency (EPA) has received the Certification of Completion for work conducted under the Administrative Order for Removal Action on Consent (Order) for Operable Unit 2 (OU 2) for the Brookhurst/Mystery Bridge U.S. Highway 20 site, signed by KN Energy.

In accordance with Section XXII of the Order, this letter constitutes EPA's approval of the certification by KN Energy (KN) of satisfaction of activities required by the Order. This notice does not terminate any obligation of KN to comply with continuing obligations of the Order.

If you have any questions regarding this letter, please contact Dennis Jaramillo at (303) 312-6580, or for questions regarding legal matters, please contact Sheldon Muller at (303) 312 -6916.

Sincerely,

Dale Vodehnal
Program Director
Office of Ecosystem Protection and Remediation

cc: Bert Garcia, EPR-SR
Sheldon Muller, ENF-L
Sharon Abendschan, ENF-T

6/9/98

6/10/98 ENF-T

8ENF-T 6/11/98

8ENF-L S. Muller 6/22/98

Printed on Recycled Paper

1995 ADRIAN BROWN CONSULTANTS OU2 PHASE 1 REPORT
KN ENERGY GAS COMPRESSOR STATION CASPER WYOMING
REPORT 1125J/950627 JUNE 27 1995

OU-2 PHASE I REPORT
KN ENERGY GAS COMPRESSOR STATION
CASPER, WYOMING

Prepared by:

Adrian Brown Consultants, Inc.
155 South Madison Street, Suite 230
Denver, Colorado 80209
(303) 399-9630

Report 1125J/950627
June 27, 1995

TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 SITE BACKGROUND 1

2.0 OBJECTIVES OF OU-2 PHASE I 2
2.1 OVERALL OBJECTIVES 2
2.2 SPECIFIC OBJECTIVES 2

3.0 SCOPE OF WORK 3

4.0 ARARs UPDATE 3

5.0 OU-2 DESIGN BASED ON CONCEPTUAL SITE MODEL 3

6.0 PRE-AIR SPARGING CONDITIONS 4
6.1 CLEANUP ACHIEVED BY OU-1 4
6.2 PRE-AIR SPARGING CHARACTERIZATION 4
6.2.1 Soil Sampling 4
6.2.2 Soil Gas Sampling 5
6.3 GROUNDWATER 6

7.0 AIR SPARGING PROGRAM 9
7.1 INSTALLATION 9
7.1.1 Construction 9
7.1.2 Drilling 9
7.2 OPTIMIZATION 9
7.2.1 Dissolved Oxygen 10
7.2.2 Oxygen, Carbon Dioxide and Methane 10
7.2.3 Volatile Organic Vapors 10
7.3 OPERATION 11
7.3.1 Air sparge well injection 11
7.3.2 Total air injection and soil gas extraction 11
7.3.3 Air sparging completion 12

8.0 RESULTS 13
8.1 SOIL 13
8.2 SOIL GAS 13
8.2.1 PID Readings 13
8.2.2 BETX levels in SVE wells 14

8.3 GROUNDWATER 16

9.0 DISCUSSION 19

10.0 CONCLUSIONS 20

11.0 BIBLIOGRAPHY 21

TABLES

Table 1: Maximum Contaminant Levels for BETX 1
Table 2: Soil sampling analytical results (µg/kg), July 1993 4
Table 3: Soil gas sampling analytical results (ppm), August 1993 5
Table 4: Pre-sparging groundwater BETX concentrations (µg/l) 7
Table 5: Soil sampling analytical results (µg/kg), February 1995 13
Table 6: BETX concentrations in soil gas during air sparging program 15
Table 7: Benzene concentrations in groundwater (µg/l) 17

FIGURES

Figure 1 Conceptual model of transport of BETX
Figure 2 Thickness of stained soil, KN Facility
Figure 3 Cross-section A-A'
Figure 4 KN Energy system progress (as of 5/93)
Figure 5 Soil sample locations
Figure 6 SVE wells installed for air sparging program
Figure 7 Benzene concentrations (µg/l) March 24-26, 1993
Figure 8 Air sparge well completion
Figure 9 Sparge wells installed for air sparging program
Figure 10 Air sparging optimization - dissolved oxygen levels: ABC-24
Figure 11 KNABC-24 dissolved oxygen - SPG-5 injection: 9 scfm
Figure 12 KNABC-24 dissolved oxygen - SPG-5 injection: 5 scfm
Figure 13 Air sparging optimization - SVE testing results
Figure 14 Air sparging optimization - SPG-5 testing results
Figure 15 Air sparging program - average well injection rate
Figure 16 Air sparging program - air sparge wells in operation
Figure 17 Air sparging program - air injection rate
Figure 18 Air sparging program - soil gas extraction rate
Figure 19 Air sparging program - air injection and soil gas extraction
Figure 20 Air sparging program - soil characterization
Figure 21 Air sparging program - SVE wells PID readings
Figure 22a Air sparging program - SVE wells PID readings Group 1
Figure 22b Air sparging program - SVE wells PID readings Group 2

Figure 22c Air sparging program - SVE wells PID readings Group 3
Figure 22d Air sparging program - SVE wells PID readings Group 4
Figure 22e Air sparging program - SVE wells PID readings Group 5
Figure 23a Benzene concentrations in soil gas
Figure 23b Ethylbenzene concentrations in soil gas
Figure 23c Toluene concentrations in soil gas
Figure 23d Xylenes concentrations in soil gas
Figure 24 Total BETX concentrations in soil gas
Figure 25 Groundwater monitoring and air sparge well location map
Figure 26a Air sparging program - groundwater benzene concentrations KNABC-5
Figure 26b Air sparging program - groundwater benzene concentrations KNMW-7
Figure 26c Air sparging program - groundwater benzene concentrations KNABC-17
Figure 26d Air sparging program - groundwater benzene concentrations KNABC-27
Figure 26e Air sparging program - groundwater benzene concentrations KNABC-91
Figure 26f Air sparging program - groundwater benzene concentrations KNGW-02
Figure 26g Air sparging program - groundwater benzene concentrations KNMW-6
Figure 27 Air sparging program - background groundwater benzene concentrations
Figure 28 Air sparging program - groundwater benzene concentrations KNMW-5
Figure 29a Air sparging program - groundwater benzene concentrations EPA 1-9
Figure 29b Air sparging program - groundwater benzene concentrations EPA 1-10
Figure 29c Air sparging program - groundwater benzene concentrations EPA 2-11
Figure 30a Benzene concentrations in GW extraction well KNABC-70
Figure 30b Benzene concentrations in GW extraction well KNABC-71
Figure 30c Benzene concentrations in GW extraction well KNABC-72
Figure 30d Benzene concentrations in GW extraction well KNABC-73
Figure 31 Benzene concentrations in GW extraction wells - Composite
Figure 32 Reduction of benzene in groundwater during air sparging
Figure 33 Benzene rate of removal from groundwater during air sparging program

PLATES

Plate 1 Air sparging operational time schematic

APPENDICES

APPENDIX A EPA letter to KN Counsel Jeff Groy dated June 5, 1995
APPENDIX B Laboratory Analytical Results
B-1: Soil sampling analytical results
B-2: Soil gas (SVE) sampling analytical results
B-3: Groundwater sampling analytical results
APPENDIX C Borehole Logs
C-1: Pre-sparging soil borehole logs, July 1993
C-2: Post-sparging soil borehole logs, February 1995

1.0 INTRODUCTION

This report summarizes activities that were performed at the KN Energy, Inc. Gas Compressor Station in Casper, Wyoming (KN Facility), a part of the U.S. Highway 20/Mystery Bridge Road Superfund Site. The work was conducted in accordance with the OU-2 Phase I Workplan for the KN Energy Gas Compressor Station, Casper, Wyoming (ABC, 1993d) (OU-2 Workplan), and Revised Air Sparging Report for the KN Energy Gas Compressor Station, Casper, Wyoming (ABC, 1993b) (Air Sparging Report). Groundwater monitoring activities were, and still are, directed by the Remedial Action Groundwater Monitoring Plan for the KN Energy Gas Compressor Station, Casper, Wyoming (ABC, 1993c) (GMP).

1.1 SITE BACKGROUND

KN Energy, Inc. (KN) has operated the KN Facility since 1965. In 1985, groundwater under and immediately north of the KN Facility was found to contain trace amounts of dissolved hydrocarbons that were suspected to have originated, in part, from the KN Facility (Ecology and Environment, 1987). The constituents of concern at the KN Facility are benzene, ethylbenzene, toluene, and xylene (BETX) for which the maximum contaminant levels (MCLs) are listed in Table 1.

Table 1: Maximum Contaminant Levels for BETX

Constituent	MCL (µg/l)
Benzene	5
Ethylbenzene	700
Toluene	1,000
Xylenes	10,000

Source: EPA Drinking Water Regulations and Health Advisories November 1994

Since November 1989, KN has undertaken a removal action at the KN Facility, which is part of the Site. EPA divided the KN Facility into two operable units: Operable Unit One (OU-1), which addresses groundwater remediation, and Operable Unit Two (OU-2), which addresses remediation of source areas.

KN's removal action consisted of groundwater pump and treat (PAT) and soil vapor extraction (SVE) systems that remove hydrocarbons via three phases: free floating product, groundwater, and soil vapor. The SVE system extracts vapor phase hydrocarbons from the unsaturated interval between the water table and the ground surface. The PAT system pumps groundwater to the surface where volatile hydrocarbons are removed by air stripping. Floating product, when present, is removed from the groundwater extraction wells when the PAT system is in operation. As part of OU-1, the removal action was selected as the remedy for the

KN Facility. The OU-1 remedial system continued to operate while the work set forth by the OU-2 Workplan was conducted. The site conceptual model and relationship between OU-1 and OU-2, and the overall remedial system, including the air sparging system installed under the OU-2 Workplan, is described in detail in the OU-1/OU-2 Design Report, KN Energy Gas Compressor Station (ABC, 1993e).

2.0 OBJECTIVES OF OU-2 PHASE I

2.1 OVERALL OBJECTIVES

The overall objective for OU-2 at the KN Facility is to "[e]nsure long-term effectiveness and permanence of OU-1 remediation by eliminating the sources of groundwater contamination at the site, such as contaminated subsurface soils or free product (excluding sources associated with the groundwater plume extending from the LARCO property into the Brookhurst Subdivision), so that the concentration in groundwater of contaminants originating from these sources never exceed Maximum Contaminant Levels (MCLs) or proposed MCLs" (EPA, 1991).

2.2 SPECIFIC OBJECTIVES

The specific objectives for OU-2 are as follows:

1. Evaluate the remedial action;
2. Confirm soil conditions;
3. Enhance the ongoing remedial action by implementing a full-scale air sparging system;
4. Update existing applicable or relevant and appropriate requirements (ARARs), if necessary;
5. After completing air sparging operations, identify any remaining source areas, if any;
6. Address remaining source areas, if necessary.

3.0 SCOPE OF WORK

The proposed scope of work for achieving the objectives of OU-2 Phase I is set forth in the OU-2 Workplan (ABC, 1993d) and outlined in the following steps:

1. Evaluate the results of the groundwater sampling conducted in March 1993;
2. Collect soil samples from the remaining (pre-air sparging program) impacted areas as part of the air sparging program;
3. Implement a full-scale air sparging program;
4. Review and revise the ARARs;
5. Confirm soil conditions at the KN Facility after completion of the air sparging program;
6. Assess success of the existing PAT and SVE systems and air sparging program;
7. Prepare a summary report for OU-2 Phase I; and
8. Perform a feasibility study for the remediation of any remaining source areas, if necessary.

4.0 ARARs UPDATE

A new assessment to update the ARARs has been determined to be unnecessary as indicated by letter from the EPA shown in Appendix A.

5.0 OU-2 DESIGN BASED ON CONCEPTUAL SITE MODEL

The use of a conceptual site model is necessary to establish a hypothesis for the transport of the BETX constituents in the existing soil/groundwater system. The current conceptual model is illustrated in Figure 1. It is based on two BETX source points: the process area and the former flare pit, whose areal and cross-sectional extents are shown in Figures 2 and 3 (ABC, 1989). The source from the process area migrated vertically into the soil, while the source from the former flare pit was subject to burning, which resulted in a low volatile hydrocarbon fluid that migrated into the soil. The BETX compounds migrated by gravity in the vertical direction to the water table, and spread horizontally in the vadose zone by capillarity. The floating product spread out on the water table becoming elongated down gradient to the northeast and was smeared vertically in the saturated zone due to fluctuating water levels. When groundwater contacts these materials, BETX components transfer into the groundwater in the dissolved state.

Air sparging was employed largely as a final polishing step to the OU-1 removal action. Air sparging targets the capillary zone, which contains partial residual saturation of hydrocarbons and provides a source of BETX to dissolve into the groundwater. The capillary zone is not easily remediated by the PAT and SVE technologies since both technologies have limited access to this zone. Air sparging, which injects air into the aquifer, provides a fluid medium capable of volatilizing remaining hydrocarbons, and delivering oxygen to enhance biodegradation in this zone. Air sparging was chosen as the remedial technology for OU-2.

6.0 PRE-AIR SPARGING CONDITIONS

Air sparging was chosen as the technology for OU-2 to achieve and maintain final cleanup standards. The levels of BETX existing in the groundwater system at the KN Facility prior to air sparging were already very low due to the cleanup efforts during OU-1. Because of this, air sparging acted as primarily as a final polishing step to the remedial action. This section describes the conditions that existed prior to the start of air sparging.

6.1 CLEANUP ACHIEVED BY OU-1

The OU-1 remedial system has been very successful in remediating the majority of hydrocarbons that were released at the KN Facility. The three technologies used in the remedial system were pump-and-treat, soil vapor extraction and product recovery. In addition, in-situ biodegradation by indigenous bacteria has contributed to the reduction of hydrocarbon mass at the KN Facility. Figure 4 presents the removal rates over time for the various treatment technologies.

6.2 PRE-AIR SPARGING CHARACTERIZATION

Prior to the startup of the air sparging program, the site conditions were characterized by conducting a sampling program that consisted of groundwater, soil, and soil gas sampling. The results are discussed below.

6.2.1 Soil Sampling

In accordance with the OU-2 Workplan and the Air Sparging Report, soil samples were collected at the five locations shown in Figure 5 in order to characterize soil conditions prior to air sparging. Sampling was performed from July 15, 1993 to July 19, 1993 following procedures set forth in ABC-SOP-SLS023 (ABC, 1993a), which consists of drilling with a hollow-stem auger and collecting soil samples with a split spoon sampler every five feet. The sample exhibiting the highest reading using a photo-ionization detector (PID) was sent to an analytical laboratory to analyze for BETX using EPA Method 8260 modified for selective ion monitoring, a technique used to obtain lower detection limits. The analytical results of the soil sampling are shown in Table 2 and Appendix B-1, and the borehole logs are shown in Appendix C-1.

Table 2: Soil sampling analytical results (µg/kg), July 1993

Sample Location	BENZENE	ETHYLBENZENE	TOLUENE	XYLENES	NOTES
SB-01	<10.00	810	<9.75	5500	North of KNABC-09
SB-02	<10.00	660	<9.75	4900	Center of old pond
SB-03	<10.00	2000	<9.75	11000	Near flare pit
SB-04	<10.00	5900	<9.75	22000	West of KNABC-27
SB-05	<10.00	1400	<9.75	5300	Completed as KNABC-91

Borehole ABC-SB-05 was completed for use as a 2" groundwater monitoring well, as shown in the borehole log in Appendix C-1. Photographs of soil samples from boreholes KN-SB-01, KN-SB-02 and KN-SB-03 are shown in Photos 1-3 at the end of this report.

Table 2 indicates that both benzene and toluene in residual hydrocarbons in the soil were undetectable at detection limits of 10 µg/kg and 9.75 µg/kg, respectively. Ethylbenzene and xylenes were present at low to moderate concentrations, ranging from 660 µg/kg to 22,000 µg/kg.

6.2.2 Soil Gas Sampling

Ten new SVE wells, shown in Figure 6, were installed to provide an adequate zone of evacuation in the vadose zone during air sparging so that no injected air enriched in volatiles could escape from the KN Facility. The SVE blower that was operating as part of the OU-1 system was upgraded in size to increase extraction capacity. The new SVE wells were also used as monitoring points during the air sparging program to evaluate vadose zone conditions.

Soil gas sampling of the 10 new SVE wells was conducted to test if a rebound of the soil gas BETX concentrations occurred after the SVE system had been shut off as well as to establish pre-air sparging soil gas concentrations. On August 24, 1993, after the SVE system had been off for a period of 114 days (since April 22, 1993), samples were collected in Tenax absorbtion tubes and sent to an analytical laboratory for BETX analysis using EPA Method 8260.

The field blank detected toluene, ethylbenzene and xylenes above the detection limit, which is not unusual given the quality of the ambient air in this area. Soil vapor extraction well SVE-80 measured the highest amount of BETX in any of the SVE wells, with benzene detected at 0.167 total micrograms, or 3.34 ppm. Table 3 summarizes the results, and the analytical reports are shown in Appendix B-2. The soil gas sampling results reveal that rebound of BETX in the soil gas was not appreciable after 114 days of SVE shutdown.

Table 3: Soil gas sampling analytical results (ppm), August 1993

Sample Location	Benzene	Ethylbenzene	Toluene	Xylenes
KNSVE-63	0.12	0.1	0.94	0.68
KNSVE-64	1.56	0.1	0.74	0.58
KNSVE-65	0.2	0.1	0.76	0.52
KNSVE-66	0.2	0.22	0.94	1.74
KNSVE-67	<0.08	0.32	1.52	1.26
KNSVE-68	0.12	0.12	0.82	0.64
KNSVE-69	0.14	0.08	0.84	0.7
KNSVE-80	3.34	0.58	2.2	1.96
KNSVE-81	<0.08	<0.06	1.94	0.52
KNSVE-82	0.12	0.1	0.9	0.74
FIELD BLANK	<0.08	0.5	1.26	1.54

6.3 GROUNDWATER

Groundwater sampling was conducted in March 1993 to determine the pre-sparging BETX concentrations in the shallow aquifer. The results indicated that there was one remaining zone where BETX concentrations exceeded the MCLs, and one zone where BETX concentrations were at the MCLs, as shown in Figure 7. The zone where benzene exceeded the MCL was around the flare pit (KNGW-2 and KNMW-6), and the zone where benzene was at the MCL was along the northern fenceline (KNABC-11 and KNABC-27). The maximum benzene concentration measured was 40 µg/l in groundwater monitoring well KNGW-02. Table 4 shows pre-sparging analytical results for BETX dissolved in the groundwater at the KN Facility, including historical maximum and minimum values up until that time.

Table 4: Pre-sparging groundwater BETX concentrations (µg/l)

Well Name	Pre-Sparge Date	Benzene			Ethylbenzene			Toluene			Xylenes		
		Pre-Sparge	Minimum	Maximum	Pre-Sparge	Minimum	Maximum	Pre-Sparge	Minimum	Maximum	Pre-Sparge	Minimum	Maximum
MCL		5			700			1,000			10,000		
EPA-1-08	03-Feb-92	<1.00	<1.00	4.00j	<5.00	<1.00	2.00J	<5.00	<1.00	100.00	<5.00	<1.00	<5.00
EPA-1-09	26-Mar-93	4.00	<0.80	7.00	22	<1.00	22.00	<0.78	<0.78	96.00	<23.00	<1.00	<23.00
EPA-1-10	26-Mar-93	<0.80	<0.80	40.00	40.00	<1.00	40.00	<0.78J	<0.78	98.00	11.00	<1.00	27.00
EPA-1-11	01-Nov-90	<1.00	<1.00	<5.00	<5.00	<1.00	<5.00	<5.00	<1.00	<6.00	<5.00	<1.00	<5.00
EPA-2-11	26-Mar-93	<0.80	<0.80	70.00	6.00	<1.00	190.00	<0.78	<0.78	101.00	9.00	<3.00	1300.00
EPA-2-14	26-Mar-93	<0.80	<0.80	2.00	6.00	<1.00	6.00	<0.78	<0.78	105.00	<3.00	<1.00	<3.00
KNABC-01	25-Mar-93	<0.80	<0.80	<1.00	<0.60	<0.60	<5.00	<0.78	<0.78	<5.00	<1.54	<1.00	<5.00
KNABC-02	24-Mar-93	<0.80	<0.80	0.41	<0.60	<0.60	<5.00	<0.78	<0.78	1.04	<1.54	<0.01	<5.00
KNABC-03	24-Mar-93	<0.80	<0.80	<1.00	<0.60	<0.60	<5.00	<0.78	<0.78	<5.00	<1.54	<1.00	<5.00
KNABC-05	25-Mar-93	3.00	<0.80	330.00	38.00	<5.00	160.00	<0.78	<0.78	53.00	25.00	<5.00	1940.00
KNABC-06	25-Mar-93	1.00	<1.00	1.00	3.00	<1.00	<3.00	<0.78	<0.78	<5.00	3.00	<5.00	<7.00
KNABC-07	24-Mar-93	<0.80	<0.80	<5.00	<0.60	<0.60	<5.00	<0.78	<0.78	9.00	<1.54	<1.00	7.00
KNABC-09	25-Mar-93	<0.80	<0.80	<5.00	2.00	<1.00	<2.00	<0.78	<0.78	9.00	4.00	<1.00	10.00
KNABC-10	25-Mar-93	<0.80	<0.80	<5.00	<0.60	<0.60	<5.00	<0.78	<0.78	9.00	<1.54	<1.00	34.00
KNABC-11	25-Mar-93	5.00	<1.00	33.00	120.00	<1.00	120.00	<0.78	<0.78	83.00	54.00	<5.00	1300.00
KNABC-12	25-Mar-93	3.00	<0.50	3.00	5.00	<1.00	5.00	<0.78	<0.50	104.00	10.00	<0.50	110.00
KNABC-15	24-Mar-93	<0.80	<0.80	0.46	<0.60	<0.01	<5.00	<0.78	<0.78	0.75	<1.54	<0.01	<5.00
KNABC-16	24-Mar-93	<0.80	<0.80	<1.00	<0.60	<0.60	<5.00	<0.78	<0.78	2.81	<1.54	<1.00	<5.00
KNABC-17	25-Mar-93	4.00	<1.00	<100.00	31.00	<5.00	31.00	<0.78	<0.78	<100.00	12.00	<5.00	360.00
KNABC-18	24-Mar-93	<0.80	<0.80	<1.00	<0.60	<0.60	<5.00	<0.78	<0.78	1.33	<1.54	<1.00	14.00
KNABC-19	24-Mar-93	<0.80	<0.80	<1.00	<0.60	<0.60	<5.00	<0.78	<0.78	6.00	<1.54	<1.00	72.00
KNABC-20	25-Mar-93	0.80	<0.80	3.91	70.00	<5.00	110.00	<0.78	<0.78	2.67	62.00	<5.00	411.02
KNABC-21	24-Mar-93	<0.80	<0.80	<1.00	<0.60	<0.60	<5.00	<0.78	<0.78	<5.00	<1.54	<1.00	<5.00
KNABC-22	30-Oct-90	<1.00	<0.50	<1.00	<5.00	<0.50	<5.00	<5.00	<0.50	<5.00	<5.00	<0.50	<5.00
KNABC-23	24-Mar-93	<0.80	<0.80	<1.00	<0.60	<0.60	<5.00	<0.78	<0.78	<5.00	<1.54	<1.54	<5.00
KNABC-24	01-Nov-90	<1.00	<0.50	<5.0J,M	<5.00	<0.50	40.00	<5.00	<0.50	105.00	<5.00	<0.50	47.00
KNABC-25	25-Mar-93	<0.80	<0.50	200.00	<0.60	<0.50	170.00	<0.78	<0.50	<10.00	<1.54	<0.50	270.00
KNABC-26	25-Nov-92	<0.80	<0.80	220.00	7.00	<5.00	1600.00	<0.78	<0.78	520.00	3.00	3.00	6900.00

Well Name	Pre-Sparge Date	Benzene			Ethylbenzene			Toluene			Xylenes		
		Pre-Sparge	Minimum	Maximum	Pre-Sparge	Minimum	Maximum	Pre-Sparge	Minimum	Maximum	Pre-Sparge	Minimum	Maximum
MCL		5			700			1,000			10,000		
KNABC-27	25-Mar-93	5.00	<5.00	25.00	240.00	<5.00	240.00	<0.78	<0.78	52.00	300.00	42.00	300.00
KNABC-34	4-Oct-92	7.00	<1.00	54.00	13.00	<5.00	86.00	<0.78	<0.50	12.00	18.00	<5.00	270.00
KNABC-35	31-Mar-92	97.00	3.00	7370.00	45.00	<5.00	1535.00	16.00	<5.00	400.00	190.00	<5.00	2415.00
KNABC-36	28-Jul-92	2.00	<1.00	155.00	13.00	<5.00	164.00	<0.78	<0.78	25.00	13.00	13.00	820.00
KNABC-50	19-Oct-92	4.00	1.00	29.00	48.00	<50.00	177.00	4.008	<0.78	284.00	13.00	6.00	943.00
KNABC-70	13-Apr-93	6.00	3.00	15.00	6.00	3.00	16.00	<0.78	<0.78	6.00	31.00	9.00	64.00
KNABC-71	13-Apr-93	<0.80	<0.80	<0.80	4.00	4.00	4.00	<0.78	<0.78	<0.78	4.00	4.00	4.00
KNABC-72	13-Apr-93	22.00	13.00	200.00	79.00	30.00	92.00	<0.78	<0.78	1.00	210.00	77.00	210.00
KNABC-73	13-Apr-93	22.00	5.00	82.00	45.00	36.00	140.00	<0.78	<0.78	2.00	83.00	68.00	190.00
KNGW-01	24-Mar-93	<0.80	<0.80	<1.00	<0.60	<0.60	<5.00	<0.78	<0.78	<5.00	<1.54	<1.54	<5.00
KNGW-02	26-Mar-93	40.00	<1.00	40.00	110.00	<5.00	110.00	<0.78	<0.78	38.00	160.00	<5.00	160.00
KNGW-03	26-Mar-93	4.00	<1.00	<4.00	36.00	<5.00	36.00	<0.78	<0.78	5.00	39.00	<5.00	170.00
KNMW-04	25-Mar-93	<0.80	<0.80	<5.00	<0.60	<0.60	<5.00	<0.78	<0.78	<5.00	<1.54	<1.54	<5.00
KNMW-05	25-Mar-93	<0.80	<0.80	<500.00	<0.60	<0.60	210.0J	<0.78	<0.78	<500.00	<1.54	<1.54	1800.00
KNMW-06	26-Mar-93	18.00	<1.00	4200.0SP	6.00	<1.00	6.00	<0.78	<0.78	5000.0SP	16.00	<3.00	920.00
KNMW-07	26-Mar-93	<0.80	<0.80	<250.00	4.00	<1.00	140.0j	<0.78	<0.78	90.00	7.00	<3.00	1100.00
OBG-07	26-Mar-93	<0.80	<0.80	<5.00	<0.60	<0.60	<5.00	<0.78	<0.78	<5.00	<1.54	<1.00	<5.00

7.0 AIR SPARGING PROGRAM

7.1 INSTALLATION

7.1.1 Construction

An addition to the PAT/SVE system concrete pad was made to accomodate a new 16' X 16' building to house two rotary screw compressors, an externally heated regenerative dryer, and ancillary equipment related to the air sparging system. The pad was constructed with fiber reinforced concrete to extend the pad to the east by 22 feet. The width of the pad in the north-south direction remains the same at 30 feet. The northern half of the east side of the concrete pad is ramped to allow vehicular access to the pad.

The air sparging building was constructed with 9' walls to ensure ample room for the regenerative dryer. An 8' wide garage door on the eastern side provides access to the interior so that the compressors and dryer could be easily installed and removed, and to provide ventilation in the summer season. A man-size door is also installed on the eastern side of the building, south of the garage door. On the north wall of the building, a motorized 42" X 42" damper was installed to provide ventilation for operation of the compressors during the winter months.

The belts and sheaves on the SVE blower were exchanged for larger duplex belts and sheaves to increase the capacity of the SVE system. The maximum capacity was increased to approximately 110 scfm, from approximately 75 scfm.

The power supply to the Remedial System was increased in order to drive the two 25 horsepower rotary screw air compressors and the externally heated regenerative air dryer. The primary electrical transformers that supply power to the Remedial System were upgraded and an additional 100 amp disconnect was added to the circuitry.

Photo 4 is an overhead view of the upgraded KN Facility. Photo 5 shows the eastern side of the air sparging operations building, and Photo 6 is a closeup of the air compressor and air dryer before hookup.

7.1.2 Drilling

Fifty-four air sparging wells were installed in the air sparging zone on approximately fifty foot centers over a two month period from July, 1993 to September, 1993. The air sparging well completions all followed the same specifications that are shown in Figure 8. Figure 9 is a map of the KN Facility showing the location of the air sparging wells and Photo 7 shows their spacing.

7.2 OPTIMIZATION

Prior to full-scale startup of the air sparging system, smaller scale testing was perfromed using a singe air sparge point (SPG-5) to optimize operational parameters. The testing consisted of injecting air at variable known rates into the air sparge well and monitoring parameters such as dissolved oxygen in the groundwater, and oxygen, carbon dioxide, methane and volatile vapors concentrations in the soil gas. To evaluate the effects of each component of the system, testing was performed in conjunction with the operation of the SVE system, and while

the SVE system was shut down. Based on the number of air sparge wells to be in operation at any given time, the size of the air compressors, knowledge gained from a previous air sparge test, and literature review, the air injection flowrate was set between 5 and 10 scfm to conduct the optimization. Monitoring well KNABC-24 was used to monitor the effects of air injection at SPG-5 on the groundwater system, and various SVE wells were used to monitor the effects on the soil gas. Photos 8 and 9 show the control section at SPG-5 and soil gas sampling from the SVE well network, respectively.

7.2.1 Dissolved Oxygen

The dissolved oxygen measurements in groundwater well KNABC-24 suggested that injection of air at approximately 5 scfm was most efficient in oxygenating the water in the aquifer. Figures 10, 11 and 12 show the effect of variable flowrates on the oxygen transfer to the water and indicates that the dissolved oxygen content of the water increases when air is injected at a lower pressure/flowrate (about 5 scfm). Higher injection pressures (flowrates) cause channeling that prevent air from dispersing throughout the saturated zone.

7.2.2 Oxygen, Carbon Dioxide and Methane

A portable GA-90 Infrared Gas Analyzer was used in the field to collect data on oxygen, carbon dioxide, and methane. Oxygen, carbon dioxide and methane provide an indirect measure of the bioactivity taking place in the vadose zone. Aerobic bacteria consume oxygen during the hydrocarbon degrading respiration process and produce carbon dioxide as a metabolic by-product. Methane can be produced in the absence of oxygen by anaerobes known as methanogens; bacteria that produce methane as a metabolic by-product.

Five of the ten SVE wells sampled measured appreciable quantities of methane in the soil gas before the SVE system was turned on. The presence of methane in SVE-64, SVE-65, SVE-66, SVE-80, and SVE-81 suggests that anaerobic decomposition was taking place due to the lack of oxygen available to the bacteria in the subsurface. The bacteria present in the subsurface at the KN Facility may be facultative, meaning that when there is oxygen present the microbes function aerobically, but in the absence of oxygen, they function as anaerobes.

Operation of the SVE system caused a substantial increase in the concentration of oxygen and decrease in the concentration of carbon dioxide and methane in the unsaturated zone as it drew soil gas from outside the zone of impact and from the atmosphere through channels of low resistance (e.g. - Elkhorn Creek bank cut). Figure 13 shows the change in oxygen, carbon dioxide and methane during the testing period and indicates that soil gas concentrations were trending towards atmospheric concentrations of 21% oxygen and zero percent carbon dioxide. Methane was completely extracted during the test period.

Soil gas measurements of oxygen and carbon dioxide concentrations in the vadose zone during air injection through SPG-5 confirmed that lower flowrates disperse the injected air more efficiently. Figure 14 shows that at higher flowrates the concentration of oxygen in the soil gas increases, whereas at lower flowrates, the oxygen concentration in the vadose zone decreases, but increases in the groundwater (Figures 11 & 12). This suggests that higher injection pressures do cause channeling to occur.

7.2.3 Volatile Organic Vapors

Monitoring of volatile organic vapors using a photo-ionization detector (PID) was not successful using the field apparatus designed for use during the optimization period. All organic vapors

extracted from the SVE wells for measurement with the GA-90 were at or below background levels. Collection of a representative sample of the soil gas was not possible as the vacuum on the testing apparatus exerted a higher negative pressure than the pump on the PID could counteract. A different testing apparatus was designed for use during full-scale air sparging operations, the results of which are discussed in Section 8.0 of this report.

7.3 OPERATION

The air sparging program was initiated on October 28, 1993 and operated for 495 days until March 9, 1995. Air injection took place through five clusters of air sparging wells, labelled as Groups 1 through 5, starting at the downgradient (northeastern) edge of the KN Facility and progressing in an upgradient direction (Plate 1).[1] Photos 10, 11 and 12 show the components of the air sparging delivery system.

7.3.1 Air sparge well injection

The average air injection rate per air sparging well during the air sparging program was 6.7 scfm. System instabilities prevented injecting air at lower flowrates. The daily average injection rate per air sparging well is shown in Figure 15 along with the 30 day running average. The number of air sparging wells operating at any given time during the program ranged from 4 to 15 wells according to reconfiguration schedules, maintenance and treatment zones. Figure 16 shows the daily number of wells in operation during the air sparging program.

7.3.2 Total air injection and soil gas extraction

The daily air injection flowrate for the entire system, shown in Figure 17, varied during the air sparging program primarily due to the number of air sparging wells in operation, but also because of well maintenance and systems upsets. Total air injection was maintained at flowrates between approximately 50 scfm and 100 scfm depending on the number of air sparging wells in operation at any given time. A total of 58 million cubic feet of air was injected into the subsurface during the air sparging program.

Soil gas extraction flowrates, shown in Figure 18, varied due to changes in the configuration of the operational wells and upsets in the PAT system. Extraction rates were maintained above air injection flowrates at approximately 115 scfm to ensure that all air injected was recovered. A total of 78 million cubic feet of soil gas was extracted from the vadose zone resulting in a soil gas extraction to air injection ratio of 1.34. Figure X (ext/inj vs time) shows the cumulative air injection and soil gas removal volumes over time.

---

[1] The Air Sparging Report proposed operating separate cells made up of a number of air sparging wells, however, the capacity of the air compressors allowed more than one cell to operate at a time. In addition, the air sparging wells around the flare pit were operated virtually continuously throughout the air sparging program to target the remaining zone of impact. For these reasons, the operation of the air sparging system has been delineated into operational groups based on chronology. Nevertheless, the conditions of monitoring as set forth in the Air Sparging Report were maintained throughout the air sparging program.

7.3.3 Air sparging completion

Soil gas measurements of volatile organic vapors with a PID were used to identify when air sparging of a group of wells was complete. PID readings below 5 ppm, as calibrated to 100 ppm isobutane, were considered to be indicative of completion. Confirmation groundwater and soil gas samples were then collected from groundwater monitoring and SVE wells closest to the operating group of air sparging wells, as set forth in the Air Sparging Report[2]. The results are presented in Section 8.0 of this report.

[2] The Air Sparging Report proposes groundwater sampling from the network of groundwater monitoring wells on the KN Facility. A number of these wells were regularly sampled in accordance with the GMP and were used for both the purpose of monitoring under the GMP and confirmation of air sparging completion during the air sparging program.

8.0 RESULTS

8.1 SOIL

In accordance with the OU-2 Workplan and the Air Sparging Report, soil samples were collected as close as possible to the five locations shown in Figure 5 in order to characterize soil conditions after air sparging treatment. Sampling was performed from February 16, 1995 to February 22, 1995, following procedures set forth in ABC-SOP-SLS023 (ABC, 1993a), which consists of drilling with a hollow-stem auger and collecting soil samples with a split spoon sampler every five feet. The sample exhibiting the highest reading using a photo-ionization detector (PID) was sent to an analytical laboratory to analysis for BETX using EPA Method 8260 modified for selective ion monitoring, a technique used to obtain lower detection limits. The analytical results of the soil sampling are shown in Table 5 and Appendix B-1, and the borehole logs are shown in Appendix C-2.

Table 5: Soil sampling analytical results (µg/kg), February 1995

Sample Location	BENZENE	ETHYLBENZENE	TOLUENE	XYLENES	NOTES
SB-01A	<8	570	<8	2900	North of KNABC-09
SB-02A	<8	280	<8	260	Center of old pond
SB-03A	<8	93	<8	400	Near flare pit
SB-04A	<8	1700	<8	3000	West of KNABC-27
SB-05A	<8	280	<8	430	Completed as KNABC-91

Figure 20 shows the reduction in total BETX in the soil column compared to pre-sparging conditions. Benzene and toluene were below detection in the pre-sparging period, and remained below detection limits after the air sparging was completed. Ethylbenzene and xylenes, which account for the majority of the BETX constituents in the soil, were substantially reduced during the air sparging program. The average total BETX reduction over the air sparging program was 9,915 µg/kg.

8.2 SOIL GAS

Soil gas monitoring consisted of field measurements and laboratory analyses of samples collected from the SVE network of wells. Field samples were collected intermittently to monitor the progress of the air sparging program, and samples for laboratory analysis were collected to confirm vadose zone conditions following the completion of air sparging one of the groups of wells.

8.2.1 PID Readings

Soil gas samples were collected in the field by temporarily isolating each SVE well from the extraction system and collecting a sample of soil gas into a tedlar bag (Photo 13). A PID, calibrated to 100 ppm isobutane, was attached to the tedlar bag and measured the volatile organic vapors concentrations.

Figure 21 shows that after beginning air injection into each new group of air sparging wells the SVE network operating in that zone, with the exception of Group 2 wells, indicated an elevated level of organic vapors in the soil gas. Over time as air sparging continued, the PID readings trended downwards indicating the reduction of organic vapors in the vadose zone. Without adequate background PID measurements, it is difficult to ascertain whether the soil gas in the vadose zone was elevated in organic vapors due to air sparging activities in the saturated zone, or due to volatilization of residual hydrocarbons trapped in the soil matrix of the unsaturated zone. Figures 22 (a, c-e) (indiv. G1345 PID) however, suggest that air sparging caused an initial rise in the concentration of volatile organic vapors in the vadose zone as the injected air liberated volatile hydrocarbons from the saturated zone and transported them to the vadose zone, where they were measured and extracted.

8.2.2 BETX levels in SVE wells

Soil gas concentrations of BETX were already very low at the beginning of the air sparging program, but a decrease in the concentrations was still observed throughout the air sparging program. Figures 23 (a-d) show a downward trend in the concentrations of the different BETX constituents, and Figure 24 shows the total BETX concentration and the decreasing trendline associated with the data. Spikes within the individual groups indicate that air sparging was active in transporting BETX to the vadose zone, and the decreasing BETX concentrations suggest that the zone of residual hyrocarbon saturation at the water table and the saturated zone was being depleted in BETX constituents. The laboratory analytical results are included in Appendix B-2 and are summarized in Table 6.

Table 6: BETX concentrations in soil gas during air sparging program

NAME	DATE	Benzene (ug/l)	Toluene (ug/l)	Ethylbenzene (ug/l)	Xylenes (ug/l)	Total BTEX (ug/l)
SVE-63	8/24/93	0.12	0.94	0.1	0.68	1.84
SVE-64	8/24/93	1.56	0.74	0.1	0.58	2.98
SVE-65	8/24/93	0.2	0.76	0.1	0.52	1.58
SVE-66	8/24/93	0.2	0.94	0.22	1.74	3.1
SVE-67	8/24/93	< 0.08	1.52	0.32	1.26	3.18
SVE-68	8/24/93	0.12	0.82	0.12	0.64	1.7
SVE-69	8/24/93	0.14	0.84	0.08	0.70	1.76
SVE-80	8/24/93	3.34	2.2	0.58	1.96	8.08
SVE-81	8/24/93	< 0.08	1.94	< 0.06	0.52	2.6
SVE-82	8/24/93	0.12	0.9	0.1	0.74	1.86
SVE-89	8/24/93	< 0.08	0.84	0.08	0.7	1.7
SVE-63	2/9/94	< 0.08	0.36	< 0.06	< 0.16	< 0.66
SVE-64	2/9/94	< 0.08	0.28	< 0.06	< 0.16	< 0.58
SVG-1	2/9/94	< 0.08	0.54	< 0.06	< 0.16	< 0.76
SVE-29	3/16/94	< 0.08	0.46	0.22	0.5	1.26
SVE-63	3/16/94	< 0.18	1.24	0.3	0.74	2.36
SVE-65	3/16/94	0.08	0.74	0.46	2.22	3.6
SVE-66	3/16/94	< 0.22	0.78	0.38	0.92	2.16
SVE-80	3/16/94	0.24	0.7	0.22	0.94	2.08
SVE-81	3/16/94	0.08	0.86	0.18	0.78	2.06
SVE-63	4/21/94	< 0.08	0.4	< 0.06	< 0.16	< 0.7
SVE-64	4/21/94	< 0.08	0.22	< 0.06	< 0.16	< 0.52
SVE-65	4/21/94	< 0.08	0.3	< 0.06	0.22	0.66
SVE-66	4/21/94	< 0.08	0.24	< 0.06	< 0.16	< 0.54
SVE-80	4/21/94	< 0.08	1.1	< 0.06	< 0.16	< 1.4
SVE-81	4/21/94	< 0.08	0.98	< 0.06	< 0.16	< 1.28
SVE-63	8/5/94	< 0.12	0.1	< 0.06	0.18	0.42
SVE-66	8/5/94	0.08	0.38	< 0.06	0.32	0.88
SVE-81	8/5/94	< 0.08	0.24	< 0.06	0.26	0.64
SVE-82	8/5/94	< 0.08	0.24	< 0.06	< 0.16	< 0.54
SVE-60	10/24/94	< 0.08	0.28	< 0.06	0.28	0.7
SVE-63	10/24/94	< 0.08	0.18	0.1	0.54	0.9
SVE-67	10/24/94	< 0.08	0.3	< 0.08	0.34	0.8
SVE-68	10/24/94	< 0.08	0.16	< 0.08	< 0.08	< 0.4
SVE-28	12/17/94	< 0.08	0.5	0.3	1.82	2.7
SVE-48	12/17/94	< 0.08	0.16	0.24	1.64	2.12
SVE-69	12/17/94	< 0.12	0.14	0.1	0.84	1.16
SVE-28	1/23/95	0.08	0.2	< 0.08	0.5	0.9
SVE-48	1/23/95	< 0.08	< 0.08	< 0.08	0.36	0.6
SVE-69	1/23/95	< 0.08	0.14	< 0.08	0.58	0.88
SVE-28	2/13/95	< 0.08	0.2	< 0.08	< 0.08	< 0.44
SVE-48	2/13/95	< 0.08	0.2	< 0.08	< 0.08	< 0.44
SVE-69	2/13/95	< 0.08	0.12	< 0.08	< 0.08	< 0.36
SVE-63	4/5/95	< 0.08	0.32	< 0.08	0.16	0.64
SVE-64	4/5/95	< 0.08	0.36	< 0.08	0.22	0.74
SVE-65	4/5/95	< 0.08	0.26	< 0.08	< 0.08	< 0.5
SVE-66	4/5/95	< 0.08	0.1	< 0.08	< 0.08	< 0.34
SVE-67	4/5/95	< 0.08	0.24	< 0.08	< 0.08	< 0.48
SVE-68	4/5/95	< 0.08	0.2	< 0.08	< 0.08	< 0.44
SVE-69	4/5/95	< 0.1	0.22	< 0.08	< 0.08	< 0.46
SVE-80	4/5/95	0.08	0.32	< 0.08	< 0.08	< 0.58
SVE-81	4/5/95	< 0.08	0.26	< 0.08	< 0.08	< 0.5
SVE-82	4/5/95	< 0.08	0.28	< 0.08	< 0.08	< 0.52

8.3 GROUNDWATER

Groundwater BETX concentrations were used to determine the success air sparging had on a zone during the air sparging program. Groundwater monitoring wells that were identified from the KN Facility network of wells for monitoring during the air sparing program, as set forth in the Air Sparging Report, were sampled to confirm that groundwater met the MCLs after soil gas PID measurements indicated that air sparging was complete. Some of the monitoring wells were regularly sampled in accordance with the GMP, so the data serves both the purpose of monitoring groundwater BETX concentrations under OU-1, the Remedial Action, and confirming the status of air sparging progress, under OU-2. Figure 25 shows the location of the air sparging wells and groundwater monitoring wells at the KN Facility. Table 7 summarizes the groundwater BETX concentrations measured in all monitoring wells during the air sparging program. The wellnames shaded in Table 7 indicate those monitoring wells identified as monitoring points in the air sparging program. If BETX concentrations in the groundwater did not meet MCLs air sparging continued in that zone, or resampling was initiated with the approval of the EPA.

Table 7 shows that BETX concentrations in the groundwater were reduced during the air sparging program. Figures 26 (a-g) show the historical data, and data collected during air sparging, for each of the GMP wells that were part of the monitoring network used in the air sparging program. Since air injection progressed from the northeastern (downgradient) corner of the KN Facility to the eastern edge of the processing plant in an upgradient direction, groundwater aerated by the sparging process continued to be transported in the downgradient direction through zones that had previously been sparged. In this manner, air sparging provided a polishing effect to the aquifer. Figures 26 (a-g) show the effect that air sparging had on the benzene concentrations in the groundwater monitoring wells downgradient of the air sparging zone. In each case that benzene was detected above the MCLs prior to air sparging, a reduction in concentration to below the MCL was measured after air sparging commenced upgradient from the well. In some cases, such as in Figure 26a, the benzene concentration initially increased from below the MCL as hydrocarbons were liberated by the agitation of the aquifer material by air sparging. After being liberated, the constituents were degraded biologically or volatilized and removed from the groundwater.

The rightmost seven colums of Table 7 show the results of the confirmation samples collected at different times, depending on which group of air sparging wells was being sparged. All the samples measured benzene concentrations below the MCL except for KNABC-34 on March 16, 1995, which was believed to be a non-representative sample because of the wells prior use as a groundwater extraction well. After obtaining EPA approval, KNABC-34 was resampled on April 6, 1995 and found to be below the MCLs for all of the BETX constituents.

Figure 27 shows that the background groundwater benzene concentrations for the KN Facility have consistently been below the MCL, and Figure 28 shows that the groundwater flowing across the southern end of the flare pit is not impacted by historic releases from the flare pit. Figures 29(a-c) show that air sparging has also provided offsite protection from BETX being transported from the KN Facility. The benzene concentrations have been reduced or consistently remain below the MCL as a result of the air sparging program.

Table 7: Benzene concentrations in groundwater (µg/l)

	GMP MONITORING WELLS																			
DATE	ABC-2	ABC-5	ABC-12	ABC-17	ABC-27	ABC-91	GW-2	MW-5	MW-6	MW-7	EPA-1-9	EPA-1-10	EPA-2-11	ABC-25	GW-3	ABC-90	ABC-11	ABC-20	ABC-9	ABC-34
10-15-93	<0.8	<0.8	2	4	38	6	21	<0.8	130	2	<0.8	1	5							
12-2-93							15		30					<0.8	2					
1-12-94	<0.8	6	14	5	<0.8	6	13	<0.8	12	<0.8	<0.8	<0.8	<0.8							
4-20-94	<0.8	<0.8	<0.8	9	2	<0.8	15	<0.8	26	<0.8	<0.8	<0.8	<0.8		<0.8	0.9				
6-28-94					7	24											2			
7-21-94 to 8-1-94	<0.8	2	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	0.9	<0.8	<0.8	<0.8	<0.8							
9-15-94 to 9-16-94	<0.8	30	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	1							
10-3-94		43																		
10-14-94	<0.8	25	<0.8	1	2	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	2							
10-26-94																		<0.8		
11-20-94 to 11-21-94	<0.8	7	<0.8	1	4	0.9	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8							
12-17-94	<0.8	<0.8	2	1	1	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8							
1-14-95 to 1-15-95	<0.8	<0.8	<0.8	4	2	1	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8							
2-8-95																			2	
2-13-95	<0.8	<0.8	<0.8	2	1	1	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8							
3-16-95	<0.8	<0.8	<0.8	2	3	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8							13
4-6-95																				3
4-18-95 to 4-19-95	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8							
5-16-95	<0.8	<0.8	3	5	2	<0.8	<0.8	<0.8	<0.8	<0.8	1	<0.8	<0.8							

Note: Shaded well names were chosen from the KN Facility well network to monitor BETX concentrations during the air sparging program.

Benzene concentrations measured in samples collected from the groundwater extraction wells were also reduced during the air sparging program. Figures 30(a-d) show the benzene concentrations compared to the time when air sparging in the zone around the extraction well began. Since the groundwater extraction wells draw water into the pump radially, air sparging taking place downgradient from the well still impacted the quality of water extracted from the well. Due to mechanical and electrical difficulties, KNABC-71 was not operational during most of the air sparging program, but KNABC-70, KNABC-72, and KNABC-73 exhibited the same response to air sparging that was observed in the groundwater monitoring wells. Shortly after air sparging started benzene concentrations in the extracted groundwater began to decline and continued to decline to below MCLs. Figure 31 shows the benzene concentration of the extracted groundwater after it was composited as it flowed into the Remedial System. The benzene concentrations, at first over the MCLs, were alternately reduced and increased and then reduced again during the air sparging program as different groups of air sparge wells remediated historically impacted zones.

Analytical results for groundwater samples are shown in Appendix B-3.

9.0 DISCUSSION

The dissolved benzene concentration reduction data from the groundwater system at the KN Facility indicates that the half-life for benzene under air sparging conditions is approximately 34 days. The first order degradation equation, commonly used to model biological systems, and derived from the data is $C(t) = C_o e^{-0.0205t}$, where C(t) is the concentration at time t, C_o is the initial concentration, and t is time. A plot of the data and the fitted decay line is shown in Figure 32. Based on this decay equation, concentrations of benzene in the groundwater, and the operational conditions of the air sparging system at the KN Facility, a removal of approximately 1.75 pounds of benzene was achieved. This amount of benzene removal does not reflect a limitation of the air sparging technology, but rather the limited amount of benzene available in the groundwater system. The removal rate of benzene during the air sparging program is shown in Figure 33.

The BETX concentrations in the soil were substantially reduced through air sparging and indicate that approximately 1,600 pounds of BETX was volatilized, mineralized or otherwise reduced at the KN Facility. This equates to approximately 11,600 pounds of hyrdocarbon material being destroyed. Assuming 100% combustion of hyrdocarbons, and the requirement of 3.5 lbs. of O_2 for every pound of hydrocarbon destroyed, the transfer efficiency of oxygen to the aquifer is 4.5%.

10.0 CONCLUSIONS

Air sparging was chosen as the technology for OU-2 to remove BETX from the residual source material causing groundwater at the KN Facility to exceed MCLs. Treatment resulted in the reduction of BETX in the soil matrix and groundwater. Benzene, the last remaining component of BETX above the groundwater MCLs at the KN Facility, was reduced to below the 5 μg/l regulatory limit. The groundwater continues to be monitored monthly under the GMP.

Insofar as the focus of OU-2 is to "[e]nsure long-term effectiveness and permanence of OU-1 remediation by eliminating the sources of groundwater contamination at the site..." the air sparging program has been successful in achieving that goal. No identifiable source areas remain at the KN Facility and no further action is considered necessary at this time.

11.0 BIBLIOGRAPHY

ABC, 1989, Engineering Evaluation/Cost Analysis For Response Actions At The Casper Compressor Station, Casper, Wyoming, Adrian Brown Consultants, Inc., Denver, Colorado, March 1989.

ABC, 1991, Phase I Remedial Design Sampling and Analysis Plan for the KN Energy Gas Compressor Station, Casper, Wyoming, Adrian Brown Consultants, Inc., Denver, Colorado, December 1991.

ABC, 1992a, OU-2 Phase I Site Safety Plan for the KN Energy Casper Compressor Station, Casper, Wyoming, Adrian Brown Consultants, Denver, Colorado, March 1992.

ABC, 1992b, ABC's Response to U.S. Environmental Protection Agency's Comments on the OU-2 Phase I Work Plan, Denver, Colorado, May 1992.

ABC, 1993a, OU-1/OU-2 Sampling and Analysis Plan for the KN Energy Gas Compressor Station, Casper, Wyoming, Adrian Brown Consultants, Inc., Denver, Colorado, June 1993.

ABC, 1993b, Revised Air Sparging Report for the KN Energy Gas Compressor Station, Casper, Wyoming, Adrian Brown Consultants, Inc., Denver, Colorado, June 1993.

ABC, 1993c, Remedial Action Groundwater Monitoring Plan for the KN Energy Gas Compressor Station, Casper, Wyoming, Adrian Brown Consultants, Inc., Denver, Colorado, in preparation.

ABC, 1993d, OU-2 Phase I Workplan for the KN Energy Gas Compressor Station, Casper, Wyoming, Adrian Brown Consultants, Inc., Denver, Colorado, June 28, 1993.

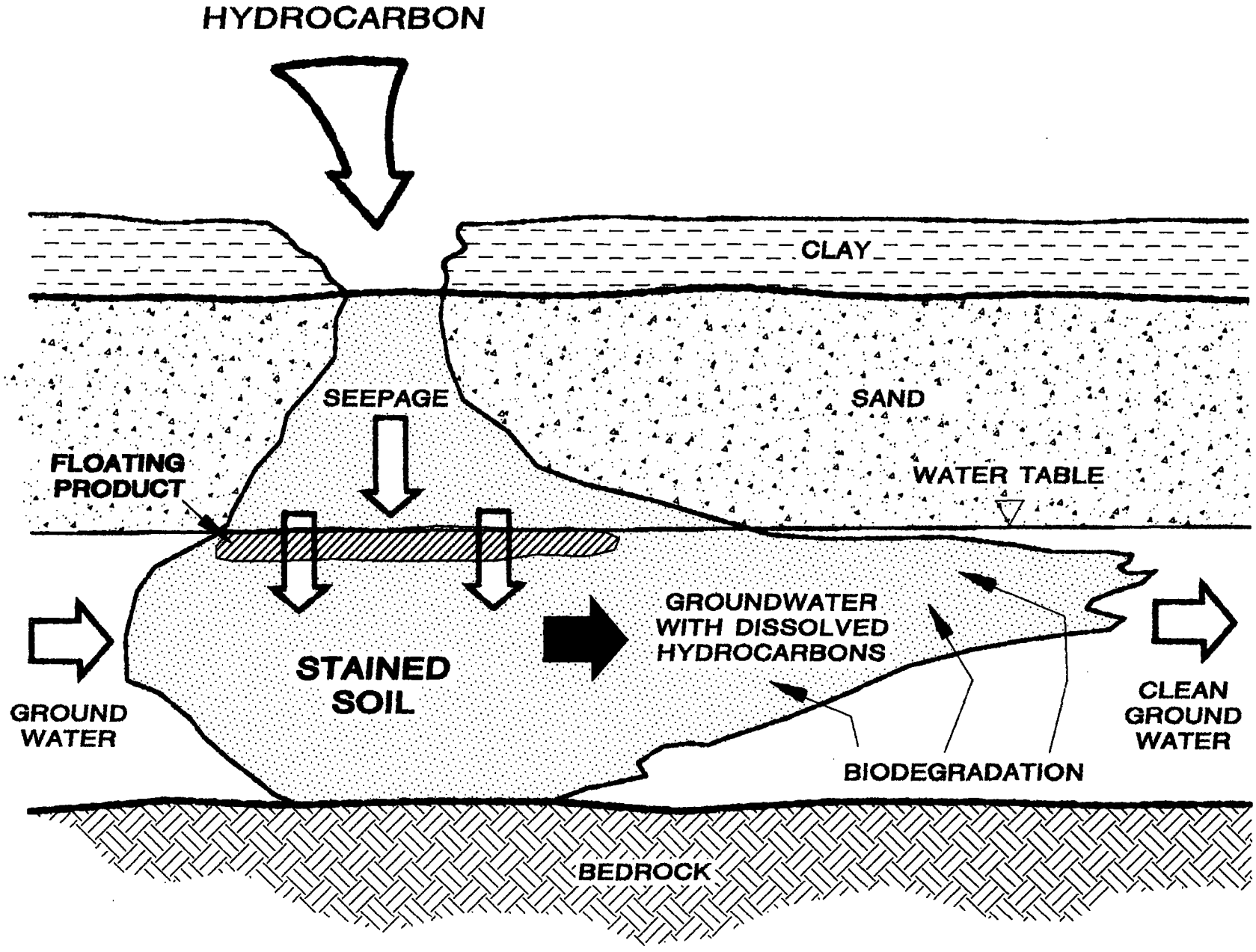
Ecology and Environment, 1987. Expanded Site Investigation - Mystery Bridge Road and Highway 20, Evansville, Wyoming - Final Report. Report prepared for EPA Superfund Branch by Ecology and Environment Field Investigation Team, August 1987. TDD F08-8702-23; CERCLIS: WY091546005.

EPA, 1990, Record of Decision, RI/FS Mystery Bridge Road/U.S. Highway 20 Superfund Site, Operable Unit 1 - Groundwater, September 24, 1990, Declaration Statement, Denver, Colorado, September 1990.

EPA, 1991, Work to be Performed by KN Energy, Inc. for the Conduct of the OU-2 RI/FS Mystery Bridge Road/U.S. Highway 20 Superfund Site Natrona County, Wyoming, Denver, Colorado, December 1991.

EPA, 1992, U.S. Environmental Protection Agency's Comments on the OU-2 Phase I Work Plan, Denver, Colorado, March 23, 1992 and June 4, 1992.

FIGURES



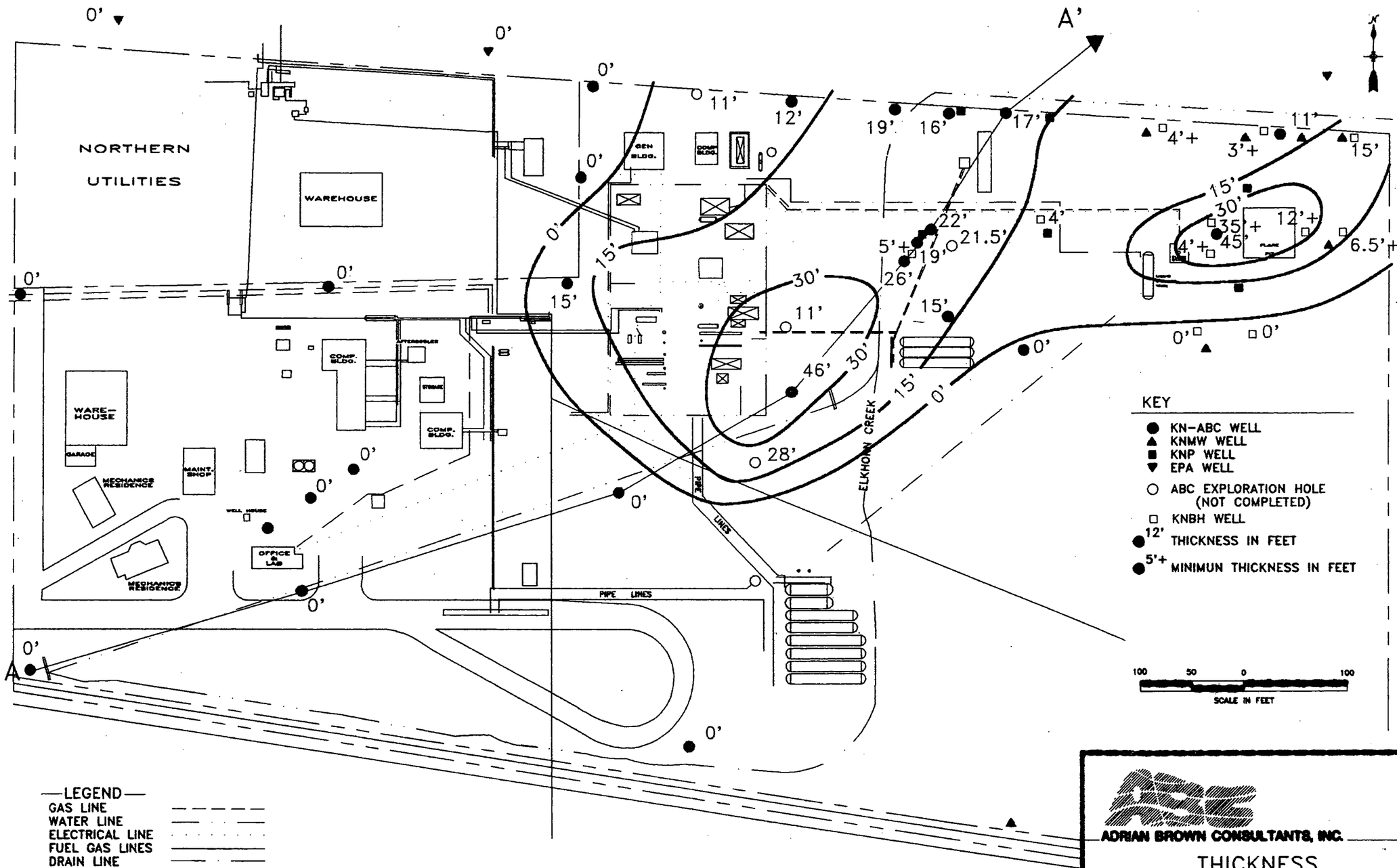
ADRIAN BROWN CONSULTANTS, INC.

D:\P\1125J\CONCEPT2.DWG 950627

NOT TO SCALE

CONCEPTUAL MODEL OF TRANSPORT OF BTEX

Figure 1

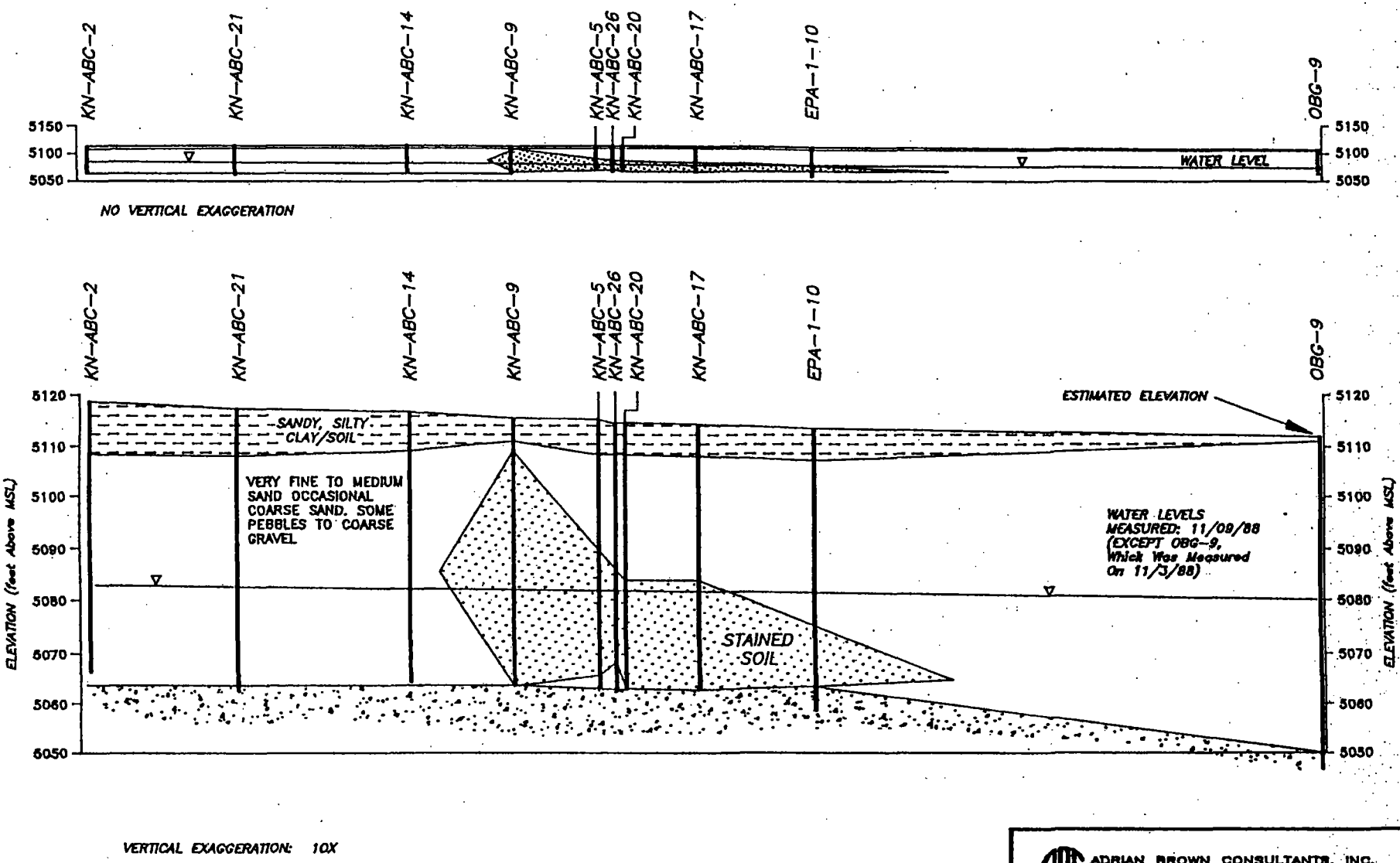


ADRIAN BROWN CONSULTANTS, INC.

THICKNESS OF STAINED SOIL, KN FACILITY

Figure 2

D:\F\1125J\STAINSL5.DWG 950627



ADRIAN BROWN CONSULTANTS, INC.

CROSS-SECTION A-A'

Source: EE/CA (ABC, 1989)

(CROSS-SECTION LOCATION ON Figure 2)

11253/930628

Figure 3

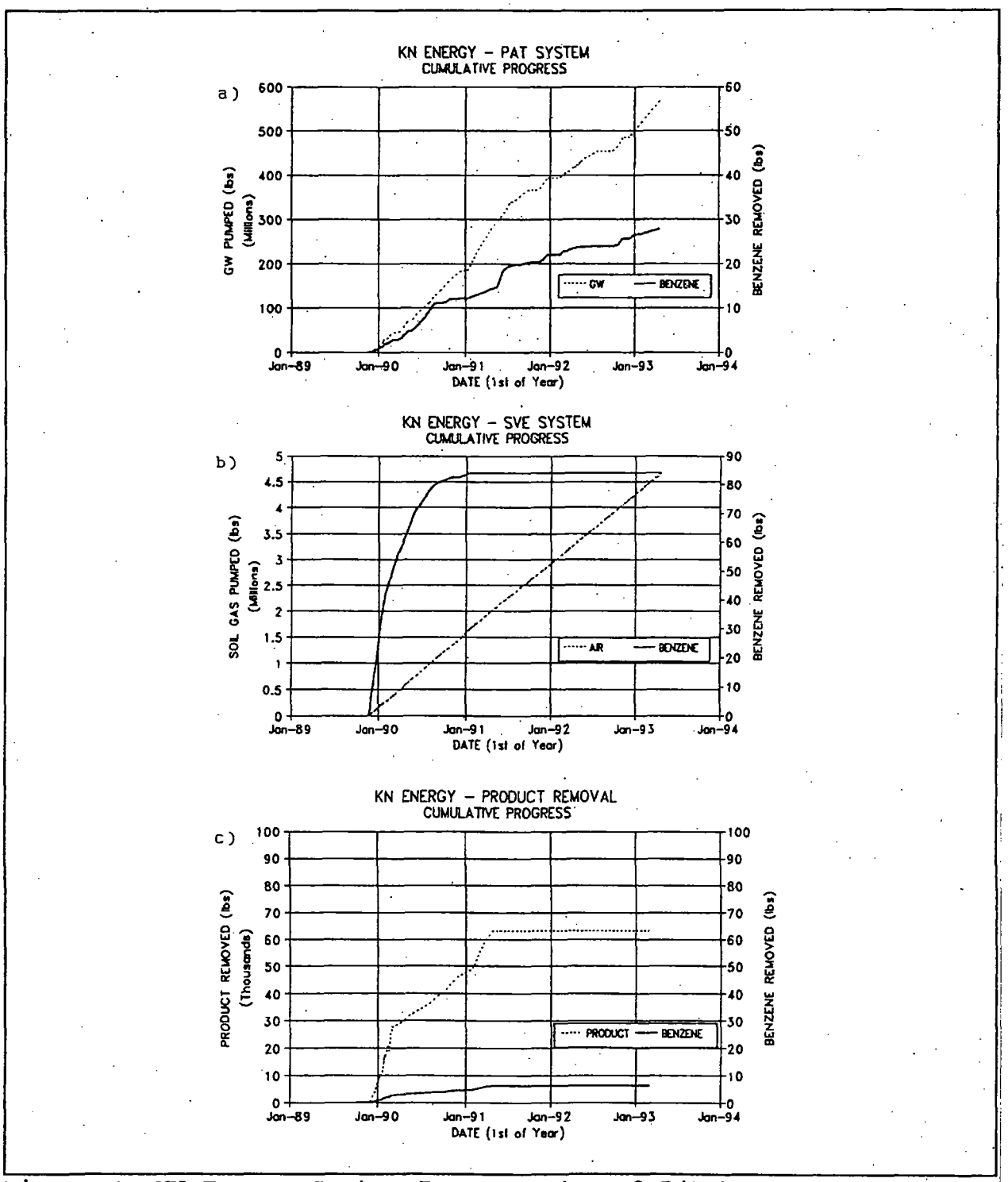


Figure 4 KN Energy System Progress (as of 5/93)

NORTHERN UTILITIES

WAREHOUSE

WARE-HOUSE

GARAGE

MECHANICS RESIDENCE

MAINT-SHOP

COMP. BLDG.

STORAGE

OFFICE & LAB

GEN BLDG.

FLARE PIT

ELKHORN CREEK

PIPE LINES

INFILTRATION GALLERY

ABC-SB-01

ABC-SB-02

ABC-SB-03

ABC-SB-04

ABC-SB-05

ABC-1 ABC-2 ABC-3 ABC-5 ABC-6 ABC-7 ABC-9 ABC-10 ABC-11 ABC-12 ABC-15 ABC-16 ABC-17 ABC-18 ABC-19 ABC-20 ABC-21 ABC-23 ABC-24 ABC-25 ABC-27 ABC-70

MW-4 MW-5 MW-6 MW-7

GW-1 GW-2 GW-3

EPA 1-10 EPA 1-9 EPA 2-11 EPA 2-14

OBG-7

100 50 0 100

SCALE IN FEET

KEY

- WATER LEVEL MONITORING WELLS
- PROPOSED BOREHOLE LOCATIONS
- GROUNDWATER >MCL BENZENE IN MONITOR WELLS (MARCH 1993)

—LEGEND—

- GAS LINE
- ELKHORN CREEK
- ELECTRICAL LINE
- FUEL GAS LINES
- DRAIN LINE

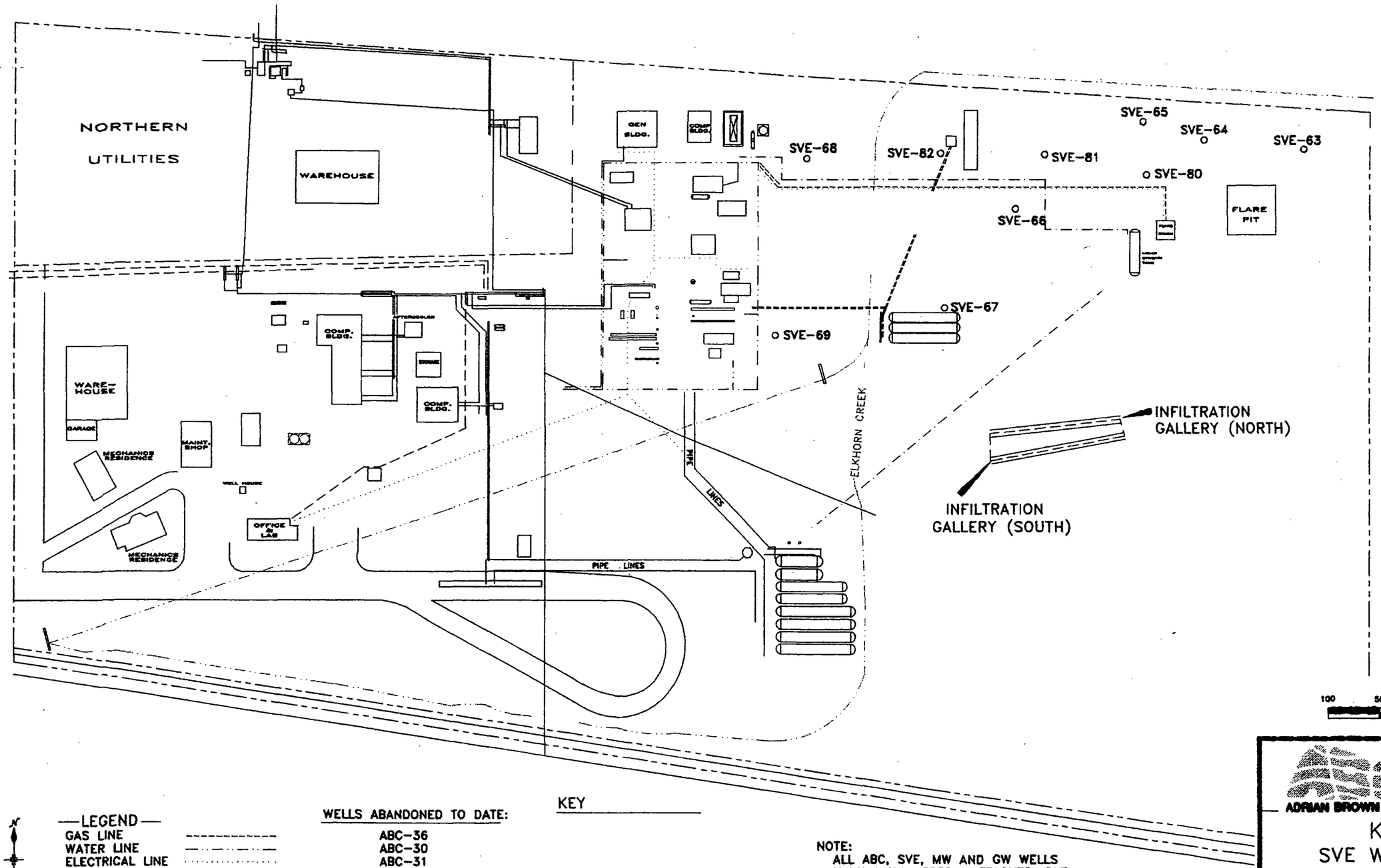
NOTE:
ALL ABC, SVE, MW AND GW WELLS HAVE A KN- PREFIX ATTACHED, BUT ARE NOT SHOWN HERE FOR CLARITY PURPOSES

D:\P\1125J\SOILSAMP.DWG 950627

ADRIAN BROWN CONSULTANTS, INC.

KN ENERGY
SOIL SAMPLE
LOCATIONS

Figure 5



KEY

—LEGEND—

GAS LINE	----------
WATER LINE	—·—·—·—
ELECTRICAL LINE	·····
FUEL GAS LINES	————
DRAIN LINE	—·—·—·—

WELLS ABANDONED TO DATE:

ABC-36
ABC-30
ABC-31
ABC-32
ABC-33
ABC-22

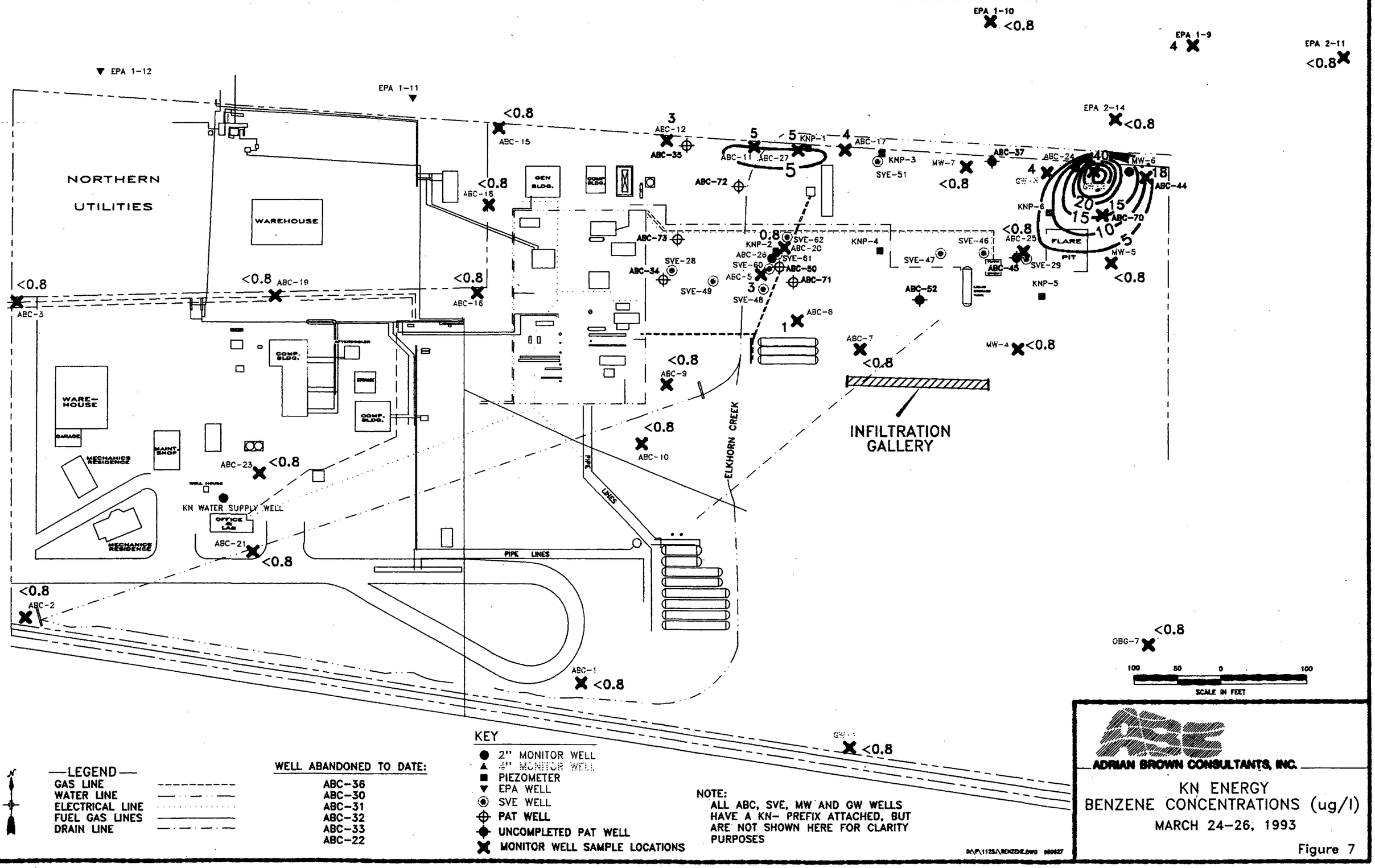
NOTE:
ALL ABC, SVE, MW AND GW WELLS HAVE A KN- PREFIX ATTACHED, BUT ARE NOT SHOWN HERE FOR CLARITY PURPOSES

D:\P\1125A\SVEWELLS.DWG 950627

ADRIAN BROWN CONSULTANTS, INC.

KN ENERGY
SVE WELLS INSTALLED
FOR AIR SPARGING PROGRAM

Figure 6



—LEGEND—

- GAS LINE
- WATER LINE
- ELECTRICAL LINE
- FUEL GAS LINES
- DRAIN LINE

WELL ABANDONED TO DATE:

ABC-36
ABC-30
ABC-31
ABC-32
ABC-33
ABC-22

KEY

- 2" MONITOR WELL
- 4" MONITOR WELL
- PIEZOMETER
- EPA WELL
- SVE WELL
- PAT WELL
- UNCOMPLETED PAT WELL
- MONITOR WELL SAMPLE LOCATIONS

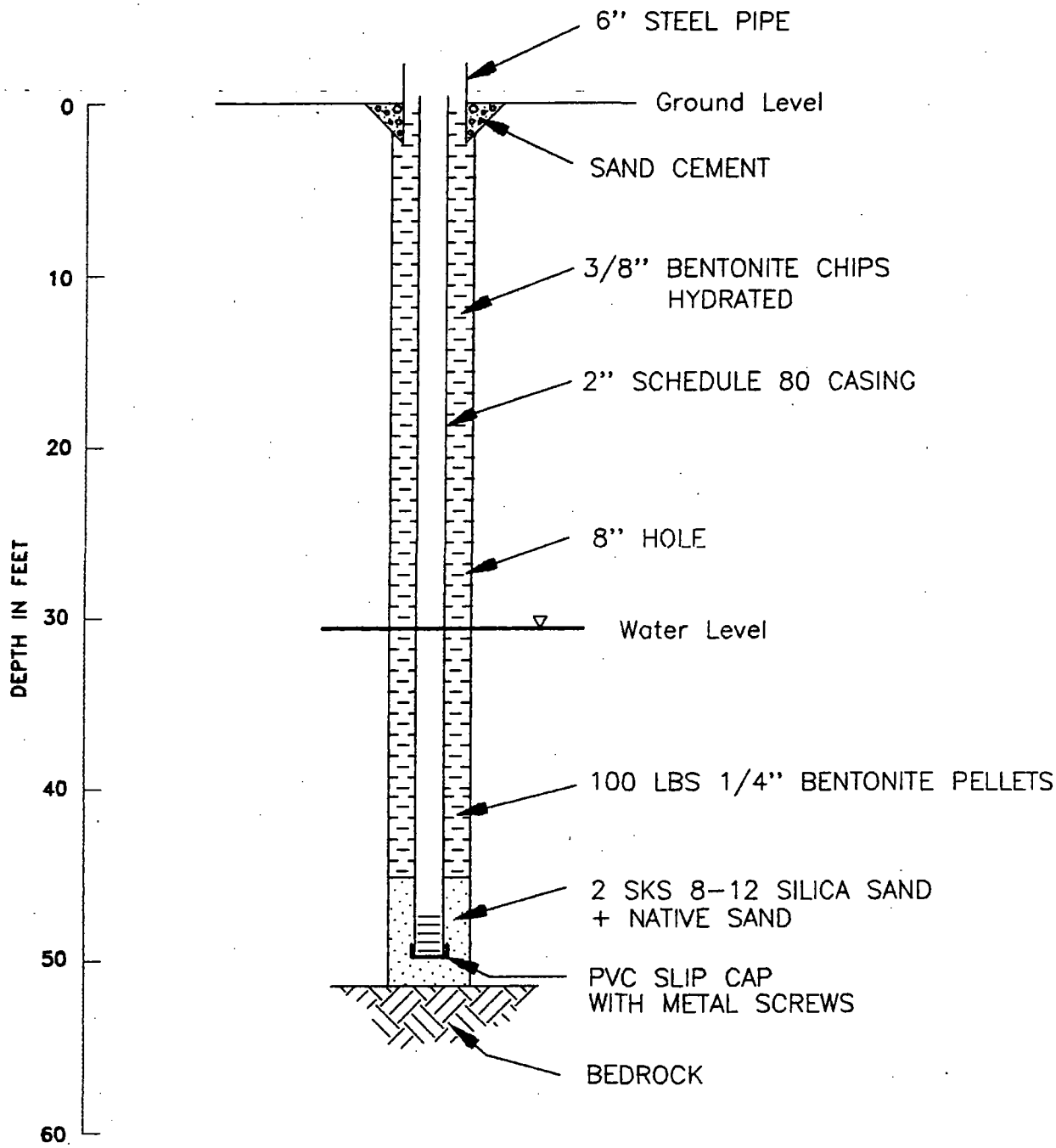
NOTE:
ALL ABC, SVE, MW AND GW WELLS HAVE A KN- PREFIX ATTACHED, BUT ARE NOT SHOWN HERE FOR CLARITY PURPOSES

D:\P\1123\BENZENE.DWG 960627

ADRIAN BROWN CONSULTANTS, INC.

KN ENERGY
BENZENE CONCENTRATIONS (ug/l)
MARCH 24-26, 1993

Figure 7

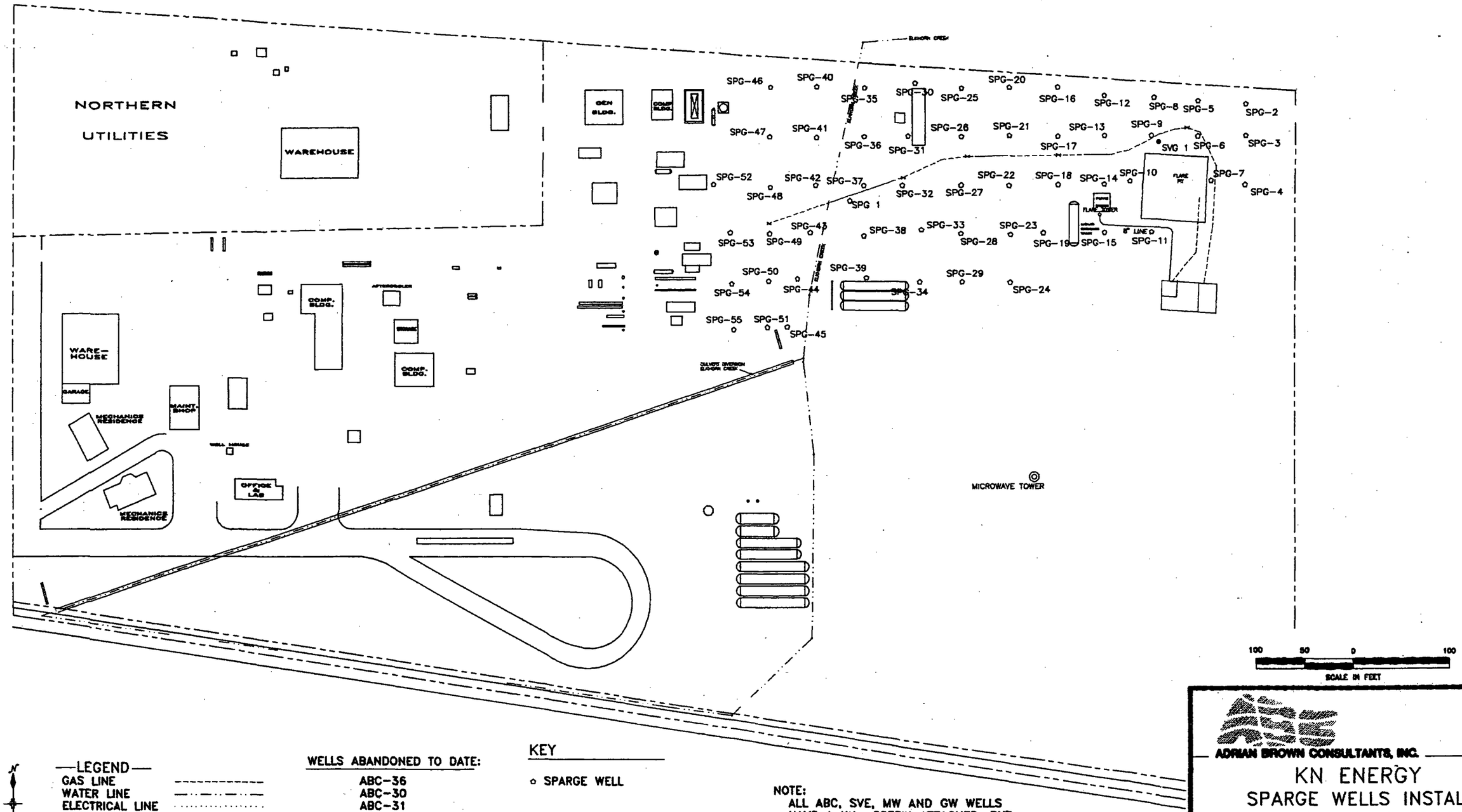


ADRIAN BROWN CONSULTANTS, INC.

KN ENERGY
AIR SPARGE WELL COMPLETION

D:\P\1125J\AIR.DWG 950627

Figure 8



—LEGEND—

- GAS LINE
- WATER LINE
- ELECTRICAL LINE
- FUEL GAS LINES
- DRAIN LINE

WELLS ABANDONED TO DATE:

ABC-36
ABC-30
ABC-31
ABC-32
ABC-33
ABC-22

KEY

○ SPARGE WELL

NOTE:
ALL ABC, SVE, MW AND GW WELLS HAVE A KN- PREFIX ATTACHED, BUT ARE NOT SHOWN HERE FOR CLARITY PURPOSES

D:\P\1125J\SPGWELLS.DWG 950627

ADRIAN BROWN CONSULTANTS, INC.

KN ENERGY
SPARGE WELLS INSTALLED
FOR AIR SPARGING PROGRAM

Figure 9

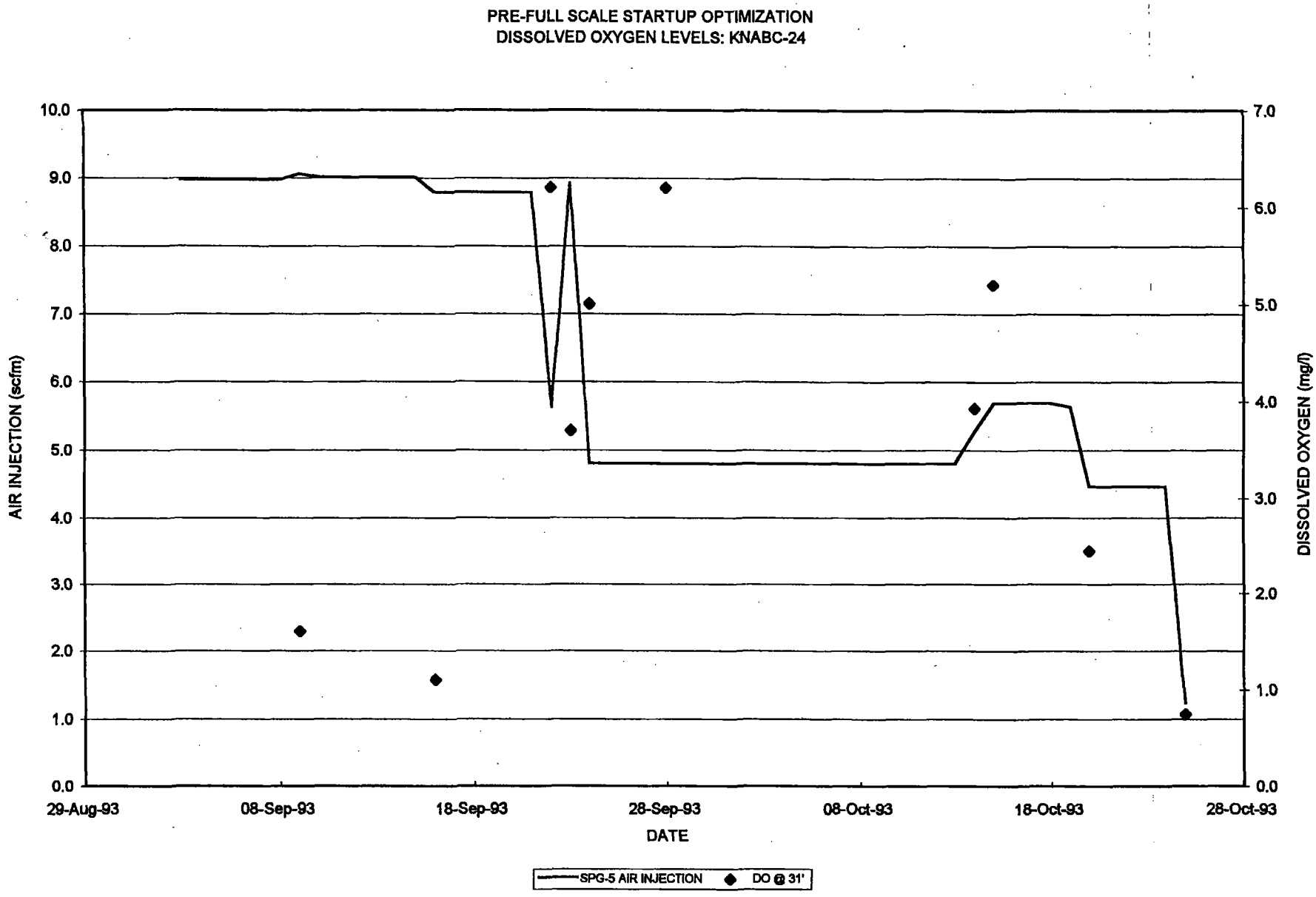

PRE-FULL SCALE STARTUP OPTIMIZATION
DISSOLVED OXYGEN LEVELS: KNABC-24
AIR INJECTION (scfm)
DISSOLVED OXYGEN (mg/l)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
29-Aug-93
08-Sep-93
18-Sep-93
28-Sep-93
08-Oct-93
18-Oct-93
28-Oct-93
DATE
SPG-5 AIR INJECTION
DO @ 31'

Figure 10

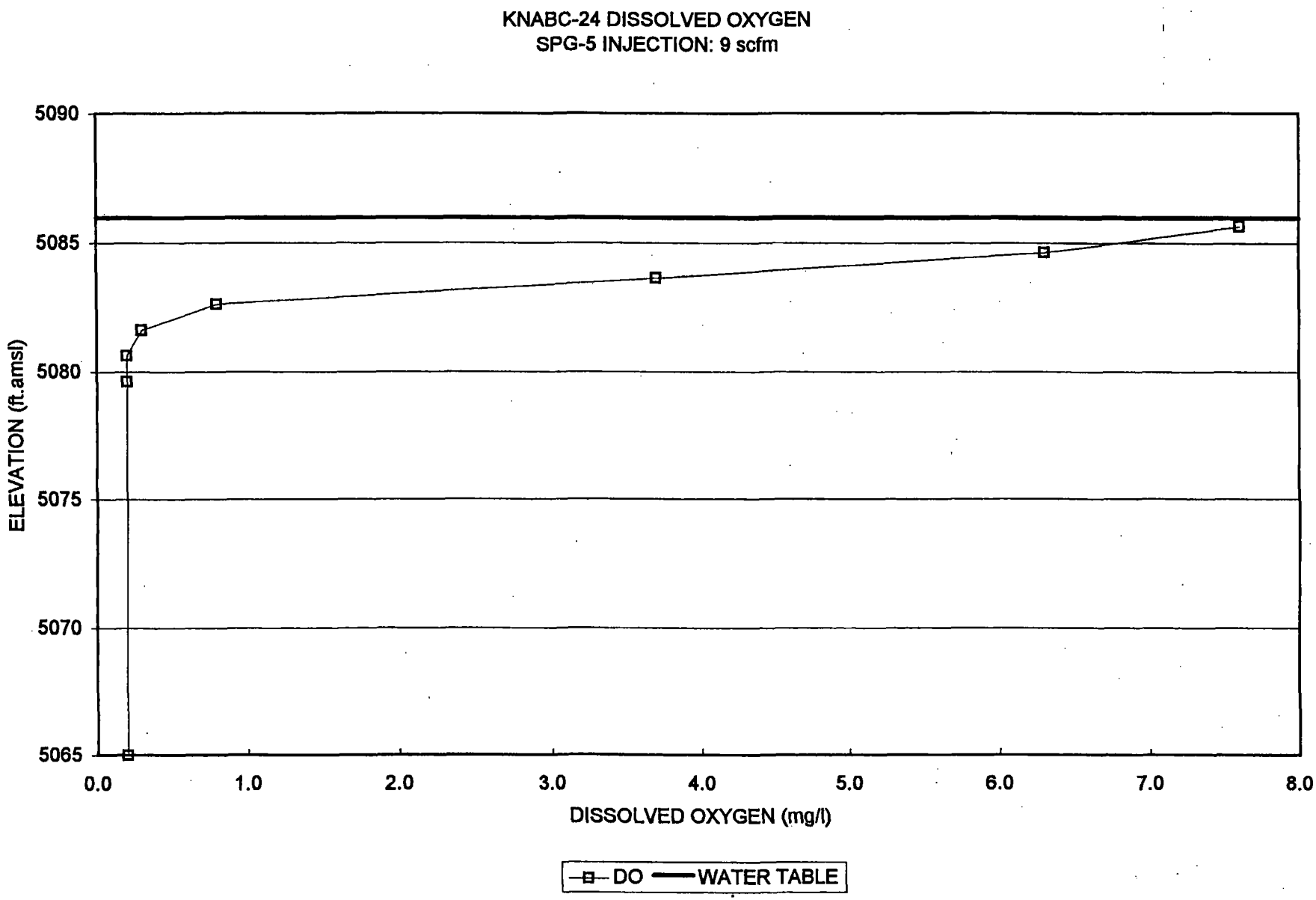

KNABC-24 DISSOLVED OXYGEN
SPG-5 INJECTION: 9 scfm
ELEVATION (ft.amsl)
5090
5085
5080
5075
5070
5065
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
DISSOLVED OXYGEN (mg/l)
DO
WATER TABLE

Figure 11

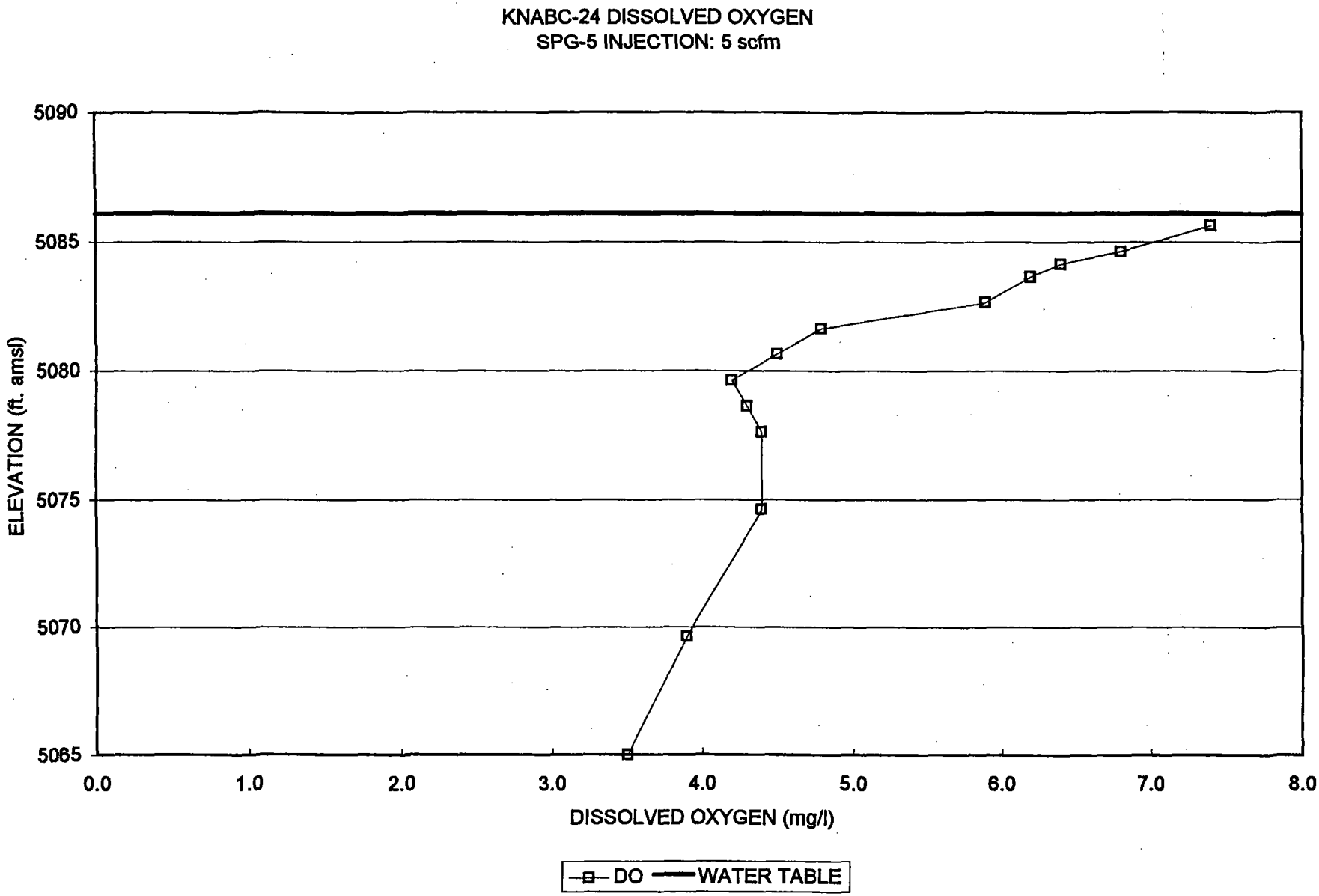

KNABC-24 DISSOLVED OXYGEN
SPG-5 INJECTION: 5 scfm
ELEVATION (ft. amsl)
5090
5085
5080
5075
5070
5065
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
DISSOLVED OXYGEN (mg/l)
DO
WATER TABLE

Figure 12

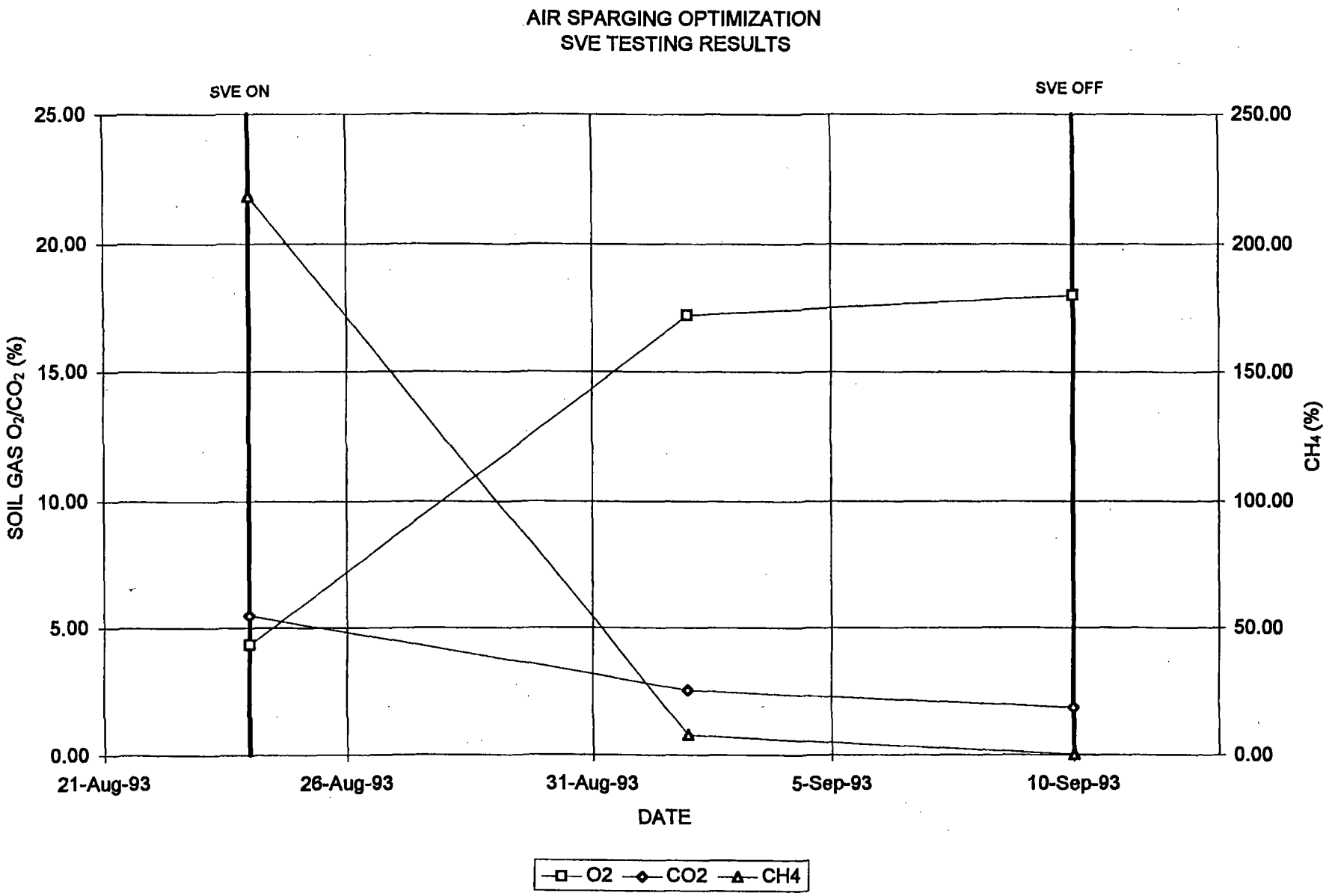

AIR SPARGING OPTIMIZATION
SVE TESTING RESULTS
SVE ON
SVE OFF
25.00
20.00
15.00
10.00
5.00
0.00
250.00
200.00
150.00
100.00
50.00
0.00
SOIL GAS O2/CO2 (%)
CH4 (%)
21-Aug-93
26-Aug-93
31-Aug-93
5-Sep-93
10-Sep-93
DATE
O2
CO2
CH4

Figure 13

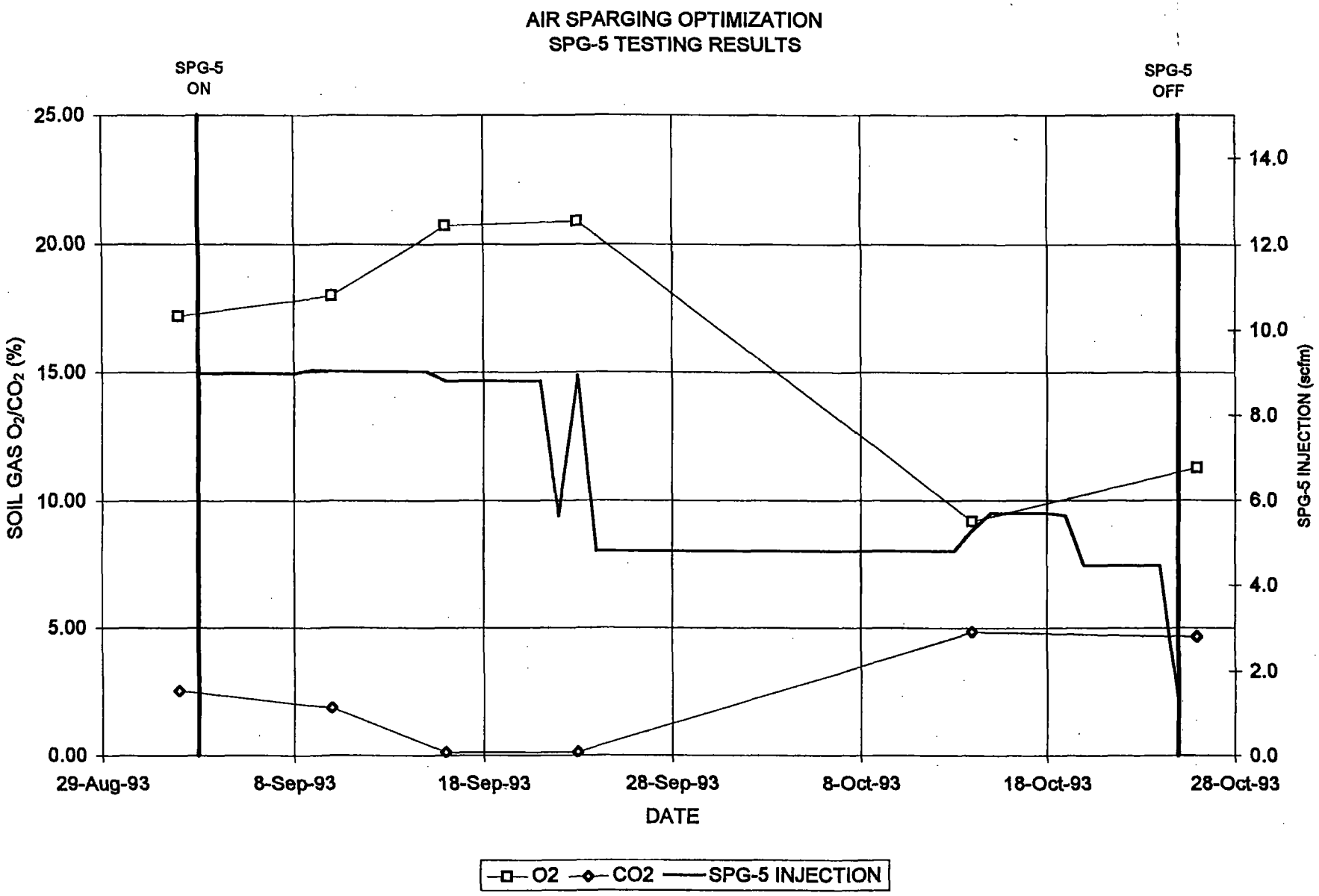

AIR SPARGING OPTIMIZATION
SPG-5 TESTING RESULTS
SPG-5 ON
SPG-5 OFF
SOIL GAS O2/CO2 (%)
SPG-5 INJECTION (scfm)
25.00
20.00
15.00
10.00
5.00
0.00
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
29-Aug-93
8-Sep-93
18-Sep-93
28-Sep-93
8-Oct-93
18-Oct-93
28-Oct-93
DATE
O2
CO2
SPG-5 INJECTION

Figure 14

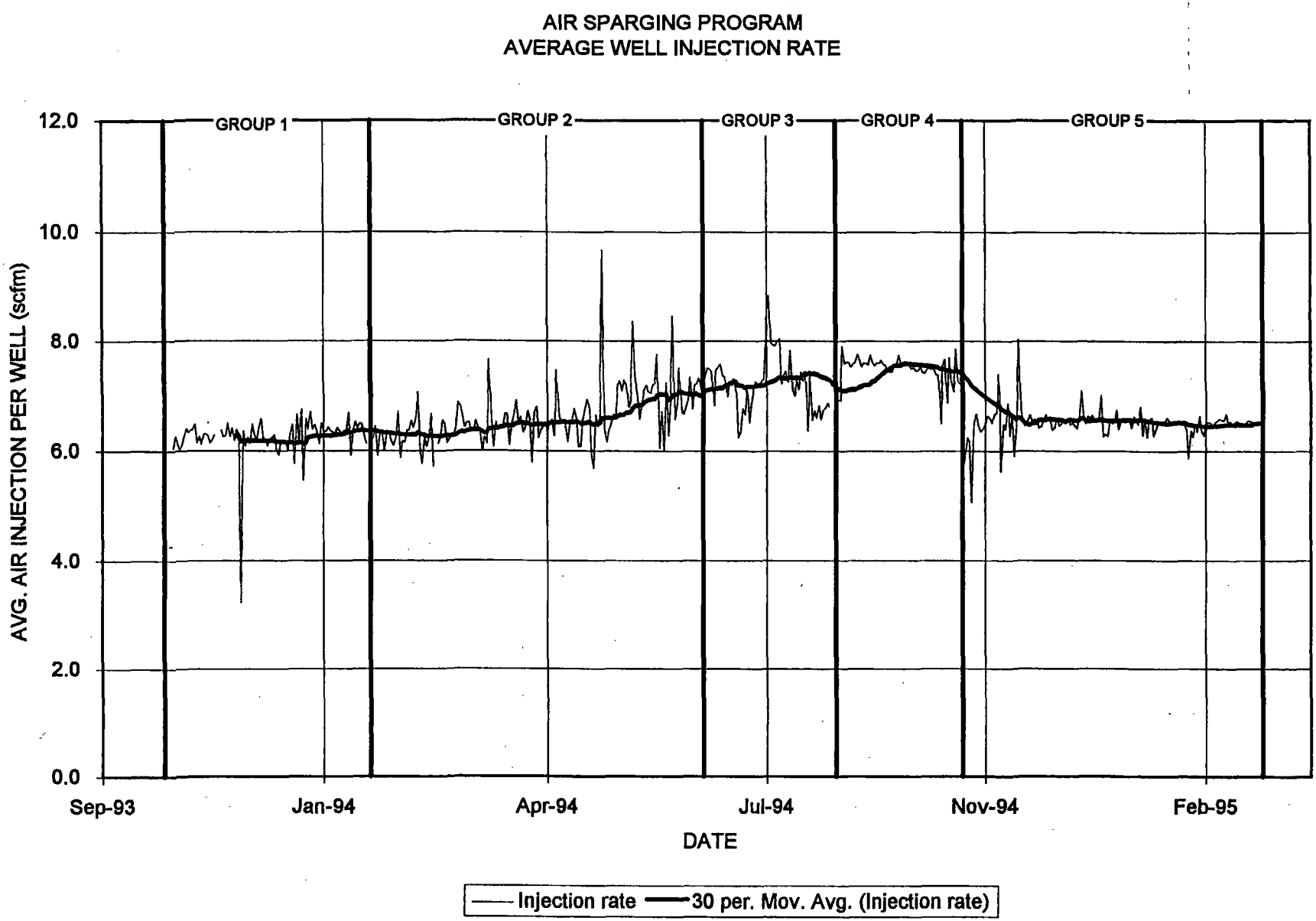

AIR SPARGING PROGRAM
AVERAGE WELL INJECTION RATE
GROUP 1
GROUP 2
GROUP 3
GROUP 4
GROUP 5
12.0
10.0
8.0
6.0
4.0
2.0
0.0
AVG. AIR INJECTION PER WELL (scfm)
Sep-93
Jan-94
Apr-94
Jul-94
Nov-94
Feb-95
DATE
Injection rate
30 per. Mov. Avg. (Injection rate)

Figure 15

AIR SPARGING PROGRAM
AIR SPARGE WELLS IN OPERATION

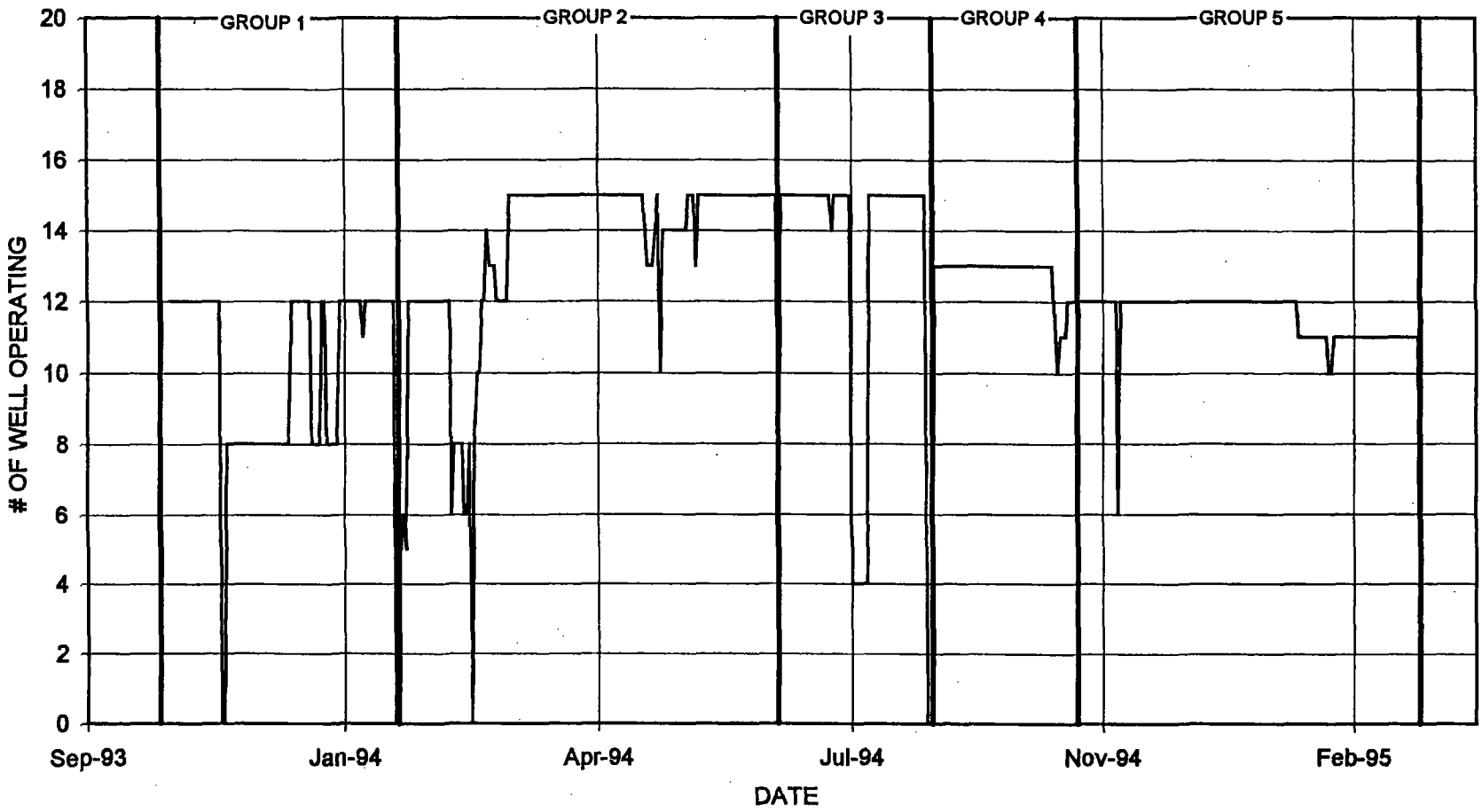


Figure 16

AIR SPARGING PROGRAM
AIR INJECTION RATE

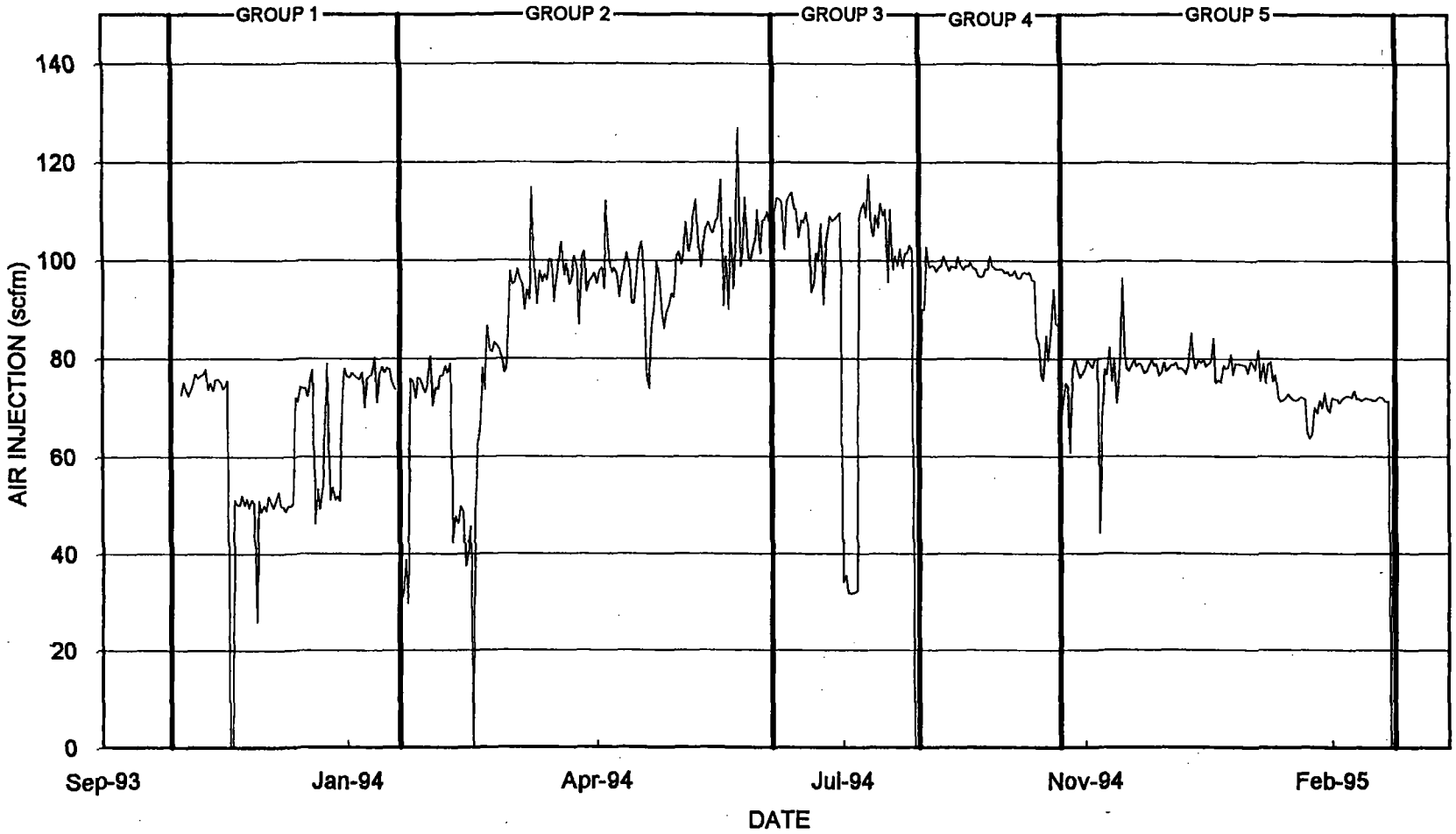


Figure 17

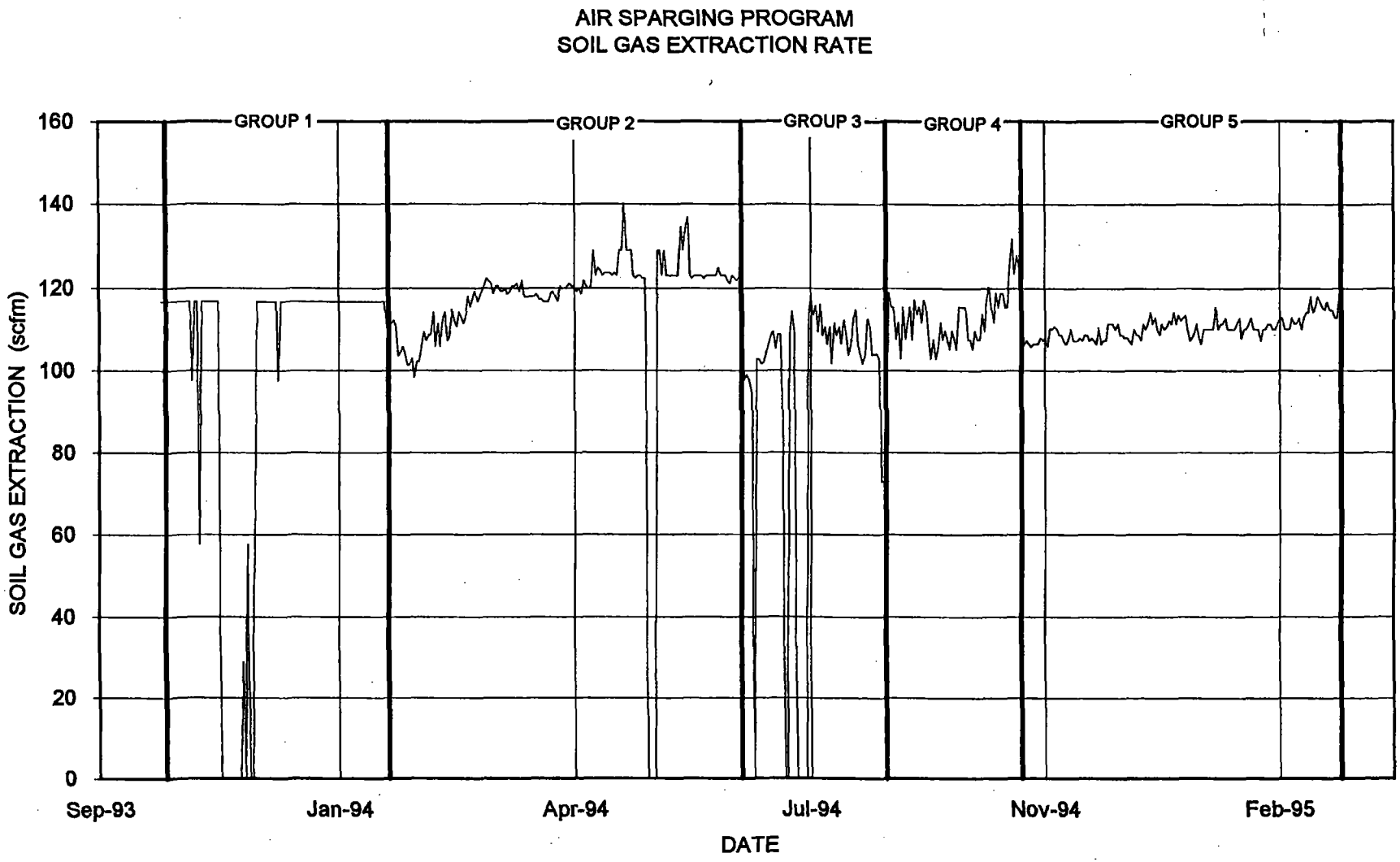

AIR SPARGING PROGRAM
SOIL GAS EXTRACTION RATE
GROUP 1
GROUP 2
GROUP 3
GROUP 4
GROUP 5
SOIL GAS EXTRACTION (scfm)
160
140
120
100
80
60
40
20
0
Sep-93
Jan-94
Apr-94
Jul-94
Nov-94
Feb-95
DATE

Figure 18

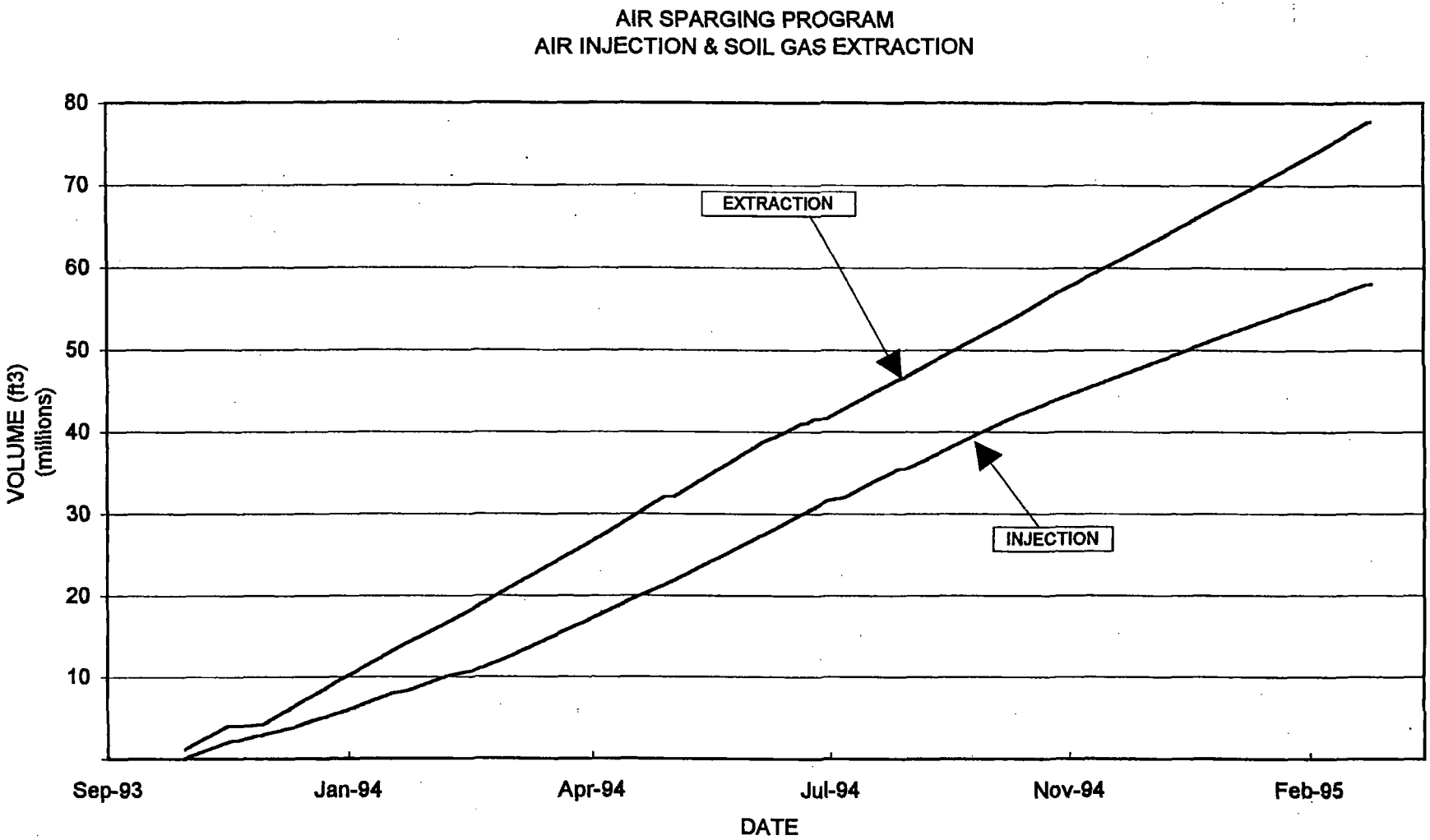

AIR SPARGING PROGRAM
AIR INJECTION & SOIL GAS EXTRACTION
80
70
60
50
40
30
20
10
VOLUME (ft3)
(millions)
EXTRACTION
INJECTION
Sep-93
Jan-94
Apr-94
Jul-94
Nov-94
Feb-95
DATE

Figure 19

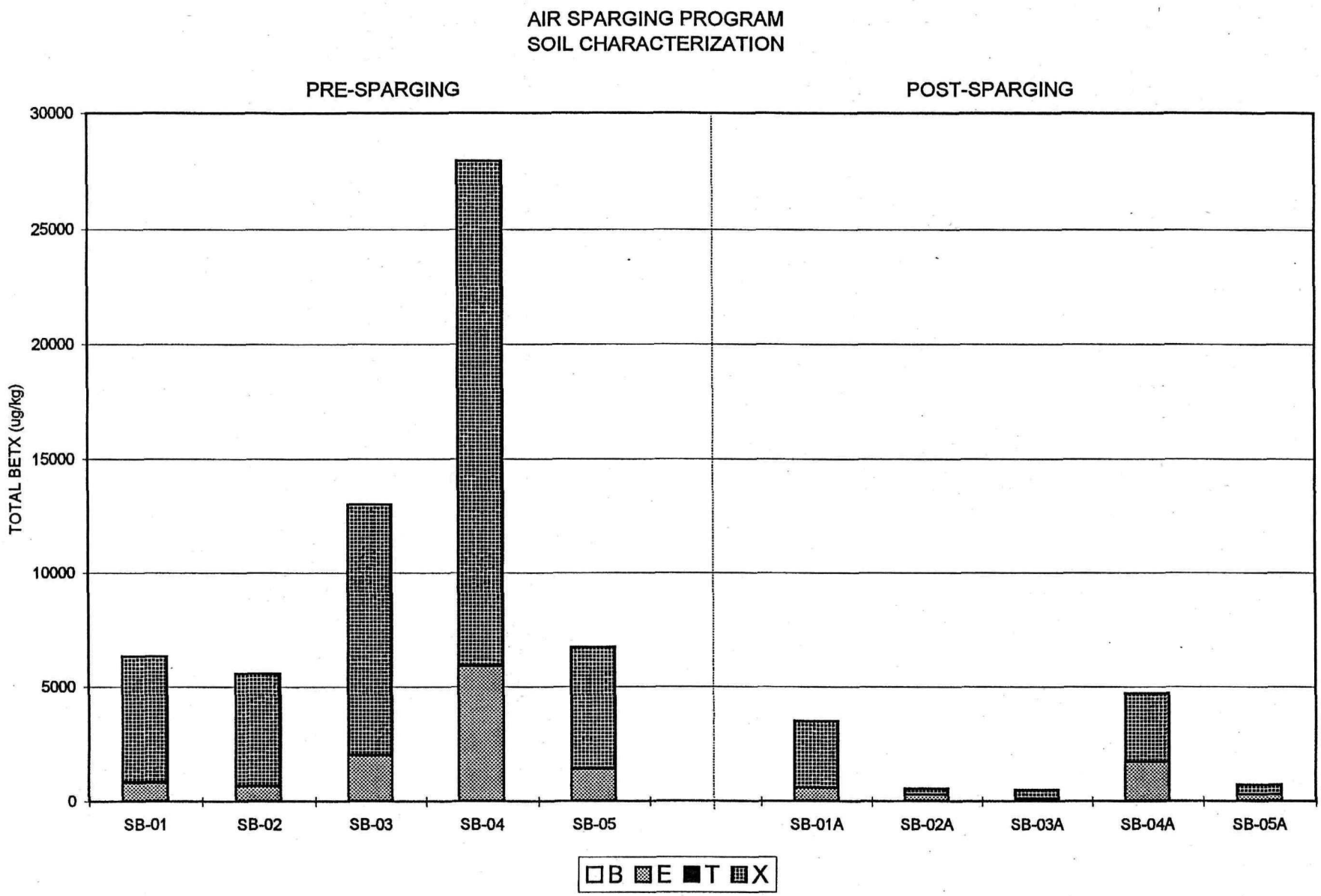

AIR SPARGING PROGRAM
SOIL CHARACTERIZATION
PRE-SPARGING
POST-SPARGING
TOTAL BETX (ug/kg)
30000
25000
20000
15000
10000
5000
0
SB-01
SB-02
SB-03
SB-04
SB-05
SB-01A
SB-02A
SB-03A
SB-04A
SB-05A
B
E
T
X

Figure 20

AIR SPARGING PROGRAM
SVE WELLS PID READINGS

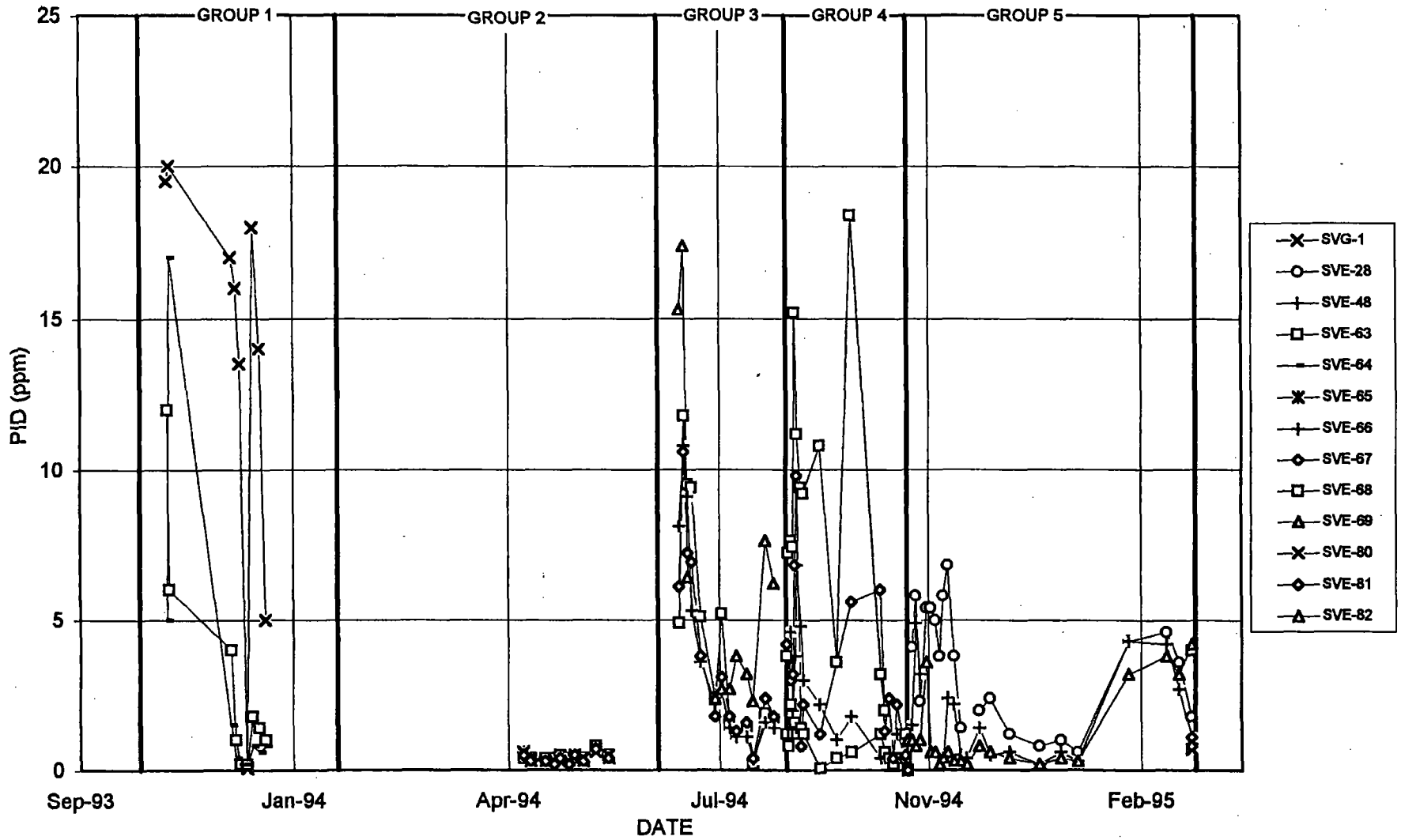


Figure 21

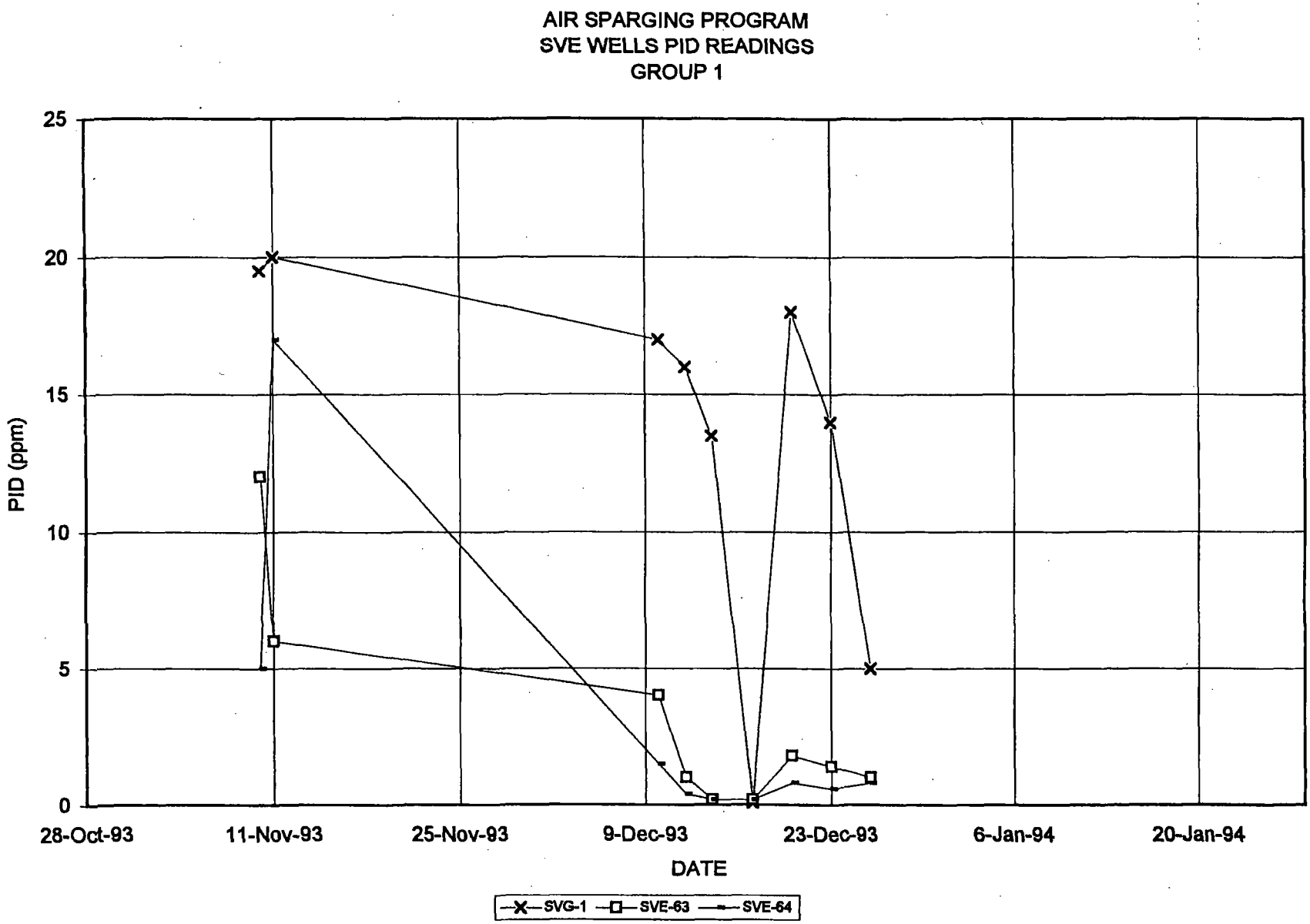

AIR SPARGING PROGRAM
SVE WELLS PID READINGS
GROUP 1
PID (ppm)
25
20
15
10
5
0
28-Oct-93
11-Nov-93
25-Nov-93
9-Dec-93
23-Dec-93
6-Jan-94
20-Jan-94
DATE
SVG-1
SVE-63
SVE-64

Figure 22a

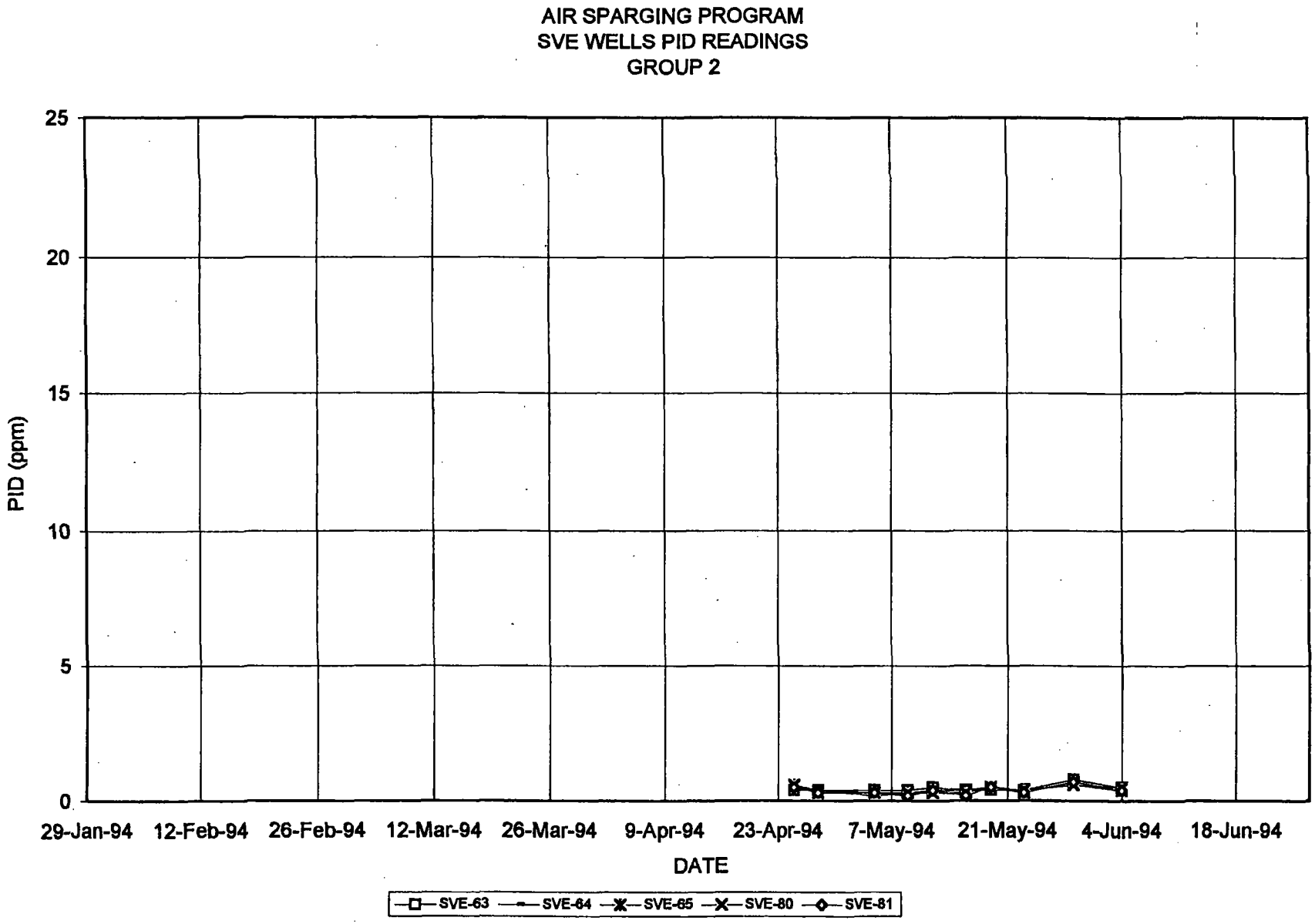

AIR SPARGING PROGRAM
SVE WELLS PID READINGS
GROUP 2
PID (ppm)
25
20
15
10
5
0
29-Jan-94
12-Feb-94
26-Feb-94
12-Mar-94
26-Mar-94
9-Apr-94
23-Apr-94
7-May-94
21-May-94
4-Jun-94
18-Jun-94
DATE
SVE-63
SVE-64
SVE-65
SVE-80
SVE-81

Figure 22b

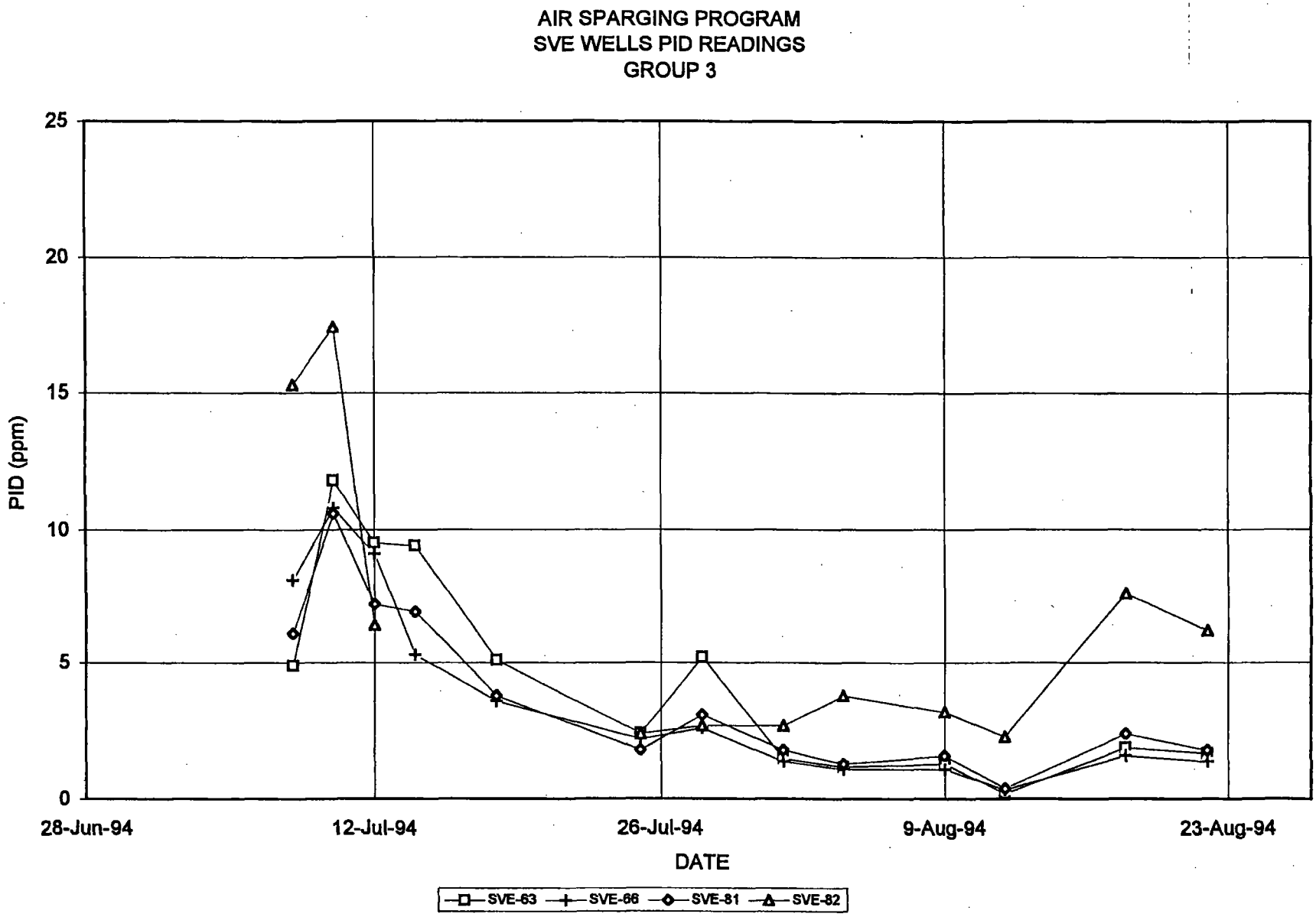

AIR SPARGING PROGRAM
SVE WELLS PID READINGS
GROUP 3
PID (ppm)
25
20
15
10
5
0
28-Jun-94
12-Jul-94
26-Jul-94
9-Aug-94
23-Aug-94
DATE
SVE-63
SVE-66
SVE-81
SVE-82

Figure 22c

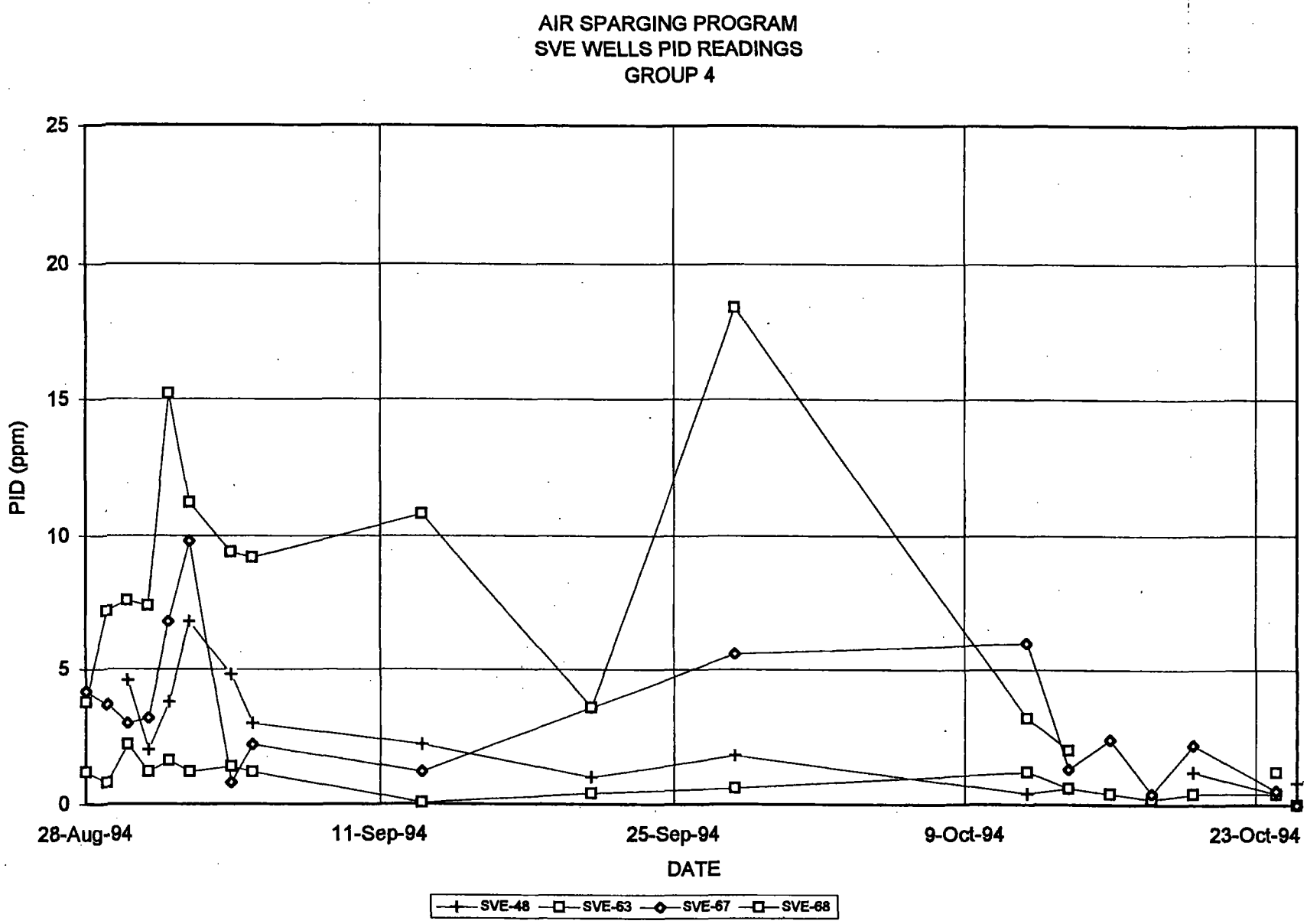

AIR SPARGING PROGRAM
SVE WELLS PID READINGS
GROUP 4
PID (ppm)
25
20
15
10
5
0
28-Aug-94
11-Sep-94
25-Sep-94
9-Oct-94
23-Oct-94
DATE
SVE-48
SVE-63
SVE-67
SVE-68

Figure 22d

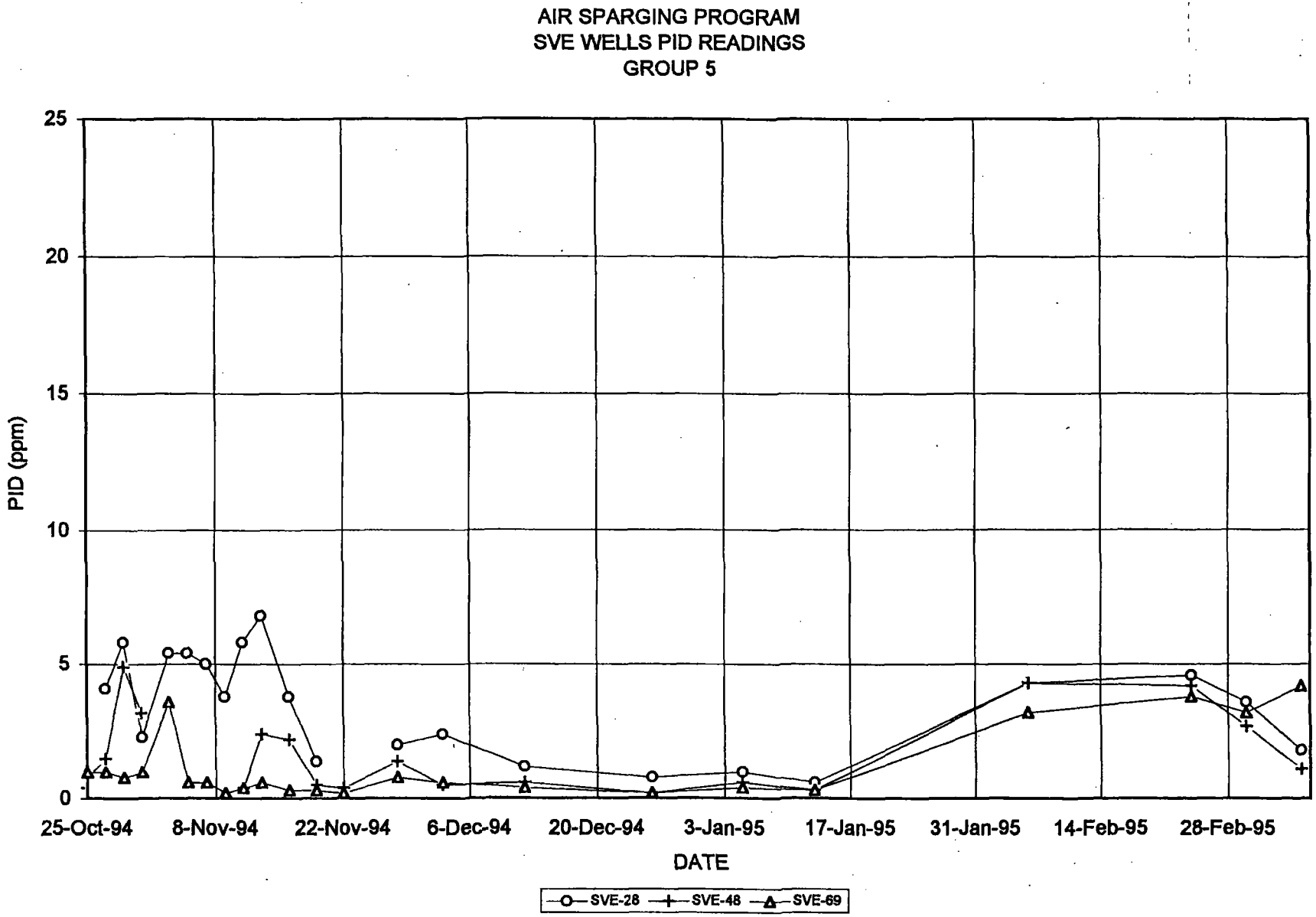

AIR SPARGING PROGRAM
SVE WELLS PID READINGS
GROUP 5
PID (ppm)
25
20
15
10
5
0
25-Oct-94
8-Nov-94
22-Nov-94
6-Dec-94
20-Dec-94
3-Jan-95
17-Jan-95
31-Jan-95
14-Feb-95
28-Feb-95
DATE
SVE-28
SVE-48
SVE-69

Figure 22e

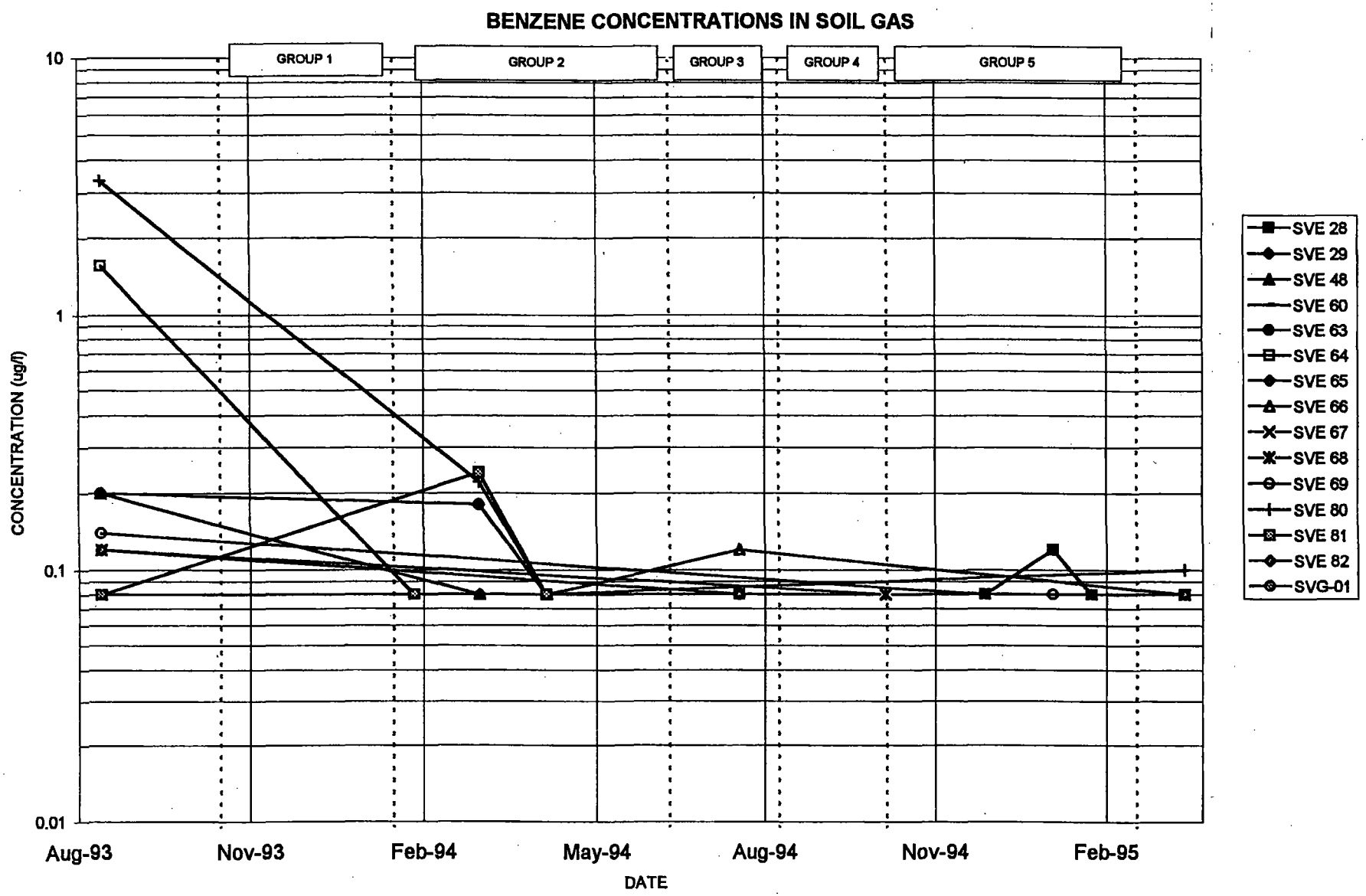

BENZENE CONCENTRATIONS IN SOIL GAS
GROUP 1
GROUP 2
GROUP 3
GROUP 4
GROUP 5
10
1
0.1
0.01
CONCENTRATION (ug/l)
Aug-93
Nov-93
Feb-94
May-94
Aug-94
Nov-94
Feb-95
DATE
SVE 28
SVE 29
SVE 48
SVE 60
SVE 63
SVE 64
SVE 65
SVE 66
SVE 67
SVE 68
SVE 69
SVE 80
SVE 81
SVE 82
SVG-01

Figure 23a

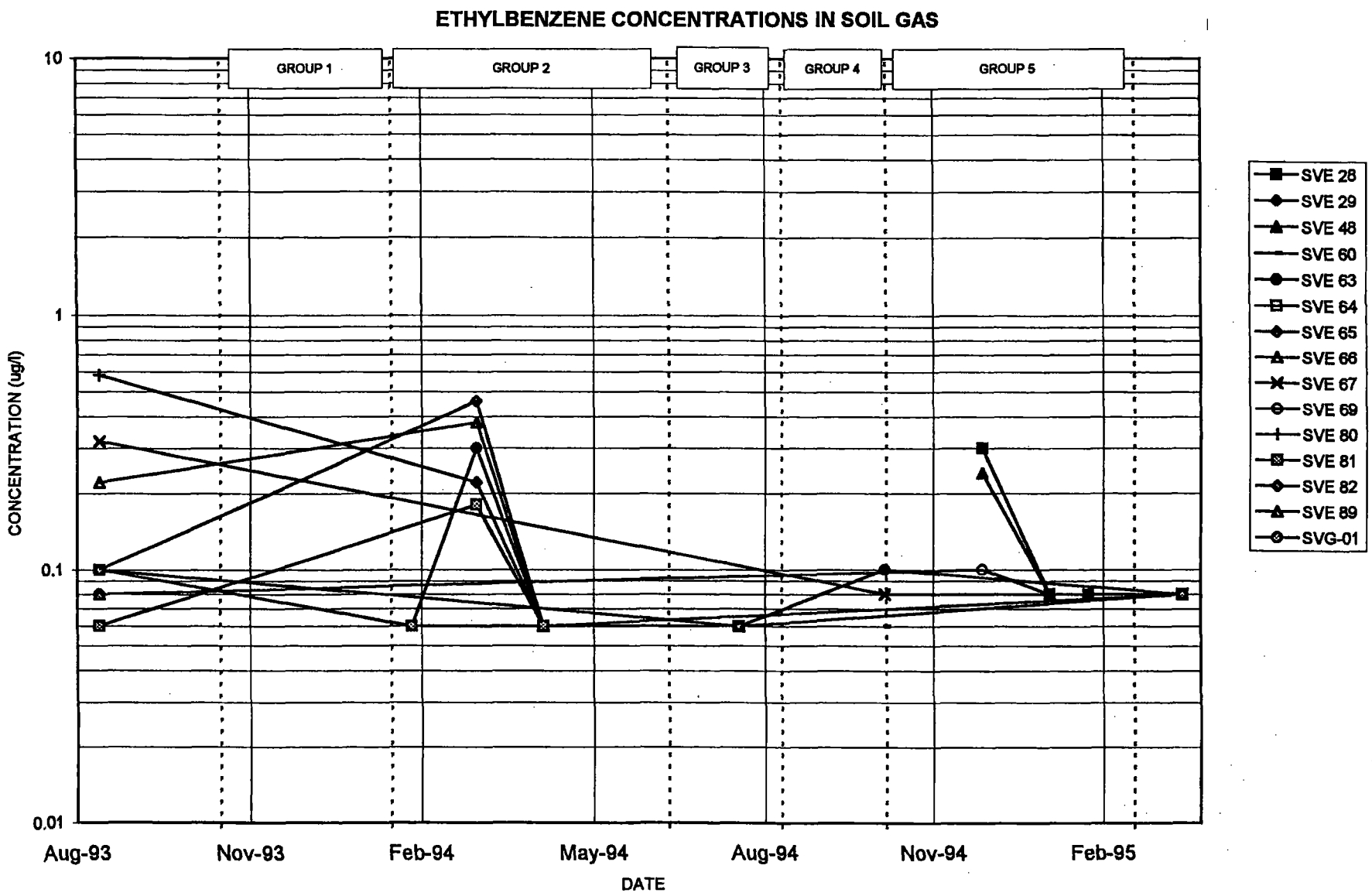

ETHYLBENZENE CONCENTRATIONS IN SOIL GAS
GROUP 1
GROUP 2
GROUP 3
GROUP 4
GROUP 5
10
1
0.1
0.01
CONCENTRATION (ug/l)
Aug-93
Nov-93
Feb-94
May-94
Aug-94
Nov-94
Feb-95
DATE
SVE 28
SVE 29
SVE 48
SVE 60
SVE 63
SVE 64
SVE 65
SVE 66
SVE 67
SVE 69
SVE 80
SVE 81
SVE 82
SVE 89
SVG-01

Figure 23b

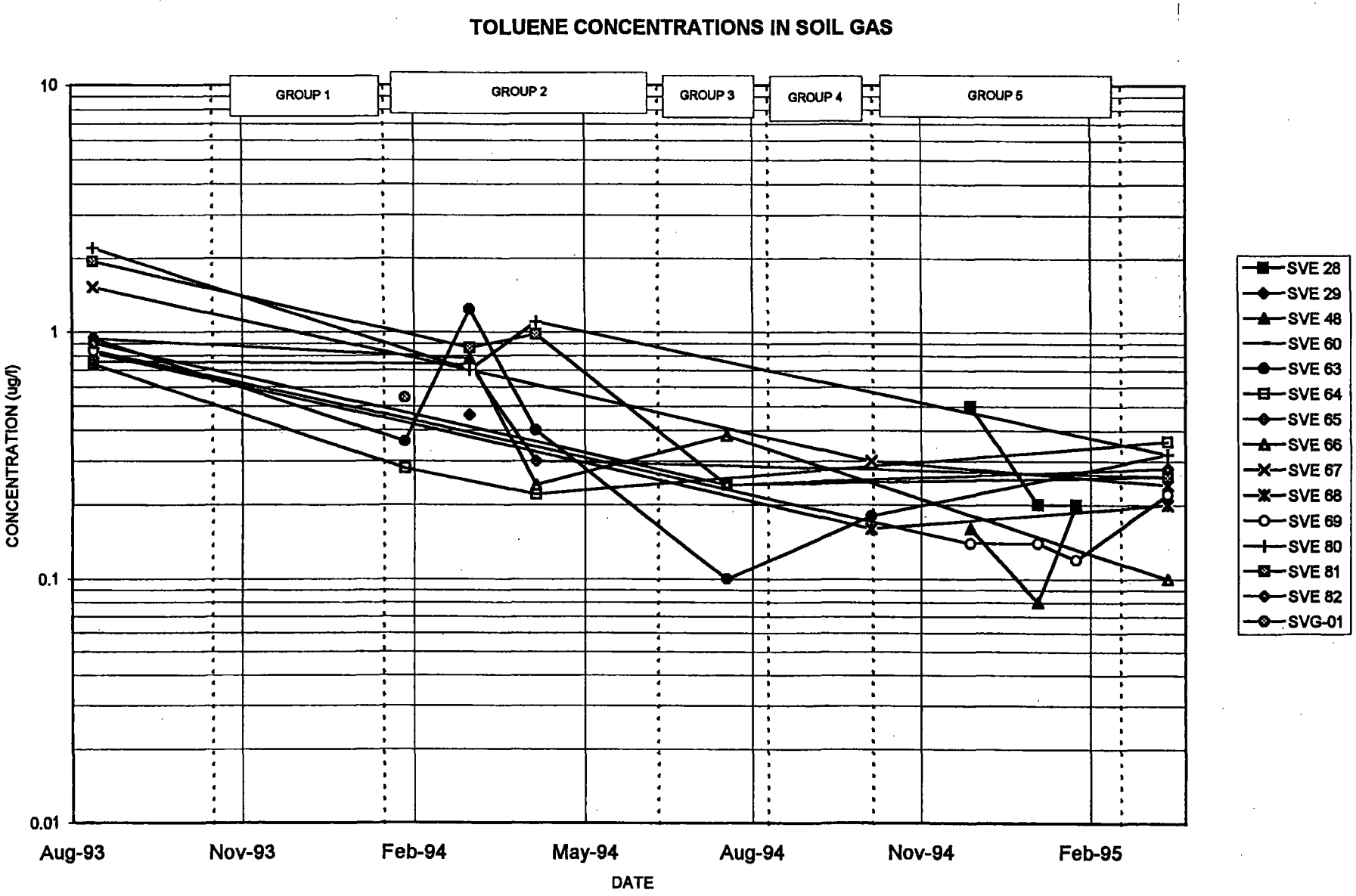

TOLUENE CONCENTRATIONS IN SOIL GAS
GROUP 1
GROUP 2
GROUP 3
GROUP 4
GROUP 5
10
1
0.1
0.01
CONCENTRATION (ug/l)
Aug-93
Nov-93
Feb-94
May-94
Aug-94
Nov-94
Feb-95
DATE
SVE 28
SVE 29
SVE 48
SVE 60
SVE 63
SVE 64
SVE 65
SVE 66
SVE 67
SVE 68
SVE 69
SVE 80
SVE 81
SVE 82
SVG-01

Figure 23c

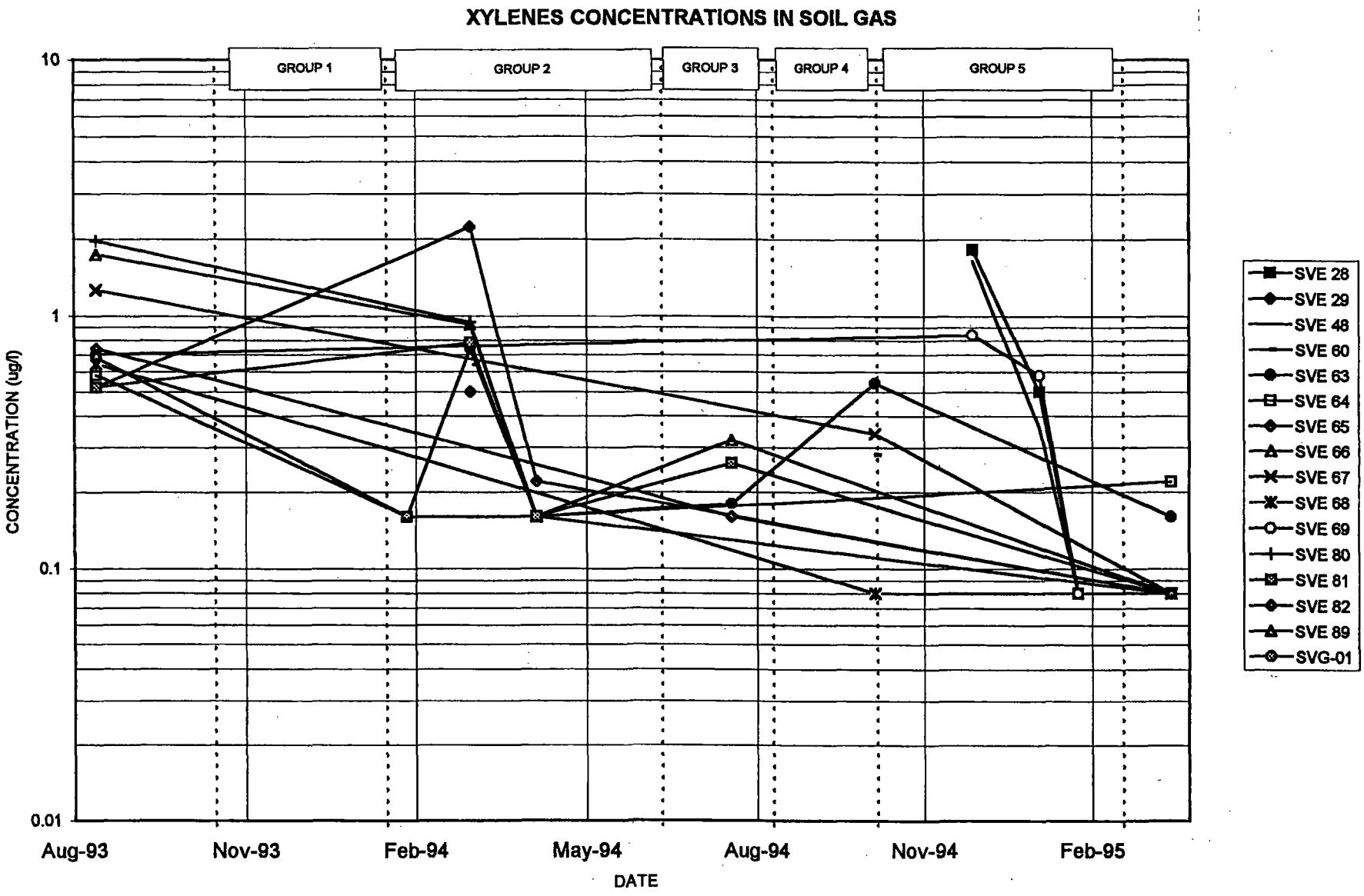

XYLENES CONCENTRATIONS IN SOIL GAS
GROUP 1
GROUP 2
GROUP 3
GROUP 4
GROUP 5
10
1
0.1
0.01
CONCENTRATION (ug/l)
Aug-93
Nov-93
Feb-94
May-94
Aug-94
Nov-94
Feb-95
DATE
SVE 28
SVE 29
SVE 48
SVE 60
SVE 63
SVE 64
SVE 65
SVE 66
SVE 67
SVE 68
SVE 69
SVE 80
SVE 81
SVE 82
SVE 89
SVG-01

Figure 23d

TOTAL BETX CONCENTRATIONS IN SOIL GAS

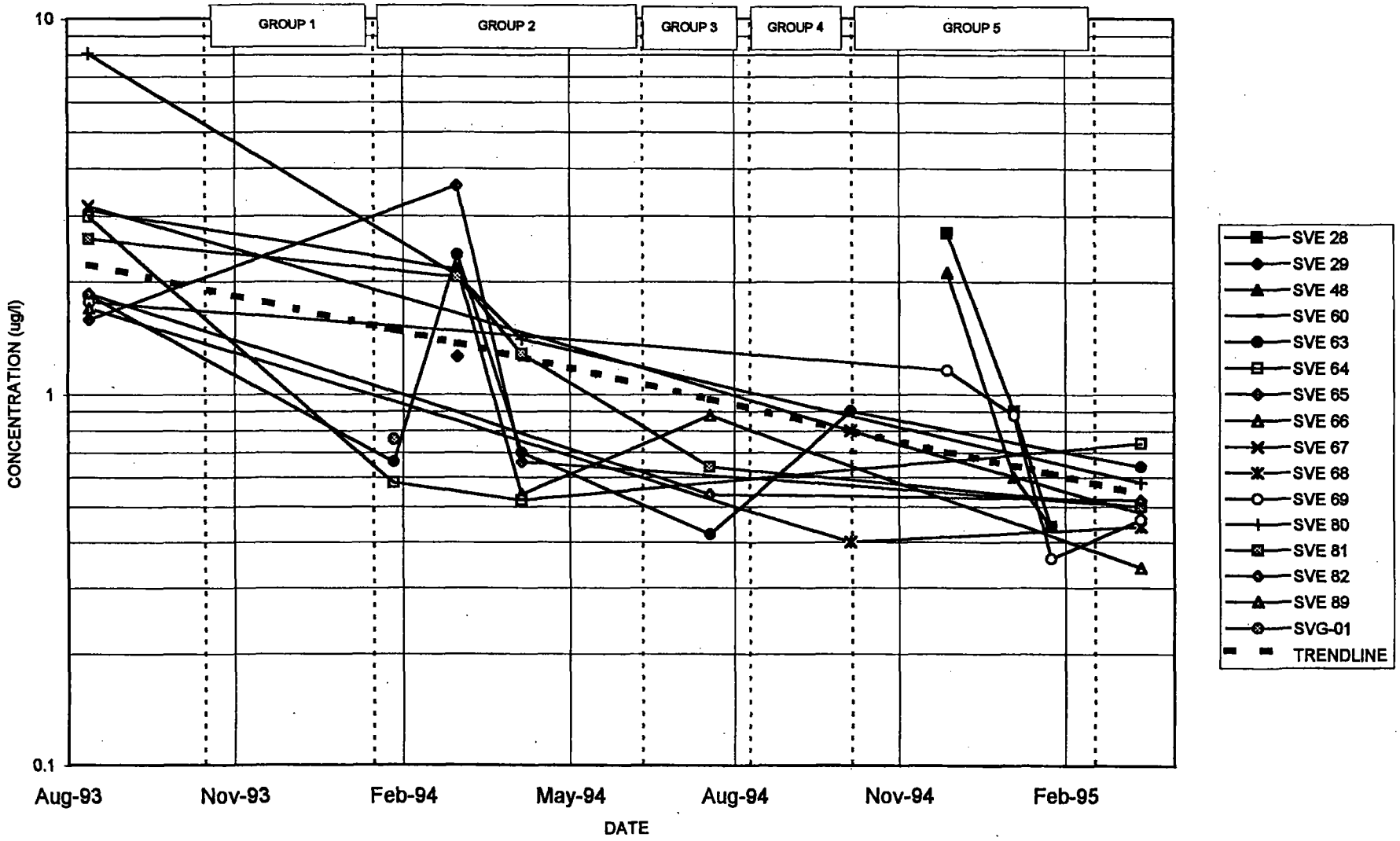
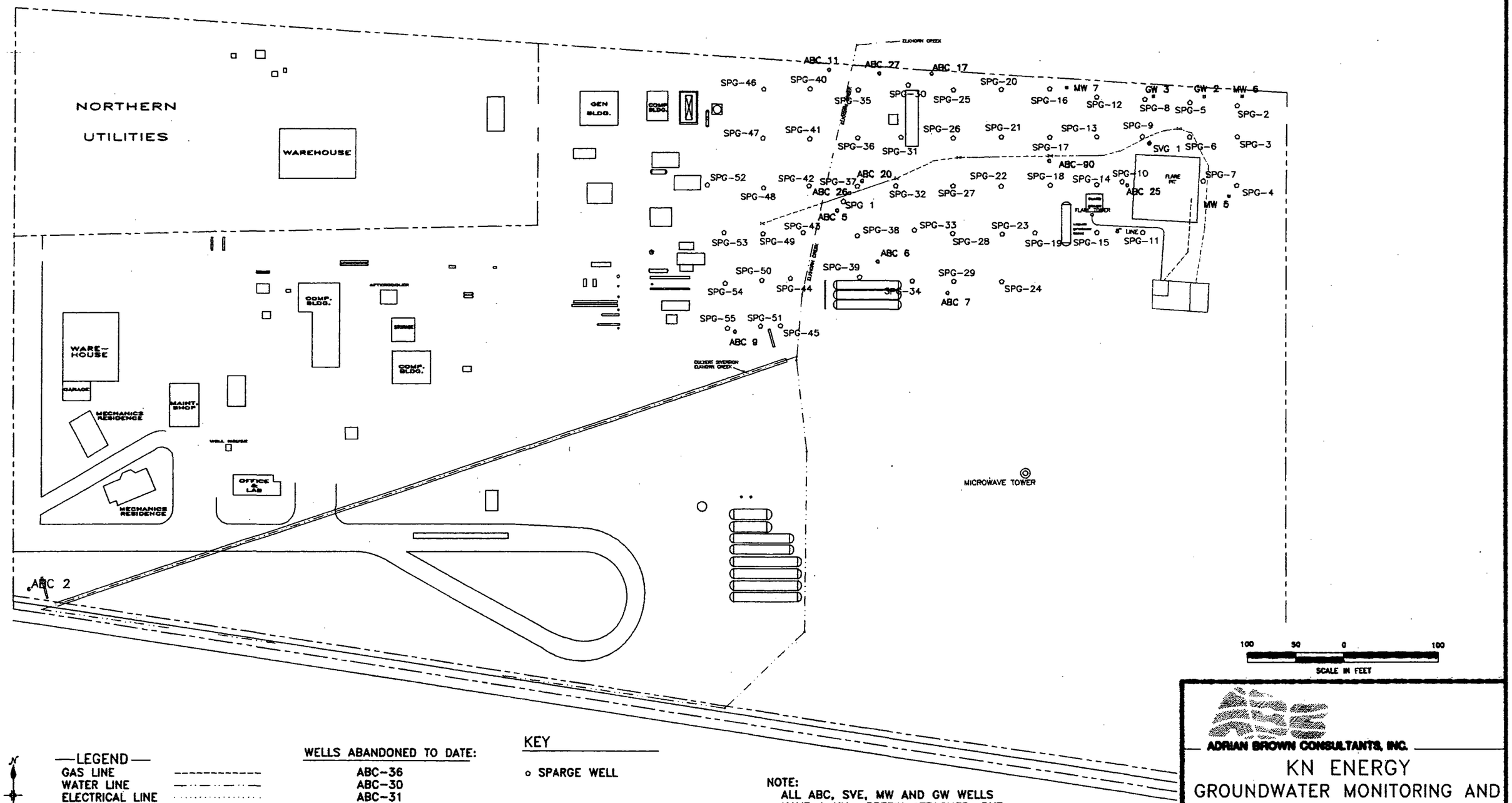


Figure 24



—LEGEND—

- GAS LINE
- WATER LINE
- ELECTRICAL LINE
- FUEL GAS LINES
- DRAIN LINE

WELLS ABANDONED TO DATE:

ABC-36
ABC-30
ABC-31
ABC-32
ABC-33
ABC-22

KEY

o SPARGE WELL

NOTE:
ALL ABC, SVE, MW AND GW WELLS HAVE A KN- PREFIX ATTACHED, BUT ARE NOT SHOWN HERE FOR CLARITY PURPOSES

D:\P\1125J\SPGWELLS.DWG 950627

ADRIAN BROWN CONSULTANTS, INC.

KN ENERGY
GROUNDWATER MONITORING AND AIR SPARGE WELL LOCATION MAP

Figure 25

AIR SPARGING PROGRAM
GROUNDWATER BENZENE CONCENTRATIONS

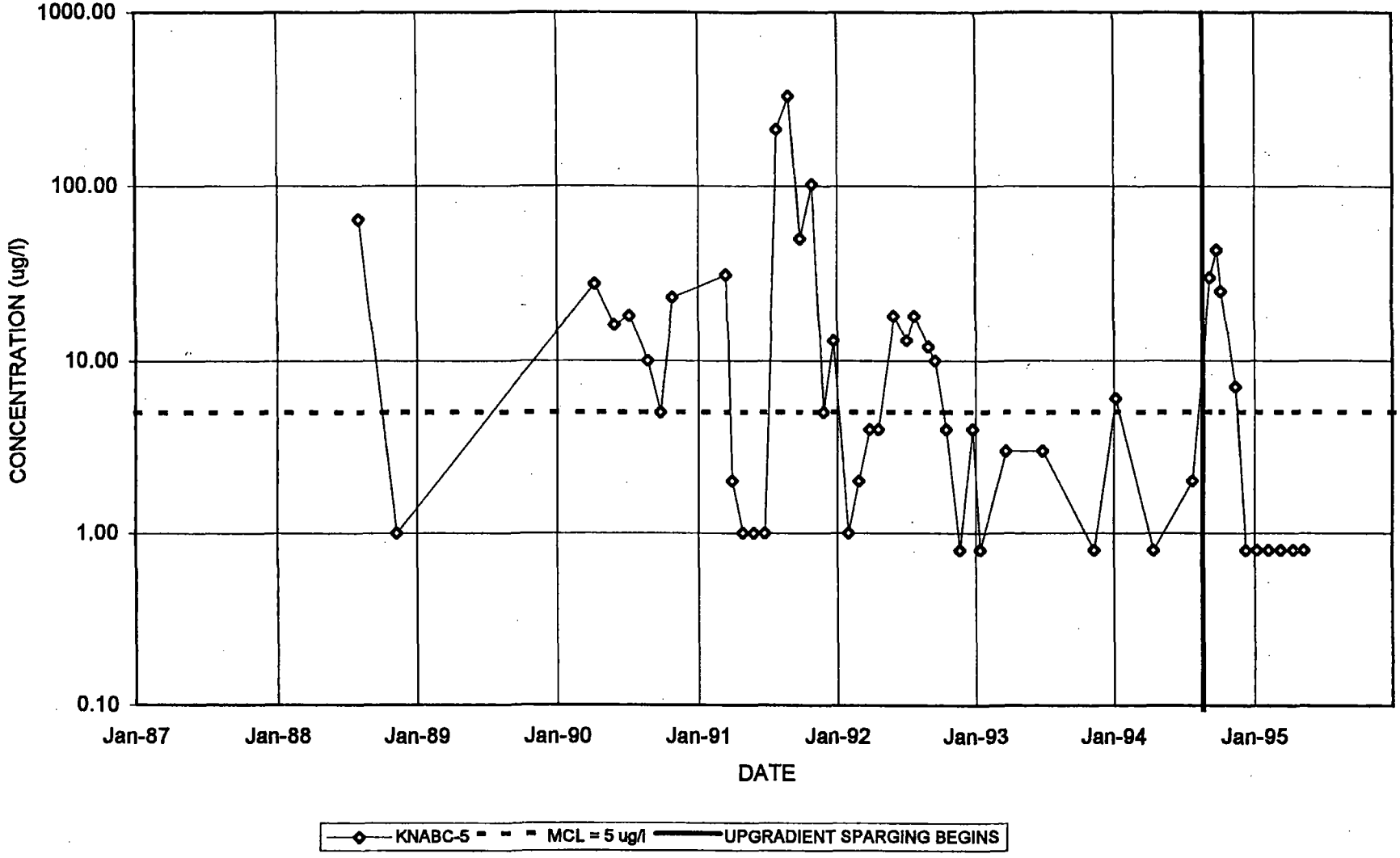


Figure 26a

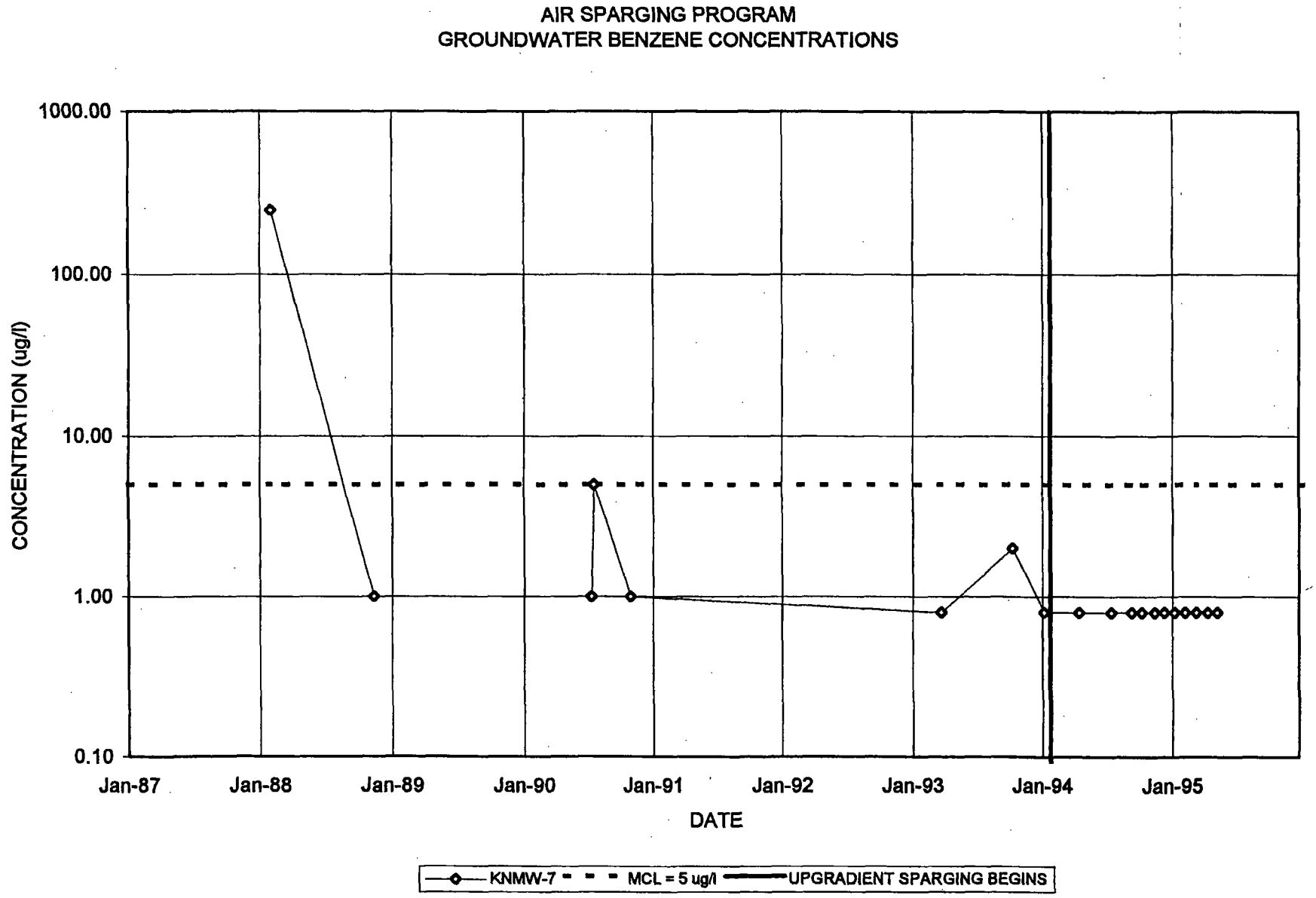

AIR SPARGING PROGRAM
GROUNDWATER BENZENE CONCENTRATIONS
1000.00
100.00
10.00
1.00
0.10
CONCENTRATION (ug/l)
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
DATE
KNMW-7
MCL = 5 ug/l
UPGRADIENT SPARGING BEGINS

Figure 26b

AIR SPARGING PROGRAM
GROUNDWATER BENZENE CONCENTRATIONS

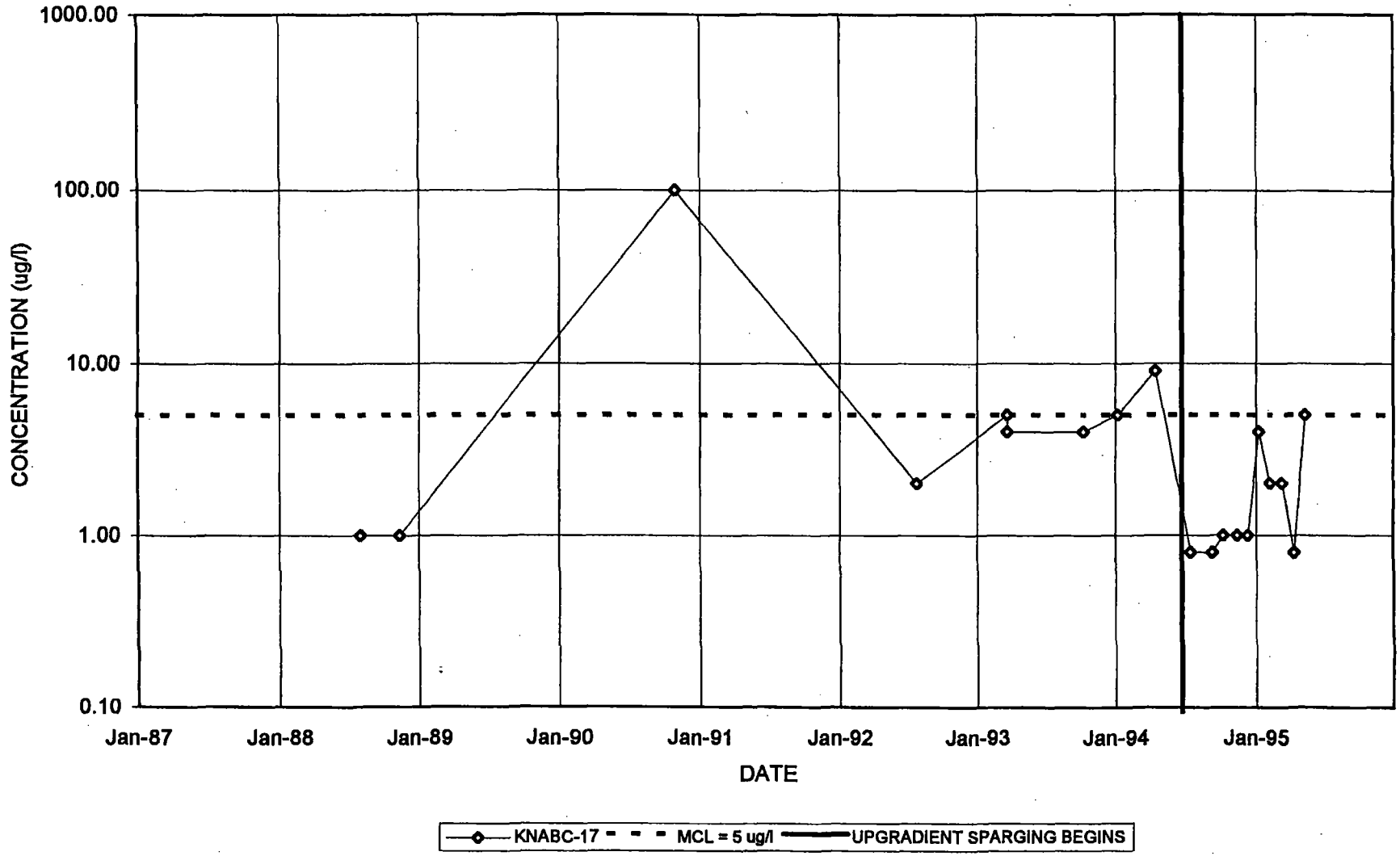


Figure 26c

AIR SPARGING PROGRAM
GROUNDWATER BENZENE CONCENTRATIONS

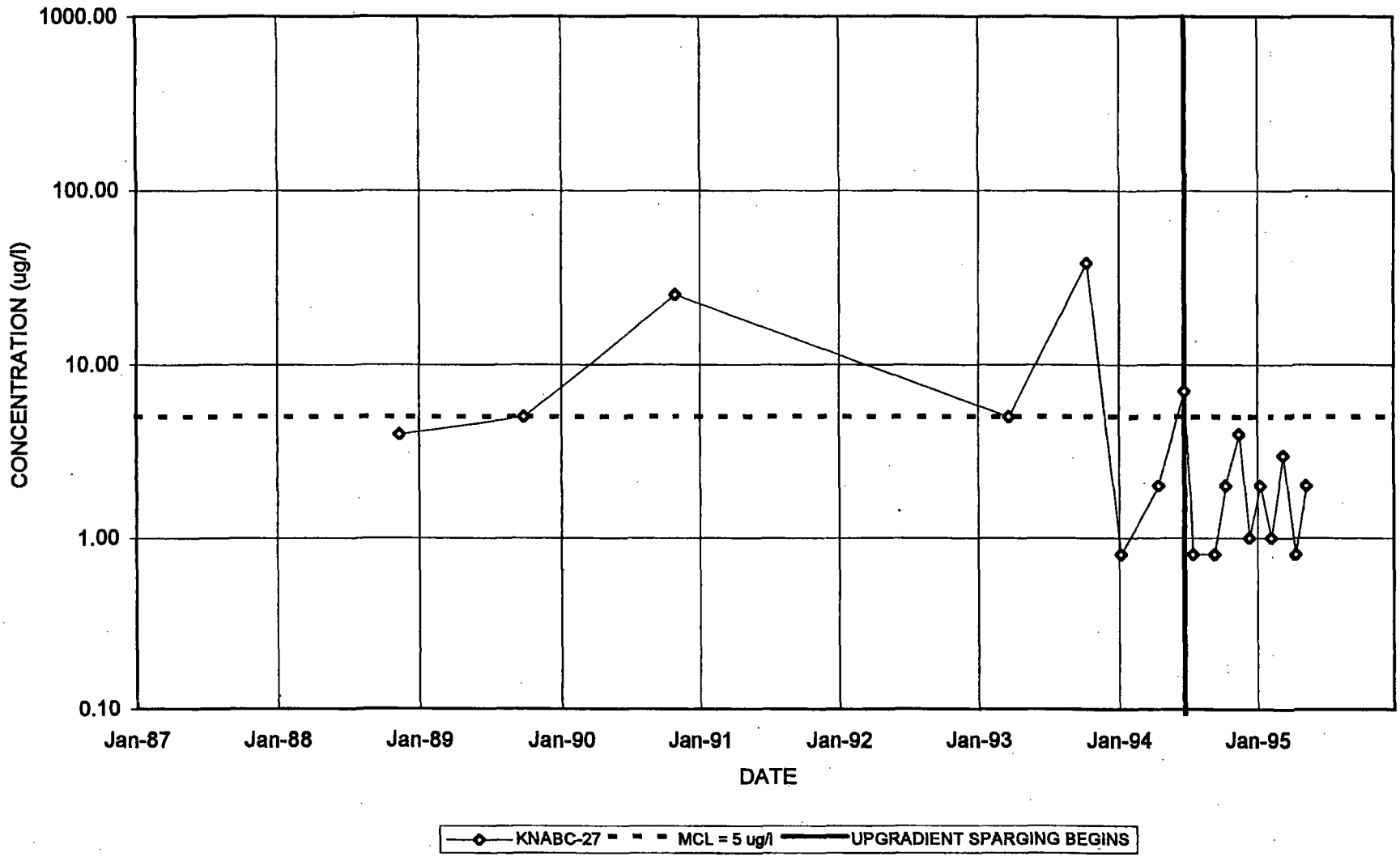


Figure 26d

AIR SPARGING PROGRAM
GROUNDWATER BENZENE CONCENTRATIONS

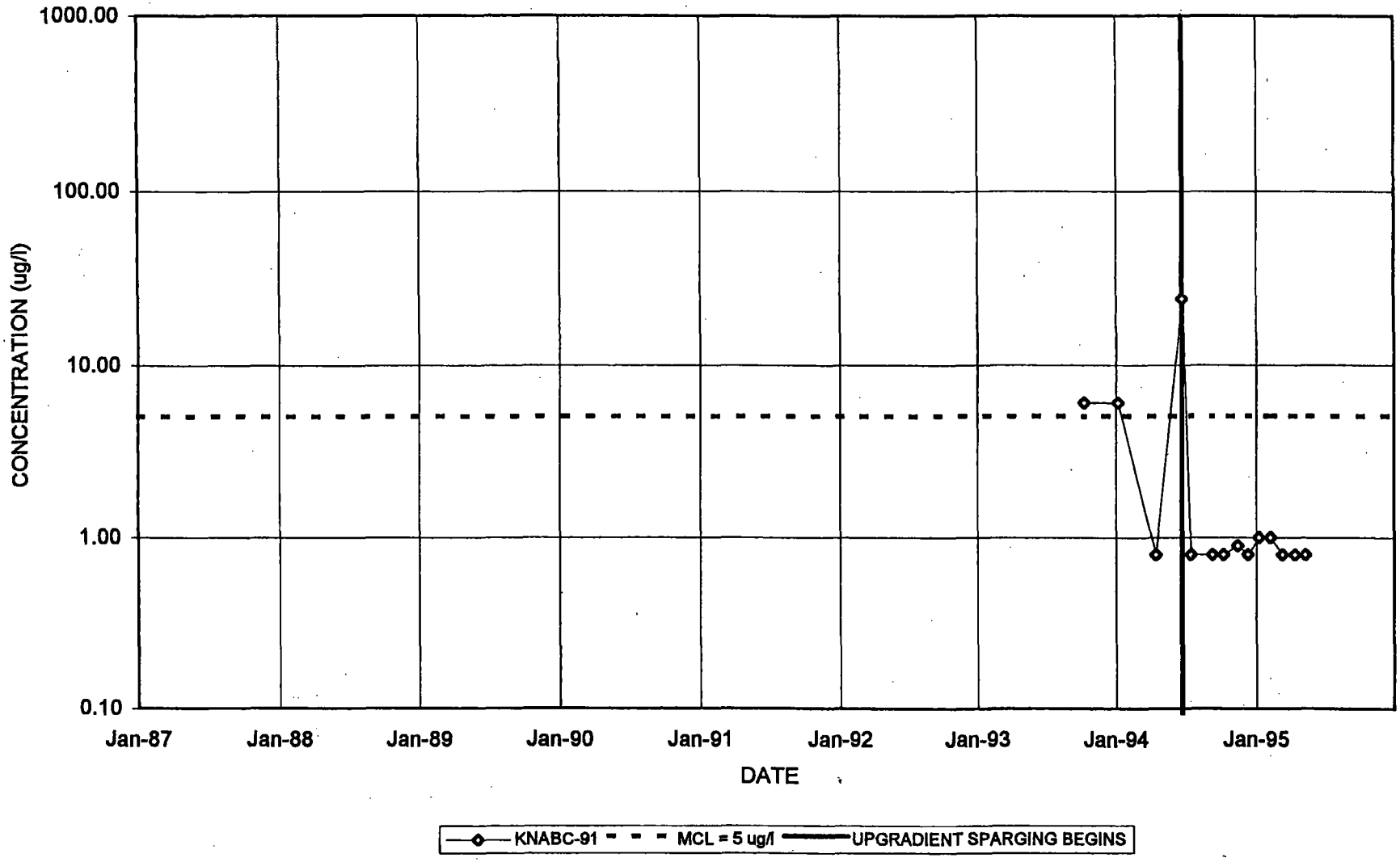


Figure 26e

AIR SPARGING PROGRAM
GROUNDWATER BENZENE CONCENTRATIONS

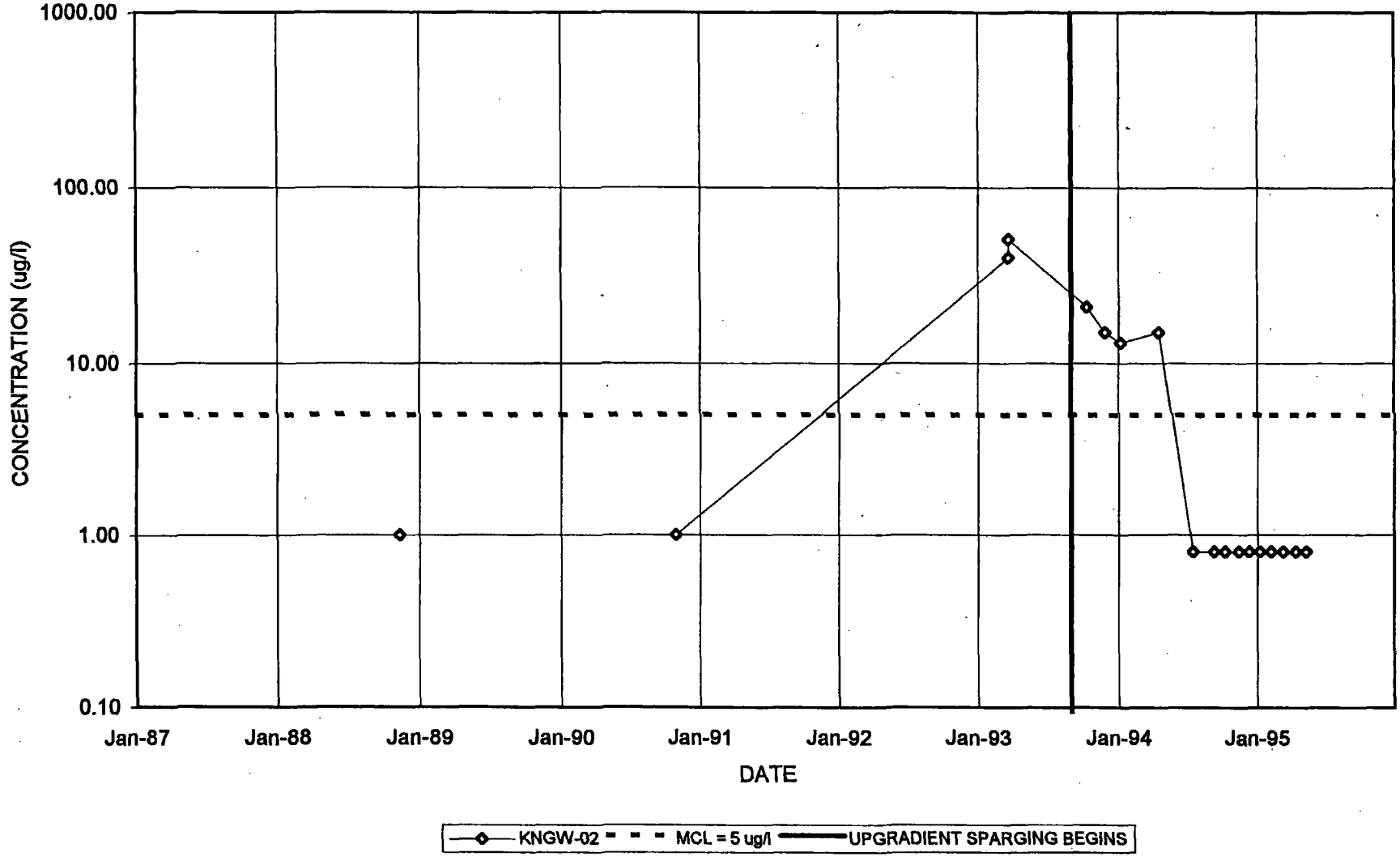


Figure 26f

AIR SPARGING PROGRAM
GROUNDWATER BENZENE CONCENTRATIONS

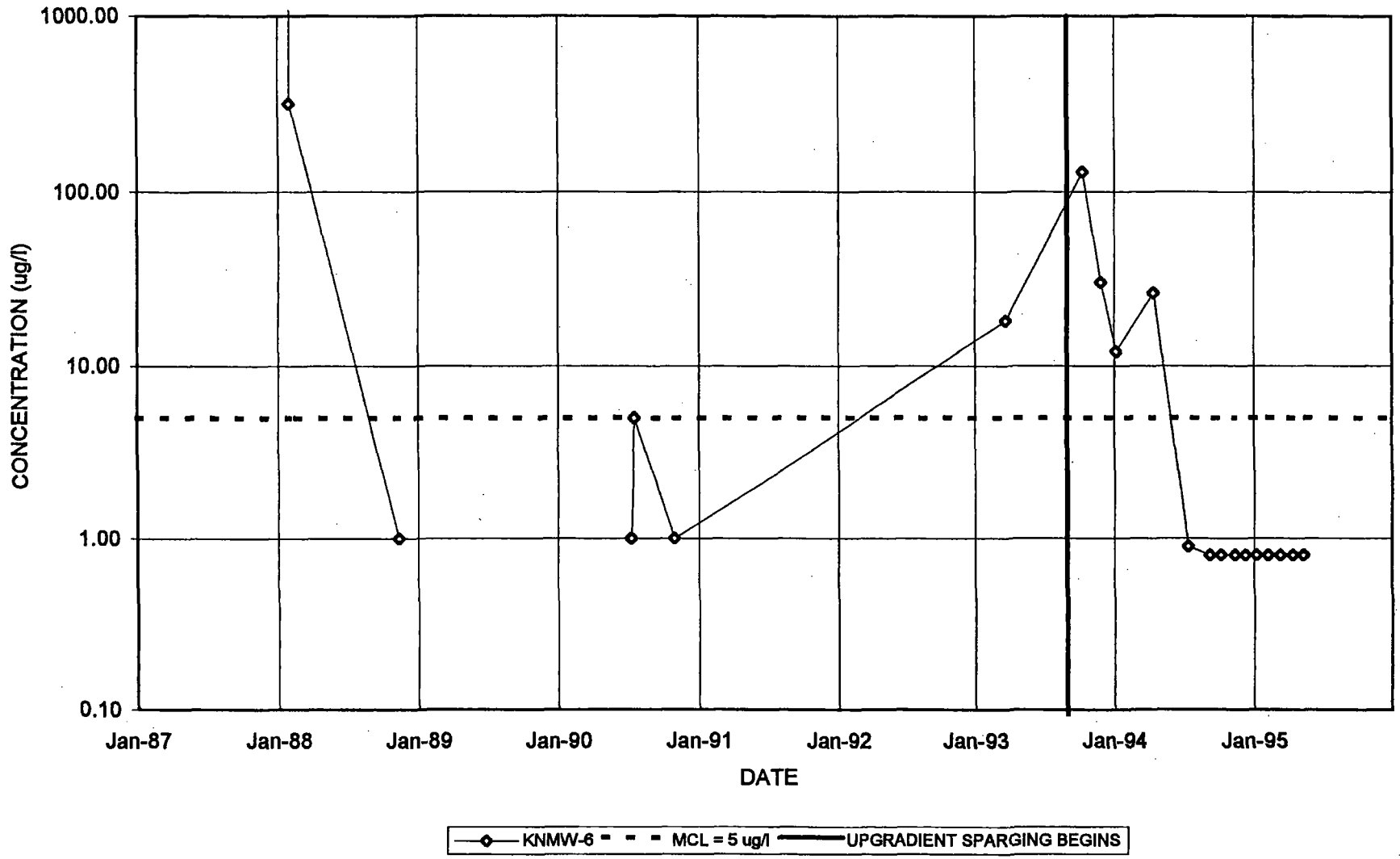


Figure 26g

AIR SPARGING PROGRAM
BACKGROUND GROUNDWATER BENZENE CONCENTRATIONS

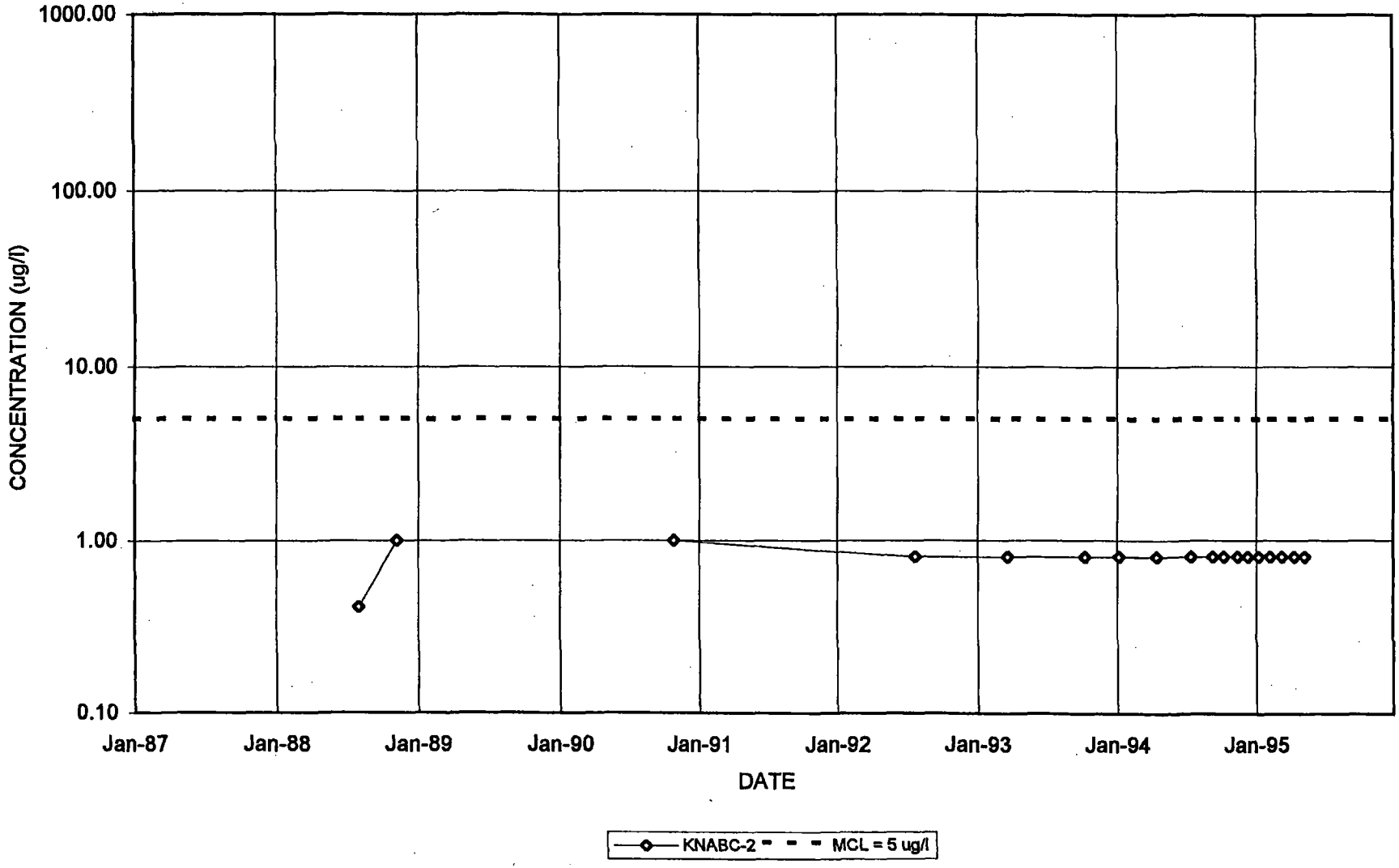


Figure 27

AIR SPARGING PROGRAM
GROUNDWATER BENZENE CONCENTRATIONS

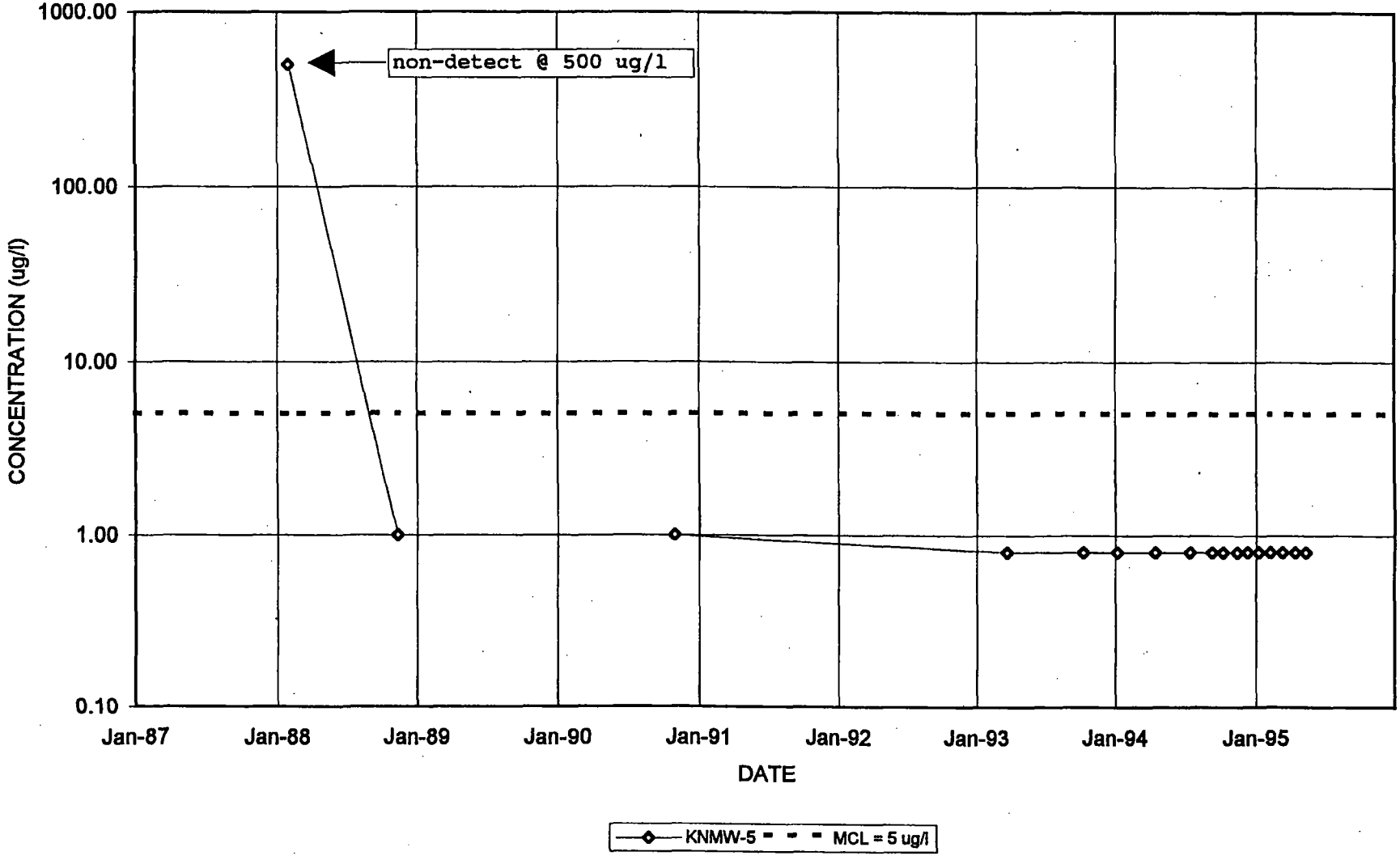


Figure 28

AIR SPARGING PROGRAM
GROUNDWATER BENZENE CONCENTRATIONS

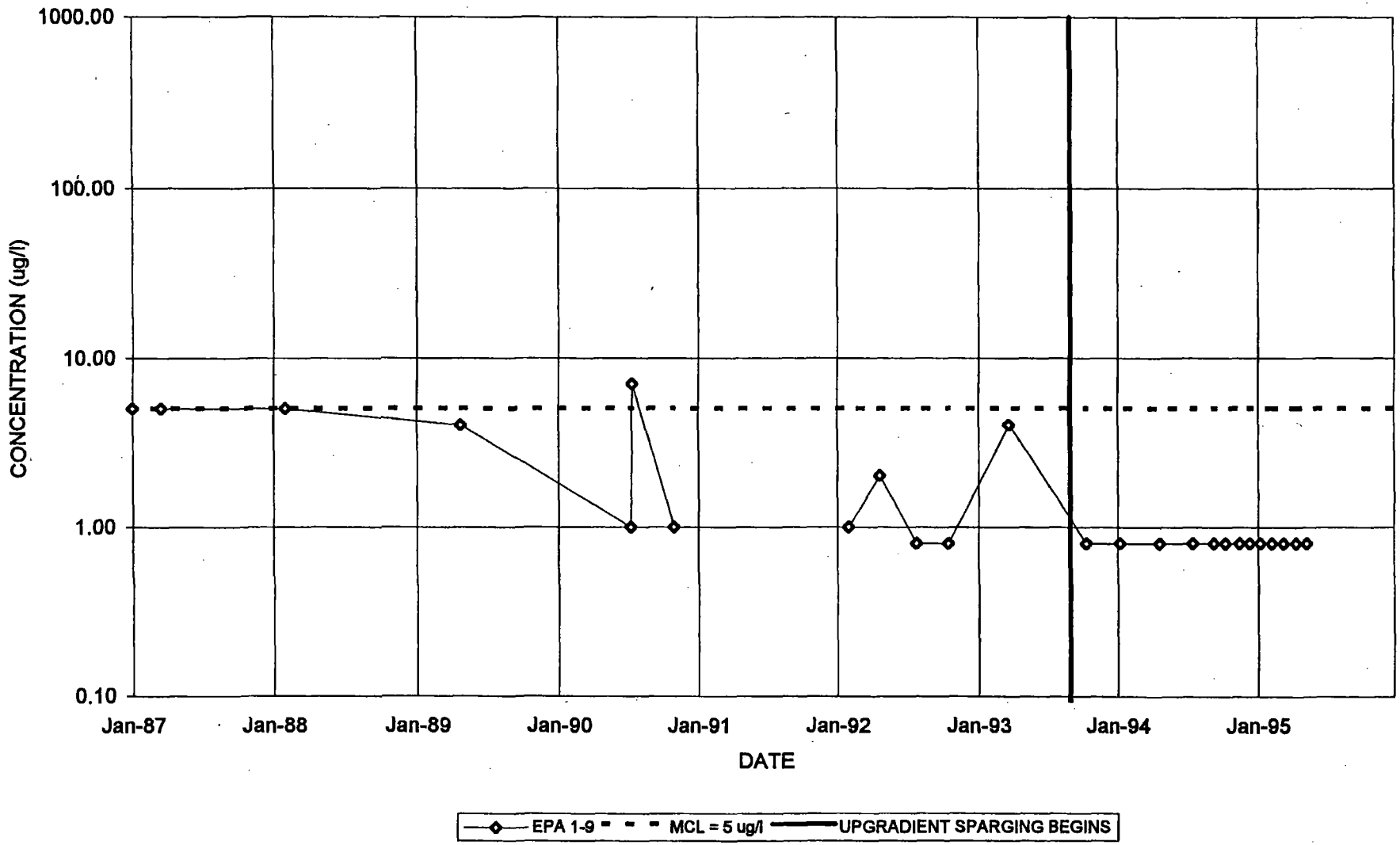


Figure 29a

AIR SPARGING PROGRAM
GROUNDWATER BENZENE CONCENTRATIONS

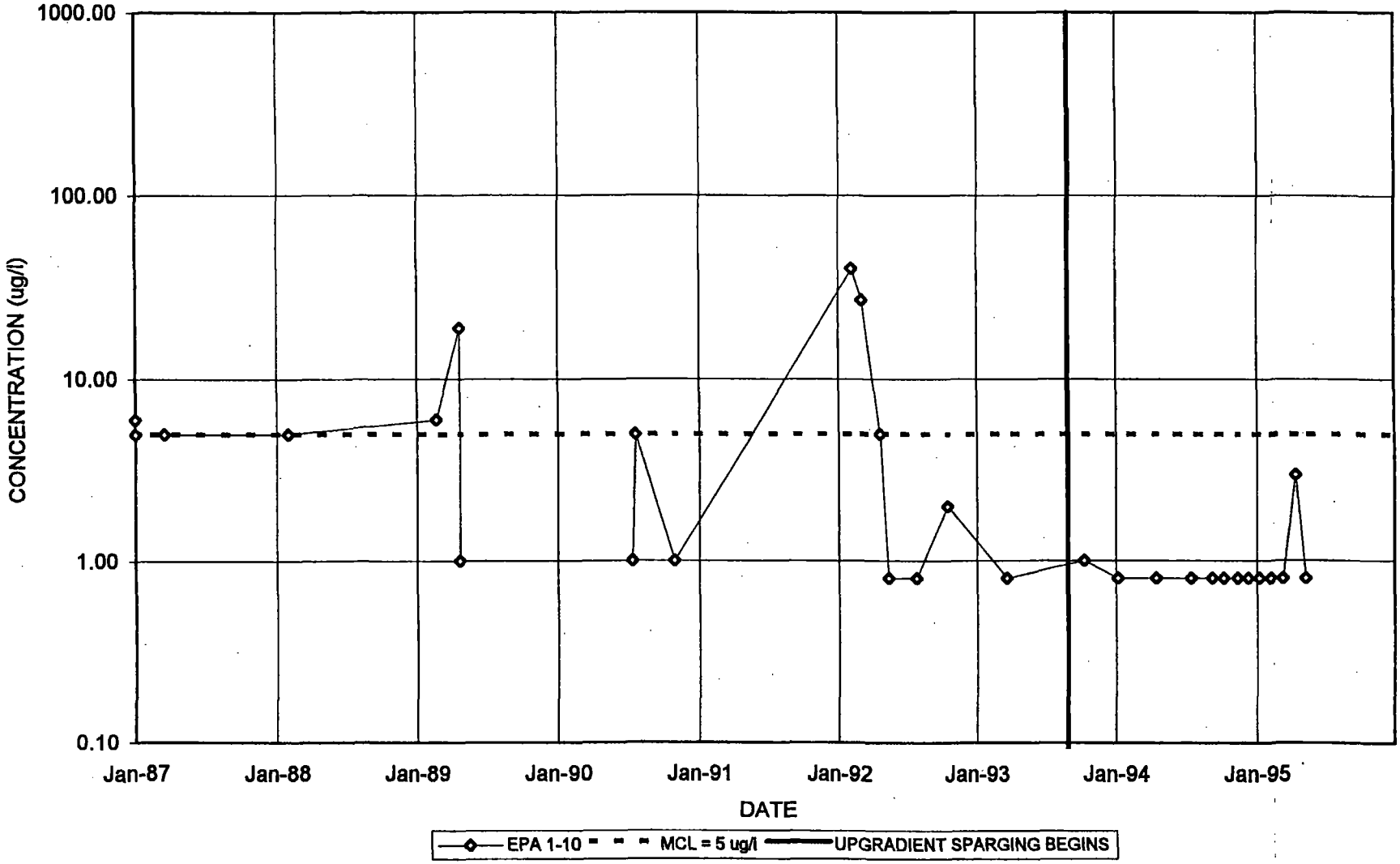


Figure 29b

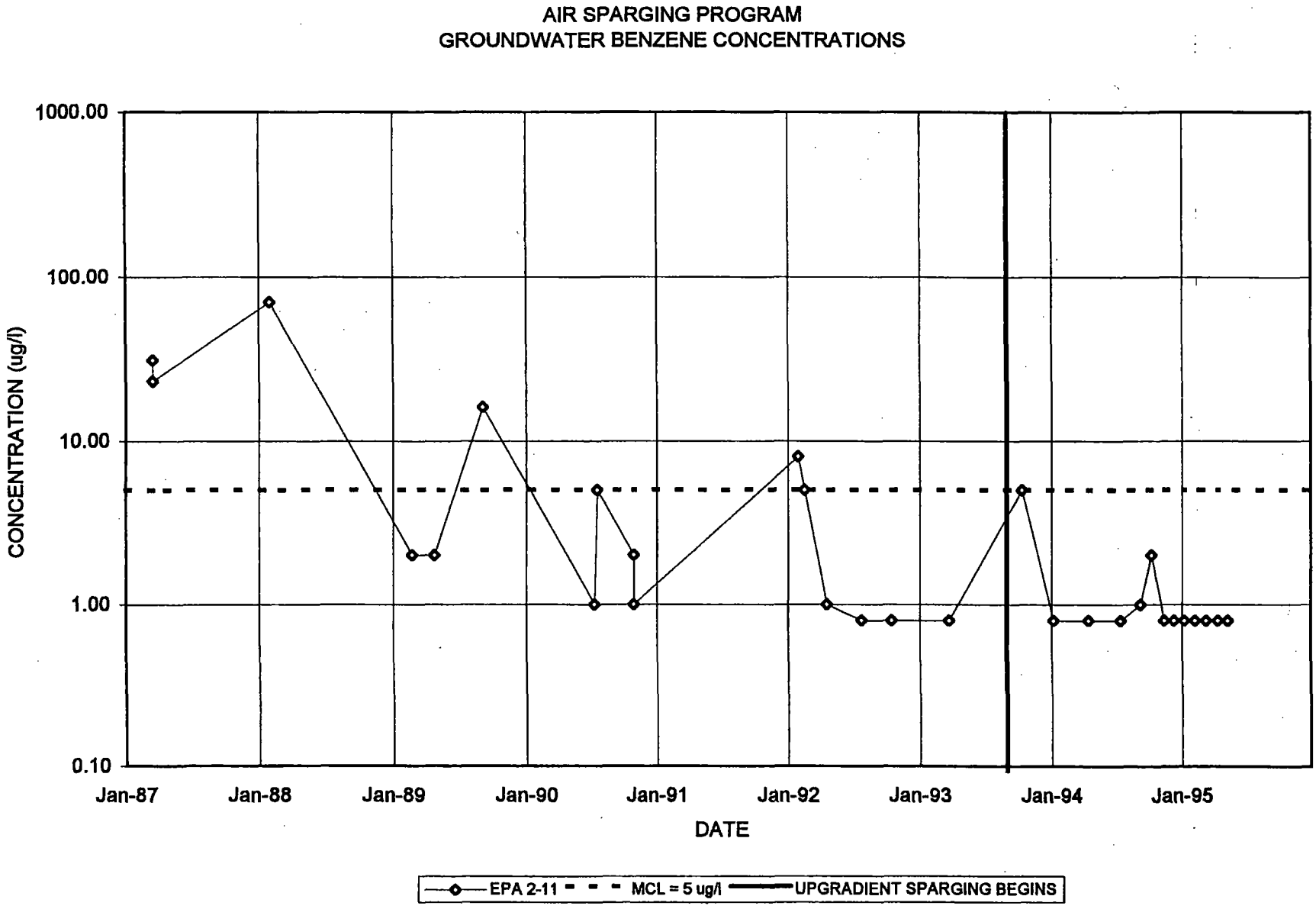

AIR SPARGING PROGRAM
GROUNDWATER BENZENE CONCENTRATIONS
1000.00
100.00
10.00
1.00
0.10
CONCENTRATION (ug/l)
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
DATE
EPA 2-11
MCL = 5 ug/l
UPGRADIENT SPARGING BEGINS

Figure 29c

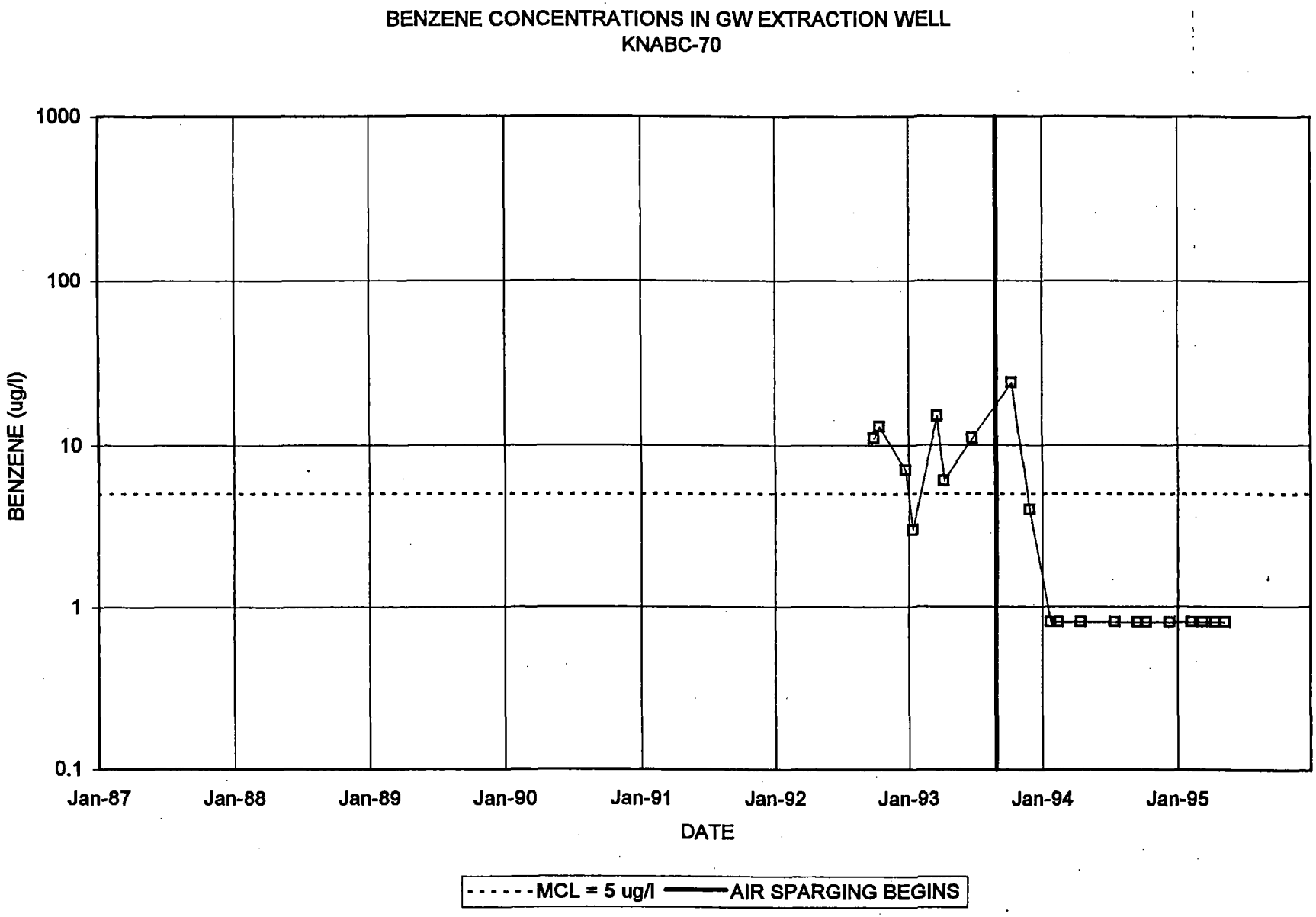

BENZENE CONCENTRATIONS IN GW EXTRACTION WELL
KNABC-70
1000
100
10
1
0.1
BENZENE (ug/l)
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
DATE
MCL = 5 ug/l
AIR SPARGING BEGINS

Figure 30a

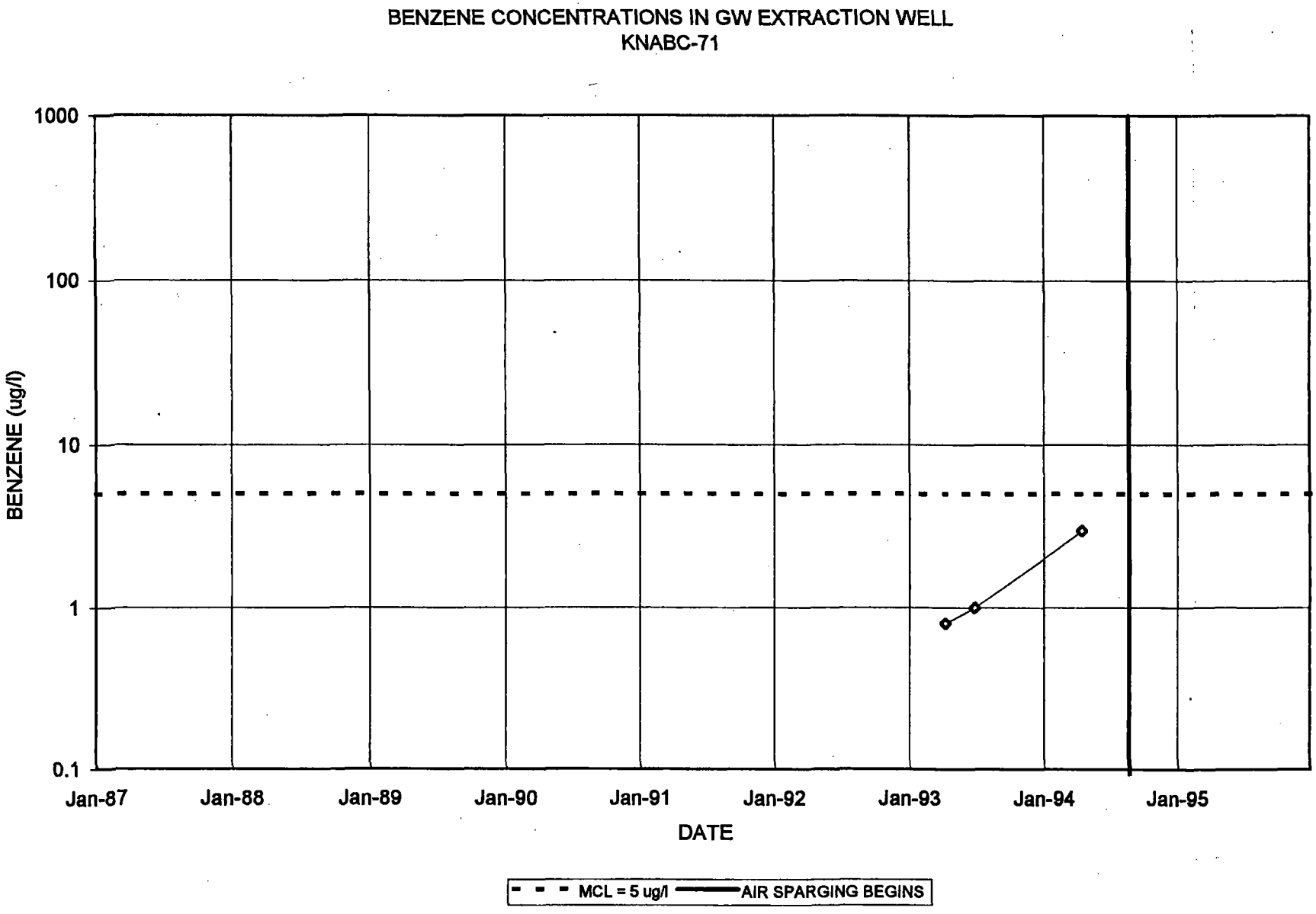

BENZENE CONCENTRATIONS IN GW EXTRACTION WELL
KNABC-71
1000
100
10
1
0.1
BENZENE (ug/l)
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
DATE
MCL = 5 ug/l
AIR SPARGING BEGINS

Figure 30b

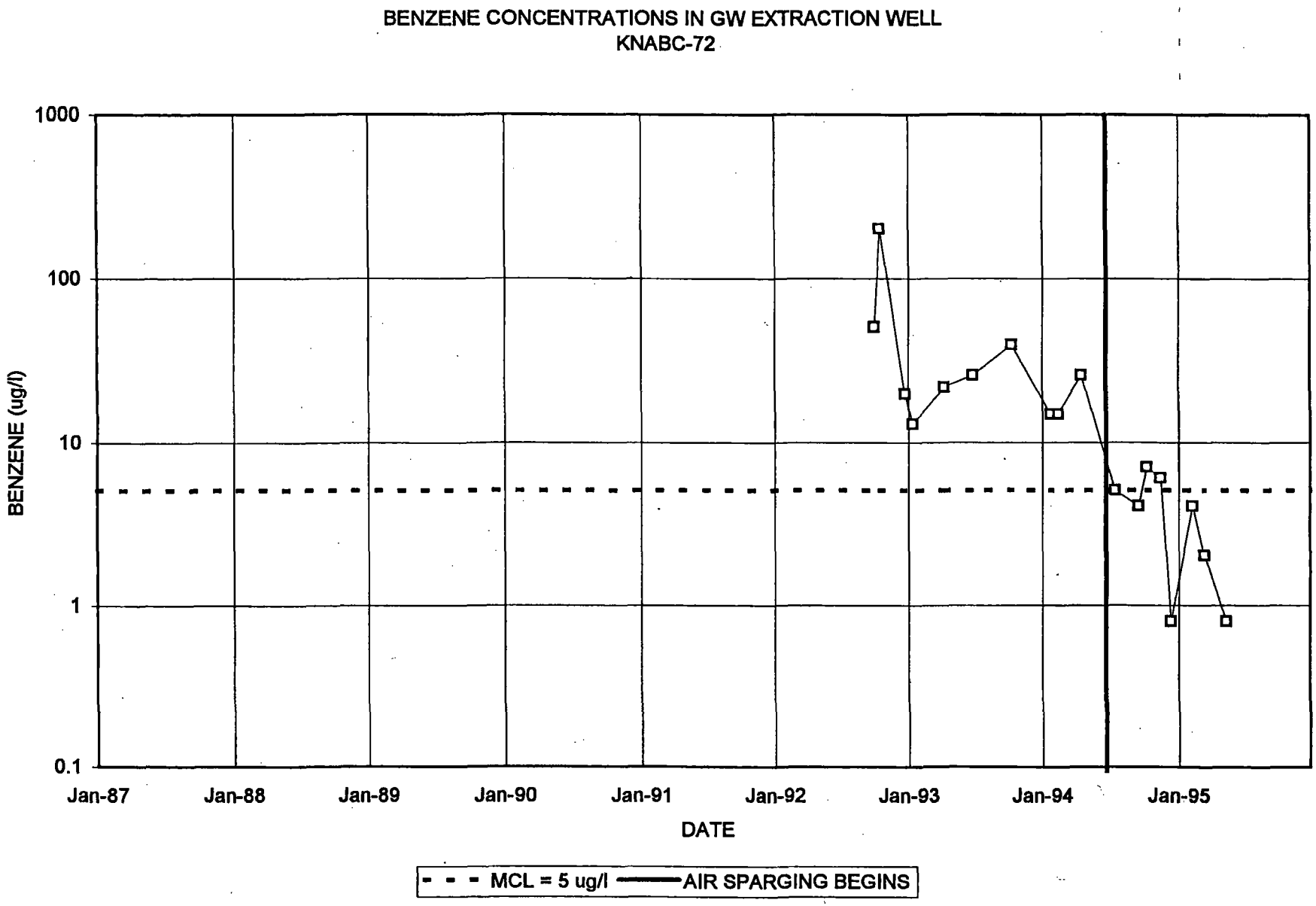

BENZENE CONCENTRATIONS IN GW EXTRACTION WELL
KNABC-72
1000
100
10
1
0.1
BENZENE (ug/l)
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
DATE
MCL = 5 ug/l
AIR SPARGING BEGINS

Figure 30c

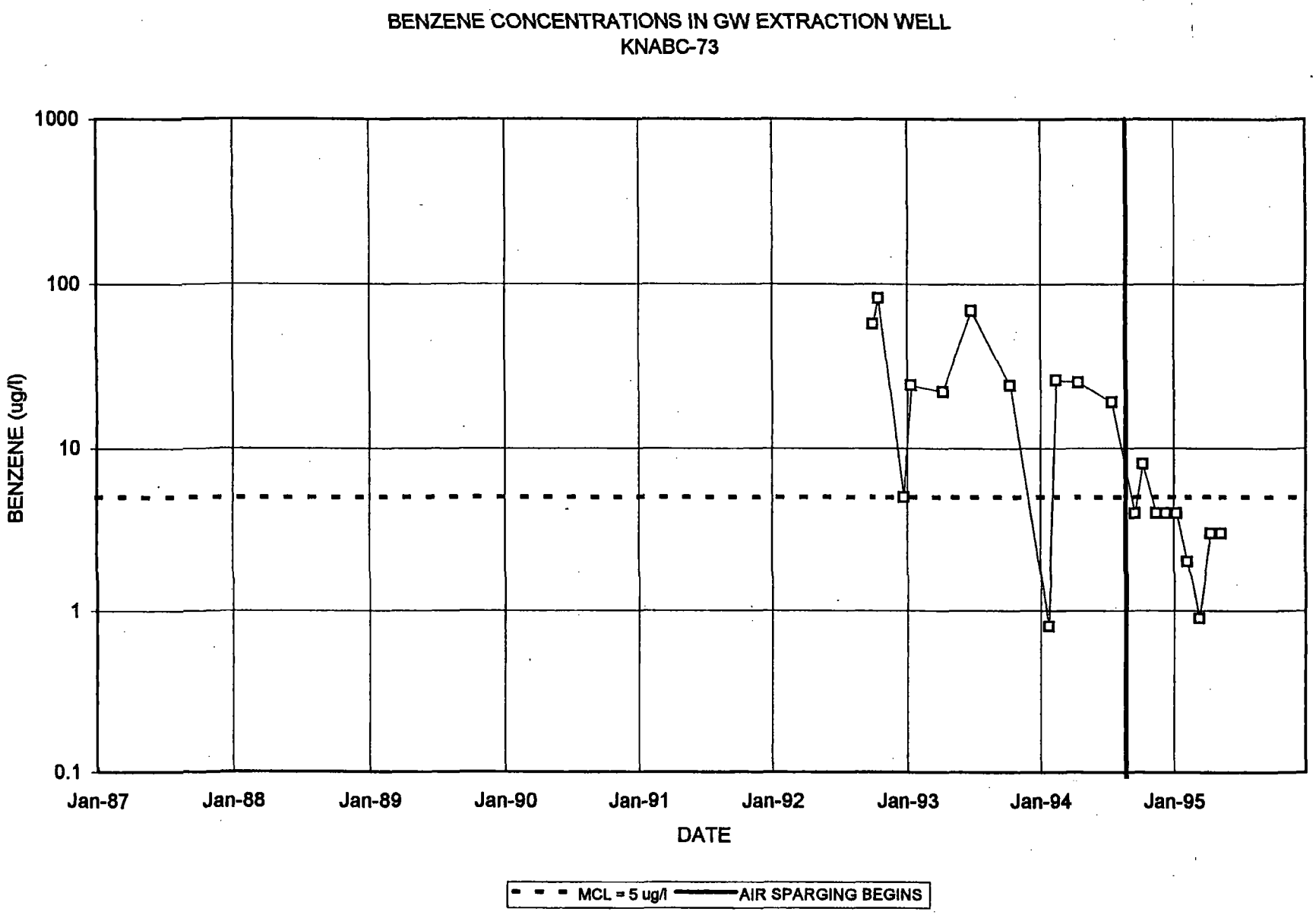

BENZENE CONCENTRATIONS IN GW EXTRACTION WELL
KNABC-73
1000
100
10
1
0.1
BENZENE (ug/l)
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
DATE
MCL = 5 ug/l
AIR SPARGING BEGINS

Figure 30d

BENZENE CONCENTRATIONS IN GW EXTRACTION WELLS
COMPOSITE

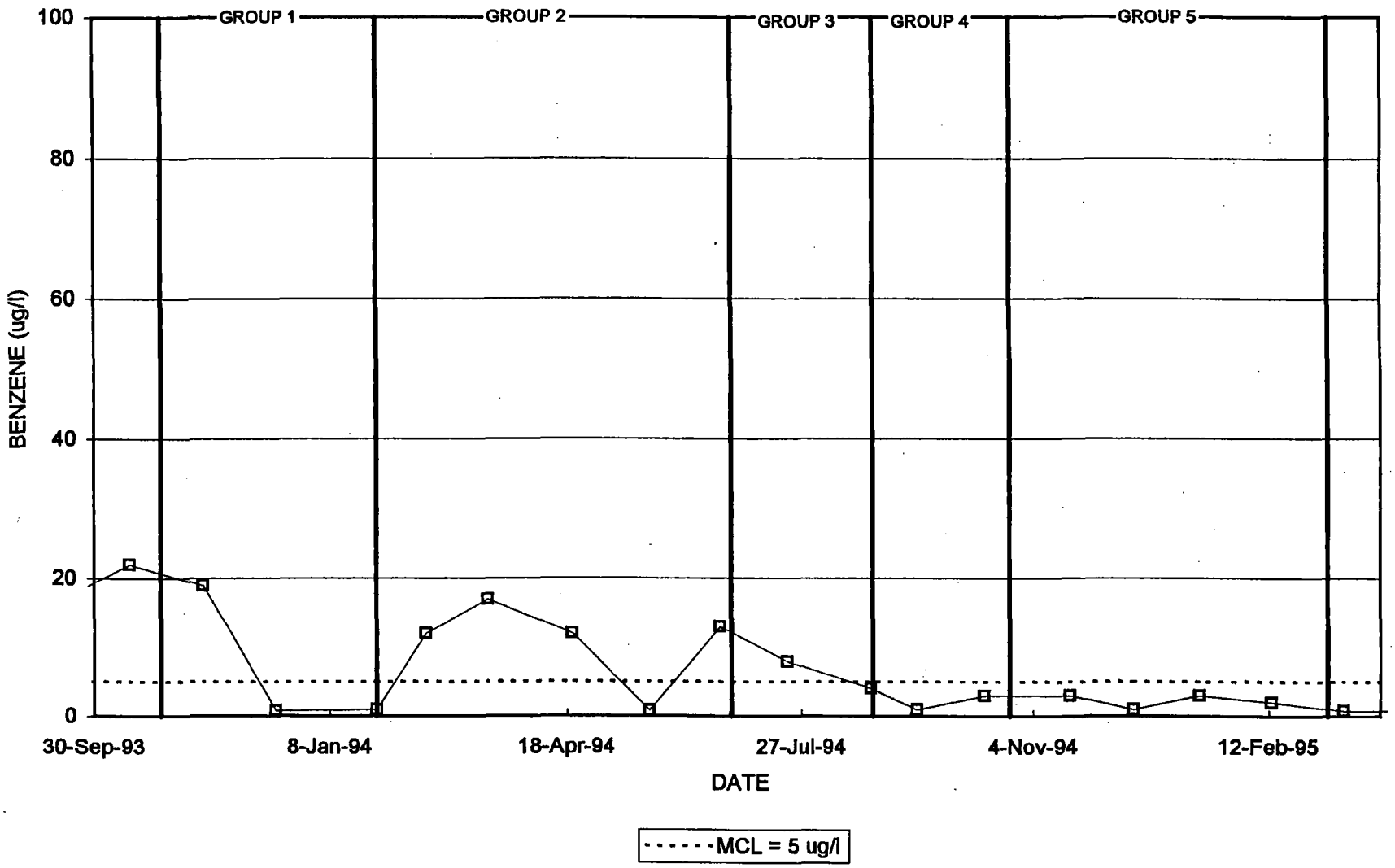


Figure 31

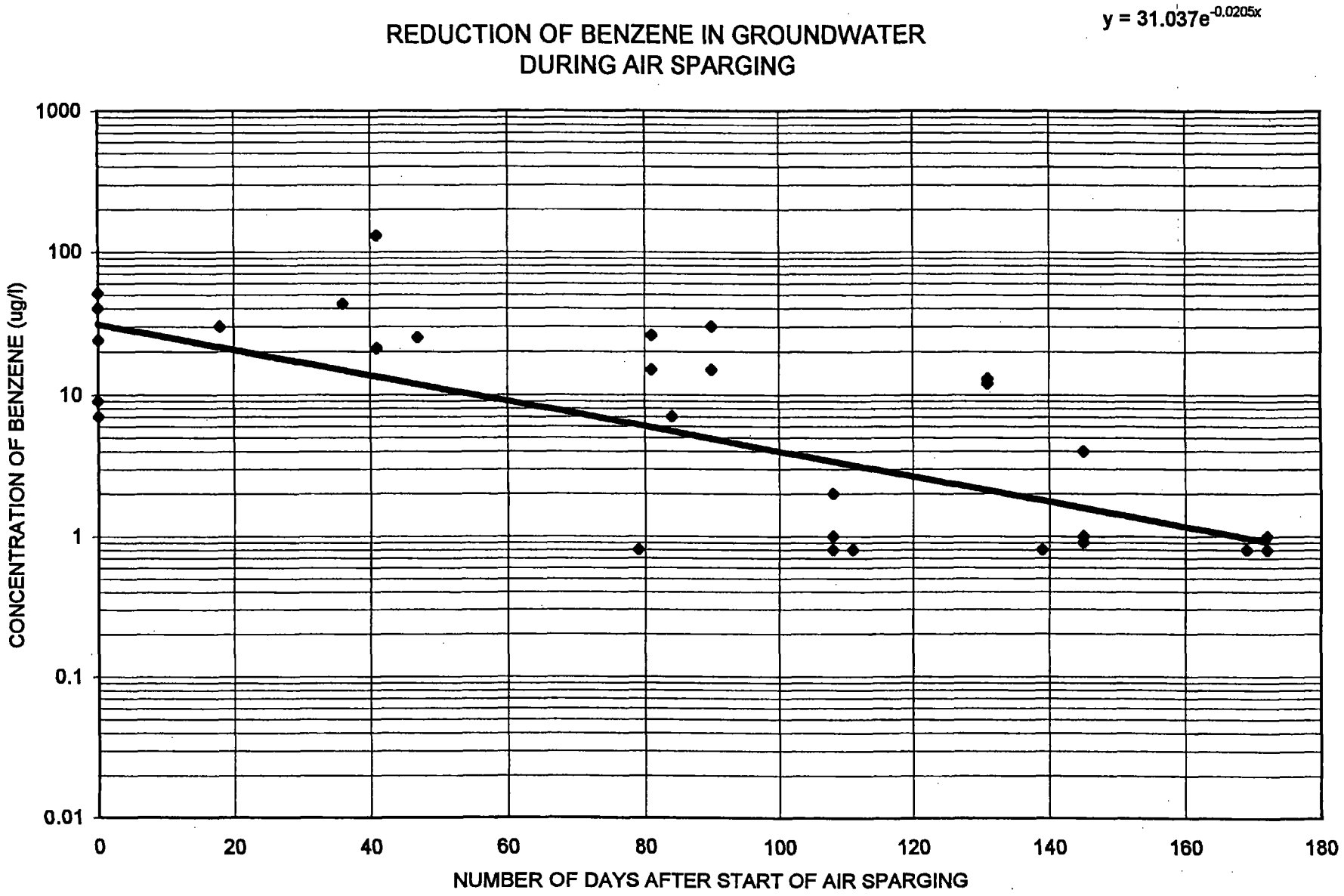

REDUCTION OF BENZENE IN GROUNDWATER
DURING AIR SPARGING
y = 31.037e^-0.0205x
CONCENTRATION OF BENZENE (ug/l)
1000
100
10
1
0.1
0.01
0
20
40
60
80
100
120
140
160
180
NUMBER OF DAYS AFTER START OF AIR SPARGING

Figure 32

BENZENE RATE OF REMOVAL FROM GROUNDWATER
DURING AIR SPARGING PROGRAM

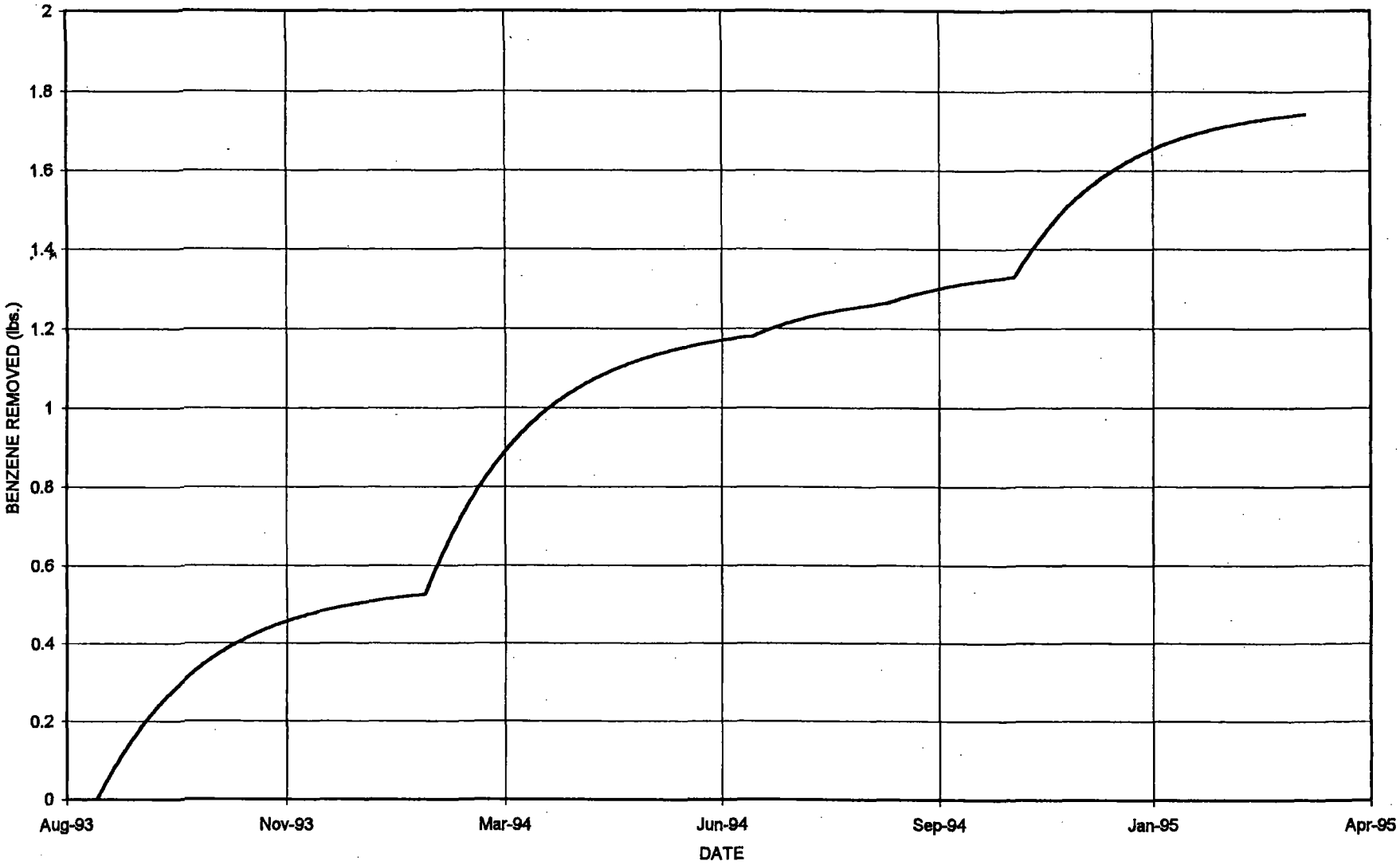
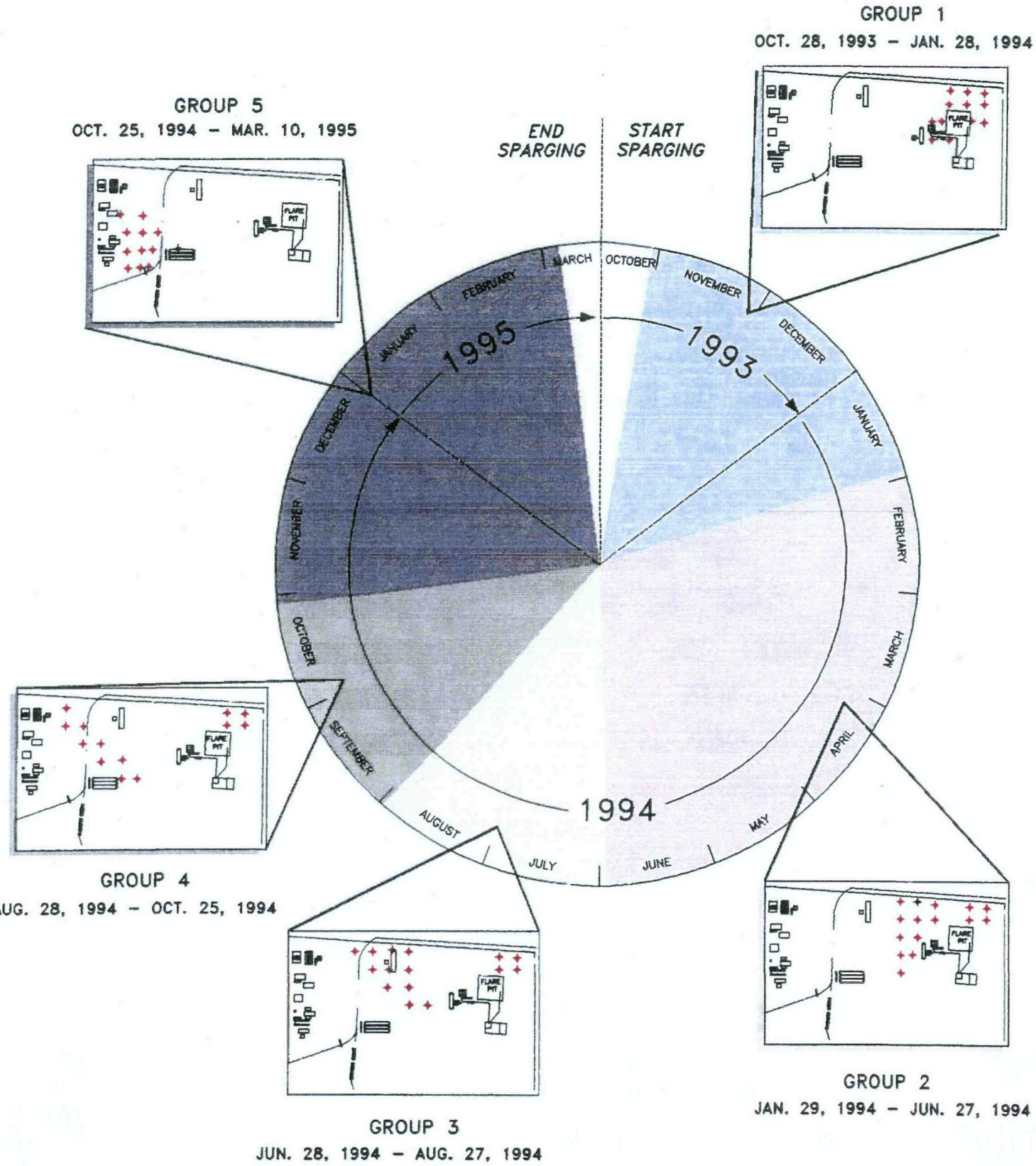


Figure 33

PLATES



ADRIAN BROWN CONSULTANTS, INC.

AIR SPARGING WELL
Not to scale

D:\P\1125J\SPGTK05.DWG 6/21/95

AIR SPARGING OPERATIONAL TIME SCHEMATIC

Plate 1

PHOTOGRAPHS

Photo 1: ABC-SB-01 Split spoon soil sample

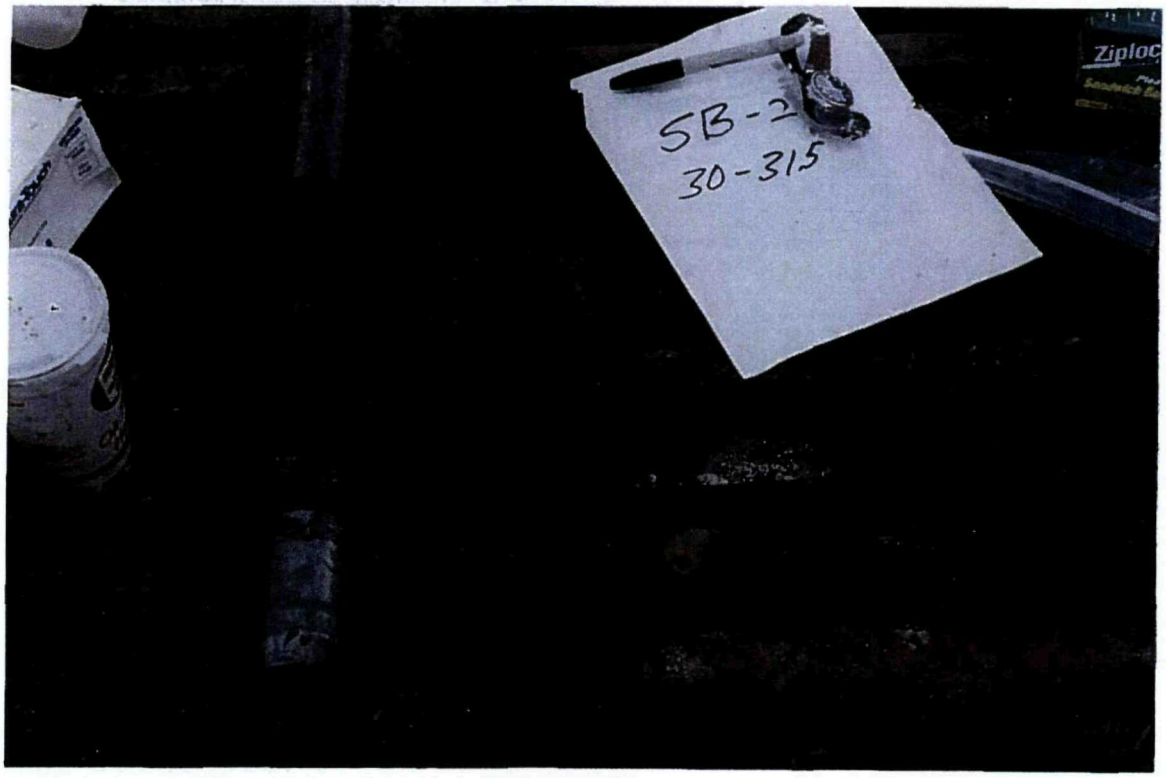


Photo 2: ABC-SB-02 Split spoon soil sample

Photo 3: ABC-SB-03 Split spoon soil sample

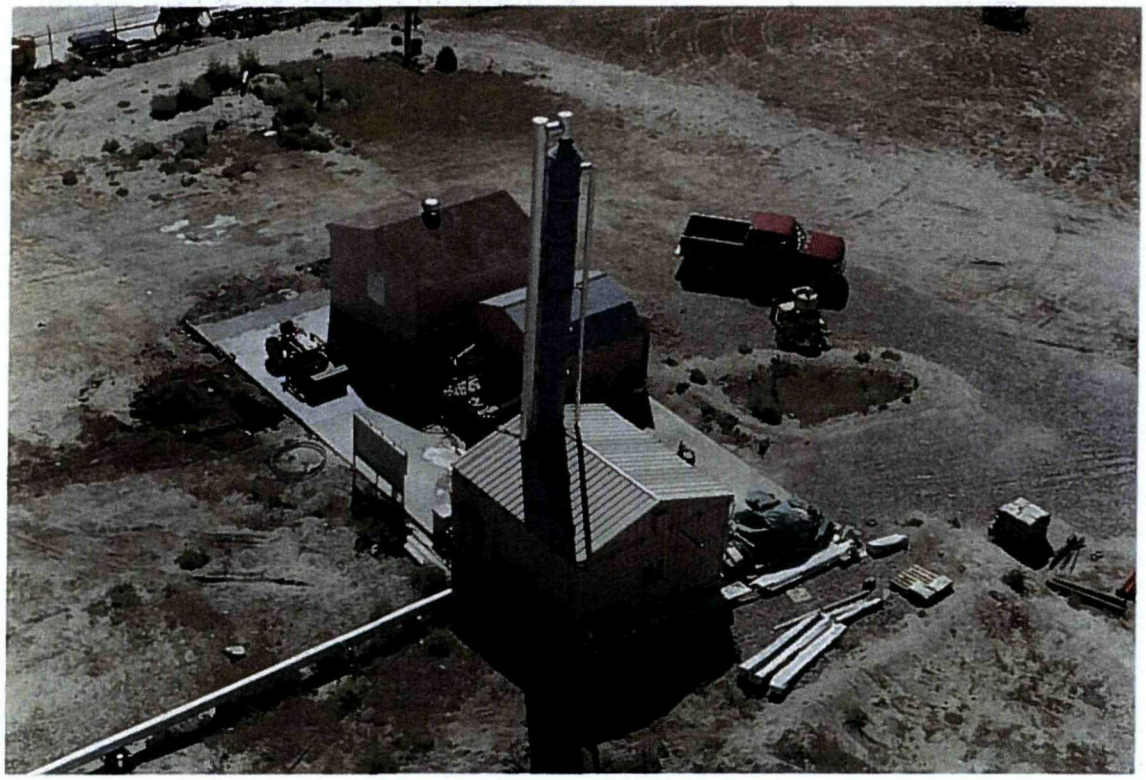


Photo 4: Overhead view of KN Remedial System

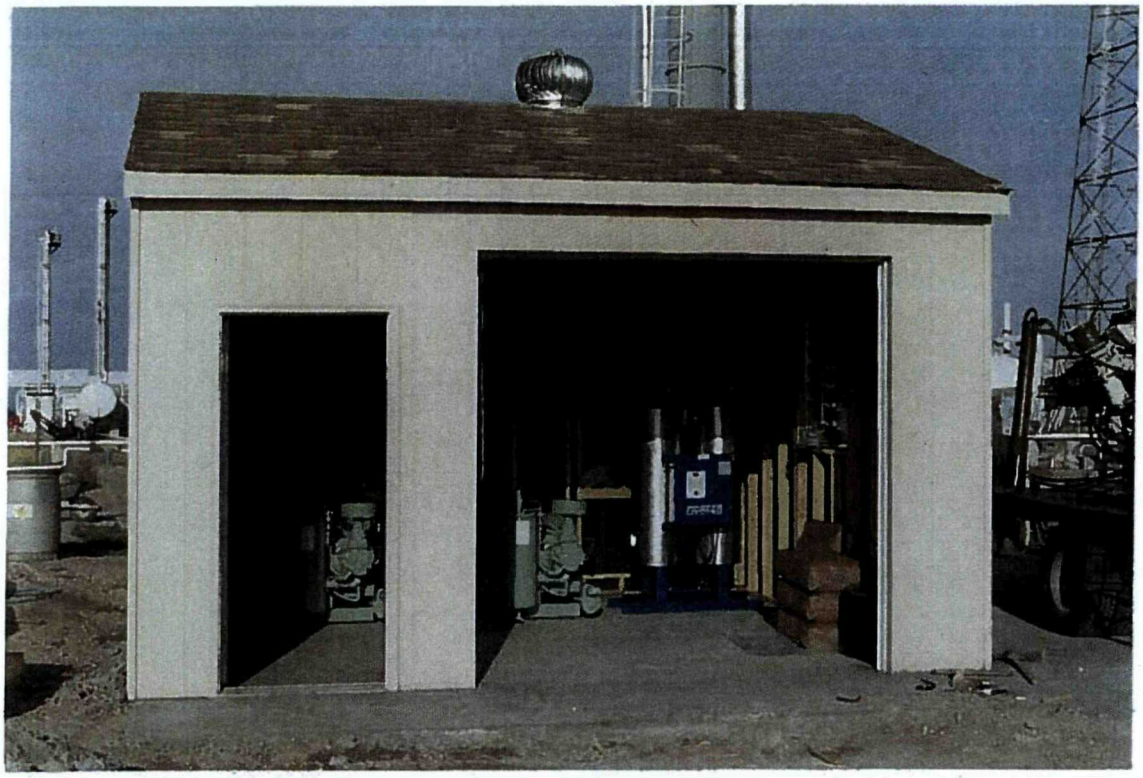


Photo 5: East side of air sparging operations building

Photo 6: 2 X 10 - 25 Sullair Air compressors and one Pioneer regenerative air dryer

Photo 7: Air sparge wells on 50' spacing

Photo 8: Air control system on SPG-5

Photo 9: Soil gas testing apparatus

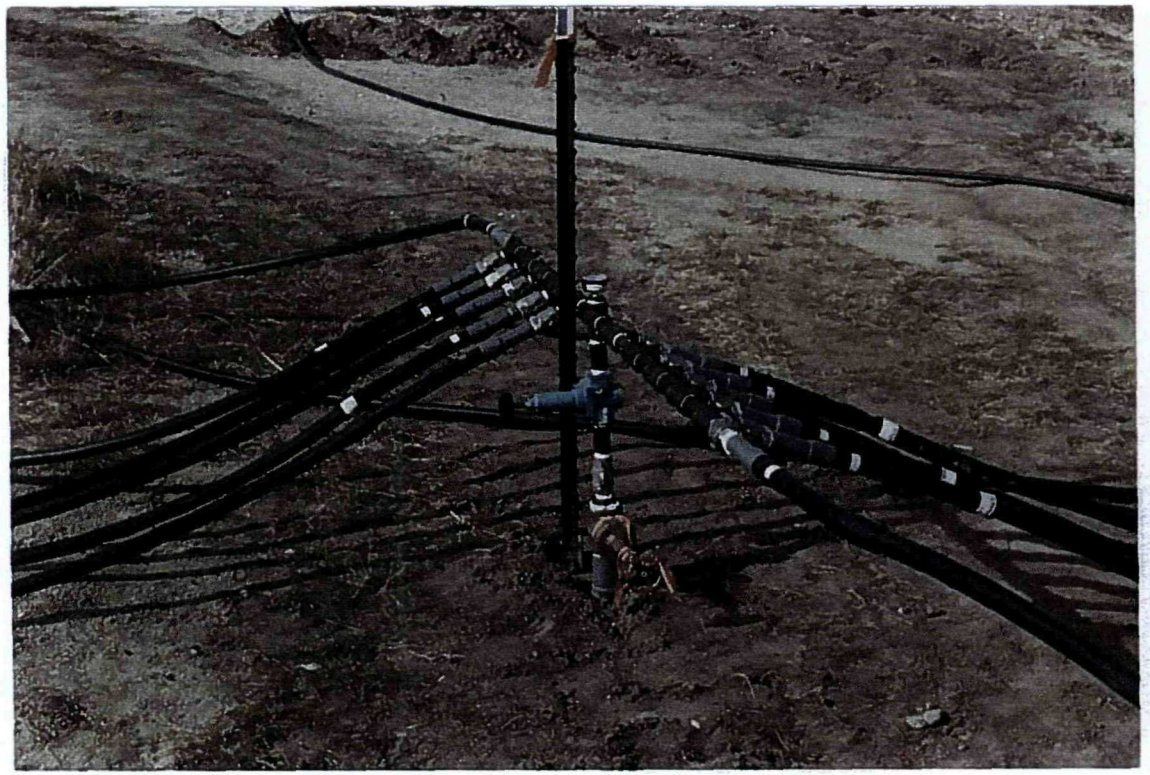


Photo 10: Air sparge delivery manifold ↑

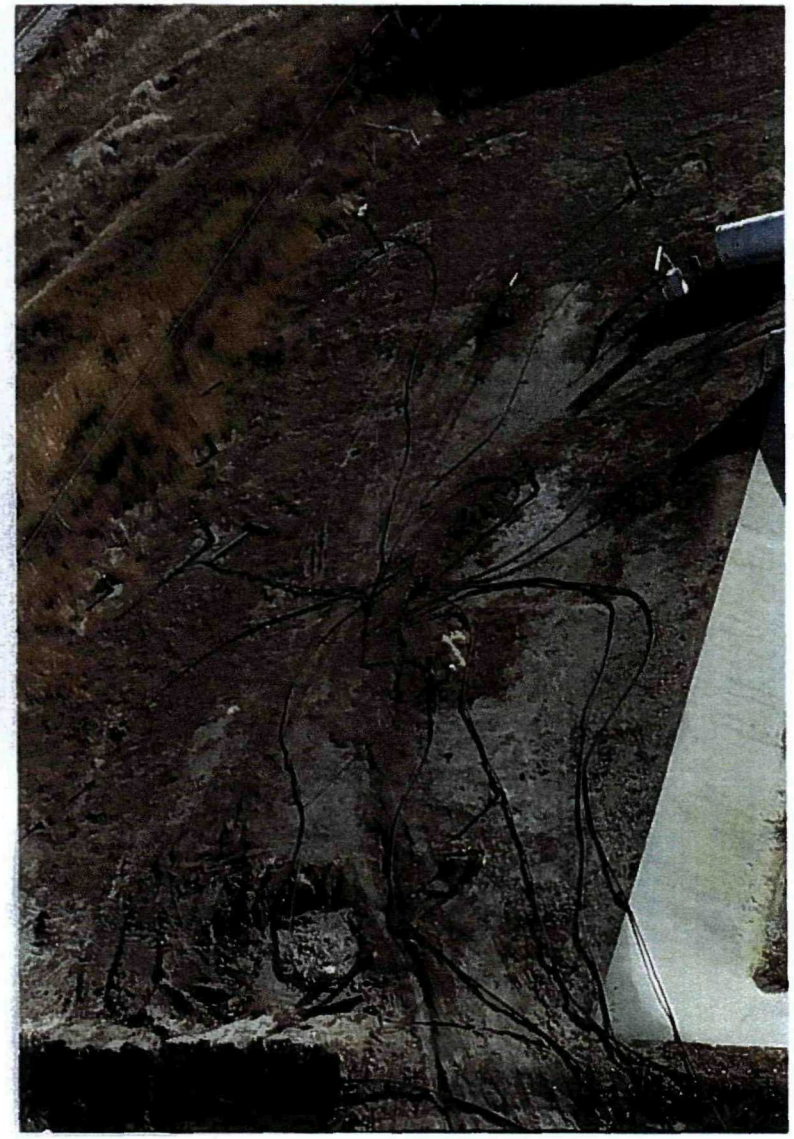


Photo 11: Overhead view of Air sparge delivery lines →

Photo 12: Air sparge well control section →

Photo 13: Soil gas sample collection apparatus ↓

APPENDICES

APPENDIX A

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2466

RECEIVED
JUN 1 2 1995
Stoel Rives Boley Jones & Grey

Ref: 8HWM-SR

JUN 5 1995

Jeffrey B. Groy, Esq.
Stoel, Rives, Boley, Jones & Grey
Suite 1100, One Utah Center
201 South Main Street
Salt Lake City, UT 84111-4904

Dear Mr. Groy:

This letter is to follow up on our discussion regarding the need to conduct a new ARARs assessment for the Brookhurst (Mystery Bridge Road) Superfund site. As we discussed, there appears to be no reason to require that your client reopen the ARARs assessment at this time.

Should you have further questions or issues related to the project, please contact me at (303) 293-1515.

Sincerely,

Daniel Thornton
Remedial Project Manager

Printed on Recycled Paper

APPENDIX B

APPENDIX B-1

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 07/15/93, 07/16/93, 07/17/93 & 07/19/93
DATE RECEIVED: 07/20/93
DATE ANALYZED: 07/23/93
REPORT DATE: 07/27/93
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by SIM (MOD.EPA 8260)
CLIENT PROJECT: 1125K
P.A.L. PROJECT: ABC 5448

ANALYTE CONCENTRATIONS DETECTED: ug/Kg (Soil)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
SB-1	< 10.00	< 9.75	810	5,500
SB-2	< 10.00	< 9.75	660	4,900
SB-3	< 10.00	< 9.75	2,000	11,000
SB-4	< 10.00	< 9.75	5,900	22,000
SB-5	< 10.00	< 9.75	1,400	5,300

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 07/19/93
DATE RECEIVED: 07/20/93
DATE ANALYZED: 07/22/93
REPORT DATE: 07/27/93
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX (EPA 8260)
CLIENT PROJECT: 1125K
P.A.L. PROJECT: ABC 5448

ANALYTE CONCENTRATIONS DETECTED: ug/Kg (Soil)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
FIELD BLANK	< 0.80	< 0.78	< 0.60	< 1.54

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 07/19/93
DATE RECEIVED: 07/20/93
DATE ANALYZED: 07/22/93
REPORT DATE: 07/27/93
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX (EPA 8260)
CLIENT PROJECT: 1125K
P.A.L. PROJECT: ABC 5448

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
RINSE	< 0.80	< 0.78	< 0.60	< 1.54

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	**Adrian Brown Consultants**
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	7095B
ANALYSIS:	**BTEX by EPA 8260**
DATE SAMPLED:	02/22/95
DATE RECEIVED:	02/27/95
DATE ANALYZED:	03/03/95
DATE REPORTED:	03/06/95
MATRIX:	Soil
CONC: UNITS:	**µg/Kg**

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
SB-02A 35-37	**< 8**	**< 8**	**280**	**260**
SB-01A 35-37	**< 8**	**< 8**	**570**	**2,900**

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____ 002

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	**Adrian Brown Consultants**
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	7095A
ANALYSIS:	**BTEX by EPA 8260**
DATE SAMPLED:	02/16/95 & 02/17/95
DATE RECEIVED:	02/18/95
DATE ANALYZED:	02/22/95
DATE REPORTED:	02/28/95
MATRIX:	Soil
CONC: UNITS:	**µg/Kg**

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
SB-5A	**< 8**	**< 8**	**280**	**430**
SB-4A	**< 8**	**< 8**	**1,700**	**3,000**
SB-3A	**< 8**	**< 8**	**93**	**400**

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

004

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

APPENDIX B-2

8/24/93

PHOENIX ANALYTICAL LABORATORIES INC.

09-Sep-93

Joe Pollara
Adrian Brown Consultants
155 S. Madison
Suite 302
Denver, CO 80209

P.A.L. Project: ABC 5591
Client Project: 1125K

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the tenax samples submitted on 08/26/93.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 08/24/93
DATE RECEIVED: 08/26/93
DATE ANALYZED: 09/08/93 & 09/09/93
REPORT DATE: 09/09/93
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX (Mod. EPA 8260)
CLIENT PROJECT: 1125K
P.A.L. PROJECT: ABC 5591

ANALYTE CONCENTRATIONS DETECTED: Total ug

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
SVE 67	< 0.004	0.076	0.016	0.063
SVE 66	0.010	0.047	0.011	0.087
SVE 81	< 0.004	0.097	< 0.003	0.026
SVE 80	0.167	0.110	0.029	0.098
SVE 65	0.010	0.038	0.005	0.026
SVE 64	0.078	0.037	0.005	0.029
SVE 63	0.006	0.047	0.005	0.034
FIELD BLANK	< 0.004	0.063	0.025	0.077
SVE 82	0.006	0.045	0.005	0.037
SVE 68	0.006	0.041	0.006	0.032
SVE 69	0.007	0.042	0.004	0.035

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

REFERENCES FOR QC CONVENTIONS ADOPTED BY PHOENIX ANALYTICAL LABORATORIES

DATE: 1/1/92

THESE CONVENTIONS ARE GENERALLY USED. THEY ARE REVIEWED AT LEAST ANNUALLY, AND MAY NOT REFLECT CONVENTIONS CHOSEN FOR SPECIFIC PROJECTS.

ANALYSIS	QC CRITERION	REFERENCE
GCMS VOA	SURROGATES	1
(INCL. BTEX)	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GCMS SVOA		
	SURROGATES	1
	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GC VOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	INSTRUMENT TUNES (BFB)	2
	QC SPIKES	
GC SVOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	QC SPIKES	2
METALS		
	QC SPIKES	2, AND SPECIFIED BY QC STANDARD
	BLANKS	2
	DUPLICATES	2
	MATRIX SPIKES	2

1. CLP STATEMENT OF WORK, 1990
2. SW-846 IN THE SPECIFIC METHOD
3. LABORATORY CRITERION, 3X STANDARD DEVIATION
4. STANDARD METHODS
5. OTHER - SPECIFIED IN REPORT

#29 D:\QPRO\QAQC\QCREPORT

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

2/9/94

PHOENIX ANALYTICAL LABORATORIES INC.

16-Feb-94

Joe Pollara
Adrian Brown Consultants
155 S. Madison
Suite 302
Denver, CO 80209

P.A.L. Project: ABC 6050B
Client Project: 1125K

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the tenax samples submitted on 02/09/94. Toluene was detected in all of the samples.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

DH

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 02/09/94
DATE RECEIVED: 02/11/94
DATE ANALYZED: 02/15/94
REPORT DATE: 02/16/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX (Mod.EPA 8260)
CLIENT PROJECT: 1125K
P.A.L. PROJECT: ABC 6050B

ANALYTE CONCENTRATIONS DETECTED: Total ug

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
SVE-63	< 0.004	0.018	< 0.003	< 0.008
SVG-1	< 0.004	0.027	< 0.003	< 0.008
SVE-64	< 0.004	0.014	< 0.003	< 0.008
FIELD BLANK	0.020	0.111	0.020	0.077

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1160

PHOENIX ANALYTICAL LABORATORIES, INC.
VOLATILE QC EVALUATION SUMMARY

METHOD:	8260
INSTRUMENT:	N
P.A.L. PROJECT:	ABC 6050B
CLIENT PROJECT:	1125K
MATRIX:	TENAX
REPORT DATE:	02/16/94
CRITERIA:	SW-846
# OF SAMPLES:	4

QC PARAMETER	% IN LIMITS	REMARKS
HOLDING TIMES:	100	
SAMPLE PRESERVATION:	N/A	
BFB:	100	
DAILY CAL. STD.	100	
BLANK LEVELS	100	
IS AREAS	100	
IS RET TIMES	100	
SS RECOVERIES	100	
MATRIX SPIKE, DUP		
RECOVERIES	N/A	
RPD	N/A	
QC SPIKE		
RECOVERIES	N/A	

LABORATORY INTERPRETATION OF DATA QUALITY PARAMETERS:
DATA ACCURACY AND PRECISION WITHIN EXPECTED LIMITS?
YES X NO____

PRESERVATION REFERS TO CLIENT PRESERVATION
PLEASE REFER TO CASE NARRATIVE AND INDIVIDUAL DATA SHEETS FOR ADDITIONAL COMMENTS.

COMMENTS:

REPORTED BY: _____ APPROVED BY: _____

PHOENIX ANALYTICAL LABORATORIES INC.

REFERENCES FOR QC CONVENTIONS ADOPTED BY PHOENIX ANALYTICAL LABORATORIES

DATE: 1/1/92

THESE CONVENTIONS ARE GENERALLY USED. THEY ARE REVIEWED AT LEAST ANNUALLY, AND MAY NOT REFLECT CONVENTIONS CHOSEN FOR SPECIFIC PROJECTS.

ANALYSIS	QC CRITERION	REFERENCE
GCMS VOA	SUROGATES	1
(INCL. BTEX)	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GCMS SVOA		
	SUROGATES	1
	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GC VOA		
	SUROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	INSTRUMENT TUNES (BFB)	2
	QC SPIKES	
GC SVOA		
	SUROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	QC SPIKES	2
METALS		
	QC SPIKES	2, AND SPECIFIED BY QC STANDARD
	BLANKS	2
	DUPLICATES	2
	MATRIX SPIKES	2

1. CLP STATEMENT OF WORK, 1990
2. SW-846 IN THE SPECIFIC METHOD
3. LABORATORY CRITERION, 3X STANDARD DEVIATION
4. STANDARD METHODS
5. OTHER - SPECIFIED IN REPORT

#20 D:\QPRO\QAQC\QCREPORT

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 03/16/94
DATE RECEIVED: 03/18/94
DATE ANALYZED: 04/06/94 & 04/07/94
REPORT DATE: 04/07/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by EPA 8260
CLIENT PROJECT: 1125K
P.A.L. PROJECT: ABC 6225

ANALYTE CONCENTRATIONS DETECTED: Total ug

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
TOTAL AIR	< 0.004	< 0.004	0.025	0.064
BLANK	< 0.004	0.040	0.023	0.055
SVE 66	< 0.004	0.039	0.019	0.046
SVE 63	< 0.004	0.062	0.015	0.037
SVE 29	< 0.004	0.023	0.011	0.025
SVE 65	0.009	0.037	0.023	0.111
SVE 81	0.012	0.043	0.009	0.039
SVE 80	0.011	0.035	0.011	0.047

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 04/21/94
DATE RECEIVED: 04/22/94
DATE ANALYZED: 05/04/94
REPORT DATE: 05/05/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by EPA 8260
CLIENT PROJECT: 1125
P.A.L. PROJECT: ABC 6321

ANALYTE CONCENTRATIONS DETECTED: Total ug

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
SVE-65	< 0.004	0.015	< 0.003	0.011
FIELD BLANK	0.004	0.057	< 0.003	< 0.008
SVE-63	< 0.004	0.020	< 0.003	< 0.008
SVE-80	< 0.004	0.055	< 0.003	< 0.008
SVE-81	< 0.004	0.049	< 0.003	< 0.008
SVE-66	< 0.004	0.012	< 0.003	< 0.008
SVE-64	< 0.004	0.011	< 0.003	< 0.008

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

8/5/94

PHOENIX ANALYTICAL LABORATORIES INC.

09-Aug-94

Joe Pollara
Adrian Brown Consultants
155 S. Madison
Suite 302
Denver, CO 80209

P.A.L. Project: 6595B
Client Project: 1125A

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the tenax samples submitted on 08/06/94. The results are reported in total ug.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

001

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 08/05/94
DATE RECEIVED: 08/06/94
DATE ANALYZED: 08/09/94
REPORT DATE: 08/09/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by EPA 8260
CLIENT PROJECT: 1125A
P.A.L. PROJECT: 6595B

ANALYTE CONCENTRATIONS DETECTED: Total ug

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
SVE-63	< 0.004	0.005	< 0.003	0.009
SVE-81	< 0.004	0.012	< 0.003	0.013
SVE-66	0.006	0.019	< 0.003	0.016
SVE-82	< 0.004	0.012	< 0.003	< 0.008
AIR BLANK	0.005	0.008	0.006	0.040

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: Heidi Hayes

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES, INC.
VOLATILE QC EVALUATION SUMMARY

METHOD:	8260
INSTRUMENT:	N
P.A.L. PROJECT:	6595B
CLIENT PROJECT:	~~112A~~ 1125A SH PAL 8-10-94
MATRIX:	TENAX
REPORT DATE:	08/09/94
CRITERIA:	SW-846
# OF SAMPLES:	5

QC PARAMETER	% IN LIMITS	REMARKS
HOLDING TIMES:	100	
SAMPLE PRESERVATION:	N/A	
BFB:	100	
DAILY CAL. STD.	91	--RRF %DEV FOR VINYL CHLORIDE OUT. ANALYTE NOT ON LIST & NOT DETECTED IN SAMPLE(S). NO IMPACT ON DATA.
BLANK LEVELS	100	
IS AREAS	100	
IS RET TIMES	100	
SS RECOVERIES	100	
MATRIX SPIKE, DUP		
RECOVERIES	N/A	
RPD	N/A	
QC SPIKE		
RECOVERIES	N/A	

LABORATORY INTERPRETATION OF DATA QUALITY PARAMETERS:
DATA ACCURACY AND PRECISION WITHIN EXPECTED LIMITS?
YES X NO____

PRESERVATION REFERS TO CLIENT PRESERVATION
PLEASE REFER TO CASE NARRATIVE AND INDIVIDUAL DATA SHEETS FOR ADDITIONAL COMMENTS.

COMMENTS:

REPORTED BY: [signature] APPROVED BY: Heidi Hayes

PHOENIX ANALYTICAL LABORATORIES INC.

REFERENCES FOR QC CONVENTIONS ADOPTED BY PHOENIX ANALYTICAL LABORATORIES

DATE: 1/1/92
THESE CONVENTIONS ARE GENERALLY USED. THEY ARE REVIEWED AT LEAST ANNUALLY, AND MAY NOT REFLECT CONVENTIONS CHOSEN FOR SPECIFIC PROJECTS.

ANALYSIS	QC CRITERION	REFERENCE
GCMS VOA	SURROGATES	1
(INCL. BTEX)	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GCMS SVOA		
	SURROGATES	1
	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GC VOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	INSTRUMENT TUNES (BFB)	2
	QC SPIKES	
GC SVOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	QC SPIKES	2
METALS		
	QC SPIKES	2, AND SPECIFIED BY QC STANDARD
	BLANKS	2
	DUPLICATES	2
	MATRIX SPIKES	2

1. CLP STATEMENT OF WORK, 1990
2. SW-846 IN THE SPECIFIC METHOD
3. LABORATORY CRITERION, 3X STANDARD DEVIATION
4. STANDARD METHODS
5. OTHER - SPECIFIED IN REPORT

#20 D:\QPRO\QAQC\QCREPORT

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

10/24/94

PHOENIX ANALYTICAL LABORATORIES INC.

09-Nov-94

Joe Pollara
Adrian Brown Consultants
155 S. Madison Street
Suite 302
Denver, CO 80209

P.A.L. Project: 6782B
Client Project: 1125A

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the tenax samples submitted on October 26, 1994. The results for the samples are reported in total µg.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

001

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	**Adrian Brown Consultants**
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	6782B
ANALYSIS:	**BTEX by EPA 8260**
DATE SAMPLED:	10/24/94
DATE RECEIVED:	10/26/94
DATE ANALYZED:	11/07/94
DATE REPORTED:	11/09/94
MATRIX:	Tenax
CONC: UNITS:	**Total μg**

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
SVE 63	< 0.004	0.009	0.005	0.027
SVE 67	< 0.004	0.015	< 0.004	0.017
SVE 60	< 0.004	0.014	< 0.004	0.014
SVE 68	< 0.004	0.008	< 0.004	< 0.004
BLANK AIR	0.007	0.021	< 0.004	< 0.004

** All "<" values are MDLs.

QUALITY CONRTOL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: Heidi Hayes

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES, INC.

VOLATILE QC EVALUATION SUMMARY

CLIENT:	**Adrian Brown Consultants**
METHOD:	**8260**
CRITERIA:	**SW-846**
INSTRUMENT:	N
P.A.L. PROJECT:	6782B
CLIENT PROJECT:	1125A
MATRIX:	TENAX
# OF SAMPLES:	5

QC PARAMETER:	% METHOD CRITERIA IN LIMITS	REMARKS
HOLDING TIME:	100	
SAMPLE PRESERVATION:	N/A	
BFB TUNE:	100	
DAILY CAL. STD.:	100	
BLANK LEVELS:	100	
IS AREAS	100	
IS RET. TIMES	100	
SS RECOVERIES	100	
MATRIX SPIKE, DUP.	N/A	
RECOVERIES	N/A	
RPD		
QC SPIKE		
RECOVERIES	N/A	

LABORATORY INTERPRETATION OF DATA QUALITY PARAMETERS:
DATA ACCURACY AND PRECISION WITHIND EXPECTED LIMITS?

YES X NO____

PRESERVATION REFERS TO CLIENT PRESERVATION

PLEASE REFER TO CASE NARRATIVE AND INDIVIDUAL DATA SHEETS FOR ADDITIONAL COMMENTS.

REPORTED BY: [signature] REVIEWED BY: Heidi Hayes

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	**Adrian Brown Consultants**
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	6690
ANALYSIS:	**BTEX by EPA 8260**
DATE SAMPLED:	12/17/94 & 12/18/94
DATE RECEIVED:	12/20/94
DATE ANALYZED:	12/29/94
DATE REPORTED:	12/29/94
MATRIX:	Water
CONC: UNITS:	**Total µg**

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
TOTAL AIR	< 0.004	0.008	< 0.004	< 0.004
BLANK AIR	< 0.004	0.008	< 0.004	< 0.004
SVE 28	< 0.004	0.025	0.015	0.091
SVE 48	< 0.004	0.008	0.012	0.082
SVE 69	< 0.004	0.007	0.005	0.042

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

004

1-23-95

PHOENIX ANALYTICAL LABORATORIES INC.

01-Feb-95

Joe Pollara
Adrian Brown Consultants
155 S. Madison Street
Suite 302
Denver, CO 80209

P.A.L. Project: 7040A
Client Project: 1125A

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the tenax samples submitted on January 25, 1994. Results are reported in total µg.

If you have any questions, please call.

Sincerely,

Lonnie Pallin
Laboratory Manager

FILE → 1125
→ JRP (2) ↳ 1st 3pp only

001

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	**Adrian Brown Consultants**
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	7040A
ANALYSIS:	**BTEX by EPA 8260**
DATE SAMPLED:	01/23/95
DATE RECEIVED:	01/25/95
DATE ANALYZED:	02/01/95
DATE REPORTED:	02/01/95
MATRIX:	Tenax
CONC: UNITS:	**Total μg**

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
SVE 28	**0.006**	**0.01**	**< 0.004**	**0.025**
SVE 48	**< 0.004**	**< 0.004**	**< 0.004**	**0.018**
BLANK	**< 0.004**	**0.01**	**< 0.004**	**< 0.004**
SVE 69	**< 0.004**	**0.007**	**< 0.004**	**0.029**

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

GCMS QC Evaluation Summary

Report Date:2/1/95

Client: Adrian Brown Consultants
Method: EPA 8260
Criteria: SW-846
Instrument: N
PAL Project #: 7040A
Client Project #: 1125A
Matrix: Tenax
Number of Samples: 4

QC Parameter	Method Criteria Acceptance	Comments/Actions
Holding Times	☒Pass ☐Fail	
Sample Preservation	☐Pass ☐Fail	NA
Sample Storage	☒Pass ☐Fail	
Tune Evaluation	☒Pass ☐Fail	
Initial Calibration	☒Pass ☐Fail	
Continuing Calibration	☒Pass ☐Fail	
Method Blanks	☒Pass ☐Fail	
QC Spike Sample	☐Pass ☐Fail	NA
MS/MSD	☐Pass ☐Fail	NA
IS Areas	☒Pass ☐Fail	
Surrogate Recoveries	☒Pass ☐Fail	
Retention Times	☒Pass ☐Fail	

Laboratory Interpretation:

Data meets guidelines established within the SOP for the Phoenix Data Reporting Level **3.**

Refer to the case narrative and individual data sheets for additional comments and actions.

Data Reviewed by: _____ Approved by: _____

003

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	**Adrian Brown Consultants**
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	7095A
ANALYSIS:	**BTEX by EPA 8260**
DATE SAMPLED:	02/13/95 & 02/17/95
DATE RECEIVED:	02/18/95
DATE ANALYZED:	02/27/95
DATE REPORTED:	02/28/95
MATRIX:	Tenax
CONC: UNITS:	**Total µg**

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
BLANK	< 0.004	0.012	< 0.004	< 0.004
TOTAL AIR	< 0.004	0.013	< 0.004	< 0.004
SVE 28	< 0.004	0.010	< 0.004	< 0.004
SVE 48	< 0.004	0.010	< 0.004	< 0.004
SVE 69	< 0.004	0.006	< 0.004	< 0.004

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

005

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

4-5-95

PHOENIX ANALYTICAL LABORATORIES INC.

13-Apr-95

Joe Pollara
Adrian Brown Consultants
155 S. Madison Street
Suite 230
Denver, CO 80209

P.A.L. Project: 7258
Client Project: 1125J

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the tenax samples submitted on April 06, 1995. Results are reported in total µg.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

RECEIVED APR 17 1995

001

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	**Adrian Brown Consultants**
CLIENT PROJECT:	1125J
P.A.L. PROJECT:	7258
ANALYSIS:	**BTEX by EPA 8260**
DATE SAMPLED:	04/05/95
DATE RECEIVED:	04/06/95
DATE ANALYZED:	04/11/95
DATE REPORTED:	04/13/95
MATRIX:	Tenax
CONC: UNITS:	**Total μg**

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
SVE-69	< 0.004	0.01	< 0.004	< 0.004
SVE-68	< 0.004	0.011	< 0.004	< 0.004
SVE-82	< 0.004	0.014	< 0.004	< 0.004
SVE-67	< 0.004	0.012	< 0.004	< 0.004
SVE-66	< 0.004	0.005	< 0.004	< 0.004
SVE-81	< 0.004	0.013	< 0.004	< 0.004
SVE-80	0.005	0.016	< 0.004	< 0.004
SVE-65	< 0.004	0.013	< 0.004	< 0.004
SVE-64	< 0.004	0.018	< 0.004	0.011
SVE-63	< 0.004	0.016	< 0.004	0.008
FIELD BLANK	< 0.004	0.018	< 0.004	< 0.004

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____ 002

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

GCMS QC Evaluation Summary

Report Date: 4/13/95

Client: Adrian Brown Consultants
Method: EPA 8260
Criteria: SW-846
Instrument: N
PAL Project #: 7258
Client Project #: 1125J
Matrix: Tenax
Number of Samples: 11, QC Spike

QC Parameter	Method Criteria Acceptance	Comments/Actions
Holding Times	☒Pass ☐Fail	
Sample Preservation	☐Pass ☐Fail	NA
Sample Storage	☒Pass ☐Fail	
Tune Evaluation	☒Pass ☐Fail	
Initial Calibration	☒Pass ☐Fail	
Continuing Calibration	☒Pass ☐Fail	
Method Blanks	☒Pass ☐Fail	
QC Spike Sample	☒Pass ☐Fail	
MS/MSD	☐Pass ☐Fail	NA
IS Areas	☒Pass ☐Fail	
Surrogate Recoveries	☒Pass ☐Fail	
Retention Times	☒Pass ☐Fail	

Laboratory Interpretation:

Data meets guidelines established within the SOP for the Phoenix Data Reporting Level **3.**

Refer to the case narrative and individual data sheets for additional comments and actions.

Data Reviewed by: _____ Approved by: _____

003

APPENDIX B-3

10/14/93

PHOENIX ANALYTICAL LABORATORIES INC.

27-Oct-93

Joe Pollara
Adrian Brown Consultants
155 S. Madison
Suite 302
Denver, CO 80209

P.A.L. Project: ABC 5777
Client Project: 1125A

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the samples submitted on 10/18/93.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 10/14/93
DATE RECEIVED: 10/18/93
DATE ANALYZED: 10/21/93 & 10/22/93
REPORT DATE: 10/27/93
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX (EPA 8260)
CLIENT PROJECT: 1125A
P.A.L. PROJECT: ABC 5777

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
ABC-2	< 0.80	< 0.78	< 0.60	< 1.54
ABC-12	2	< 0.78	6	5
ABC-27	38	< 0.78	25	6
ABC-17	4	< 0.78	8	6
ABC-91	6	< 0.78	9	3
KNMW-7	2	< 0.78	13	4
KNMW-5	< 0.80	< 0.78	< 0.60	< 1.54
KNGW-2	21	< 0.78	34	14
KNMW-6	130	< 0.78	50	32

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 10/15/93
DATE RECEIVED: 10/18/93
DATE ANALYZED: 10/22/93, 10/23/93 & 10/25/93
REPORT DATE: 10/27/93
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX (EPA 8260)
CLIENT PROJECT: 1125A
P.A.L. PROJECT: ABC 5777

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
EPA 2-11	5	< 0.78	< 0.60	5
EPA 1-9	< 0.80	< 0.78	< 0.60	< 1.54
EPA 1-10	1	< 0.78	18	2
ABC-72	40	< 0.78	56	85
ABC-70	24	< 0.78	25	55
ABC-98	22	< 0.78	23	55
ABC-73	24	< 0.78	46	43
ABC-99	26	< 0.78	14	43
COMPOSITE	22	< 0.78	32	50
INJECTION	< 0.80	< 0.78	< 0.60	< 1.54
FIELD BLANK	< 0.80	< 0.78	< 0.60	< 1.54

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: Robert N. Tukes

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 10/16/93
DATE RECEIVED: 10/18/93
DATE ANALYZED: 10/22/93
REPORT DATE: 10/27/93
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX (EPA 8260)
CLIENT PROJECT: 1125A
P.A.L. PROJECT: ABC 5777

ANALYTE CONCENTRATIONS DETECTED: Total ug

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
FIELD BLANK	0.021	0.163	0.193	2.700
TOTAL AIR	0.014	0.016	0.009	0.085

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

REFERENCES FOR QC CONVENTIONS ADOPTED BY PHOENIX ANALYTICAL LABORATORIES

DATE: 1/1/92

THESE CONVENTIONS ARE GENERALLY USED. THEY ARE REVIEWED AT LEAST ANNUALLY, AND MAY NOT REFLECT CONVENTIONS CHOSEN FOR SPECIFIC PROJECTS.

ANALYSIS	QC CRITERION	REFERENCE
GCMS VOA	SURROGATES	1
(INCL. BTEX)	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GCMS SVOA		
	SURROGATES	1
	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GC VOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	INSTRUMENT TUNES (BFB)	2
	QC SPIKES	
GC SVOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	QC SPIKES	2
METALS		
	QC SPIKES	2, AND SPECIFIED BY QC STANDARD
	BLANKS	2
	DUPLICATES	2
	MATRIX SPIKES	2

1. CLP STATEMENT OF WORK, 1990
2. SW-846 IN THE SPECIFIC METHOD
3. LABORATORY CRITERION, 3X STANDARD DEVIATION
4. STANDARD METHODS
5. OTHER - SPECIFIED IN REPORT

#20 D:\QPRO\QAQC\QCREPORT

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

12/2/93

PHOENIX ANALYTICAL LABORATORIES INC.

13-Dec-93

Joe Pollara
Adrian Brown Consultants
155 S. Madison
Suite 302
Denver, CO 80209

P.A.L. Project: ABC 5947
Client Project: 1125K

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the water samples submitted on 12/06/93.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 12/02/93
DATE RECEIVED: 12/06/93
DATE ANALYZED: 12/07/93 & 12/08/93
REPORT DATE: 12/13/93
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX (EPA 8260)
CLIENT PROJECT: 1125K
P.A.L. PROJECT: ABC 5947

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
ABC-25	< 0.80	< 0.78	< 0.60	< 1.54
GW-3	2	< 0.78	15	4
GW-2	15	< 0.78	28	13
MW-6	30	< 3.90	11	15
FIELD BLANK	< 0.80	< 0.78	< 0.60	< 1.54
ABC-70	4	< 0.78	9	31

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

REFERENCES FOR QC CONVENTIONS ADOPTED BY PHOENIX ANALYTICAL LABORATORIES

DATE: 1/1/92

THESE CONVENTIONS ARE GENERALLY USED. THEY ARE REVIEWED AT LEAST ANNUALLY, AND MAY NOT REFLECT CONVENTIONS CHOSEN FOR SPECIFIC PROJECTS.

ANALYSIS	QC CRITERION	REFERENCE
GCMS VOA	SURROGATES	1
(INCL. BTEX)	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GCMS SVOA		
	SURROGATES	1
	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GC VOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	INSTRUMENT TUNES (BFB)	2
	QC SPIKES	
GC SVOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	QC SPIKES	2
METALS		
	QC SPIKES	2, AND SPECIFIED BY QC STANDARD
	BLANKS	2
	DUPLICATES	2
	MATRIX SPIKES	2

1. CLP STATEMENT OF WORK, 1990
2. SW-846 IN THE SPECIFIC METHOD
3. LABORATORY CRITERION, 3X STANDARD DEVIATION
4. STANDARD METHODS
5. OTHER - SPECIFIED IN REPORT

#20 D:\QPRO\QAQC\QCREPORT

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

1/12-13/94

PHOENIX ANALYTICAL LABORATORIES INC.

24-Jan-94

Joe Pollara
Adrian Brown Consultants
155 S. Madison
Suite 302
Denver, CO 80209

P.A.L. Project: ABC 6050
Client Project: KN ENERGY

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the water samples submitted on 01/14/94. Please note that the value for total xylenes in sample KNMW-7 is different from the value which was originally faxed to you on 01/21/94. The original value was listed as 1 ug/l. This has been changed to < 1.54 ug/l. The value originally reported was for m,p-xylene only, not total xylenes.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 01/12/94 & 01/13/94
DATE RECEIVED: 01/14/94
DATE ANALYZED: 01/17/94, 01/18/94, 01/19/94
REPORT DATE: 01/24/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX (EPA 8260)
CLIENT PROJECT: KN ENERGY
P.A.L. PROJECT: ABC 6050

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
EPA 1-9	< 0.80	< 0.78	< 0.60	< 1.54
EPA 1-10	< 0.80	< 0.78	17	11
KNMW-7	< 0.80	< 0.78	3	< 1.54
EPA 2-11	< 0.80	< 0.78	4	4
KNMW-6	12	< 0.78	10	17
KNABC-5	6	< 0.78	2	< 1.54
KNABC-91	6	< 0.78	13	5
FB-2	< 0.80	< 0.78	< 0.60	< 1.54
KNABC-27	< 0.80	< 0.78	19	9
KNGW-2	13	< 0.78	34	16
KNABC-17	5	< 0.78	35	13
KNABC-2	< 0.80	< 0.78	< 0.60	< 1.54
FB-1	< 0.80	< 0.78	< 0.60	< 1.54
KNABC-12	14	< 0.78	23	9
KNMW-5	< 0.80	< 0.78	< 0.60	< 1.54

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES, INC.
VOLATILE QC EVALUATION SUMMARY

METHOD:	8260
INSTRUMENT:	N
P.A.L. PROJECT:	ABC 6050
CLIENT PROJECT:	KN ENERGY
MATRIX:	WATER
REPORT DATE:	01/24/94
CRITERIA:	SW-846
# OF SAMPLES:	15, MS, MSD, QC CHECK

QC PARAMETER	% IN LIMITS	REMARKS
HOLDING TIMES:	100	
SAMPLE PRESERVATION:	YES	
BFB:	100	
DAILY CAL. STD.	100	
BLANK LEVELS	100	
IS AREAS	100	
IS RET TIMES	100	
SS RECOVERIES	100	
MATRIX SPIKE, DUP		
RECOVERIES	100	
RPD	100	
QC SPIKE		
RECOVERIES	100	

LABORATORY INTERPRETATION OF DATA QUALITIY PARAMETERS:
DATA ACCURACY AND PRECISION WITHIN EXPECTED LIMITS?
YES X NO____

PRESERVATION REFERS TO CLIENT PRESERVATION
PLEASE REFER TO CASE NARRATIVE AND INDIVIDUAL DATA SHEETS FOR ADDITIONAL COMMENTS.

COMMENTS:

REPORTED BY: _____ APPROVED BY: _____

PHOENIX ANALYTICAL LABS
VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

PHOENIX ANALYTICAL LABORATORIES INC.

DATE SAMPLED: 01/13/94
DATE RECEIVED: 01/14/93
DATE ANALYZED: 01/17/94
DATE REPORTED: 01/24/94
CLIENT NAME: Adrian Brown Consultants
CLIENT PROJECT: KN ENERGY
P.A.L. PROJECT: ABC 6050

CLIENT SAMPLE: EPA 1-9
P.A.L. SAMPLE: ABC 54118

CONCENTRATION UNITS: ug/l

MATRIX SPIKE:

COMPOUND	SPIKE ADDED (ug/l)	SAMPLE CONC. (ug/l)	MS CONC. (ug/l)	MS % REC.	QC LIMITS
Benzene	50	0	45	90	77-120
Toluene	50	0	45	90	78-126
Ethyl Benzene	50	0	44	88	75-123
o-Xylene	50	0	42	84	70-129

DUPLICATE:

COMPOUND	SPIKE ADDED (ug/l)	SAMPLE CONC. (ug/l)	MS CONC. (ug/l)	MS % REC.	% RPD	QC LIMITS RPD	QC LIMITS RECOVERY
Benzene	50	0	44	88	2	12	77-120
Toluene	50	0	44	88	2	8	78-126
Ethyl Benzene	50	0	43	86	2	10	75-123
o-Xylene	50	1	41	80	5	10	70-129

VALUES OUTSIDE OF QC LIMITS:

RECOVERY: 0
RPD: 0

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABS
VOLATILE QC SPIKE RECOVERY

PHOENIX ANALYTICAL LABORATORIES INC.

DATE SAMPLED:
DATE RECEIVED:
DATE ANALYZED: 01/17/94
DATE REPORTED: 01/24/94
CLIENT NAME: Adrian Brown Consultants
CLIENT PROJECT: KN ENERGY
P.A.L. PROJECT: ABC 6050

CLIENT SAMPLE: N/A
P.A.L. SAMPLE: QC SPIKE

CONCENTRATION UNITS: ug/l

MATRIX SPIKE:

COMPOUND	SPIKE ADDED (ug/l)	SAMPLE CONC. (ug/l)	MS CONC. (ug/l)	MS % REC.	QC LIMITS
Benzene	20	0	16.4	82	77-120
Toluene	20	0	16.0	80	78-126
Ethyl Benzene	20	0	16.4	82	75-123
o-Xylene	20	0	16.1	81	70-129

VALUES OUTSIDE OF QC LIMITS:

RECOVERY: 0
RPD: 0

PHOENIX ANALYTICAL LABORATORIES INC.

REFERENCES FOR QC CONVENTIONS ADOPTED BY PHOENIX ANALYTICAL LABORATORIES

DATE: 1/1/92

THESE CONVENTIONS ARE GENERALLY USED. THEY ARE REVIEWED AT LEAST ANNUALLY, AND MAY NOT REFLECT CONVENTIONS CHOSEN FOR SPECIFIC PROJECTS.

ANALYSIS	QC CRITERION	REFERENCE
GCMS VOA	SURROGATES	1
(INCL. BTEX)	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GCMS SVOA		
	SURROGATES	1
	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GC VOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	INSTRUMENT TUNES (BFB)	2
	QC SPIKES	
GC SVOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	QC SPIKES	2
METALS		
	QC SPIKES	2, AND SPECIFIED BY QC STANDARD
	BLANKS	2
	DUPLICATES	2
	MATRIX SPIKES	2

1. CLP STATEMENT OF WORK, 1990
2. SW-846 IN THE SPECIFIC METHOD
3. LABORATORY CRITERION, 3X STANDARD DEVIATION
4. STANDARD METHODS
5. OTHER - SPECIFIED IN REPORT

#20 D:\QPRO\QAQC\QCREPORT

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

1/28/94

FEB - 8

PHOENIX ANALYTICAL LABORATORIES INC.

07-Feb-94

Joe Pollara
Adrian Brown Consultants
155 S. Madison
Suite 302
Denver, CO 80209

P.A.L. Project: ABC 6050A
Client Project: 1125A

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the water sample submitted on 02/01/94. All of the sample containers indicated that the samples were preserved with HCl; however, when the samples were analyzed and the pH was taken, all the values were pH=7. This indicates that the samples were not adequately preserved. This only affects one set of results (see below) because all samples were run within seven days.

Please note that the COMPOSITE sample exhibited very non-standard behavior. The sample was originally run on 02/03/94, within the seven day hold time. The areas for surrogate standard two (SS2, toluene d8) and internal standard three (IS3, chlorobenzene d5) exhibited very low area responses. Because of this, SS2 and SS3 (bromofluorobenzene) had values which were skewed low and high, respectively. In addition, the values for analytes which were detected were most likely biased very high, especially toluene, ethylbenzene and total xylenes. The sample was rerun on 02/07/94, which is past the seven day hold time for non-preserved samples. The same matrix affect was again observed, but to a lesser degree. However, no analytes were detected in this run. Because of this phenomenon, all found values and MDLs have been "J" qualified to indicate that they are estimates. In addition, the "J" qualifiers for the analysis performed on 02/07/94 also indicate that the hold time was exceeded.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 01/28/94
DATE RECEIVED: 02/01/94
DATE ANALYZED: 02/03/94, 02/04/94 & 02/07/94
REPORT DATE: 02/07/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX (EPA 8260)
CLIENT PROJECT: 1125A
P.A.L. PROJECT: ABC 6050A

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
FIELD BLANK	< 0.80	< 0.78	< 0.60	< 1.54
INJECTION	< 0.80	< 0.78	< 0.60	< 1.54
COMPOSITE	1 J	< 0.78 J	1 J	17 J
COMPOSITE (RERUN)	< 0.80 J	< 0.78 J	< 0.60 J	< 1.54 J
ABC-70	< 0.80	< 0.78	< 0.60	< 1.54
ABC-73	< 0.80	< 0.78	< 0.60	< 1.54
ABC-72	15	< 0.78	20	21

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED:	01/28/94
DATE RECEIVED:	02/01/94
DATE ANALYZED:	02/04/94
REPORT DATE:	02/07/94
CLIENT:	Adrian Brown Consultants
ANALYSIS:	BTEX (EPA 8260)
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	ABC 6050A

ANALYTE CONCENTRATIONS DETECTED: Total ug (Tenax)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
TOTAL AIR	0.004	0.011	< 0.003	< 0.008
BLANK	< 0.004	0.016	< 0.003	< 0.008

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES, INC.
VOLATILE QC EVALUATION SUMMARY

METHOD:	8260
INSTRUMENT:	N
P.A.L. PROJECT:	ABC 6050A
CLIENT PROJECT:	1125A
MATRIX:	WATER & TENAX
REPORT DATE:	02/07/94
CRITERIA:	SW-846
# OF SAMPLES:	8, MS, MSD, QC CHECK

QC PARAMETER	% IN LIMITS	REMARKS
HOLDING TIMES:	100	
SAMPLE PRESERVATION:	NONE	SEE LETTER
BFB:	100	
DAILY CAL. STD.	100	
BLANK LEVELS	100	
IS AREAS	94	SEE LETTER
IS RET TIMES	100	
SS RECOVERIES	78	SEE LETTER
MATRIX SPIKE, DUP		
RECOVERIES	100	
RPD	75	ACCEPTABLE
QC SPIKE		
RECOVERIES	100	

LABORATORY INTERPRETATION OF DATA QUALITY PARAMETERS:
DATA ACCURACY AND PRECISION WITHIN EXPECTED LIMITS?
YES ✓ NO____

PRESERVATION REFERS TO CLIENT PRESERVATION
PLEASE REFER TO CASE NARRATIVE AND INDIVIDUAL DATA SHEETS FOR ADDITIONAL COMMENTS.

COMMENTS:

REPORTED BY: _____ APPROVED BY: _____

PHOENIX ANALYTICAL LABS
VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

PHOENIX ANALYTICAL LABORATORIES INC.

DATE SAMPLED: 01/28/94
DATE RECEIVED: 02/01/94
DATE ANALYZED: 02/03/94
DATE REPORTED: 02/07/94
CLIENT NAME: Adrian Brown Consultants
CLIENT PROJECT: 1125A
P.A.L. PROJECT: ABC 6050A

CLIENT SAMPLE: INJECTION
P.A.L. SAMPLE: ABC 54646

CONCENTRATION UNITS: ug/l (Water)

MATRIX SPIKE:

COMPOUND	SPIKE ADDED (ug/l)	SAMPLE CONC. (ug/l)	MS CONC. (ug/l)	MS % REC.	QC LIMITS
Benzene	50	0	46	92	77-120
Toluene	50	0	52	104	78-126
Ethyl Benzene	50	0	43	86	75-123
o-Xylene	50	0	41	82	70-129

DUPLICATE:

COMPOUND	SPIKE ADDED (ug/l)	SAMPLE CONC. (ug/l)	MS CONC. (ug/l)	MS % REC.	% RPD	QC LIMITS RPD	QC LIMITS RECOVERY
Benzene	50	0	45	90	2	12	77-120
Toluene	50	0	44	88	17	8	78-126
Ethyl Benzene	50	0	39	78	10	10	75-123
o-Xylene	50	0	42	84	2	10	70-129

VALUES OUTSIDE OF QC LIMITS:

RECOVERY: 0
RPD: 1

PHOENIX ANALYTICAL LABS
VOLATILE QC SPIKE RECOVERY

PHOENIX ANALYTICAL LABORATORIES INC.

DATE SAMPLED:
DATE RECEIVED:
DATE ANALYZED: 02/03/94
DATE REPORTED: 02/07/94
CLIENT NAME: Adrian Brown Consultants
CLIENT PROJECT: 1125A
P.A.L. PROJECT: ABC 6050A

CLIENT SAMPLE: N/A
P.A.L. SAMPLE: QC SPIKE

CONCENTRATION UNITS: ug/l (Water)

MATRIX SPIKE:

COMPOUND	SPIKE ADDED (ug/l)	SAMPLE CONC. (ug/l)	MS CONC. (ug/l)	MS % REC.	QC LIMITS
Benzene	20	0	17.9	90	77-120
Toluene	20	0	16.4	82	78-126
Ethyl Benzene	20	0	15.6	78	75-123
o-Xylene	20	0	15.8	79	70-129

VALUES OUTSIDE OF QC LIMITS:

RECOVERY: 0

PHOENIX ANALYTICAL LABORATORIES INC.

REFERENCES FOR QC CONVENTIONS ADOPTED BY PHOENIX ANALYTICAL LABORATORIES

DATE: 1/1/92

THESE CONVENTIONS ARE GENERALLY USED. THEY ARE REVIEWED AT LEAST ANNUALLY, AND MAY NOT REFLECT CONVENTIONS CHOSEN FOR SPECIFIC PROJECTS.

ANALYSIS	QC CRITERION	REFERENCE
GCMS VOA	SURROGATES	1
(INCL. BTEX)	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GCMS SVOA		
	SURROGATES	1
	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GC VOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	INSTRUMENT TUNES (BFB)	2
	QC SPIKES	
GC SVOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	QC SPIKES	2
METALS		
	QC SPIKES	2, AND SPECIFIED BY QC STANDARD
	BLANKS	2
	DUPLICATES	2
	MATRIX SPIKES	2

1. CLP STATEMENT OF WORK, 1990
2. SW-846 IN THE SPECIFIC METHOD
3. LABORATORY CRITERION, 3X STANDARD DEVIATION
4. STANDARD METHODS
5. OTHER - SPECIFIED IN REPORT

#20 D:\QPRO\QAQC\QCREPORT

2/18/94

RECEIVED
MAR 1 1994
ADRIAN BROWN CONSULTANTS INC

PHOENIX ANALYTICAL LABORATORIES INC.

28-Feb-94

Joe Pollara
Adrian Brown Consultants
155 S. Madison
Suite 302
Denver, CO 80209

P.A.L. Project: ABC 6050C
Client Project: 1125

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the water and tenax samples submitted on 02/19/94. Please note that while the sample containers indicate they were preserved, several of the samples had inadequate preservation. They are samples INJECTION, pH=7; COMPOSITE, pH=7; and ABC-74, pH=5. Because the samples were run within seven days, the impact on the data is most likely minimal.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

002

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 02/18/94
DATE RECEIVED: 02/19/94
DATE ANALYZED: 02/22/94
REPORT DATE: 02/25/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX (EPA 8260)
CLIENT PROJECT: 1125
P.A.L. PROJECT: ABC 6050C

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
FIELD BLANK	< 0.80	< 0.78	< 0.60	< 1.54
INJECTION	< 0.80	< 0.78	< 0.60	< 1.54
COMPOSITE	12	< 0.78	11	13
ABC-70	< 0.80	< 0.78	1	3
ABC-72	15	< 0.78	43	110
ABC-74	26	< 0.78	32	68

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 02/18/94
DATE RECEIVED: 02/19/94
DATE ANALYZED: 02/25/94
REPORT DATE: 02/25/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEXH (EPA 8260)
CLIENT PROJECT: 1125
P.A.L. PROJECT: ABC 6050C

ANALYTE CONCENTRATIONS DETECTED: Total ug

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
FIELD BLANK	0.007	0.016	< 0.003	< 0.008
TOTAL AIR	0.012	0.013	0.012	0.025

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

REFERENCES FOR QC CONVENTIONS ADOPTED BY PHOENIX ANALYTICAL LABORATORIES

DATE: 1/1/92

THESE CONVENTIONS ARE GENERALLY USED. THEY ARE REVIEWED AT LEAST ANNUALLY, AND MAY NOT REFLECT CONVENTIONS CHOSEN FOR SPECIFIC PROJECTS.

ANALYSIS	QC CRITERION	REFERENCE
GCMS VOA (INCL. BTEX)	SURROGATES	1
	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GCMS SVOA		
	SURROGATES	1
	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GC VOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	INSTRUMENT TUNES (BFB)	2
	QC SPIKES	
GC SVOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	QC SPIKES	2
METALS		
	QC SPIKES	2, AND SPECIFIED BY QC STANDARD
	BLANKS	2
	DUPLICATES	2
	MATRIX SPIKES	2

1. CLP STATEMENT OF WORK, 1990
2. SW-846 IN THE SPECIFIC METHOD
3. LABORATORY CRITERION, 3X STANDARD DEVIATION
4. STANDARD METHODS
5. OTHER - SPECIFIED IN REPORT

#20 D:\QPRO\QAQC\QCREPORT

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

3-16-94

PHOENIX ANALYTICAL LABORATORIES INC.

14-Apr-94

Joe Pollara
Adrian Brown Consultants
155 S. Madison
Suite 302
Denver, CO 80209

P.A.L. Project: ABC 6225
Client Project: 1125K

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the water and tenax samples submitted on 03/18/94.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

001

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 03/16/94
DATE RECEIVED: 03/18/94
DATE ANALYZED: 03/30/94
REPORT DATE: 04/07/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by EPA 8260
CLIENT PROJECT: 1125K
P.A.L. PROJECT: ABC 6225

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
COMPOSITE	17	1	37	120
INJECTION	< 0.80	< 0.78	0.8	2
FIELD BLANK	< 0.80	< 0.78	< 0.60	< 1.54

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

REFERENCES FOR QC CONVENTIONS ADOPTED BY PHOENIX ANALYTICAL LABORATORIES

DATE: 1/1/92
THESE CONVENTIONS ARE GENERALLY USED. THEY ARE REVIEWED AT LEAST ANNUALLY, AND MAY NOT REFLECT CONVENTIONS CHOSEN FOR SPECIFIC PROJECTS.

ANALYSIS	QC CRITERION	REFERENCE
GCMS VOA	SURROGATES	1
(INCL. BTEX)	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GCMS SVOA		
	SURROGATES	1
	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GC VOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	INSTRUMENT TUNES (BFB)	2
	QC SPIKES	
GC SVOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	QC SPIKES	2
METALS		
	QC SPIKES	2, AND SPECIFIED BY QC STANDARD
	BLANKS	2
	DUPLICATES	2
	MATRIX SPIKES	2

1. CLP STATEMENT OF WORK, 1990
2. SW-846 IN THE SPECIFIC METHOD
3. LABORATORY CRITERION, 3X STANDARD DEVIATION
4. STANDARD METHODS
5. OTHER - SPECIFIED IN REPORT

#20 D:\QPRO\QAQC\QCREPORT

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES, INC.
VOLATILE QC EVALUATION SUMMARY

METHOD:	8260
INSTRUMENT:	N
P.A.L. PROJECT:	ABC 6225
CLIENT PROJECT:	1125K
MATRIX:	WATER & TENAX
REPORT DATE:	04/14/94
CRITERIA:	SW-846
# OF SAMPLES:	11

QC PARAMETER	% IN LIMITS	REMARKS
HOLDING TIMES:	100	
SAMPLE PRESERVATION:	YES (WATER)	
BFB:	100	
DAILY CAL. STD.	100	
BLANK LEVELS	100	
IS AREAS	100	
IS RET TIMES	100	
SS RECOVERIES	100	
MATRIX SPIKE, DUP		
RECOVERIES	N/A	
RPD	N/A	
QC SPIKE		
RECOVERIES	N/A	

LABORATORY INTERPRETATION OF DATA QUALITY PARAMETERS:
DATA ACCURACY AND PRECISION WITHIN EXPECTED LIMITS?
YES ✓ NO____

PRESERVATION REFERS TO CLIENT PRESERVATION
PLEASE REFER TO CASE NARRATIVE AND INDIVIDUAL DATA SHEETS FOR ADDITIONAL COMMENTS.

COMMENTS:

REPORTED BY: _____ APPROVED BY: _____

4/20/94

PHOENIX ANALYTICAL LABORATORIES INC.

05-May-94

Joe Pollara
Adrian Brown Consultants
155 S. Madison
Suite 302
Denver, CO 80209

P.A.L. Project: ABC 6321, A & ABC 6326
Client Project: 1125, 1125A

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the water and tenax samples submitted on 04/22/94 and 04/25/94. Please note that due to an operator error, the data for sample ABC-72 was unusable. The reanalysis is in progress, and the data will be reported to you by 05/10/94.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

001

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 04/20/94
DATE RECEIVED: 04/22/94
DATE ANALYZED: 04/27/94 & 04/28/94
REPORT DATE: 05/05/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by EPA 8260
CLIENT PROJECT: 1125
P.A.L. PROJECT: ABC 6321

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
INJECTION	< 0.80	< 0.78	< 0.60	< 1.54
COMPOSITE	12	< 0.78	34	86
ABC-2	< 0.80	< 0.78	< 0.60	< 1.54
ABC-5	< 0.80	< 0.78	3	4
ABC-12	< 0.80	< 0.78	< 0.60	< 1.54
ABC-17	9	< 0.78	73	63
ABC-27	2	2	110	160
ABC-90	< 0.80	< 0.78	35	35
ABC-91	< 0.80	< 0.78	1	< 1.54
KNGW-2	15	1	77	110
KNGW-3	< 0.80	< 0.78	21	7
FIELD BLANK	< 0.80	< 0.78	< 0.60	< 1.54

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____ for Rob Turkisher

002

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 04/21/94
DATE RECEIVED: 04/22/94
DATE ANALYZED: 04/28/94
REPORT DATE: 05/05/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by EPA 8260
CLIENT PROJECT: 1125
P.A.L. PROJECT: ABC 6321

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
KNMW-7	< 0.80	< 0.78	0.8	2
KNMW-6	26	1	63	120
ABC-70	< 0.80	< 0.78	5	16
KNMW-5	< 0.80	< 0.78	< 0.60	< 1.54
ABC-71	3	< 0.78	6	5
ABC-73	25	< 0.78	47	120
EPA 1-10	< 0.80	< 0.78	2	< 1.54
EPA 2-11	< 0.80	< 0.78	6	12

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____
for Rob Turkington

003

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 04/25/94
DATE RECEIVED: 04/25/94
DATE ANALYZED: 04/28/94
REPORT DATE: 05/05/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by EPA 8260
CLIENT PROJECT: 1125
P.A.L. PROJECT: ABC 6321A

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
EPA 1-9	< 0.80	< 0.78	1	< 1.54

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 04/21/94
DATE RECEIVED: 04/25/94
DATE ANALYZED: 05/04/94
REPORT DATE: 05/05/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by EPA 8260
CLIENT PROJECT: 1125A
P.A.L. PROJECT: ABC 6326

ANALYTE CONCENTRATIONS DETECTED: Total ug

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
TOTAL AIR	0.008	0.722	0.005	0.008

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES, INC.
VOLATILE QC EVALUATION SUMMARY

METHOD:	8260
INSTRUMENT:	N
P.A.L. PROJECT:	ABC 6321,A, ABC 6326
CLIENT PROJECT:	1125
MATRIX:	WATER & TENAX
REPORT DATE:	05/05/95
CRITERIA:	SW-846
# OF SAMPLES:	29

QC PARAMETER	% IN LIMITS	REMARKS
HOLDING TIMES:	100	
SAMPLE PRESERVATION:	YES	
BFB:	100	
DAILY CAL. STD.	91	BTEX ANALYTES UNAFFECTED.
BLANK LEVELS	100	
IS AREAS	100	
IS RET TIMES	100	
SS RECOVERIES	100	
MATRIX SPIKE, DUP		
RECOVERIES	N/A	
RPD	N/A	
QC SPIKE		
RECOVERIES	N/A	

LABORATORY INTERPRETATION OF DATA QUALITY PARAMETERS:
DATA ACCURACY AND PRECISION WITHIN EXPECTED LIMITS?
YES X NO____

PRESERVATION REFERS TO CLIENT PRESERVATION
PLEASE REFER TO CASE NARRATIVE AND INDIVIDUAL DATA SHEETS FOR ADDITIONAL COMMENTS.

COMMENTS:

REPORTED BY: _____ APPROVED BY: Robert N. Tucker

PHOENIX ANALYTICAL LABORATORIES INC.

REFERENCES FOR QC CONVENTIONS ADOPTED BY PHOENIX ANALYTICAL LABORATORIES

DATE: 1/1/92

THESE CONVENTIONS ARE GENERALLY USED. THEY ARE REVIEWED AT LEAST ANNUALLY, AND MAY NOT REFLECT CONVENTIONS CHOSEN FOR SPECIFIC PROJECTS.

ANALYSIS	QC CRITERION	REFERENCE
GCMS VOA	SURROGATES	1
(INCL. BTEX)	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GCMS SVOA		
	SURROGATES	1
	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GC VOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	INSTRUMENT TUNES (BFB)	2
	QC SPIKES	
GC SVOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	QC SPIKES	2
METALS		
	QC SPIKES	2, AND SPECIFIED BY QC STANDARD
	BLANKS	2
	DUPLICATES	2
	MATRIX SPIKES	2

1. CLP STATEMENT OF WORK, 1990
2. SW-846 IN THE SPECIFIC METHOD
3. LABORATORY CRITERION, 3X STANDARD DEVIATION
4. STANDARD METHODS
5. OTHER - SPECIFIED IN REPORT

#20 D:\QPRO\QAQC\QCREPORT

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

5-23-94

PHOENIX ANALYTICAL LABORATORIES INC.

30-May-94

Joe Pollara
Adrian Brown Consultants
155 S. Madison
Suite 240
Denver, CO 80209

P.A.L. Project: ABC 6412
Client Project: 1125A

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the water and tenax samples submitted on 05/24/94. The water sample results are reported in ug/l, and the tenax values are reported in total ug.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

001

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

REQUEST FOR DATA VERIFICATION--

Request initiated by-CLIENT COMPANY Adrian Brown Consultants
CONTACT Joe Pollara
DATE 06/01/94

Due Date:

P.A.L. Project # : ABC 6412
P.A.L. Sample # : ABC 59790 ABC 59792
Client Sample I.D: Composite Blank
Describe Request :

Please verify results - could there have been a mixup?

Client Sample #'s & P.A.L. Sample #'s checked on the sample container vs the Chain of Custody? (Yes) No

All Sample #'s & Run #'s checked on the container vs the Instrument log Sample #'s & Run #'s? (Yes) No

Run #'s checked against chromatograms? (Yes) No

Calculations recalculated? (Yes) No

Previous run samples checked? (Yes) No
Note the Run # (incl instrument) _____

Analyst _____ Date _____

Laboratory Manager _____ Date _____

Laptop:Results.ed

Blank sample clean.
Composite sample clean
Injection has low levels

Blank sample has lower level of CO_2 in front of chromatogram. characteristic of non-site water. This is additional confirmation

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 05/23/94
DATE RECEIVED: 05/24/94
DATE ANALYZED: 05/26/94
REPORT DATE: 05/30/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX (Mod.EPA 8260)
CLIENT PROJECT: 1125A
P.A.L. PROJECT: ABC 6412

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
INJECTION	< 0.80	< 0.78	< 0.60	6
COMPOSITE	< 0.80	< 0.78	< 0.60	< 1.54
BLANK	< 0.80	< 0.78	< 0.60	< 1.54

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

002

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 05/23/94
DATE RECEIVED: 05/24/94
DATE ANALYZED: 05/24/94
REPORT DATE: 05/30/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX (EPA 8260)
CLIENT PROJECT: 1125A
P.A.L. PROJECT: ABC 6412

ANALYTE CONCENTRATIONS DETECTED: Total ug

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
TOTAL AIR	0.004	0.041	< 0.003	< 0.008
BLANK	< 0.004	0.036	0.008	0.043

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

31-May-94

PHOENIX ANALYTICAL LABORATORIES INC.

Joe Pollara
Adrian Brown Consultants
155 S. Madison
Suite 302
Denver, CO 80209

P.A.L. Project: ABC 6321
Client Project: 1125

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the water sample submitted on 04/21/94. The results for this sample were originally faxed to you on 05/10/94. Due to an error on my part, the final report was not issued until today, 05/31/94. Because of this, you will not be charged for this one analysis. Sorry for any inconvenience that this may have caused.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

001

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 04/21/94
DATE RECEIVED: 04/22/94
DATE ANALYZED: 05/06/94
REPORT DATE: 05/10/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX (EPA 8260)
CLIENT PROJECT: 1125
P.A.L. PROJECT: ABC 6321

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
ABC-72	26	2	68	140

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

002

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

REFERENCES FOR QC CONVENTIONS ADOPTED BY PHOENIX ANALYTICAL LABORATORIES

DATE: 1/1/92

THESE CONVENTIONS ARE GENERALLY USED. THEY ARE REVIEWED AT LEAST ANNUALLY, AND MAY NOT REFLECT CONVENTIONS CHOSEN FOR SPECIFIC PROJECTS.

ANALYSIS	QC CRITERION	REFERENCE
GCMS VOA	SUERGATES	1
(INCL. BTEX)	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GCMS SVOA		
	SURROGATES	1
	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GC VOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	INSTRUMENT TUNES (BFB)	2
	QC SPIKES	
GC SVOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	QC SPIKES	2
METALS		
	QC SPIKES	2, AND SPECIFIED BY QC STANDARD
	BLANKS	2
	DUPLICATES	2
	MATRIX SPIKES	2

1. CLP STATEMENT OF WORK, 1990
2. SW-846 IN THE SPECIFIC METHOD
3. LABORATORY CRITERION, 3X STANDARD DEVIATION
4. STANDARD METHODS
5. OTHER - SPECIFIED IN REPORT

#20 D:\QPRO\QAQC\QCREPORT

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

6-22-94

RECEIVED
JUL 5 1994

PHOENIX ANALYTICAL LABORATORIES INC.

30-Jun-94

Joe Pollara
Adrian Brown Consultants
155 S. Madison
Suite 302
Denver, CO 80209

P.A.L. Project: 2002 6517
Client Project: 1125A

Dear Joe:

Enclosed are the results of the EPA 8260 VOA analysis for the water and tenax samples submitted on 06/23/94.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

001

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 06/22/94
DATE RECEIVED: 06/23/94
DATE ANALYZED: 06/24/94
REPORT DATE: 06/30/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by EPA 8260
CLIENT PROJECT: 1125A
P.A.L. PROJECT: 2002 6517

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
COMPOSITE	13	< 0.78	44	130
INJECTION	< 0.80	< 0.78	< 0.60	< 1.54
BLANK	< 0.80	< 0.78	< 0.60	< 1.54

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

6/28/94

RE JUL 8 1994 ADRIAN

PHOENIX ANALYTICAL LABORATORIES INC.

06-Jul-94

Joe Pollara
Adrian Brown Consultants
155 S. Madison
Suite 302
Denver, CO 80209

P.A.L. Project: 2002 6517A
Client Project: 1125A

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the water samples submitted on 06/30/94. BTEX analytes were detected in all non-blank samples.

If you have any questions, please call.

Sincerely,

Lonnie Ballin
Laboratory Manager

001

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 06/28/94
DATE RECEIVED: 06/30/94
DATE ANALYZED: 07/01/94
REPORT DATE: 07/06/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by EPA 8260
CLIENT PROJECT: 1125A
P.A.L. PROJECT: 2002 6517A

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
BLANK	< 0.80	< 0.78	< 0.60	< 1.54
ABC-91	24	< 0.78	17	18
ABC-90	0.9	< 0.78	28	33
ABC-27	7	< 0.78	150	210
ABC-11	2	< 0.78	78	96

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

002

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES, INC.
VOLATILE QC EVALUATION SUMMARY

METHOD:	8260
INSTRUMENT:	N
P.A.L. PROJECT:	2002 6517A
CLIENT PROJECT:	1125A
MATRIX:	WATER
REPORT DATE:	07/06/94
CRITERIA:	SW-846
# OF SAMPLES:	5

QC PARAMETER	% IN LIMITS	REMARKS
HOLDING TIMES:	100	
SAMPLE PRESERVATION:	YES	
BFB:	100	
DAILY CAL. STD.	100	
BLANK LEVELS	100	
IS AREAS	100	
IS RET TIMES	100	
SS RECOVERIES	100	
MATRIX SPIKE, DUP		
RECOVERIES	N/A	
RPD	N/A	
QC SPIKE		
RECOVERIES	N/A	

LABORATORY INTERPRETATION OF DATA QUALITY PARAMETERS:
DATA ACCURACY AND PRECISION WITHIN EXPECTED LIMITS?
YES X NO____

PRESERVATION REFERS TO CLIENT PRESERVATION
PLEASE REFER TO CASE NARRATIVE AND INDIVIDUAL DATA SHEETS FOR ADDITIONAL COMMENTS.

COMMENTS:

REPORTED BY: _____ APPROVED BY: _____

7/21-22/94

RECEIVED
AUG 4 1994
ADRIAN BROWN CONS...

PHOENIX ANALYTICAL LABORATORIES INC.

02-Aug-94

Joe Pollara
Adrian Brown Consultants
155 S. Madison Street
Suite 302
Denver, CO 80209

P.A.L. Project: 6595
Client Project: 1125A

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis performed on the water and tenax samples submitted on 07/26/94. The values for the tenax samples are reported in total micrograms (ug). There are several items of interest associated with this project.

First, the chain of custody lists two ABC-12 samples, both of which were sampled on 07/22/94 but at different times. The samples are reported as ABC-12 (10:30) and ABC-12 (11:00). The results for both of these samples were very similar.

Second, only nine of the samples were adequately preserved, i.e. only nine samples had a pH of 2 or less. Three samples had a pH of 7, one sample had a pH of 4 and 6 samples had a pH of 3. This was not a problem in that the seven day hold time for unpreserved water samples was met. This could have been a potential problem if the seven day hold time had been exceeded.

Finally, please note that the matrix spike and the QC spike showed higher than normal recoveries of 1,1-dichloroethene. This could indicate that values for early eluting halogenated analytes such as 1,1-DCE and isomers of 1,2-DCE may have been biased slightly high. Since these analytes were not on the requested target list, and were not detected in the samples, this is not a problem.

If you have any questions, please call

Sincerely,

Lonnie Fallin
Laboratory Manager

001

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 07/21/94 & 07/22/94
DATE RECEIVED: 07/26/94
DATE ANALYZED: 07/26/94 & 07/27/94
REPORT DATE: 08/02/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by EPA 8260
CLIENT PROJECT: 1125A
P.A.L. PROJECT: 6595

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
EPA2-11	< 0.80	< 0.78	2	4
EPA1-09	< 0.80	< 0.78	< 0.60	< 1.54
EPA1-10	< 0.80	< 0.78	8	20
ABC-2	< 0.80	< 0.78	< 0.60	2
ABC-27	< 0.80	< 0.78	13	21
ABC-17	< 0.80	< 0.78	< 0.60	< 1.54
KNMW-7	< 0.80	< 0.78	< 0.60	< 1.54
ABC-91	< 0.80	< 0.78	1	< 1.54
ABC-12 (10:30)	< 0.80	< 0.78	1	4

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 07/22/94, 07/23/94 & 07/24/94
DATE RECEIVED: 07/26/94
DATE ANALYZED: 07/27/94
REPORT DATE: 08/02/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by EPA 8260
CLIENT PROJECT: 1125A
P.A.L. PROJECT: 6595

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
KNGW-2	< 0.80	< 0.78	3	7
KNMW-6	0.9	< 0.78	10	13
KNMW-5	< 0.80	< 0.78	< 0.60	2
ABC-12 (11:00)	< 0.80	< 0.78	1	3
ABC-72	5	< 0.78	43	280
ABC-73	19	< 0.78	40	130
INJECTION	< 0.80	< 0.78	< 0.60	< 1.54
COMPOSITE	8	< 0.78	29	150
BLANK	< 0.80	< 0.78	< 0.60	< 1.54
ABC-70	< 0.80	< 0.78	6	24

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 07/23/94
DATE RECEIVED: 07/26/94
DATE ANALYZED: 07/28/94
REPORT DATE: 08/02/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by EPA 8260
CLIENT PROJECT: 1125A
P.A.L. PROJECT: 6595

ANALYTE CONCENTRATIONS DETECTED: Total ug

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
TOTAL AIR	< 0.004	0.006	< 0.003	< 0.008
BLANK AIR	< 0.004	0.007	< 0.003	< 0.008

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES, INC.
VOLATILE QC EVALUATION SUMMARY

METHOD:	8260
INSTRUMENT:	N
P.A.L. PROJECT:	6595
CLIENT PROJECT:	1125A
MATRIX:	WATER & TENAX
REPORT DATE:	07/06/94
CRITERIA:	SW-846
# OF SAMPLES:	21, MS, MSD, QC SPIKE

QC PARAMETER	% IN LIMITS	REMARKS
HOLDING TIMES:	100	
SAMPLE PRESERVATION:	47	SEE LETTER
BFB:	100	
DAILY CAL. STD.	100	
BLANK LEVELS	100	
IS AREAS	100	
IS RET TIMES	100	
SS RECOVERIES	100	
MATRIX SPIKE, DUP		
RECOVERIES	90	
RPD	80	
QC SPIKE		
RECOVERIES	80	

LABORATORY INTERPRETATION OF DATA QUALITY PARAMETERS:
DATA ACCURACY AND PRECISION WITHIN EXPECTED LIMITS?
YES X NO____

PRESERVATION REFERS TO CLIENT PRESERVATION
PLEASE REFER TO CASE NARRATIVE AND INDIVIDUAL DATA SHEETS FOR ADDITIONAL COMMENTS.

COMMENTS:

REPORTED BY: _____ APPROVED BY: _____

PHOENIX ANALYTICAL LABORATORIES INC.

REFERENCES FOR QC CONVENTIONS ADOPTED BY PHOENIX ANALYTICAL LABORATORIES

DATE: 1/1/92

THESE CONVENTIONS ARE GENERALLY USED. THEY ARE REVIEWED AT LEAST ANNUALLY, AND MAY NOT REFLECT CONVENTIONS CHOSEN FOR SPECIFIC PROJECTS.

ANALYSIS	QC CRITERION	REFERENCE
GCMS VOA	SURROGATES	1
(INCL. BTEX)	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GCMS SVOA		
	SURROGATES	1
	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GC VOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	INSTRUMENT TUNES (BFB)	2
	QC SPIKES	
GC SVOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	QC SPIKES	2
METALS		
	QC SPIKES	2, AND SPECIFIED BY QC STANDARD
	BLANKS	2
	DUPLICATES	2
	MATRIX SPIKES	2

1. CLP STATEMENT OF WORK, 1990
2. SW-846 IN THE SPECIFIC METHOD
3. LABORATORY CRITERION, 3X STANDARD DEVIATION
4. STANDARD METHODS
5. OTHER - SPECIFIED IN REPORT

#20 D:\QPRO\QAQC\QCREPORT

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABS
VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT NAME: Adrian Brown Consultants
CLIENT PROJECT: 1125A
P.A.L. PROJECT: 6595
DATE ANALYZED: 07/27/94

CONCENTRATION UNITS: ug/l
CLIENT SAMPLE NO: EPA1-10 P.A.L. NO: 61897

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONC. (ug/L)	MS CONC. (ug/L)	MS % REC	QC LIMITS
1,1-Dichloroethene	50	0	85	170	61-145
Trichloroethene	50	0	40	80	71-120
Benzene	50	0	43	86	76-127
Toluene	50	0	46	92	76-125
Chlorobenzene	50	0	54	108	75-130

DUPLICATE:

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONC. (ug/L)	MS CONC. (ug/L)	MS % REC	% RPD	QC LIMITS RPD	QC LIMITS RECOVERY
1,1-Dichloroethene	50	0	72	144	17	14	61-145
Trichloroethene	50	0	37	74	8	14	71-120
Benzene	50	0	39	78	10	11	76-127
Toluene	50	0	43	86	7	13	76-125
Chlorobenzene	50	0	50	100	8	13	75-130

VALUES OUTSIDE OF QC LIMITS:
RPD: 1
RECOVERY: 1

COMMENTS:

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABS
VOLATILE QC SPIKE RECOVERY

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT NAME: Adrian Brown Consultants
CLIENT PROJECT: 1125A
P.A.L. PROJECT: 6595
DATE ANALYZED: 07/27/94

CONCENTRATION UNITS: ug/l
CLIENT SAMPLE NO: N/A P.A.L. NO: QC SPIKE

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONC. (ug/L)	MS CONC. (ug/L)	MS % REC	QC LIMITS
1,1-Dichloroethene	20	0	36.5	183	61-145
Trichloroethene	20	0	18.2	91	71-120
Benzene	20	0	17.3	87	76-127
Toluene	20	0	16.2	81	76-125
Chlorobenzene	20	0	17	85	75-130

VALUES OUTSIDE OF QC LIMITS:

RECOVERY: 1

COMMENTS:

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

8/1/94

PHOENIX ANALYTICAL LABORATORIES INC.

05-Aug-94

Joe Pollara
Adrian Brown Consultants
155 S. Madison
Suite 302
Denver, CO 80209

P.A.L. Project: 6595A
Client Project: 1125A

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the water sample submitted on 08/02/94.

If you have any questions, please call.

Sincerely,

Lonnie Pallin
Laboratory Manager

001

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 08/01/94
DATE RECEIVED: 08/02/94
DATE ANALYZED: 08/03/94
REPORT DATE: 08/05/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by EPA 8260
CLIENT PROJECT: 1125A
P.A.L. PROJECT: 6595A

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
ABC-5	2	< 0.78	2	< 1.54

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

002

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES, INC.
VOLATILE QC EVALUATION SUMMARY

METHOD:	8260
INSTRUMENT:	N
P.A.L. PROJECT:	6595A
CLIENT PROJECT:	1125A
MATRIX:	WATER
REPORT DATE:	08/05/94
CRITERIA:	SW-846
# OF SAMPLES:	1

QC PARAMETER	% IN LIMITS	REMARKS
HOLDING TIMES:	100	
SAMPLE PRESERVATION:	YES	
BFB:	100	
DAILY CAL. STD.	100	
BLANK LEVELS	100	
IS AREAS	100	
IS RET TIMES	100	
SS RECOVERIES	100	
MATRIX SPIKE, DUP		
RECOVERIES	N/A	
RPD	N/A	
QC SPIKE		
RECOVERIES	N/A	

LABORATORY INTERPRETATION OF DATA QUALITY PARAMETERS:
DATA ACCURACY AND PRECISION WITHIN EXPECTED LIMITS?
YES X NO____

PRESERVATION REFERS TO CLIENT PRESERVATION
PLEASE REFER TO CASE NARRATIVE AND INDIVIDUAL DATA SHEETS FOR ADDITIONAL COMMENTS.

COMMENTS:

REPORTED BY: _____ APPROVED BY: _____

PHOENIX ANALYTICAL LABORATORIES INC.

REFERENCES FOR QC CONVENTIONS ADOPTED BY PHOENIX ANALYTICAL LABORATORIES

DATE: 1/1/92

THESE CONVENTIONS ARE GENERALLY USED. THEY ARE REVIEWED AT LEAST ANNUALLY, AND MAY NOT REFLECT CONVENTIONS CHOSEN FOR SPECIFIC PROJECTS.

ANALYSIS	QC CRITERION	REFERENCE
GCMS VOA.	SURROGATES	1
(INCL. BTEX)	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GCMS SVOA		
	SURROGATES	1
	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GC VOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	INSTRUMENT TUNES (BFB)	2
	QC SPIKES	
GC SVOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	QC SPIKES	2
METALS		
	QC SPIKES	2, AND SPECIFIED BY QC STANDARD
	BLANKS	2
	DUPLICATES	2
	MATRIX SPIKES	2

1. CLP STATEMENT OF WORK, 1990
2. SW-846 IN THE SPECIFIC METHOD
3. LABORATORY CRITERION, 3X STANDARD DEVIATION
4. STANDARD METHODS
5. OTHER - SPECIFIED IN REPORT

#20 D:\QPRO\QAQC\QCREPORT

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

9/15/94

RECEIVED
OCT 4 1994

PHOENIX
ANALYTICAL
LABORATORIES
INC.

30-Sep-94

Joe Pollara
Adrian Brown Consultants
155 S. Madison
Suite 302
Denver, CO 80209

P.A.L. Project: 6742,A,B
Client Project: 1125A

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the water and tenax samples submitted on 09/17/94, 09/20/94 and 09/23/94. The water samples are reported in ug/l and the tenax samples are reported in total ug.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

001

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 09/15/94
DATE RECEIVED: 09/17/94
DATE ANALYZED: 09/20/94
REPORT DATE: 09/30/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by EPA 8260
CLIENT PROJECT: 1125A
P.A.L. PROJECT: 6742

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
ABC-2	< 0.80	< 0.78	< 0.60	< 1.54
ABC-12	< 0.80	< 0.78	< 0.60	< 1.54
ABC-27	< 0.80	< 0.78	10	< 1.54
KNMW-5	< 0.80	< 0.78	< 0.60	< 1.54
KNMW-6	< 0.80	< 0.78	3	< 1.54
KNGW-2	< 0.80	< 0.78	< 0.60	< 1.54
INJECTION	< 0.80	< 0.78	< 0.60	< 1.54
COMPOSITE	1	< 0.78	4	15

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: Heidi Hayes

002

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 09/15/94
DATE RECEIVED: 09/17/94
DATE ANALYZED: 09/20/94
REPORT DATE: 09/30/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by EPA 8260
CLIENT PROJECT: 1125A
P.A.L. PROJECT: 6742

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
BLANK	< 0.80	< 0.78	< 0.60	< 1.54
ABC-5	30	< 0.78	2	< 1.54
ABC-17	< 0.80	< 0.78	0.8	< 1.54
KNMW-7	< 0.80	< 0.78	< 0.60	< 1.54
ABC-91	< 0.80	< 0.78	0.9	< 1.54

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: Heidi Hayes

003

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 09/14/94
DATE RECEIVED: 09/20/94
DATE ANALYZED: 09/20/94
REPORT DATE: 09/30/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by EPA 8260
CLIENT PROJECT: 1125A
P.A.L. PROJECT: 6742A

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
EPA2-11	1	< 0.78	2	3
EPA1-9	< 0.80	< 0.78	< 0.60	< 1.54
EPA1-10	< 0.80	< 0.78	0.7	< 1.54

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: Heidi Hayes

004

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 09/22/94
DATE RECEIVED: 09/23/94
DATE ANALYZED: 09/26/94
REPORT DATE: 09/30/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by EPA 8260
CLIENT PROJECT: 1125A
P.A.L. PROJECT: 6742B

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
ABC-70	< 0.80	< 0.78	2	7
ABC-72	4	< 0.78	11	32
ABC-73	4	< 0.78	12	36

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: Heidi Hayes 005

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 09/15/94
DATE RECEIVED: 09/17/94
DATE ANALYZED: 09/29/94
REPORT DATE: 09/30/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by EPA 8260
CLIENT PROJECT: 1125A
P.A.L. PROJECT: 6742

ANALYTE CONCENTRATIONS DETECTED: Total ug

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
TOTAL AIR	0.010	0.020	0.004	0.031
BLANK AIR	0.005	0.016	0.012	0.085

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: Heidi Hayes

006

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES, INC.
VOLATILE QC EVALUATION SUMMARY

METHOD:	8260
INSTRUMENT:	N
P.A.L. PROJECT:	6742,A,B
CLIENT PROJECT:	1125A
MATRIX:	WATER & TENAX
REPORT DATE:	09/30/94
CRITERIA:	SW-846
# OF SAMPLES:	21, 2 MS, 2 MSD, QC SPIKE

QC PARAMETER	% IN LIMITS	REMARKS
HOLDING TIMES:	100	
SAMPLE PRESERVATION:	YES	
BFB:	100	
DAILY CAL. STD.	82	--RRF FOR BROMOFORM AND 1,1,2,2-TETRACHLOROPROPANE LOW IN STDN6602.
BLANK LEVELS	100	ANALYTES NOT ON REQUESTED LIST; BTEX ANALYTES ALL WITHIN CALIBRATION.
IS AREAS	100	NO IMPACT ON DATA.
IS RET TIMES	100	
SS RECOVERIES	100	
MATRIX SPIKE, DUP		
RECOVERIES	100	
RPD	100	
QC SPIKE		
RECOVERIES	100	

LABORATORY INTERPRETATION OF DATA QUALITY PARAMETERS:
DATA ACCURACY AND PRECISION WITHIN EXPECTED LIMITS?
YES X NO____

PRESERVATION REFERS TO CLIENT PRESERVATION
PLEASE REFER TO CASE NARRATIVE AND INDIVIDUAL DATA SHEETS FOR ADDITIONAL COMMENTS.

COMMENTS:

REPORTED BY: [signature] APPROVED BY: Heidi Hayes

PHOENIX ANALYTICAL LABORATORIES INC.

REFERENCES FOR QC CONVENTIONS ADOPTED BY PHOENIX ANALYTICAL LABORATORIES

DATE: 1/1/92

THESE CONVENTIONS ARE GENERALLY USED. THEY ARE REVIEWED AT LEAST ANNUALLY, AND MAY NOT REFLECT CONVENTIONS CHOSEN FOR SPECIFIC PROJECTS.

ANALYSIS	QC CRITERION	REFERENCE
GCMS VOA	SURROGATES	1
(INCL. BTEX)	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GCMS SVOA		
	SURROGATES	1
	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GC VOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	INSTRUMENT TUNES (BFB)	2
	QC SPIKES	
GC SVOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	QC SPIKES	2
METALS		
	QC SPIKES	2, AND SPECIFIED BY QC STANDARD
	BLANKS	2
	DUPLICATES	2
	MATRIX SPIKES	2

1. CLP STATEMENT OF WORK, 1990
2. SW-846 IN THE SPECIFIC METHOD
3. LABORATORY CRITERION, 3X STANDARD DEVIATION
4. STANDARD METHODS
5. OTHER - SPECIFIED IN REPORT

#20 D:\QPRO\QAQC\QCREPORT

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABS
VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT NAME: Adrian Brown Consultants
CLIENT PROJECT: 1125A
P.A.L. PROJECT: 6742
DATE ANALYZED: 09/20/93

CONCENTRATION UNITS: ug/l
CLIENT SAMPLE NO: COMPOSITE P.A.L. NO: 64027

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONC. (ug/L)	MS CONC. (ug/L)	MS % REC	QC LIMITS
1,1-Dichloroethene	50	0	46	92	61-145
Trichloroethene	50	0	44	88	71-120
Benzene	50	1	43	84	76-127
Toluene	50	0	42	84	76-125
Chlorobenzene	50	0	42	84	75-130

DUPLICATE:

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONC. (ug/L)	MS CONC. (ug/L)	MS % REC	% RPD	QC LIMITS RPD	QC LIMITS RECOVERY
1,1-Dichloroethene	50	0	40	80	14	14	61-145
Trichloroethene	50	0	40	80	10	14	71-120
Benzene	50	1	41	80	5	11	76-127
Toluene	50	0	38	76	10	13	76-125
Chlorobenzene	50	0	38	76	10	13	75-130

VALUES OUTSIDE OF QC LIMITS:
RPD: 0
RECOVERY: 0

COMMENTS:

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABS
VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT NAME: Adrian Brown Consultants
CLIENT PROJECT: 1125A
P.A.L. PROJECT: 6742A
DATE ANALYZED: 09/20/93

CONCENTRATION UNITS: ug/l
CLIENT SAMPLE NO: EPA2-11 P.A.L. NO: 64171

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONC. (ug/L)	MS CONC. (ug/L)	MS % REC	QC LIMITS
1,1-Dichloroethene	50	0	54	108	61-145
Trichloroethene	50	0	39	78	71-120
Benzene	50	1	46	90	76-127
Toluene	50	0	50	100	76-125
Chlorobenzene	50	0	49	98	75-130

DUPLICATE:

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONC. (ug/L)	MS CONC. (ug/L)	MS % REC	% RPD	QC LIMITS RPD	QC LIMITS RECOVERY
1,1-Dichloroethene	50	0	55	110	2	14	61-145
Trichloroethene	50	0	41	82	5	14	71-120
Benzene	50	1	50	98	9	11	76-127
Toluene	50	0	54	108	8	13	76-125
Chlorobenzene	50	0	53	106	8	13	75-130

VALUES OUTSIDE OF QC LIMITS:
RPD: 0
RECOVERY: 0

COMMENTS:

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABS
VOLATILE QC SPIKE RECOVERY

CLIENT NAME:
CLIENT PROJECT:
P.A.L. PROJECT:
DATE ANALYZED: 09/20/93

CONCENTRATION UNITS: ug/l
CLIENT SAMPLE NO: N/A P.A.L. NO: 742N6598

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONC. (ug/L)	MS CONC. (ug/L)	MS % REC	QC LIMITS
1,1-Dichloroethene	30	0	37.3	124	61-145
Trichloroethene	30	0	25	83	71-120
Benzene	30	0	24.6	82	76-127
Toluene	30	0	28.5	95	76-125
Chlorobenzene	30	0	28.3	94	75-130

VALUES OUTSIDE OF QC LIMITS:

RECOVERY: 0

COMMENTS:

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

10/3/94

07-Oct-94

PHOENIX ANALYTICAL LABORATORIES INC.

Joe Pollara
Adrian Brown Consultants
155 S. Madison
Suite 302
Denver, CO 80209

P.A.L. Project: 6782
Client Project: 1125A/KN
Energy

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the water sample submitted on 10/05/94. Benzene and ethylbenzene were detected at 43ppb and 3ppb respectively.

If you have any questions, please call.

Sincerely,

Craig Dever
Chemist

001

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED:	10/03/94
DATE RECEIVED:	10/05/94
DATE ANALYZED:	10/07/94
REPORT DATE:	10/07/94
CLIENT:	Adrian Brown Consultants
ANALYSIS:	BTEX by EPA 8260
CLIENT PROJECT:	1125A/KN Energy
P.A.L. PROJECT:	6782

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
ABC-5	43	< 0.78	3	< 1.54

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____ 002

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES, INC.
VOLATILE QC EVALUATION SUMMARY

METHOD:	8260
INSTRUMENT:	N
P.A.L. PROJECT:	6782
CLIENT PROJECT:	1125A/KN Energy
MATRIX:	WATER
REPORT DATE:	10/07/94
CRITERIA:	SW-846
# OF SAMPLES:	1

QC PARAMETER	% IN LIMITS	REMARKS
HOLDING TIMES:	100	
SAMPLE PRESERVATION:	YES	
BFB:	100	
DAILY CAL. STD.	100	
BLANK LEVELS	100	
IS AREAS	100	
IS RET TIMES	100	
SS RECOVERIES	100	
MATRIX SPIKE, DUP		
RECOVERIES	N/A	
RPD	N/A	
QC SPIKE		
RECOVERIES	N/A	

LABORATORY INTERPRETATION OF DATA QUALITY PARAMETERS:
DATA ACCURACY AND PRECISION WITHIN EXPECTED LIMITS?
YES ✓ NO____

PRESERVATION REFERS TO CLIENT PRESERVATION
PLEASE REFER TO CASE NARRATIVE AND INDIVIDUAL DATA SHEETS FOR ADDITIONAL COMMENTS.

COMMENTS:

REPORTED BY: _____ APPROVED BY: _____

PHOENIX ANALYTICAL LABORATORIES INC.

REFERENCES FOR QC CONVENTIONS ADOPTED BY PHOENIX ANALYTICAL LABORATORIES

DATE: 1/1/92

THESE CONVENTIONS ARE GENERALLY USED. THEY ARE REVIEWED AT LEAST ANNUALLY, AND MAY NOT REFLECT CONVENTIONS CHOSEN FOR SPECIFIC PROJECTS.

ANALYSIS	QC CRITERION	REFERENCE
GCMS VOA	SURROGATES	1
(INCL. BTEX)	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GCMS SVOA		
	SURROGATES	1
	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GC VOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	INSTRUMENT TUNES (BFB)	2
	QC SPIKES	
GC SVOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	QC SPIKES	2
METALS		
	QC SPIKES	2, AND SPECIFIED BY QC STANDARD
	BLANKS	2
	DUPLICATES	2
	MATRIX SPIKES	2

1. CLP STATEMENT OF WORK, 1990
2. SW-846 IN THE SPECIFIC METHOD
3. LABORATORY CRITERION, 3X STANDARD DEVIATION
4. STANDARD METHODS
5. OTHER - SPECIFIED IN REPORT

#20 D:\QPRO\QAQC\QCREPORT

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

10/14/94

PHOENIX ANALYTICAL LABORATORIES INC.

31-Oct-94

Joe Pollara
Adrian Brown Consultants
155 S. Madison
Suite 302
Denver, CO 80209

P.A.L. Project: 6782A
Client Project: 1125A

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the water and tenax samples submitted on 10/15/94. The values for the water samples are reported in ug/l, and the values for the tenax samples are reported in total ug.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 10/14/94
DATE RECEIVED: 10/15/94
DATE ANALYZED: 10/19/94
REPORT DATE: 10/31/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by EPA 8260
CLIENT PROJECT: 1125A
P.A.L. PROJECT: 6782A

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
ABC-70	< 0.80	< 0.78	7	23
ABC-72	7	< 0.78	22	58
ABC-73	8	< 0.78	29	91
ABC-2	< 0.80	< 0.78	< 0.60	< 1.54
ABC-5	25	< 0.78	6	3
ABC-12	< 0.80	< 0.78	< 0.60	< 1.54
ABC-17	1	< 0.78	21	6
ABC-27	2	< 0.78	10	< 1.54
ABC-91	< 0.80	< 0.78	< 0.60	< 1.54
KNGW-2	< 0.80	< 0.78	< 0.60	< 1.54

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: Heidi Hayes

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 10/14/94
DATE RECEIVED: 10/15/94
DATE ANALYZED: 10/19/94
REPORT DATE: 10/31/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by EPA 8260
CLIENT PROJECT: 1125A
P.A.L. PROJECT: 6782A

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
KNMW-5	< 0.80	< 0.78	< 0.60	< 1.54
KNMW-6	< 0.80	< 0.78	< 0.60	< 1.54
KNMW-7	< 0.80	< 0.78	< 0.60	< 1.54
EPA 1-9	< 0.80	< 0.78	< 0.60	< 1.54
EPA 1-10	< 0.80	< 0.78	11	3
EPA 2-11	2	< 0.78	11	19
INJECTION	< 0.80	< 0.78	< 0.60	< 1.54
COMPOSITE	3	< 0.78	10	34
BLANK	< 0.80	< 0.78	< 0.60	< 1.54

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: Heidi Hayes

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 10/14/94
DATE RECEIVED: 10/15/94
DATE ANALYZED: 10/31/94
REPORT DATE: 10/31/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by EPA 8260
CLIENT PROJECT: 1125A
P.A.L. PROJECT: 6782A

ANALYTE CONCENTRATIONS DETECTED: Total ug

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
TOTAL AIR	0.045	0.025	0.029	0.030
BLANK AIR	< 0.004	0.021	< 0.003	< 0.008

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: Heidi Hayes

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES, INC.
VOLATILE QC EVALUATION SUMMARY

METHOD:	8260
INSTRUMENT:	N
P.A.L. PROJECT:	6782A
CLIENT PROJECT:	1125A
MATRIX:	WATER & TENAX
REPORT DATE:	07/06/94
CRITERIA:	SW-846
# OF SAMPLES:	21, 2 MS, 2 MSD, 2 QC CHECKS

QC PARAMETER	% IN LIMITS	REMARKS
HOLDING TIMES:	100	
SAMPLE PRESERVATION:	YES	
BFB:	100	
DAILY CAL. STD.	100	
BLANK LEVELS	100	
IS AREAS	100	
IS RET TIMES	100	
SS RECOVERIES	100	
MATRIX SPIKE, DUP		
RECOVERIES	100	
RPD	100	
QC SPIKE		
RECOVERIES	100	

LABORATORY INTERPRETATION OF DATA QUALITY PARAMETERS:
DATA ACCURACY AND PRECISION WITHIN EXPECTED LIMITS?
YES X NO____

PRESERVATION REFERS TO CLIENT PRESERVATION
PLEASE REFER TO CASE NARRATIVE AND INDIVIDUAL DATA SHEETS FOR ADDITIONAL COMMENTS.

COMMENTS:

REPORTED BY: _____ APPROVED BY: Heidi Hayes

PHOENIX ANALYTICAL LABORATORIES INC.

REFERENCES FOR QC CONVENTIONS ADOPTED BY PHOENIX ANALYTICAL LABORATORIES

DATE: 1/1/92

THESE CONVENTIONS ARE GENERALLY USED. THEY ARE REVIEWED AT LEAST ANNUALLY, AND MAY NOT REFLECT CONVENTIONS CHOSEN FOR SPECIFIC PROJECTS.

ANALYSIS	QC CRITERION	REFERENCE
GCMS VOA	SURROGATES	1
(INCL. BTEX)	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GCMS SVOA		
	SURROGATES	1
	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GC VOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	INSTRUMENT TUNES (BFB)	2
	QC SPIKES	
GC SVOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	QC SPIKES	2
METALS		
	QC SPIKES	2, AND SPECIFIED BY QC STANDARD
	BLANKS	2
	DUPLICATES	2
	MATRIX SPIKES	2

1. CLP STATEMENT OF WORK, 1990
2. SW-846 IN THE SPECIFIC METHOD
3. LABORATORY CRITERION, 3X STANDARD DEVIATION
4. STANDARD METHODS
5. OTHER - SPECIFIED IN REPORT

#20 D:\QPRO\QAQC\QCREPORT

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABS
VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT NAME: Adrian Brown Consultants
CLIENT PROJECT: 1125A
P.A.L. PROJECT: 6782A
DATE ANALYZED: 10/19/94

CONCENTRATION UNITS: ug/l
CLIENT SAMPLE NO: KNMW-6 P.A.L. NO: 64855

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONC. (ug/L)	MS CONC. (ug/L)	MS % REC	QC LIMITS
1,1-Dichloroethene	50	0	43	86	61-145
Trichloroethene	50	0	49	98	71-120
Benzene	50	0	54	108	76-127
Toluene	50	0	55	110	76-125
Chlorobenzene	50	0	49	98	75-130

DUPLICATE:

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONC. (ug/L)	MS CONC. (ug/L)	MS % REC	% RPD	QC LIMITS RPD	QC LIMITS RECOVERY
1,1-Dichloroethene	50	0	45	90	5	14	61-145
Trichloroethene	50	0	54	108	10	14	71-120
Benzene	50	0	59	118	9	11	76-127
Toluene	50	0	58	116	5	13	76-125
Chlorobenzene	50	0	53	106	8	13	75-130

VALUES OUTSIDE OF QC LIMITS:
RPD: 0
RECOVERY: 0

COMMENTS:

PHOENIX ANALYTICAL LABS
VOLATILE QC SPIKE RECOVERY

CLIENT NAME:
CLIENT PROJECT:
P.A.L. PROJECT:
DATE ANALYZED: 10/19/94

CONCENTRATION UNITS: ug/l
CLIENT SAMPLE NO: N/A P.A.L. NO: QCSN7168

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONC. (ug/L)	MS CONC. (ug/L)	MS % REC	QC LIMITS
1,1-Dichloroethene	25	0	16.8	67	61-145
Trichloroethene	25	0	26.3	105	71-120
Benzene	25	0	24.5	98	76-127
Toluene	25	0	27.3	109	76-125
Chlorobenzene	25	0	26.1	104	75-130

VALUES OUTSIDE OF QC LIMITS:

RECOVERY: 0

COMMENTS:

PHOENIX ANALYTICAL LABORATORIES INC.
3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABS
VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT NAME: Adrian Brown Consultants
CLIENT PROJECT: 1125A
P.A.L. PROJECT: 6782A
DATE ANALYZED: 10/20/94

CONCENTRATION UNITS: ug/l
CLIENT SAMPLE NO: COMPOSITE P.A.L. NO: 64867

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONC. (ug/L)	MS CONC. (ug/L)	MS % REC	QC LIMITS
1,1-Dichloroethene	50	0	49	98	61-145
Trichloroethene	50	0	57	114	71-120
Benzene	50	3	65	124	76-127
Toluene	50	0	61	122	76-125
Chlorobenzene	50	0	55	110	75-130

DUPLICATE:

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONC. (ug/L)	MS CONC. (ug/L)	MS % REC	% RPD	QC LIMITS RPD	QC LIMITS RECOVERY
1,1-Dichloroethene	50	0	44	88	11	14	61-145
Trichloroethene	50	0	54	108	5	14	71-120
Benzene	50	3	62	118	5	11	76-127
Toluene	50	0	59	118	3	13	76-125
Chlorobenzene	50	0	53	106	4	13	75-130

VALUES OUTSIDE OF QC LIMITS:
RPD: 0
RECOVERY: 0

COMMENTS:

PHOENIX ANALYTICAL LABS
VOLATILE QC SPIKE RECOVERY

CLIENT NAME:
CLIENT PROJECT:
P.A.L. PROJECT:
DATE ANALYZED: 10/20/94

CONCENTRATION UNITS: ug/l
CLIENT SAMPLE NO: N/A P.A.L. NO: QCSN7168

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONC. (ug/L)	MS CONC. (ug/L)	MS % REC	QC LIMITS
1,1-Dichloroethene	20	0	13.4	67	61-145
Trichloroethene	20	0	17.3	87	71-120
Benzene	20	0	18.6	93	76-127
Toluene	20	0	17.6	88	76-125
Chlorobenzene	20	0	18.1	91	75-130

VALUES OUTSIDE OF QC LIMITS:

RECOVERY: 0

COMMENTS:

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

10/26/94

PHOENIX ANALYTICAL LABORATORIES INC.

01-Nov-94

Joe Pollara
Adrian Brown Consultants
155 S. Madison
Suite 302
Denver, CO 80209

P.A.L. Project: 6782C
Client Project: 1125A

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the water sample submitted on 10/28/94.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

001

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES INC.

ANALYTICAL SUMMARY REPORT

DATE SAMPLED: 10/26/94
DATE RECEIVED: 10/28/94
DATE ANALYZED: 10/31/94
REPORT DATE: 11/01/94
CLIENT: Adrian Brown Consultants
ANALYSIS: BTEX by EPA 8260
CLIENT PROJECT: 1125A
P.A.L. PROJECT: 6782C

ANALYTE CONCENTRATIONS DETECTED: ug/l (Water)

CLIENT SAMPLE	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
ABC-20	< 0.80	2	23	21

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the CLP capillary column VOA method. This includes blanks, standards, and GCMS tune checks. All such QC was conducted as required and found to be within acceptable limits.

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limit. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: Heidi Hayes

002

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES, INC.
VOLATILE QC EVALUATION SUMMARY

METHOD:	8260
INSTRUMENT:	N
P.A.L. PROJECT:	6782C
CLIENT PROJECT:	1125A
MATRIX:	WATER
REPORT DATE:	11/01/94
CRITERIA:	SW-846
# OF SAMPLES:	1

QC PARAMETER	% IN LIMITS	REMARKS
HOLDING TIMES:	100	
SAMPLE PRESERVATION:	YES	
BFB:	100	
DAILY CAL. STD.	100	
BLANK LEVELS	100	
IS AREAS	100	
IS RET TIMES	100	
SS RECOVERIES	100	
MATRIX SPIKE, DUP		
RECOVERIES	N/A	
RPD	N/A	
QC SPIKE		
RECOVERIES	N/A	

LABORATORY INTERPRETATION OF DATA QUALITY PARAMETERS:
DATA ACCURACY AND PRECISION WITHIN EXPECTED LIMITS?
YES X NO____

PRESERVATION REFERS TO CLIENT PRESERVATION
PLEASE REFER TO CASE NARRATIVE AND INDIVIDUAL DATA SHEETS FOR ADDITIONAL COMMENTS.

COMMENTS:

REPORTED BY: _____ APPROVED BY: Heidi Hayes

PHOENIX ANALYTICAL LABORATORIES INC.

REFERENCES FOR QC CONVENTIONS ADOPTED BY PHOENIX ANALYTICAL LABORATORIES

DATE: 1/1/92

THESE CONVENTIONS ARE GENERALLY USED. THEY ARE REVIEWED AT LEAST ANNUALLY, AND MAY NOT REFLECT CONVENTIONS CHOSEN FOR SPECIFIC PROJECTS.

ANALYSIS	QC CRITERION	REFERENCE
GCMS VOA	SURROGATES	1
(INCL. BTEX)	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GCMS SVOA		
	SURROGATES	1
	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GC VOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	INSTRUMENT TUNES (BFB)	2
	QC SPIKES	
GC SVOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	QC SPIKES	2
METALS		
	QC SPIKES	2, AND SPECIFIED BY QC STANDARD
	BLANKS	2
	DUPLICATES	2
	MATRIX SPIKES	2

1. CLP STATEMENT OF WORK, 1990
2. SW-846 IN THE SPECIFIC METHOD
3. LABORATORY CRITERION, 3X STANDARD DEVIATION
4. STANDARD METHODS
5. OTHER - SPECIFIED IN REPORT

#20 D:\QPRO\QAQC\QCREPORT

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

11/20-21/94

PHOENIX ANALYTICAL LABORATORIES INC.

06-Dec-94

Joe Pollara
155 S. Madison Street
Suite 302
Denver, CO 80209

P.A.L. Project: 6912
Client Project: 1125A

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the water and tenax samples submitted on November 23, 1994. The BTEX values for the water samples are reported in µg/l, and the BTEX values for the tenax sample are reported in total µg.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

001

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	**Adrian Brown Consultants**
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	6912
ANALYSIS:	**BTEX by EPA 8260**
DATE SAMPLED:	11/20/94 & 11/21/94
DATE RECEIVED:	11/23/94
DATE ANALYZED:	12/01/94
DATE REPORTED:	12/06/94
MATRIX:	Water
CONC: UNITS:	µg/l

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
COMPOSITE	3	2	15	57
INJECTION	< 0.80	1	< 0.80	1
BLANK	< 0.80	< 0.80	< 0.80	< 0.80
ABC-2	< 0.80	< 0.80	< 0.80	< 0.80
ABC-5	7	< 0.80	3	2
ABC-12	< 0.80	< 0.80	< 0.80	< 0.80
ABC-72	6	< 0.80	33	60
ABC-27	4	3	140	140
ABC-91	0.9	< 0.80	6	3
KNGW-2	< 0.80	< 0.80	22	27
KNMW-5	< 0.80	2	1	3

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

002

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	**Adrian Brown Consultants**
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	6912
ANALYSIS:	**BTEX by EPA 8260**
DATE SAMPLED:	11/20/94 & 11/21/94
DATE RECEIVED:	11/23/94
DATE ANALYZED:	12/01/94 & 12/02/94
DATE REPORTED:	12/06/94
MATRIX:	Water
CONC: UNITS:	µg/l

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
KNMW-6	< 0.80	< 0.80	2	3
KNMW-7	< 0.80	< 0.80	3	9
ABC-73	4	< 0.80	24	65
ABC-17	1	< 0.80	3	4
EPA 1-9	< 0.80	< 0.80	< 0.80	< 0.80
EPA 2-11	< 0.80	< 0.80	13	15
EPA 1-10	< 0.80	< 0.80	26	41

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	**Adrian Brown Consultants**
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	6912
ANALYSIS:	**BTEX by EPA 8260**
DATE SAMPLED:	11/20/94
DATE RECEIVED:	11/23/94
DATE ANALYZED:	12/06/94
DATE REPORTED:	12/06/94
MATRIX:	Tenax
CONC: UNITS:	**Total μg**

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
TOTAL AIR	< 0.004	0.041	< 0.004	0.013
BLANK AIR	< 0.004	0.008	< 0.004	< 0.004

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

PHOENIX ANALYTICAL LABORATORIES, INC.

VOLATILE QC EVALUATION SUMMARY

CLIENT:	**Adrian Brown Consultants**
METHOD:	**8260**
CRITERIA:	**SW-846**
INSTRUMENT:	N
P.A.L. PROJECT:	6912
CLIENT PROJECT:	1125A
MATRIX:	WATER & TENAX
# OF SAMPLES:	20, MS, MSD, QC SPIKE

QC PARAMETER:	% METHOD CRITERIA IN LIMITS	REMARKS
HOLDING TIME:	100	
SAMPLE PRESERVATION:	YES	
BFB TUNE:	100	
DAILY CAL. STD.:	100	
BLANK LEVELS:	100	
IS AREAS	100	
IS RET. TIMES	100	
SS RECOVERIES	100	
MATRIX SPIKE, DUP.		
RECOVERIES	100	
RPD	100	
QC SPIKE		
RECOVERIES	100	

LABORATORY INTERPRETATION OF DATA QUALITY PARAMETERS:
DATA ACCURACY AND PRECISION WITHIND EXPECTED LIMITS?

YES X NO_____

PRESERVATION REFERS TO CLIENT PRESERVATION

PLEASE REFER TO CASE NARRATIVE AND INDIVIDUAL DATA SHEETS FOR ADDITIONAL COMMENTS.

REPORTED BY: _____ REVIEWED BY: _____

PHOENIX ANALYTICAL LABORATORIES INC.

REFERENCES FOR QC CONVENTIONS ADOPTED BY PHOENIX ANALYTICAL LABORATORIES

DATE: 1/1/92

THESE CONVENTIONS ARE GENERALLY USED. THEY ARE REVIEWED AT LEAST ANNUALLY, AND MAY NOT REFLECT CONVENTIONS CHOSEN FOR SPECIFIC PROJECTS.

ANALYSIS	QC CRITERION	REFERENCE
GCMS VOA	SURROGATES	1
(INCL. BTEX)	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GCMS SVOA		
	SURROGATES	1
	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GC VOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	INSTRUMENT TUNES (BFB)	2
	QC SPIKES	
GC SVOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	QC SPIKES	2
METALS		
	QC SPIKES	2, AND SPECIFIED BY QC STANDARD
	BLANKS	2
	DUPLICATES	2
	MATRIX SPIKES	2

1. CLP STATEMENT OF WORK, 1990
2. SW-846 IN THE SPECIFIC METHOD
3. LABORATORY CRITERION, 3X STANDARD DEVIATION
4. STANDARD METHODS
5. OTHER - SPECIFIED IN REPORT

#20 D:\QPRO\QAQC\QCREPORT

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

12/17/94

PHOENIX ANALYTICAL LABORATORIES INC.

29-Dec-94

Joe Pollara
Adrian Brown Consultants
155 S. Madison Street
Suite 302
Denver, CO 80209

P.A.L. Project: 6990
Client Project: 1125A

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the water and tenax samples submitted on December 20, 1994. The results for the water samples are reported in µg/l, and the results for the tenax samples are reported in total µg.

Please note that several of the water samples were not adequately preserved with HCl to a pH of 2 or less. A table is included showing the pH of each sample. The fact that the several of the samples were not adequately preserved does not, in this case, affect the data because the samples were run within seven days of sampling. Had the samples been analyzed past the seven day hold time for non-preserved water samples, then the data would have been negatively impacted.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

001

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	**Adrian Brown Consultants**
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	6690
ANALYSIS:	**BTEX by EPA 8260**
DATE SAMPLED:	12/17/94
DATE RECEIVED:	12/20/94
DATE ANALYZED:	12/21/94
DATE REPORTED:	12/29/94
MATRIX:	Water
CONC: UNITS:	µg/l

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
COMPOSITE	1	2	5	33
INJECTION	< 0.80	< 0.80	< 0.80	3
BLANK	< 0.80	< 0.80	< 0.80	< 0.80
ABC-2	< 0.80	< 0.80	< 0.80	< 0.80
ABC-73	4	< 0.80	20	66
ABC-12	2	< 0.80	5	16
ABC-72	< 0.80	< 0.80	27	44
ABC-27	1	2	110	170
ABC-17	1	< 0.80	9	9
ABC-91	< 0.80	< 0.80	5	5

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	**Adrian Brown Consultants**
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	6690
ANALYSIS:	**BTEX by EPA 8260**
DATE SAMPLED:	12/17/94
DATE RECEIVED:	12/20/94
DATE ANALYZED:	12/21/94 & 12/22/94
DATE REPORTED:	12/29/94
MATRIX:	Water
CONC: UNITS:	µg/l

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
KNMW-7	< 0.80	1	5	15
KNMW-5	< 0.80	< 0.80	0.9	3
KNMW-6	< 0.80	< 0.80	1	2
KNGW-2	< 0.80	< 0.80	38	41
EPA 2-11	< 0.80	< 0.80	5	11
ABC-5	< 0.80	< 0.80	4	< 0.80
ABC-70	< 0.80	< 0.80	3	8
EPA 1-09	< 0.80	< 0.80	< 0.80	< 0.80
EPA 1-10	< 0.80	0.9	12	14

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

SUMMARY ANALYTICAL FORM

CLIENT:	Adrian Brown Consultants
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	~~6690~~ 6990 SH PAL 12-29-94
ANALYSIS:	pH of Water Samples
DATE SAMPLED:	12/17/94
DATE RECEIVED:	12/20/94
DATE ANALYZED:	12/21/94 & 12/22/94
DATE REPORTED:	12/29/94
MATRIX:	Water

CLIENT SAMPLE ID:	pH
COMPOSITE	7
INJECTION	7
BLANK	2
ABC-2	4
ABC-73	3
ABC-12	7
ABC-72	7
ABC-27	2
ABC-17	2
ABC-91	7

CLIENT SAMPLE ID:	pH
KNMW-7	2
KNMW-5	4
KNMW-6	5.5
KNGW-2	6
EPA 2-11	3
ABC-5	3
ABC-70	3
EPA 1-09	5
EPA 1-10	4

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

PHOENIX ANALYTICAL LABORATORIES, INC.

VOLATILE QC EVALUATION SUMMARY

CLIENT:	**Adrian Brown Consultants**
METHOD:	**8260**
CRITERIA:	**SW-846**
INSTRUMENT:	N
P.A.L. PROJECT:	6990
CLIENT PROJECT:	1125A
MATRIX:	WATER & TENAX
# OF SAMPLES:	24, MS, MSD

QC PARAMETER:	% METHOD CRITERIA IN LIMITS	REMARKS
HOLDING TIME:	100	
SAMPLE PRESERVATION:	PARTIAL-- See letter and pH summary sheet.	
BFB TUNE:	100	
DAILY CAL. STD.:	100	
BLANK LEVELS:	100	
IS AREAS	100	
IS RET. TIMES	100	
SS RECOVERIES	100	
MATRIX SPIKE, DUP.		
RECOVERIES	100	
RPD	100	
QC SPIKE		
RECOVERIES	N/A	

LABORATORY INTERPRETATION OF DATA QUALITY PARAMETERS:
DATA ACCURACY AND PRECISION WITHIND EXPECTED LIMITS?

YES ✓ NO_____

PRESERVATION REFERS TO CLIENT PRESERVATION

PLEASE REFER TO CASE NARRATIVE AND INDIVIDUAL DATA SHEETS FOR ADDITIONAL COMMENTS.

REPORTED BY: _____ REVIEWED BY: _____

PHOENIX ANALYTICAL LABORATORIES INC.

REFERENCES FOR QC CONVENTIONS ADOPTED BY PHOENIX ANALYTICAL LABORATORIES

DATE: 1/1/92

THESE CONVENTIONS ARE GENERALLY USED. THEY ARE REVIEWED AT LEAST ANNUALLY, AND MAY NOT REFLECT CONVENTIONS CHOSEN FOR SPECIFIC PROJECTS.

ANALYSIS	QC CRITERION	REFERENCE
GCMS VOA	SURROGATES	1
(INCL. BTEX)	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GCMS SVOA		
	SURROGATES	1
	MATRIX SPIKES	1
	BLANKS	1,2
	CALIBRATIONS	1,2
	INSTRUMENT TUNES (BFB)	1
	QC SPIKES	
GC VOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	INSTRUMENT TUNES (BFB)	2
	QC SPIKES	
GC SVOA		
	SURROGATES	2
	MATRIX SPIKES	2
	BLANKS	2
	CALIBRATIONS	2
	QC SPIKES	2
METALS		
	QC SPIKES	2, AND SPECIFIED BY QC STANDARD
	BLANKS	2
	DUPLICATES	2
	MATRIX SPIKES	2

1. CLP STATEMENT OF WORK, 1990
2. SW-846 IN THE SPECIFIC METHOD
3. LABORATORY CRITERION, 3X STANDARD DEVIATION
4. STANDARD METHODS
5. OTHER - SPECIFIED IN REPORT

#20 D:\QPRO\QAQC\QCREPORT

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

1-14 & 15-15

PHOENIX ANALYTICAL LABORATORIES INC.

20-Jan-95

Joe Pollara
Adrian Brown Consultants
155 S. Madison Street
Suite 302
Denver, CO 80209

P.A.L. Project: 7040
Client Project: 1125A

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the water and tenax samples submitted on January 17, 1994. Results for the water samples are reported in µg/l, and results for the tenax samples are reported in total µg.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

FILE → 1125
→ JRP (2)

001

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	Adrian Brown Consultants
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	7040
ANALYSIS:	BTEX by EPA 8260
DATE SAMPLED:	01/14/95 & 01/15/95
DATE RECEIVED:	01/17/95
DATE ANALYZED:	01/18/95
DATE REPORTED:	01/20/95
MATRIX:	Water
CONC: UNITS:	µg/l

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
KNMW-5	< 0.80	< 0.80	< 0.80	< 0.80
KNMW-6	< 0.80	< 0.80	1	< 0.80
BLANK	< 0.80	< 0.80	< 0.80	< 0.80
INJECTION	< 0.80	< 0.80	< 0.80	< 0.80
COMPOSITE	3	< 0.80	20	33
EPA 1-9	< 0.80	< 0.80	< 0.80	< 0.80
EPA 1-10	< 0.80	< 0.80	23	14
ABC-2	< 0.80	< 0.80	< 0.80	< 0.80
ABC-73	4	< 0.80	17	44

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	**Adrian Brown Consultants**
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	7040
ANALYSIS:	**BTEX by EPA 8260**
DATE SAMPLED:	01/14/95 & 01/15/95
DATE RECEIVED:	01/17/95
DATE ANALYZED:	01/18/95 & 01/19/95
DATE REPORTED:	01/20/95
MATRIX:	Water
CONC: UNITS:	µg/l

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
ABC-12	< 0.80	< 0.80	< 0.80	2
ABC-17	4	< 0.80	25	16
ABC-27	2	4	110	180
ABC-5	< 0.80	< 0.80	1	1
KNGW-2	< 0.80	< 0.80	52	42
ABC-91	1	< 0.80	7	6
KNMW-7	< 0.80	< 0.80	14	37
EPA 2-11	< 0.80	< 0.80	12	45

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	**Adrian Brown Consultants**
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	7040
ANALYSIS:	**BTEX by EPA 8260**
DATE SAMPLED:	01/15/95
DATE RECEIVED:	01/17/95
DATE ANALYZED:	01/20/95
DATE REPORTED:	01/20/95
MATRIX:	Tenax
CONC: UNITS:	**Total μg**

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
TOTAL AIR	< 0.004	0.007	0.009	0.047
BLANK AIR	< 0.004	0.011	< 0.004	0.007

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

GCMS QC Evaluation Summary

Report Date:1/20/95

Client: Adrian Brown Consultants
Method: EPA 8260
Criteria: SW-846
Instrument: N
PAL Project #: 7040
Client Project #: 1125A
Matrix: Water & Tenax
Number of Samples: 17 Water, MS, MSD; 2 Tenax

QC Parameter	Method Criteria Acceptance	Comments/Actions
Holding Times	☒Pass ☐Fail	
Sample Preservation	☒Pass ☐Fail	
Sample Storage	☒Pass ☐Fail	
Tune Evaluation	☒Pass ☒Fail	
Initial Calibration	☒Pass ☐Fail	
Continuing Calibration	☒Pass ☐Fail	
Method Blanks	☒Pass ☐Fail	
QC Spike Sample	☐Pass ☐Fail	NA
MS/MSD	☒Pass ☐Fail	
IS Areas	☒Pass ☐Fail	
Surrogate Recoveries	☒Pass ☐Fail	
Retention Times	☒Pass ☐Fail	

Laboratory Interpretation:

Data meets guidelines established within the SOP for the Phoenix Data Reporting Level **3.**

Refer to the case narrative and individual data sheets for additional comments and actions.

Data Reviewed by: _____ Approved by: _____

MATRIX SPIKE RECOVERY SUMMARY

Client ID:	1125A; ABC-91	Data File:	040N8068.D
Sample ID:	7040; 66484	MS Data File:	040N8069.D
Date Analyzed:	01/18/95	MSD Data File:	040N8070.D
Matrix:	Water		
QC Criteria:	SW-846	Conc. Units:	µg/L

MATRIX SPIKE Analyte	Sample Conc.	Spike added	Spike Res	Spike %Rec	QC LIMITS			FLAG
1,1-Dichloroethene	0	50	70	141	61	-	145	OK
Benzene	1	50	50	99	76	-	127	OK
Trichloroethene	0	50	50	100	71	-	120	OK
Toluene	0	50	46	92	76	-	125	OK
Chlorobenzene	0	50	49	98	75	-	130	OK

MATRIX SPIKE DUPLICATE Analyte	Sample Conc.	Spike added	Spike Res	Spike %Rec	RPD %	QC RPD	QC LIMITS			FLAG
1,1-Dichloroethene	0	50	63	126	11	14	61	-	145	OK
Benzene	1	50	45	88	12	11	76	-	127	OK
Trichloroethene	0	50	45	90	10	14	71	-	120	OK
Toluene	0	50	43	85	7	13	76	-	125	OK
Chlorobenzene	0	50	45	89	10	13	75	-	130	OK

Values outside QC limits:

Recoveries: **0**

RPD: **1**

2-8-95

PHOENIX
ANALYTICAL
LABORATORIES
INC.

10-Feb-95

Joe Pollara
Adrian Brown Consultants
155 S. Madison Street
Suite 230
Denver, CO 80209

P.A.L. Project: 7095
Client Project: 1125A

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the water sample submitted on February 09, 1995. BTEX analytes were detected in the sample.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

RECEIVED
4

001

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	**Adrian Brown Consultants**
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	7095
ANALYSIS:	**BTEX by EPA 8260**
DATE SAMPLED:	02/08/95
DATE RECEIVED:	02/09/95
DATE ANALYZED:	02/09/95
DATE REPORTED:	02/10/95
MATRIX:	Water
CONC: UNITS:	**µg/l**

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
ABC-9	**2**	**< 0.80**	**6**	**6**

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

002

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

GCMS QC Evaluation Summary

Report Date:2/10/95

Client: Adrian Brown Consultants
Method: EPA 8260
Criteria: SW-846
Instrument: N
PAL Project #: 7095
Client Project #: 1125A
Matrix: Water
Number of Samples: 1

QC Parameter	Method Criteria Acceptance	Comments/Actions
Holding Times	☒Pass ☐Fail	
Sample Preservation	☒Pass ☐Fail	Sample not preserved. Samples run within seven days; no impact on data.
Sample Storage	☒Pass ☐Fail	
Tune Evaluation	☒Pass ☐Fail	
Initial Calibration	☒Pass ☐Fail	
Continuing Calibration	☒Pass ☐Fail	
Method Blanks	☒Pass ☐Fail	
QC Spike Sample	☐Pass ☐Fail	NA
MS/MSD	☐Pass ☐Fail	NA
IS Areas	☒Pass ☐Fail	
Surrogate Recoveries	☒Pass ☐Fail	
Retention Times	☒Pass ☐Fail	

Laboratory Interpretation:

Data meets guidelines established within the SOP for the Phoenix Data Reporting Level **3.**

Refer to the case narrative and individual data sheets for additional comments and actions.

Data Reviewed by: _____ Approved by: _____

2-13-95

PHOENIX
ANALYTICAL
LABORATORIES
INC.

28-Feb-95

Joe Pollara
Adrian Brown Consultants
155 S. Madison Street
Suite 230
Denver, CO 80209

P.A.L. Project: 7095A
Client Project: 1125A

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the water, soil and tenax samples submitted on February 18, 1995. Results are reported in µg/l for the water samples, µg/Kg for the soil samples and total µg for the tenax samples.

If you have any questions, please call.

Sincerely,

Lonnie Fahn
Laboratory Manager

001

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	**Adrian Brown Consultants**
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	7095A
ANALYSIS:	**BTEX by EPA 8260**
DATE SAMPLED:	02/13/95
DATE RECEIVED:	02/18/95
DATE ANALYZED:	02/20/95
DATE REPORTED:	02/28/95
MATRIX:	Water
CONC: UNITS:	µg/l

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
BLANK	< 0.8	< 0.8	< 0.8	< 0.8
COMPOSITE	2	< 0.8	11	20
INJECTION	< 0.8	< 0.8	< 0.8	< 0.8
ABC-17	2	< 0.8	18	12
ABC-91	1	< 0.8	11	11
KNMW-7	< 0.8	< 0.8	5	10
KNGW-2	< 0.8	< 0.8	32	45
KNMW-6	< 0.8	< 0.8	1	< 0.8
KNMW-5	< 0.8	< 0.8	1	< 0.8
ABC-27	1	2	70	120

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

002

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	Adrian Brown Consultants
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	7095A
ANALYSIS:	BTEX by EPA 8260
DATE SAMPLED:	02/13/95
DATE RECEIVED:	02/18/95
DATE ANALYZED:	02/21/95
DATE REPORTED:	02/28/95
MATRIX:	Water
CONC: UNITS:	µg/l

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
ABC-2	< 0.8	< 0.8	< 0.8	< 0.8
ABC-12	< 0.8	< 0.8	< 0.8	2
ABC-5	< 0.8	< 0.8	2	< 0.8
ABC-73	2	< 0.8	6	16
ABC-70	< 0.8	< 0.8	3	7
ABC-72	4	< 0.8	31	50
EPA 2-11	< 0.8	< 0.8	6	11
EPA 1-10	< 0.8	< 0.8	15	8
EPA 1-9	< 0.8	< 0.8	< 0.8	< 0.8

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

003

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

GCMS QC Evaluation Summary

Report Date: 2/28/95

Client: Adrian Brown Consultants
Method: EPA 8260
Criteria: SW-846
Instrument: N
PAL Project #: 7095A
Client Project #: 1125A
Matrix: Water, Soil & Tenax
Number of Samples: 27, MS, MSD, QC Spike

QC Parameter	Method Criteria Acceptance	Comments/Actions
Holding Times	☒Pass ☐Fail	
Sample Preservation	☒Pass ☐Fail	
Sample Storage	☒Pass ☐Fail	
Tune Evaluation	☒Pass ☐Fail	
Initial Calibration	☒Pass ☐Fail	
Continuing Calibration	☒Pass ☐Fail	
Method Blanks	☒Pass ☐Fail	
QC Spike Sample	☒Pass ☐Fail	
MS/MSD	☒Pass ☐Fail	
IS Areas	☒Pass ☐Fail	
Surrogate Recoveries	☒Pass ☐Fail	
Retention Times	☒Pass ☐Fail	

Laboratory Interpretation:

Data meets guidelines established within the SOP for the Phoenix Data Reporting Level **3.**

Refer to the case narrative and individual data sheets for additional comments and actions.

Data Reviewed by: _____ Approved by: _____

006

3-16-75

PHOENIX
ANALYTICAL
LABORATORIES
INC.

28-Mar-95

Joe Pollara
Adrian Brown Consultants
155 S. Madison Street
Suite 230
Denver, CO 80209

P.A.L. Project: 7207
Client Project: 1125A

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the water samples submitted on March 18, 1995.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

RECEIVED
MAR 30 1995

001

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	**Adrian Brown Consultants**
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	7207
ANALYSIS:	**BTEX by EPA 8260**
DATE SAMPLED:	03/16/95
DATE RECEIVED:	03/18/95
DATE ANALYZED:	03/20/95
DATE REPORTED:	03/28/95
MATRIX:	Water
CONC: UNITS:	µg/l

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
INJECTION	< 0.8	< 0.8	< 0.8	< 0.8
COMPOSITE	0.8	< 0.8	7	14
ABC-34	13	< 0.8	90	100
ABC-2	< 0.8	< 0.8	< 0.8	< 0.8
EPA 1-9	< 0.8	< 0.8	< 0.8	< 0.8
ABC-12	< 0.8	< 0.8	< 0.8	< 0.8
ABC-27	3	5	150	280
ABC-17	2	< 0.8	34	22
EPA 1-10	< 0.8	< 0.8	14	9
ABC-5	< 0.8	< 0.8	< 0.8	< 0.8

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

002

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	**Adrian Brown Consultants**
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	7207
ANALYSIS:	**BTEX by EPA 8260**
DATE SAMPLED:	03/16/95 & 03/17/95
DATE RECEIVED:	03/18/95
DATE ANALYZED:	03/20/95 & 03/21/95
DATE REPORTED:	03/28/95
MATRIX:	Water
CONC: UNITS:	µg/l

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
ABC-91	< 0.8	< 0.8	< 0.8	< 0.8
KNMW-7	< 0.8	< 0.8	0.9	2
KNGW-2	< 0.8	0.9	54	64
KNMW-6	< 0.8	< 0.8	0.8	< 0.8
KNMW-5	< 0.8	< 0.8	< 0.8	< 0.8
BLANK	< 0.8	< 0.8	< 0.8	< 0.8
ABC-70	< 0.8	< 0.8	4	10
ABC-73	0.9	< 0.8	4	10
ABC-72	2	1	19	30
EPA 2-11	< 0.8	< 0.8	1	< 0.8
TRIP BLANK	< 0.8	< 0.8	< 0.8	< 0.8

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

003

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

GCMS QC Evaluation Summary

Report Date: 3/28/95

Client: Adrian Brown Consultants
Method: EPA 8260
Criteria: SW-846
Instrument: N
PAL Project #: 7207
Client Project #: 1125A
Matrix: Water
Number of Samples: 21, MS, MSD, 2 QC Spikes

QC Parameter	Method Criteria Acceptance	Comments/Actions
Holding Times	☒Pass ☐Fail	
Sample Preservation	☒Pass ☐Fail	Samples ABC-34, ABC-27 & KNMW-6 not preserved. All run within seven days of sampling; no impact on data.
Sample Storage	☒Pass ☐Fail	
Tune Evaluation	☒Pass ☐Fail	
Initial Calibration	☒Pass ☐Fail	
Continuing Calibration	☒Pass ☐Fail	
Method Blanks	☒Pass ☐Fail	
QC Spike Sample	☒Pass ☐Fail	
MS/MSD	☒Pass ☐Fail	
IS Areas	☒Pass ☐Fail	
Surrogate Recoveries	☒Pass ☐Fail	
Retention Times	☒Pass ☐Fail	

Laboratory Interpretation:

Data meets guidelines established within the SOP for the Phoenix Data Reporting Level **3.**

Refer to the case narrative and individual data sheets for additional comments and actions.

004

Data Reviewed by: _____ Approved by: _____

4-6-95

PHOENIX ANALYTICAL LABORATORIES INC.

11-Apr-95

Joe Pollara
Adrian Brown Consultants
155 S. Madison Street
Suite 230
Denver, CO 80209

P.A.L. Project: 7264
Client Project: 1125K

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the water sample submitted on April 07, 1995.

If you have any questions, please call.

Sincerely,

Lonnie Fahn
Laboratory Manager

001

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	**Adrian Brown Consultants**
CLIENT PROJECT:	1125K
P.A.L. PROJECT:	7264
ANALYSIS:	**BTEX by EPA 8260**
DATE SAMPLED:	04/06/95
DATE RECEIVED:	04/07/95
DATE ANALYZED:	04/07/95
DATE REPORTED:	04/11/95
MATRIX:	Water
CONC: UNITS:	µg/l

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
ABC-34	**3**	**< 0.8**	**20**	**29**

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

GCMS QC Evaluation Summary

Report Date:4/11/95

Client: Adrian Brown Consultants
Method: EPA 8260
Criteria: SW-846
Instrument: N
PAL Project #: 7264
Client Project #: 1125K
Matrix: Water
Number of Samples: 1, QC Spike

QC Parameter	Method Criteria Acceptance	Comments/Actions
Holding Times	☒Pass ☐Fail	
Sample Preservation	☒Pass ☐Fail	
Sample Storage	☒Pass ☐Fail	
Tune Evaluation	☒Pass ☐Fail	
Initial Calibration	☒Pass ☐Fail	
Continuing Calibration	☒Pass ☐Fail	
Method Blanks	☒Pass ☐Fail	
QC Spike Sample	☒Pass ☐Fail	
MS/MSD	☐Pass ☐Fail	NA
IS Areas	☒Pass ☐Fail	
Surrogate Recoveries	☒Pass ☐Fail	
Retention Times	☒Pass ☐Fail	

Laboratory Interpretation:

Data meets guidelines established within the SOP for the Phoenix Data Reporting Level **3.**

Refer to the case narrative and individual data sheets for additional comments and actions.

Data Reviewed by: _____ Approved by: _____

003

4/18-19/95

PHOENIX ANALYTICAL LABORATORIES INC.

26-Apr-95

Joe Pollara
Adrian Brown Consultants
155 S. Madison Street
Suite 230
Denver, CO 80209

P.A.L. Project: 7307
Client Project: 1125A

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the water and tenax samples submitted on April 21, 1995. The results for the water samples are reported in µg/l, and the results for the tenax samples are reported in total µg.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

PHOENIX
-2

001

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	**Adrian Brown Consultants**
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	7307
ANALYSIS:	**BTEX by EPA 8260**
DATE SAMPLED:	04/18/95 & 04/19/95
DATE RECEIVED:	04/21/95
DATE ANALYZED:	04/24/95
DATE REPORTED:	04/26/95
MATRIX:	Water
CONC: UNITS:	µg/l

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
EPA 2-11	< 0.8	< 0.8	5	11
EPA 1-9	< 0.8	< 0.8	< 0.8	< 0.8
EPA 1-10	< 0.8	< 0.8	8	4
ABC-73	3	< 0.8	12	50
ABC-70	< 0.8	< 0.8	3	6
KNMW-7	< 0.8	< 0.8	< 0.8	< 0.8
KNMW-5	< 0.8	< 0.8	< 0.8	< 0.8
KNMW-6	< 0.8	< 0.8	< 0.8	< 0.8
KNGW-2	< 0.8	< 0.8	2	1
ABC-91	< 0.8	< 0.8	1	2

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

002

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	**Adrian Brown Consultants**
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	7307
ANALYSIS:	**BTEX by EPA 8260**
DATE SAMPLED:	04/19/95
DATE RECEIVED:	04/21/95
DATE ANALYZED:	04/24/95 & 04/25/95
DATE REPORTED:	04/26/95
MATRIX:	Water
CONC: UNITS:	µg/l

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
ABC-17	< 0.8	< 0.8	< 0.8	< 0.8
ABC-27	< 0.8	< 0.8	15	28
ABC-12	< 0.8	< 0.8	< 0.8	< 0.8
ABC-5	< 0.8	< 0.8	< 0.8	< 0.8
COMPOSITE	< 0.8	< 0.8	3	11
INJECTION	< 0.8	< 0.8	< 0.8	< 0.8
ABC-2	< 0.8	< 0.8	< 0.8	< 0.8
BLANK	< 0.8	< 0.8	< 0.8	< 0.8
TRIP BLANK	< 0.8	< 0.8	< 0.8	< 0.8

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

003

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	**Adrian Brown Consultants**
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	7307
ANALYSIS:	**BTEX by EPA 8260**
DATE SAMPLED:	04/19/95
DATE RECEIVED:	04/21/95
DATE ANALYZED:	04/25/95
DATE REPORTED:	04/26/95
MATRIX:	Tenax
CONC: UNITS:	**Total μg**

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
TOTAL AIR	**< 0.004**	**0.03**	**0.024**	**0.161**
BLANK AIR	**< 0.004**	**< 0.004**	**< 0.004**	**< 0.004**

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

004

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

GCMS QC Evaluation Summary

Report Date: 4/26/95

Client: Adrian Brown Consultants
Method: EPA 8260
Criteria: SW-846
Instrument: N
PAL Project #: 7307
Client Project #: 1125A
Matrix: Water & Tenax
Number of Samples: 21, MS, MSD, 2 QC Spikes

QC Parameter	Method Criteria Acceptance	Comments/Actions
Holding Times	☒Pass ☐Fail	
Sample Preservation	☒Pass ☐Fail	
Sample Storage	☒Pass ☐Fail	
Tune Evaluation	☒Pass ☐Fail	
Initial Calibration	☒Pass ☐Fail	
Continuing Calibration	☒Pass ☐Fail	
Method Blanks	☒Pass ☐Fail	
QC Spike Sample	☒Pass ☐Fail	
MS/MSD	☒Pass ☐Fail	
IS Areas	☒Pass ☐Fail	
Surrogate Recoveries	☒Pass ☐Fail	
Retention Times	☒Pass ☐Fail	

Laboratory Interpretation:

Data meets guidelines established within the SOP for the Phoenix Data Reporting Level **3.**

Refer to the case narrative and individual data sheets for additional comments and actions.

Data Reviewed by: _____ Approved by: _____

005

PHOENIX ANALYTICAL LABORATORIES INC.

30-May-95

Joe Pollara
Adrian Brown Consultants
155 S. Madison
Suite 302
Denver, CO 80209

P.A.L. Project: 7385
Client Project: 1125A

Dear Joe:

Enclosed are the results of the EPA 8260 BTEX analysis for the water and tenax samples submitted on May 19, 1995. Results are reported in µg/l for the water samples and total µg for the tenax samples.

If you have any questions, please call.

Sincerely,

Lonnie Fallin
Laboratory Manager

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	Adrian Brown Consultants
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	7385
ANALYSIS:	BTEX by EPA 8260
DATE SAMPLED:	05/16/95
DATE RECEIVED:	05/19/95
DATE ANALYZED:	05/22/95
DATE REPORTED:	05/30/95
MATRIX:	Water
CONC: UNITS:	µg/l

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
KNMW-6	< 0.8	< 0.8	< 0.8	< 0.8
KNGW-2	< 0.8	< 0.8	22	27
KNMW-5	< 0.8	< 0.8	< 0.8	< 0.8
ABC-91	< 0.8	< 0.8	< 0.8	< 0.8
KNMW-7	< 0.8	< 0.8	10	19
ABC-17	5	< 0.8	33	35
ABC-27	2	1	62	95
ABC-12	3	< 0.8	4	11
ABC-72	< 0.8	< 0.8	9	17
ABC-73	3	< 0.8	19	47
ABC-2	< 0.8	< 0.8	< 0.8	< 0.8

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	Adrian Brown Consultants
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	7385
ANALYSIS:	BTEX by EPA 8260
DATE SAMPLED:	05/15/95 & 05/16/95
DATE RECEIVED:	05/19/95
DATE ANALYZED:	05/22/95 & 05/23/95
DATE REPORTED:	05/30/95
MATRIX:	Water
CONC: UNITS:	µg/l

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
ABC-70	< 0.8	< 0.8	4	10
COMPOSITE	< 0.8	< 0.8	4	11
INJECTION	< 0.8	< 0.8	< 0.8	< 0.8
ABC-5	< 0.8	< 0.8	3	< 0.8
BLANK	< 0.8	< 0.8	< 0.8	< 0.8
EPA 2-11	< 0.8	< 0.8	5	10
EPA 1-9	1	< 0.8	5	< 0.8
EPA 1-10	< 0.8	< 0.8	1	< 0.8

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

SUMMARY ANALYTICAL FORM

PHOENIX ANALYTICAL LABORATORIES INC.

CLIENT:	Adrian Brown Consultants
CLIENT PROJECT:	1125A
P.A.L. PROJECT:	7385
ANALYSIS:	BTEX by EPA 8260
DATE SAMPLED:	05/16/95
DATE RECEIVED:	05/19/95
DATE ANALYZED:	05/30/95
DATE REPORTED:	05/30/95
MATRIX:	Tenax
CONC: UNITS:	Total μg

CLIENT SAMPLE ID:	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES
TOTAL AIR	< 0.004	< 0.004	0.011	0.066
BLANK AIR	< 0.004	< 0.004	< 0.004	< 0.004

** All "<" values are MDLs.

QUALITY CONTROL:

This method is a GCMS technique, and the quality control is as in the SW-846 capillary column volatiles method. This includes daily tune checks, daily calibration checks, daily blanks and appropriate spikes. All such QC was conducted as required and found to be within acceptable limits.

REPORTING QUALIFIERS:

"J": Indicates that the analyte concentration was found between the quantitation limit and the detection limit or otherwise outside of the calibration limits. The value seen is therefore an estimate.

"B": Indicates that the analyte was present in the daily blank. The value seen has been corrected to reflect this.

REPORTED BY: _____ REVIEWED BY: _____

3401 industrial lane • broomfield, colorado 80020 • 303/469-1101

GCMS QC Evaluation Summary

Report Date:5/30/95

Client: Adrian Brown Consultants
Method: EPA 8260
Criteria: SW-846
Instrument: N
PAL Project #: 7385
Client Project #: 1125A
Matrix: Water & Tenax
Number of Samples: 21, MS, MSD, 2 QC Spikes

QC Parameter	Method Criteria Acceptance	Comments/Actions
Holding Times	☒Pass ☐Fail	
Sample Preservation	☒Pass ☐Fail	
Sample Storage	☒Pass ☐Fail	
Tune Evaluation	☒Pass ☐Fail	
Initial Calibration	☒Pass ☐Fail	
Continuing Calibration	☒Pass ☐Fail	
Method Blanks	☒Pass ☐Fail	
QC Spike Sample	☒Pass ☐Fail	
MS/MSD	☒Pass ☐Fail	
IS Areas	☒Pass ☐Fail	
Surrogate Recoveries	☒Pass ☐Fail	
Retention Times	☒Pass ☐Fail	

Laboratory Interpretation:

Data meets guidelines established within the SOP for the Phoenix Data Reporting Level 3.

Refer to the case narrative and individual data sheets for additional comments and actions.

Data Reviewed by: _____ Approved by: _____

APPENDIX C

APPENDIX C-1

NAME: KN-ABC-SB-01

GEOLOGIC LOG

PROJ. NO: 1125J
DATE DRILLED: 7/15/93
CONTRACTOR: A. Morris & Associates
DRILLER: A. Morris Jr.
DRILLING METHOD: HSA
HAMMER WEIGHT: 140 lbs
LOGGED BY:

SHEET 1 OF 1

COMPLETION INFORMATION
BOREHOLE COMPLETED AS WELL? YES / (NO)
DEPTH OF WATER ENCOUNTERED: _____ FT.
BOREHOLE DIAMETER: _____ IN.
CASING DIAMETER: _____ IN.
CASING GAGE: SCHEDULE _____
SCREEN SLOT SIZE: _____ IN.
SCREEN SET FROM _____ FT. TO _____ FT.
TOTAL DEPTH DRILLED _____ FT.

DEPTH (FEET)	LOG	BLOWS/ DEPTH	DESCRIPTION	HNu/PID (ppm) 0 100 200	WELL COMPLETION
0					
5		55/74"	SS Coarse/medium sand; dry with gravel; clean	1	
10		37/24"	SS Medium-coarse sand with some gravel; mostly dry	0.75	
15		63/24"	SS Fine-medium grained sand; dry	2	
20		85/12"	SS 3" sample - Medium sand with gravel; dry	5	
25		89/24"	SS Medium-coarse sand; wet at 26'; bottom 3" grey in color	2	
30		20/6"	Black stained wet coarse sand	17	
35		89/18"	SS Coarse/medium sand; black stained and wet	130	
40		36/12"	SS Medium-coarse sand; grey and wet	20	
45			SS No sample, but for 1-2" clean coarse sand; no odor		
		45/24"	SS Coarse/medium sand; clean; greyish color; no odor	10	
50					

SAND
GRAVEL
SILT
BEDROCK
CLAY

ADRIAN BROWN CONSULTANTS, INC.

NAME: KN-ABC-SB-02

GEOLOGIC LOG

PROJ. NO: 1125J
DATE DRILLED: 7/16/93
CONTRACTOR: A. Morris & Associates
DRILLER: A. Morris Jr.
DRILLING METHOD: HSA
HAMMER WEIGHT: 140 lbs
LOGGED BY:

SHEET 1 OF 1

COMPLETION INFORMATION
BOREHOLE COMPLETED AS WELL? YES / (NO.)
DEPTH OF WATER ENCOUNTERED: _____ FT.
BOREHOLE DIAMETER: _____ IN.
CASING DIAMETER: _____ IN.
CASING GAGE: SCHEDULE _____
SCREEN SLOT SIZE: _____ IN.
SCREEN SET FROM _____ FT. TO _____ FT.
TOTAL DEPTH DRILLED _____ FT.

DEPTH (FEET)	LOG	BLOWS/ DEPTH	DESCRIPTION	HNu/PID (ppm) 0 100 200	WELL COMPLETION
5		22	Sand; yellow/brown very coarse; no stain or odor; 25% gravel at 6.5 feet	2	
10		38	Sand; yellow/brown very coarse; no stain or odor	2	
15		11	Sand; yellow/brown; very coarse; no stain or odor	2	
20		18	Sand; yellow/brown; very coarse; some gravel; trace light stain @ bottom; slight odor	3	
25		48	Sand medium-dark grey; banded very coarse gravel	120	
30		55	Sand; medium-dark grey; very coarse gravel; trace gravel at 31.2 feet	190	
35		220	Sand; grey; very coarse; strong odor	24	
40		38	Sand; yellow/brown, very coarse grained with fine gravel	30	
45		67	Yellow/brown very coarse sand; grey at bottom with sandstone pebbles	16	
50					

SAND
GRAVEL
SILT
BEDROCK
CLAY

BACKGROUND = 2 ppm

ADRIAN BROWN CONSULTANTS, INC.

NAME: KN-ABC-SB-03

GEOLOGIC LOG

PROJ. NO: 1125J
DATE DRILLED: 7/16/93
CONTRACTOR: A. Morris & Associates
DRILLER: A. Morris Jr.
DRILLING METHOD: HSA
HAMMER WEIGHT: 140 lbs
LOGGED BY:

SHEET 1 OF 1

COMPLETION INFORMATION
BOREHOLE COMPLETED AS WELL? YES / (NO.)
DEPTH OF WATER ENCOUNTERED: _____ FT.
BOREHOLE DIAMETER: _____ IN.
CASING DIAMETER: _____ IN.
CASING GAGE: SCHEDULE _____
SCREEN SLOT SIZE: _____ IN.
SCREEN SET FROM _____ FT. TO _____ FT.
TOTAL DEPTH DRILLED _____ FT.

DEPTH (FEET)	LOG	BLOWS/ DEPTH	DESCRIPTION	HNu/PID (ppm) 0 100 200	WELL COMPLETION
0					
5			Silty clay; brown Yellow coarse grained sand		
10			Sand; light grey; coarse grained; well saturated	2	
15			Sand; light grey; coarse grained; well saturated	2	
20			Sand; yellow/brown; coarse grained Dark yellow at bottom	2	
25		27/18	Sand; light grey; well saturated; very coarse grained; strong odor	55	
30			Sand; dark grey; very coarse grained; strong odor	150	
35			Sand; dark grey; very coarse; partially saturated; strong odor	48	
40			Sand; dark grey; strong odor;	18	
45			18" dark grey sand; 6" yellow/brown sand; very coarse - grit	17	
50			18" banded yel/brn/gy bedrock (shale)51.75' yel/brn silty clasts; gy bds	3	

SAND
SILT
CLAY
GRAVEL
BEDROCK

BACKGROUND = 2 ppm

ADRIAN BROWN CONSULTANTS, INC.

NAME: KN-ABC-SB-04

GEOLOGIC LOG

PROJ. NO: 1125J
DATE DRILLED: 7/19/93
CONTRACTOR: A. Morris & Associates
DRILLER: A. Morris Jr.
DRILLING METHOD: HSA
HAMMER WEIGHT: 140 lbs
LOGGED BY:

SHEET 1 OF 1

COMPLETION INFORMATION
BOREHOLE COMPLETED AS WELL? YES / (NO.)
DEPTH OF WATER ENCOUNTERED: _____ FT.
BOREHOLE DIAMETER: _____ IN.
CASING DIAMETER: _____ IN.
CASING GAGE: SCHEDULE _____
SCREEN SLOT SIZE: _____ IN.
SCREEN SET FROM _____ FT. TO _____ FT.
TOTAL DEPTH DRILLED _____ FT.

DEPTH (FEET)	LOG	BLOWS/ DEPTH	DESCRIPTION	HNu/PID (ppm) 0 100 200	WELL COMPLETION
0					
5			Silty clay, brown sand at bottom	2	
10			Sand; light yellow/grey; very coarse	2	
15			Sand	2	
20			Sand; light yellow/brown; very coarse; pebbles	2	
25			Sand; light yellow/brown; very coarse grained;	2	
30			Sand; light brown - brown very coarse; slight odor	2	
35			Sand; dark grey; very coarse; strong odor	80	
40			Sand; black; very coarse; moderate odor;	17	
45			Sand; black; very coarse; moderate odor;	30	
50			Clastic yellow/brown; no odor	2	

SAND
SILT
CLAY
GRAVEL
BEDROCK

BACKGROUND = 2 ppm

ADRIAN BROWN CONSULTANTS, INC.

NAME: KN-ABC-SB-05

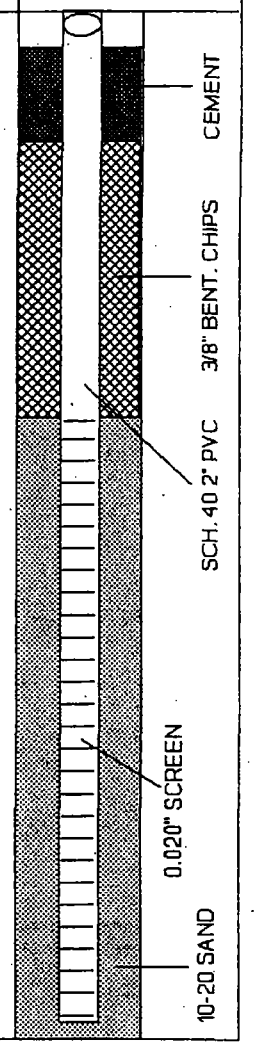
GEOLOGIC LOG

PROJ. NO: 1125J
DATE DRILLED: 7/19/93
CONTRACTOR: A. Morris & Associates
DRILLER: A. Morris Jr.
DRILLING METHOD: HSA
HAMMER WEIGHT: 140 lbs
LOGGED BY:

SHEET 1 OF 1

COMPLETION INFORMATION
BOREHOLE COMPLETED AS: KNABC-91
DEPTH OF WATER ENCOUNTERED: ____ FT.
BOREHOLE DIAMETER: 7 5/8" IN.
CASING DIAMETER: 2 IN.
CASING GAGE: PVC SCHEDULE 40
SCREEN SLOT SIZE: 0.020" IN.
SCREEN SET FROM 18.75 FT. TO 48.75 FT.
TOTAL DEPTH DRILLED 50 FT.

DEPTH (FEET)	LOG	BLOWS/ DEPTH	DESCRIPTION	HNu/PID (ppm) 0 100 200	WELL COMPLETION
0					
5			Silty clay, brown sand at bottom		
10			Sand, light brown, very coarse; 1/2 black stain at 11 feet, no odor		
15			Sand, light brown, very coarse, no odor		
20			Sand, light brown, very coarse; pebbles, no odor		
25			Sand, light yellow/brown, very coarse, well saturated, no odor		
30			Sand, dark grey, moderate odor, very coarse, poorly saturated; pebbles	20	
35			Sand, dark grey, moderate odor, very coarse, poorly saturated; pebbles	180	
40			Yellow/brown, very coarse sand		
45					
50					



SAND
GRAVEL
SILT
BEDROCK
CLAY

BACKGROUND = 2 ppm

ADRIAN BROWN CONSULTANTS, INC.

APPENDIX C-2

NAME: KN-ABC-SB-01A

GEOLOGIC LOG

PROJ. NO: 1125J
DATE DRILLED: 2/22/95
CONTRACTOR: A. Morris & Associates
DRILLER: A. Morris Jr.
DRILLING METHOD: HSA
HAMMER WEIGHT: 140 lbs
LOGGED BY:

SHEET 1 OF 1

COMPLETION INFORMATION

BOREHOLE COMPLETED AS WELL? YES / (NO)
DEPTH OF WATER ENCOUNTERED: _____ FT.
BOREHOLE DIAMETER: _____ IN.
CASING DIAMETER: _____ IN.
CASING GAGE: SCHEDULE _____
SCREEN SLOT SIZE: _____ IN.
SCREEN SET FROM _____ FT. TO _____ FT.
TOTAL DEPTH DRILLED _____ FT.

DEPTH (FEET)	LOG	BLOWS/ DEPTH	DESCRIPTION	HNu / PID (0 100 200 300 400 500)	WELL COMPLETION
0					
5			SS yellow/brown sand; very coarse gravel; no odor	2	
10			SS light brown/ trace grey sand; very coarse; poorly sorted; no odor	Bkg	
15			SS light yellow/brown sand; coarse very coarse; no odor	Bkg	
20			SS brown sand; coarse-very coarse; poorly sorted; no stain; no odor	1	
25			SS brown sand; coarse-very coarse; poorly sorted; no stain; no odor	7	
30			SS very light grey sand; coarse-very coarse; poorly sorted; trace stain; trace odor	220	
35		Water	SS black sand; trace gravel; coarse-very coarse; poorly sorted; strong odor	500	
40			SS light brown/ trace grey sand; coarse-very coarse; poorly sorted; mod. odor	60	
45			SS light brown; coarse-very coarse gravel; poorly sorted; no stain; no odor	20	
50			50-51 gravel 51-51.5 shale		

SAND
SILT
CLAY
GRAVEL
BEDROCK
SHALE

BACKGROUND=.5 ppm

ADRIAN BROWN CONSULTANTS INC

GEOLOGIC LOG

NAME: KN-ABC-SB-02A
(Center of old pond)
PROJ. NO: 1125J
DATE DRILLED: 02/22/95
CONTRACTOR: A. Morris & Associates
DRILLER: A. Morris Jr.
DRILLING METHOD: HSA
HAMMER WEIGHT: 140 lbs
LOGGED BY:

SHEET 1 OF 1

COMPLETION INFORMATION
BOREHOLE COMPLETED AS WELL? YES / (NO)
DEPTH OF WATER ENCOUNTERED: _____ FT.
BOREHOLE DIAMETER: _____ IN.
CASING DIAMETER: _____ IN.
CASING GAGE: SCHEDULE _____
SCREEN SLOT SIZE: _____ IN.
SCREEN SET FROM _____ FT. TO _____ FT.
TOTAL DEPTH DRILLED _____ FT.

DEPTH (FEET)	LOG	BLOWS/ DEPTH	DESCRIPTION	HNu / PID (0 100 200 300 400 500)	WELL COMPLETION
0					
5			SS yellow/brown; trace grey; very coarse gravel	.5	
10			SS Sand; yellow/brown; trace grey; coarse-very coarse; well sorted; no odor	.5	
15			SS Sand; yellow/brown; coarse-very coarse; poorly sorted; no stain; no odor	.75	
20			SS Sand; yellow/brown; coarse-very coarse; poorly sorted; no stain; no odor	40	
25			SS Sand; light brown/yellow; trace grey; coarse-very coarse poorly sorted; mod. petroleum odor	5	
30			SS light brown; trace grey; coarse very coarse; poorly sorted; mod. odor	90	
35		Water	SS Sand; black; trace grey; coarse-very coarse; sheen on sample; strong odor	500	
40			SS light yellow; very coarse gravel; no stain; trace odor	40	
45			SS light yellow; very coarse gravel; no stain; no odor	20	
50			50-51 gravel shale @ 51		

SAND
SILT
CLAY
GRAVEL
BEDROCK
SHALE

BACKGROUND=.1.25 ppm

ADRIAN BROWN CONSULTANTS, INC.

NAME: KN-ABC-SB-03A

GEOLOGIC LOG

PROJ. NO: 1125J
DATE DRILLED: 02/16/95
CONTRACTOR: A. Morris & Associates
DRILLER: A. Morris Jr.
DRILLING METHOD: HSA
HAMMER WEIGHT: 140 lbs
LOGGED BY:

SHEET 1 OF 1

COMPLETION INFORMATION

BOREHOLE COMPLETED AS WELL? YES / (NO)
DEPTH OF WATER ENCOUNTERED: _____ FT.
BOREHOLE DIAMETER: _____ IN.
CASING DIAMETER: _____ IN.
CASING GAGE: SCHEDULE _____
SCREEN SLOT SIZE: _____ IN.
SCREEN SET FROM _____ FT. TO _____ FT.
TOTAL DEPTH DRILLED _____ FT.

DEPTH (FEET)	LOG	BLOWS/ DEPTH	DESCRIPTION	HNu / PID (0 100 200 300 400 500)	WELL COMPLETION
0					
5			Silty sand; brown	Bkg	
10			Sand; light grey; coarse; well sorted; no stain; no odor	Bkg	
15			Sand; brown; coarse to very coarse; poorly sorted; no stain; no odor	Bkg	
20			Sand; light brown; medium to coarse; poorly sorted; no stain; no odor	Bkg	
25			Sand; light brown; coarse very coarse; poorly sorted; no stain; no odor	5	
30			Sand and gravel; light grey and brown; coarse to very coarse; poorly sorted; no stain; no odor	Bkg	
			Sand and gravel; light grey and brown; coarse to very coarse; poorly sorted; black staining; mod. odor	75	
35		Water	Sand; black; very coarse; poorly sorted; strong odor	300	
40			Sand; black; mixed brown and grey; coarse to very coarse; poorly sorted	60	
45			Sand and gravel; brown; coarse gravel; poorly sorted; no stain; no odor	60	
50			Gravel shale @ base; no sample		

SAND
SILT
CLAY
GRAVEL
BEDROCK
SHALE

BACKGROUND=1.25 ppm

ADRIAN BROWN CONSULTANTS, INC.

NAME: KN-ABC-SB-04A
(West of ABC-27)

GEOLOGIC LOG

PROJ. NO: 1125J
DATE DRILLED: 02/17/95
CONTRACTOR: A. Morris & Associates
DRILLER: A. Morris Jr.
DRILLING METHOD: HSA
HAMMER WEIGHT: 140 lbs
LOGGED BY:

SHEET 1 OF 1

COMPLETION INFORMATION

BOREHOLE COMPLETED AS WELL? YES / NO
DEPTH OF WATER ENCOUNTERED: _____ FT.
BOREHOLE DIAMETER: _____ IN.
CASING DIAMETER: _____ IN.
CASING GAGE: SCHEDULE _____
SCREEN SLOT SIZE: _____ IN.
SCREEN SET FROM _____ FT. TO _____ FT.
TOTAL DEPTH DRILLED _____ FT.

DEPTH (FEET)	LOG	BLOWS/ DEPTH	DESCRIPTION	HNu / PID (0 100 200 300 400 500)	WELL COMPLETION
0					
5			Silty clay; brown	Bkg	
			Sand; brown; coarse	Bkg	
10			Sand; coarse to very coarse; interbedded clayey brown	Bkg	
15			Gravel; no sample; no odor		
20			Gravel; no sample; no odor		
25			Sand; yellow/brown; coarse to very coarse; poorly sorted; no stain; no odor	Bkg	
30		Water	Sand; yellow/brown; medium to coarse; moderately sorted; no stain; no odor	Bkg	
35			Sand; black; coarse to very coarse; poorly sorted; strong odor	470	
40			Sand; black; coarse to very coarse; poorly sorted; strong odor	420	
45			Sand; Yellow/brown and trace grey; (wash) coarse to very coarse; poorly sorted	50	
50			Shale @ 50.5; no sample		

SAND
GRAVEL
SILT
BEDROCK
CLAY
SHALE

BACKGROUND=.5 ppm

ADRIAN BROWN CONSULTANTS, INC.

NAME: KN-ABC-SB-05A
(Twin ABC-91)

GEOLOGIC LOG

PROJ. NO: 1125J
DATE DRILLED: 02/16/95
CONTRACTOR: A. Morris & Associates
DRILLER: A. Morris Jr.
DRILLING METHOD: HSA
HAMMER WEIGHT: 140 lbs
LOGGED BY:

SHEET 1 OF 1

COMPLETION INFORMATION

BOREHOLE COMPLETED AS WELL? YES / NO
DEPTH OF WATER ENCOUNTERED: _____ FT.
BOREHOLE DIAMETER: _____ IN.
CASING DIAMETER: _____ IN.
CASING GAGE: SCHEDULE _____
SCREEN SLOT SIZE: _____ IN.
SCREEN SET FROM _____ FT. TO _____ FT.
TOTAL DEPTH DRILLED _____ FT.

DEPTH (FEET)	LOG	BLOWS/ DEPTH	DESCRIPTION	HNu / PID (0 100 200 300 400 500)	WELL COMPLETION
0					
5			Sand; light brown; coarse to very coarse; poorly sorted; occasional gravel; no stain; no odor	Bkg	
10			Sand; light brown; coarse to very coarse; poorly sorted; occasional gravel; no stain; no odor	2	
15			Sand; light brown; no gravel; no odor; no stain	Bkg	
20			Sand; light brown/yellow; coarse to very coarse; no stain; no odor; poorly sorted	Bkg	
25			Sand; coarse to very coarse; poorly sorted; no stain; no odor	Bkg	
30			Sand; light yellow/brown; poorly sorted; no stain; no odor	1.75	
35			Sand; black; coarse to very coarse; strong odor; sheen on water; sample	450	
40			Sand and gravel; brown and yellow; very coarse; strong odor	250	
45			Sand and gravel; brown and yellow; very coarse; strong odor	60	
50			Gravel no recovery; sheen @ 50.5		

SAND
GRAVEL
SILT
BEDROCK
CLAY
SHALE

BACKGROUND=1.25 ppm

ADRIAN BROWN CONSULTANTS, INC.

5B 1A 2/22/95 Bkg .5
Hnu

5-7 ss vc - gvav yel brn 2
no odor

10-12 ss vc lt brn pv sutd Bkg
tr gvav, no odor

15-17 ss, c-vc, m sutd Bkg
lt yel brn, no odor

20-22 ss, brn, c-vc, pv sutd 1
no stn no odor

25-27 ss as above 7

30-32 ss, v lt gy, c-vc pv sutd 220
tr stn tr odor

water
35-37 ss, blk, c-vc, pv sutd 500
tr gravel stg odor

40-42 ss lt brn + tr gray v-vc 60
pv sutd Mod odor

45-45 ss lt brn c-vc + gvav 20
pv sutd no stn tr odor

51.5 50-51 gravel 51-51.5
sh

Post-it® Fax Note 7671
To Joe Pollara
Co./Dept ABC
Phone #
Fax #
Date 3/24
From A. Harris
Co.
Phone #
Fax #
# of pages ▶ 3

2/17
SB 4A West of ABC-27

Hnu

5-6 slty cly brn — BKg
6-7 snd brn c
10-12 snd c-vc / intbd cly brn BKg
15-17 no sample gravel } no odor
20-22 no sample gravel }
25-27 snd, yel brn, c-vc pr sytd BKg
no stn no odor
30-32 snd, yel brn m-c m sytd BKg
no stn no odor
water
35-37 snd, blk c-vc pr sytd 470
stg odor
40-42 snd as above 420
45-47 snd yel brn + tr gy 50
(wash) c-vc pr sytd
51 sh @ 50.5 no sample

4/22/95 BKg .5
SB-2A center of old pond

Hnu

5-7 ss yel brn tr gy vc-gran .5
10-12 ss, tr gran, c-vc, w sytd .5
yel brn no odor
15-17 ss, yel brn, c-vc, p sytd .75
no stn no odor
20-22 ss as above 40
No stn tr odor
25-27 ss lt brn-yel, c-vc 5
+ tr gran p sytd
Mod pet odor
30-32 ss lt brn, tr gy 90
c-vc p sytd
Mod odor
Water
35-37 ss blk, c-vc, tr gran 500
sheen on sample
stg odor
40-42 ss lt yel vc-gran 40
no stn tr odor
45-47 ss as above 20
no stn no odor
51 50-51 gran
sh @ 51

NAME	DATE	Benzene (ug/l)	Toluene (ug/l)	Ethylbenzene (ug/l)	Xylenes (ug/l)	Total BTEX (ug/l)
SVE-63	8/24/93	0.12	0.94	0.1	0.68	1.84
SVE-64	8/24/93	1.56	0.74	0.1	0.58	2.98
SVE-65	8/24/93	0.2	0.76	0.1	0.52	1.58
SVE-66	8/24/93	0.2	0.94	0.22	1.74	3.1
SVE-67	8/24/93	< 0.08	1.52	0.32	1.26	3.18
SVE-68	8/24/93	0.12	0.82	0.12	0.64	1.7
SVE-69	8/24/93	0.14	0.84	0.08	0.70	1.76
SVE-80	8/24/93	3.34	2.2	0.58	1.96	8.08
SVE-81	8/24/93	< 0.08	1.94	< 0.06	0.52	2.6
SVE-82	8/24/93	0.12	0.9	0.1	0.74	1.86
SVE-89	8/24/93	< 0.08	0.84	0.08	0.7	1.7
SVE-63	2/9/94	< 0.08	0.36	< 0.06	< 0.16	< 0.66
SVE-64	2/9/94	< 0.08	0.28	< 0.06	< 0.16	< 0.58
SVG-1	2/9/94	< 0.08	0.54	< 0.06	< 0.16	< 0.76
SVE-29	3/16/94	< 0.08	0.46	0.22	0.5	1.26
SVE-63	3/16/94	< 0.18	1.24	0.3	0.74	2.36
SVE-65	3/16/94	0.08	0.74	0.46	2.22	3.6
SVE-66	3/16/94	< 0.22	0.78	0.38	0.92	2.16
SVE-80	3/16/94	0.24	0.7	0.22	0.94	2.08
SVE-81	3/16/94	0.08	0.86	0.18	0.78	2.06
SVE-63	4/21/94	< 0.08	0.4	< 0.06	< 0.16	< 0.7
SVE-64	4/21/94	< 0.08	0.22	< 0.06	< 0.16	< 0.52
SVE-65	4/21/94	< 0.08	0.3	< 0.06	0.22	0.66
SVE-66	4/21/94	< 0.08	0.24	< 0.06	< 0.16	< 0.54
SVE-80	4/21/94	< 0.08	1.1	< 0.06	< 0.16	< 1.4
SVE-81	4/21/94	< 0.08	0.98	< 0.06	< 0.16	< 1.28
SVE-63	8/5/94	< 0.12	0.1	< 0.06	0.18	0.42
SVE-66	8/5/94	0.08	0.38	< 0.06	0.32	0.88
SVE-81	8/5/94	< 0.08	0.24	< 0.06	0.26	0.64
SVE-82	8/5/94	< 0.08	0.24	< 0.06	< 0.16	< 0.54
SVE-60	10/24/94	< 0.08	0.28	< 0.06	0.28	0.7
SVE-63	10/24/94	< 0.08	0.18	0.1	0.54	0.9
SVE-67	10/24/94	< 0.08	0.3	< 0.08	0.34	0.8
SVE-68	10/24/94	< 0.08	0.16	< 0.08	< 0.08	< 0.4
SVE-28	12/17/94	< 0.08	0.5	0.3	1.82	2.7
SVE-48	12/17/94	< 0.08	0.16	0.24	1.64	2.12
SVE-69	12/17/94	< 0.12	0.14	0.1	0.84	1.16
SVE-28	1/23/95	0.08	0.2	< 0.08	0.5	0.9
SVE-48	1/23/95	< 0.08	< 0.08	< 0.08	0.36	0.6
SVE-69	1/23/95	< 0.08	0.14	< 0.08	0.58	0.88
SVE-28	2/13/95	< 0.08	0.2	< 0.08	< 0.08	< 0.44
SVE-48	2/13/95	< 0.08	0.2	< 0.08	< 0.08	< 0.44
SVE-69	2/13/95	< 0.08	0.12	< 0.08	< 0.08	< 0.36
SVE-63	4/5/95	< 0.08	0.32	< 0.08	0.16	0.64
SVE-64	4/5/95	< 0.08	0.36	< 0.08	0.22	0.74
SVE-65	4/5/95	< 0.08	0.26	< 0.08	< 0.08	< 0.5
SVE-66	4/5/95	< 0.08	0.1	< 0.08	< 0.08	< 0.34
SVE-67	4/5/95	< 0.08	0.24	< 0.08	< 0.08	< 0.48
SVE-68	4/5/95	< 0.08	0.2	< 0.08	< 0.08	< 0.44
SVE-69	4/5/95	< 0.1	0.22	< 0.08	< 0.08	< 0.46
SVE-80	4/5/95	0.08	0.32	< 0.08	< 0.08	< 0.58
SVE-81	4/5/95	< 0.08	0.26	< 0.08	< 0.08	< 0.5
SVE-82	4/5/95	< 0.08	0.28	< 0.08	< 0.08	< 0.52

KN ENERGY									
AIR SPARGING PROGRAM									
SOIL BETX REDUCTION									
AVG. REDUCTION OF BETX									
DUE TO AIR SPARGING		=	9915.15	ug/kg	(from BETX reduction in soil: SOIL_RES.XLS)				
AREA AFFECTED		=	75,000	ft^2					
THICKNESS OF SOIL		=	20	ft	(app. avg. thickness of stained soil)				
VOLUME OF SOIL		=	1500000	ft^3					
SOIL DENSITY		=	110	lbs/ft^3					
MASS OF STAINED SOIL		=	75000000	kg					
TOTAL BETX DESTRUCTION		=	743.6363	kg					
		=	1636	lbs.					
BETX COMPONENT									
OF FREE PRODUCT		=	14.00%		(from MSDS in Response to Comments on PPE Memo				
TOTAL HC DESTRUCTION		=	11685.71	lbs.					
transfer efficiency		=	4.50%						
combustion		=	100%						
HC destruction		=	11647	lbs.	(from AIRINJOP sheet)				

1125J

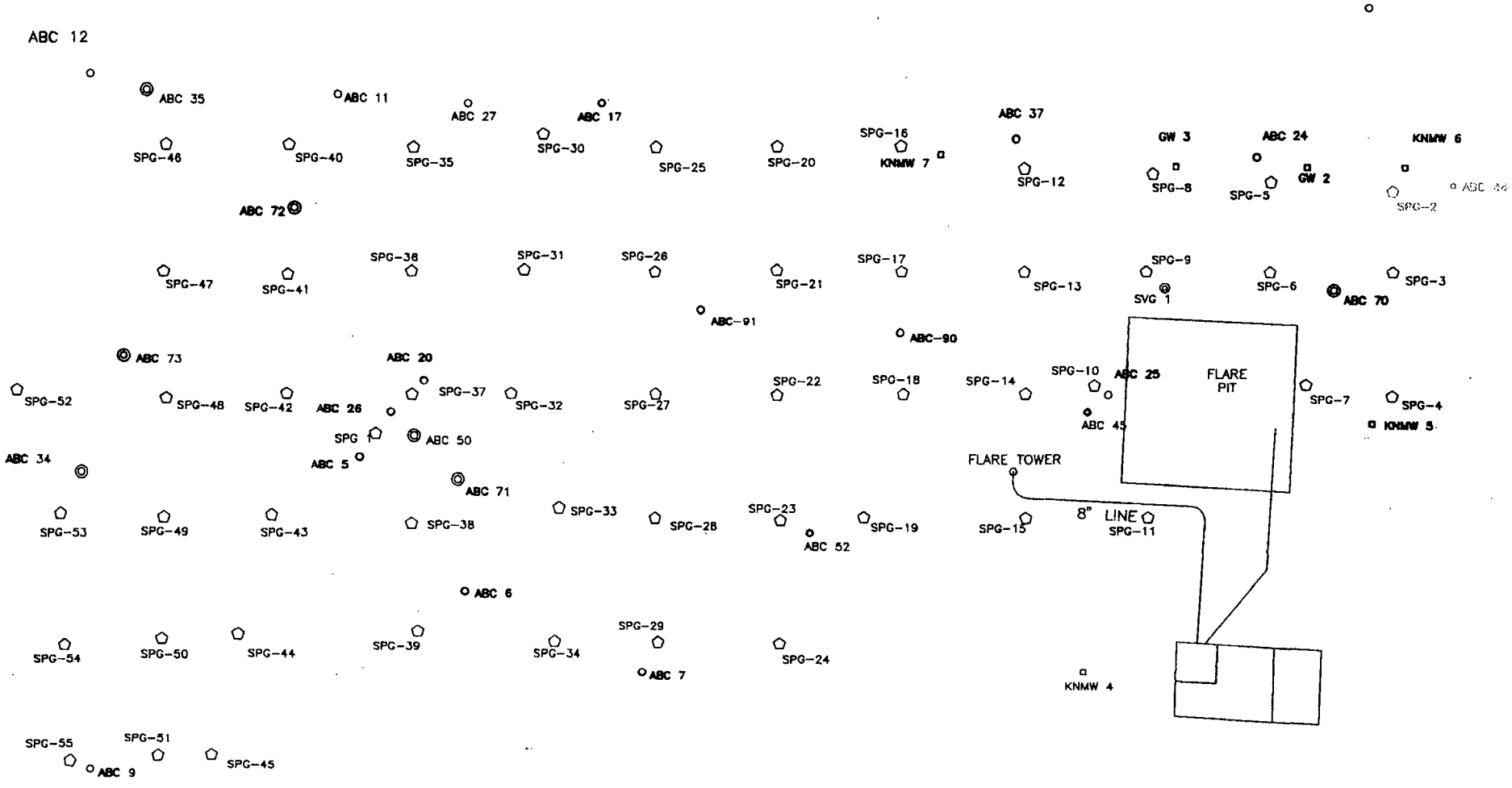
AIR SPARGING PROGRAM STAT'S

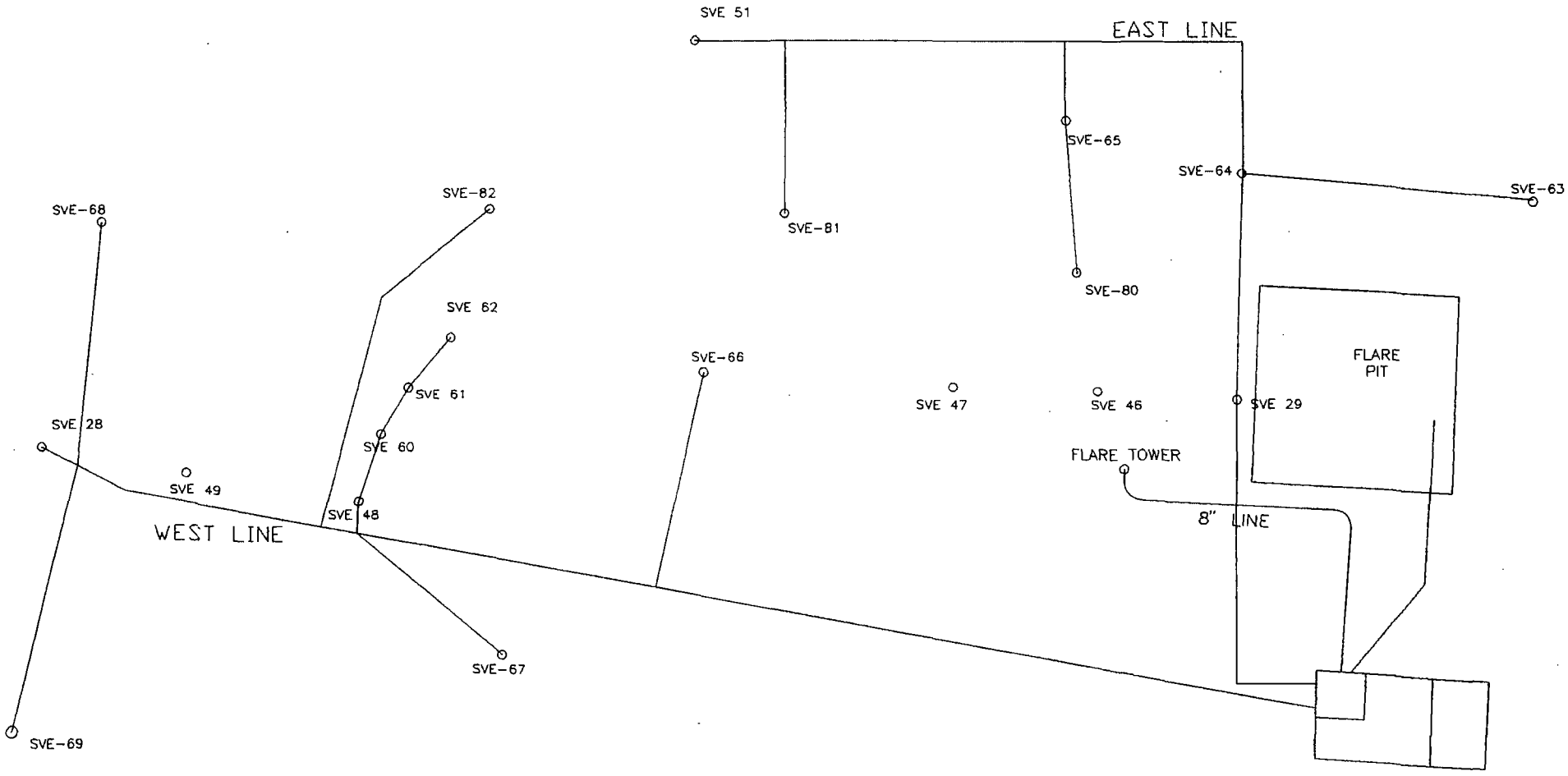
- TOTAL AIR INJECTED: 5.8×10^7 ft^3
- TOTAL AIR EXTRACTED: 7.8×10^7 ft^3
- EXT/INJ RATIO: 1.34

- AVG. AIR INJECTION RATE: 6.7 scfm/well
- # OF WELLS OPERATING: 4 - 15 at any given time

- System ~~operated for~~ online for 495 days. or 1.36 years from Oct. 28, 1993 to March 10, 1995

- SPG WELL INSTALLATION COMPLETED 9/22/93


ABC 12
ABC 35
ABC 11
ABC 27
ABC 17
SPG-46
SPG-40
SPG-35
SPG-30
SPG-25
SPG-20
SPG-16
KNMW 7
ABC 37
SPG-12
GW 3
SPG-8
ABC 24
SPG-5
GW 2
KNMW 6
SPG-2
ABC 44
ABC 72
SPG-47
SPG-41
SPG-36
SPG-31
SPG-26
SPG-21
SPG-17
SPG-13
SPG-9
SVG 1
SPG-6
ABC 70
SPG-3
ABC-91
ABC-90
ABC 73
ABC 20
SPG-52
SPG-48
SPG-42
ABC 26
SPG-37
SPG-32
SPG-27
SPG-22
SPG-18
SPG-14
SPG-10
ABC 25
FLARE PIT
SPG-7
SPG-4
KNMW 5
ABC 45
SPG 1
ABC 50
ABC 5
ABC 34
ABC 71
FLARE TOWER
8" LINE
SPG-53
SPG-49
SPG-43
SPG-38
SPG-33
SPG-28
SPG-23
ABC 52
SPG-19
SPG-15
SPG-11
ABC 6
SPG-54
SPG-50
SPG-44
SPG-39
SPG-34
SPG-29
ABC 7
SPG-24
KNMW 4
SPG-55
SPG-51
ABC 9
SPG-45


SVE 51
EAST LINE
SVE-65
SVE-64
SVE-63
SVE-81
SVE-80
SVE-82
SVE-68
SVE 62
SVE-66
FLARE
PIT
SVE 61
SVE 47
SVE 46
SVE 29
SVE 28
SVE 60
FLARE TOWER
SVE 49
SVE 48
8" LINE
WEST LINE
SVE-67
SVE-69

note: ABC-5, ABC-71 and ABC-72 will be sampled as part of the monthly sampling under the GMP, so only ABC-20 will be sampled for confirmation at this time.

currently generating SPG wells

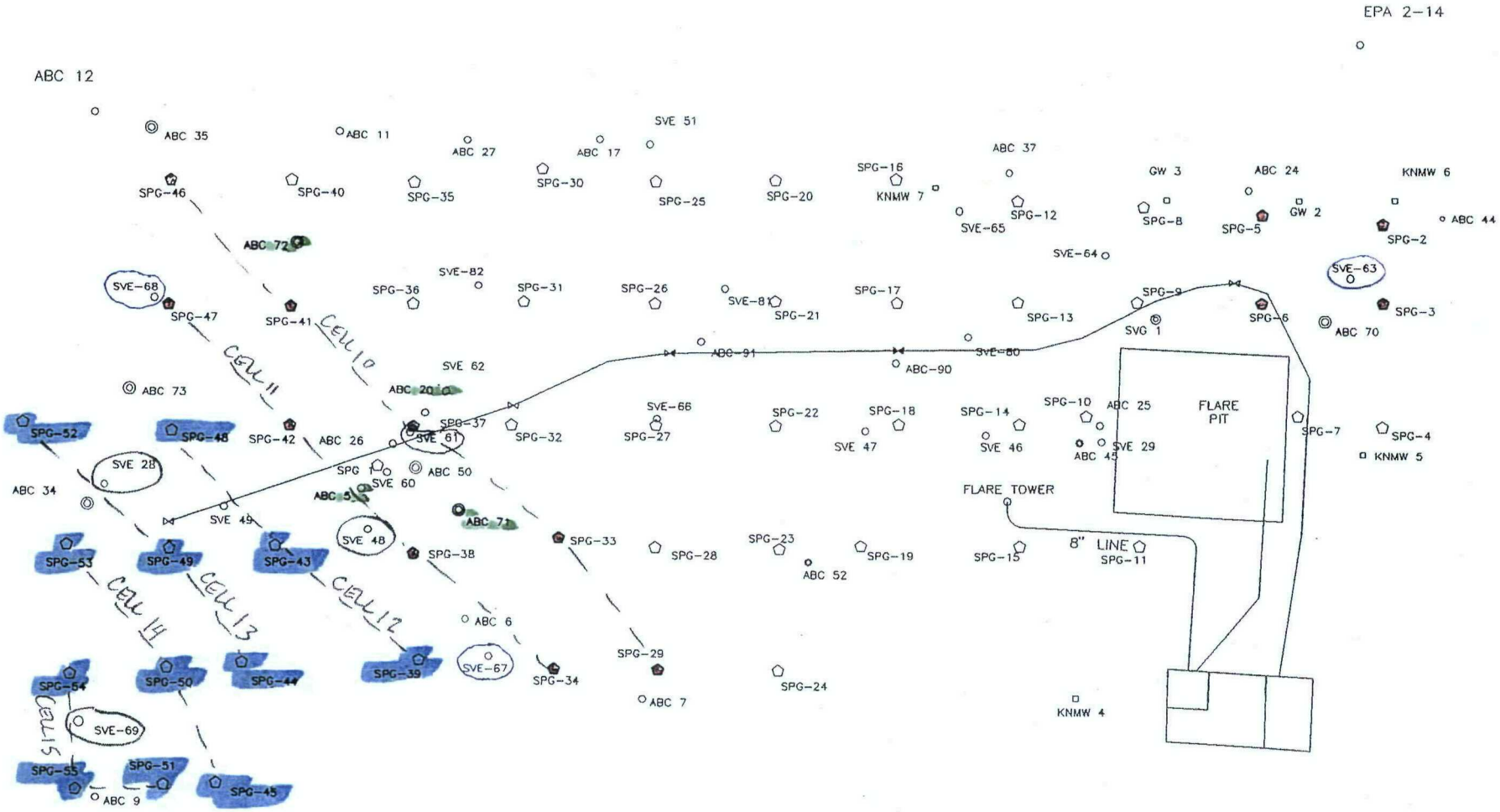
- new air injection points

- confirmation sampling poin

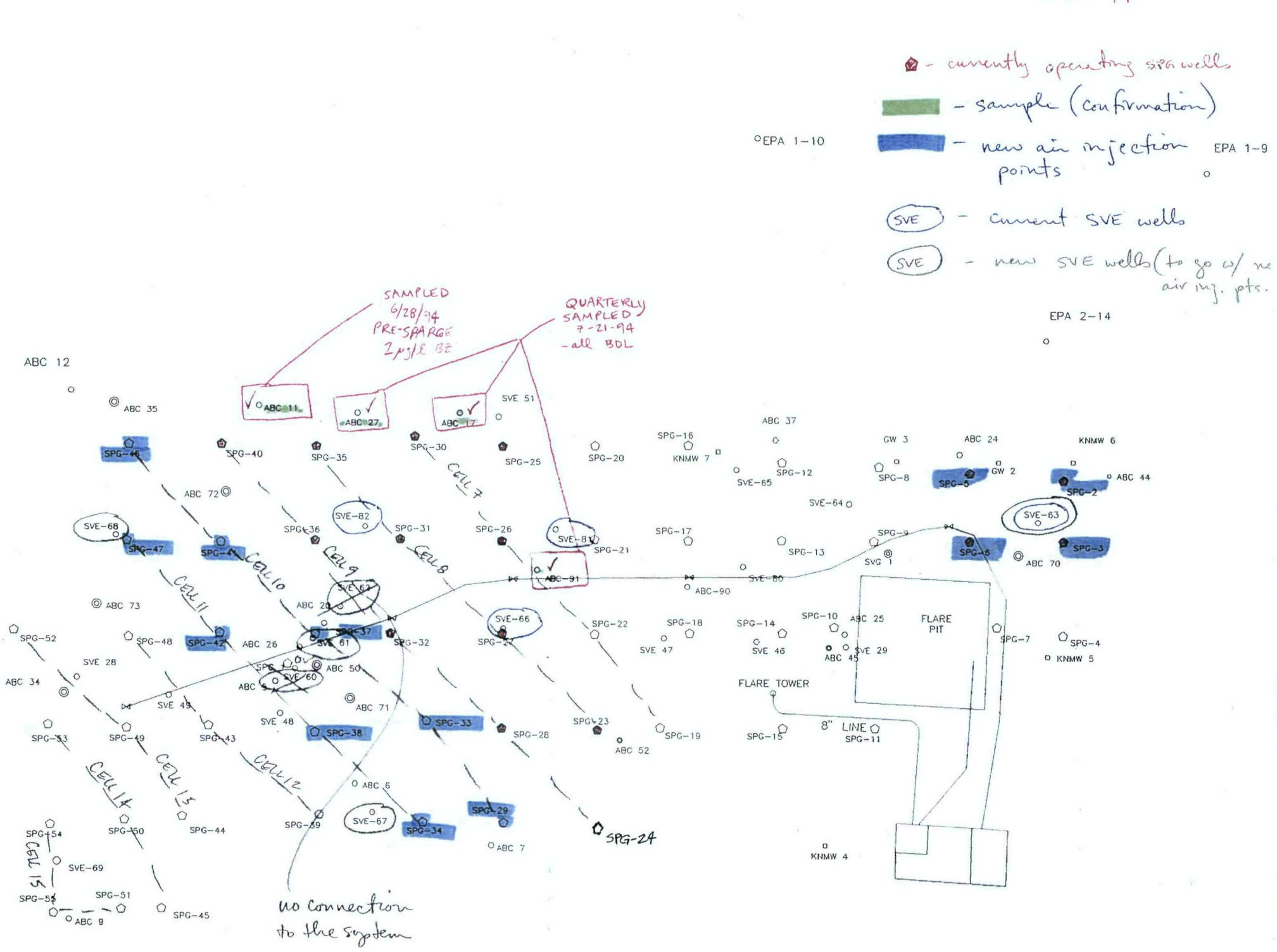
SVE - current SVE well

SVE - new SVE well

SVE-28
SVE-69
SVE-48



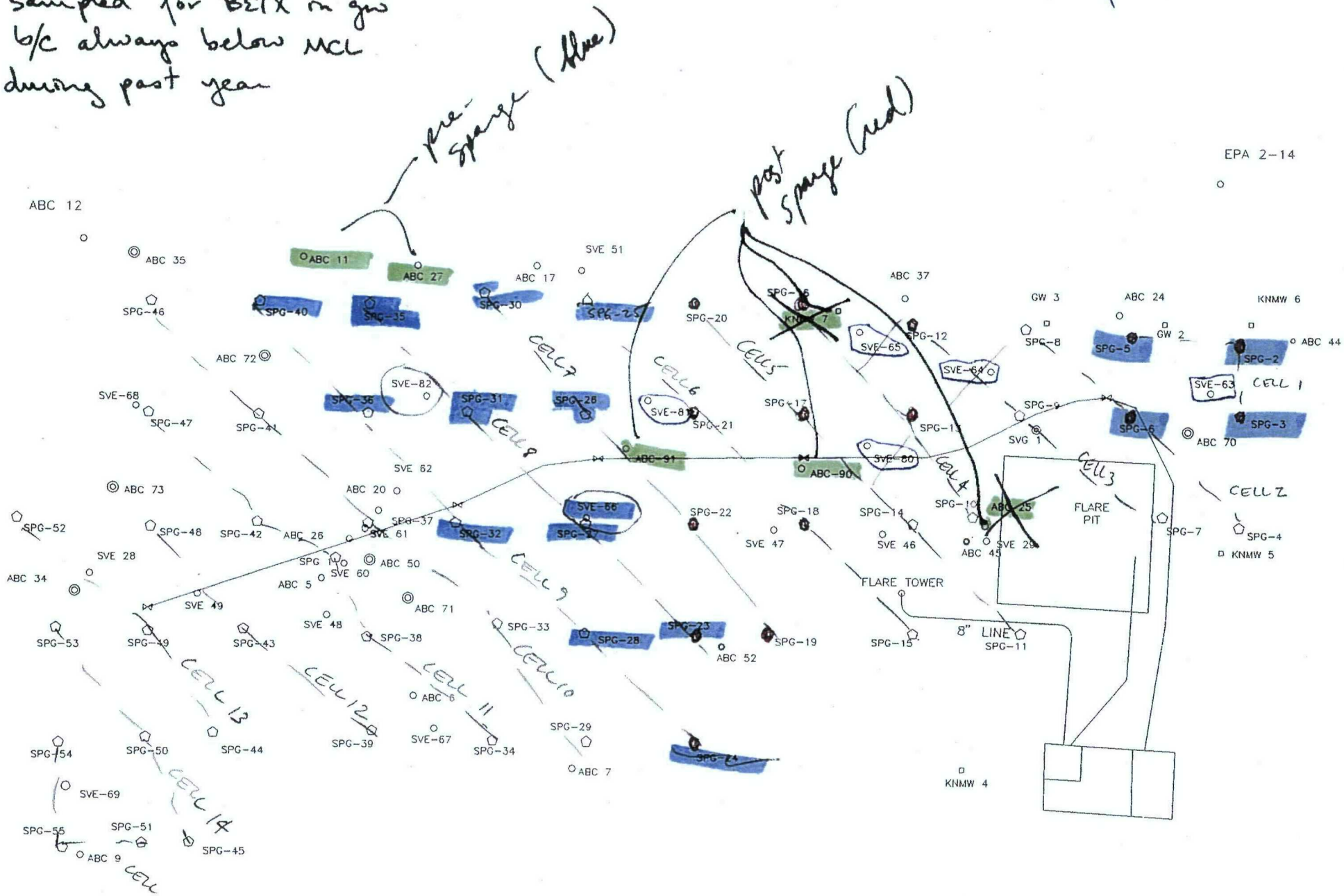
8-22-94


- currently operating SPG wells
- sample (confirmation)
- new air injection points
SVE - current SVE wells
SVE - new SVE wells (to go w/ new air inj. pts.
SAMPLED 6/28/94 PRE-SPARGE 2 µg/l BE
QUARTERLY SAMPLED 7-21-94 - all BDL
EPA 1-10
EPA 1-9
EPA 2-14
ABC 12
ABC 35
ABC 11
ABC 27
ABC 17
SVE 51
SPG-46
SPG-40
SPG-35
SPG-30
SPG-25
SPG-20
SPG-16
KNMW 7
ABC 37
GW 3
ABC 24
KNMW 6
SPG-12
SVE-65
SPG-8
SPG-5
GW 2
ABC 44
SPG-2
ABC 72
SVE-64
SVE-68
SPG-47
SPG-41
SPG-36
SVE-82
SPG-31
SPG-26
SVE-81
SPG-21
SPG-17
SPG-13
SPG-9
SVG 1
SPG-6
SVE-63
SPG-3
ABC 70
ABC-91
ABC-90
SVE-80
CELL 7
CELL 8
CELL 9
CELL 10
CELL 11
CELL 12
CELL 13
CELL 14
CELL 15
ABC 73
ABC 20
SVE 62
SPG-52
SPG-48
SPG-42
ABC 26
SPG-37
SVE 61
SPG-32
SVE-66
SPG-22
SPG-18
SPG-14
SPG-10
ABC 25
FLARE PIT
SPG-7
SPG-4
KNMW 5
SVE 28
ABC 34
SPG-27
SVE 60
ABC 50
SVE 47
SVE 46
ABC 45
SVE 29
FLARE TOWER
SVE 49
SVE 48
ABC 71
SPG-33
SPG-38
SPG-23
SPG-19
SPG-15
8" LINE
SPG-11
SPG-53
SPG-49
SPG-43
SPG-28
ABC 52
ABC 6
SPG-54
SPG-50
SPG-44
SPG-39
SVE-67
SPG-34
SPG-29
ABC 7
SPG-24
KNMW 4
SVE-69
SPG-55
SPG-51
ABC 9
SPG-45
no connection to the system

6-28-94

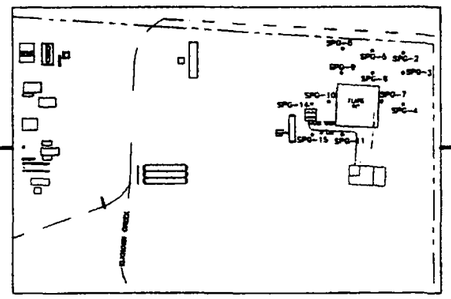
- currently operating SPG wells
- sample (confirmation or pr s
- new air injection points

• MW-7 + ABC-25 not sampled for BETX in gw b/c always below MCL during past year



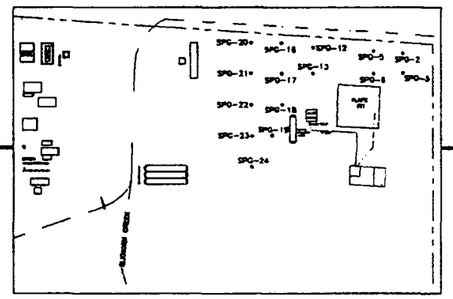
GROUP 1

OCT. 28, 1993 – JAN. 28, 1994



GROUP 2

JAN. 29, 1994 – JUN. 27, 1994

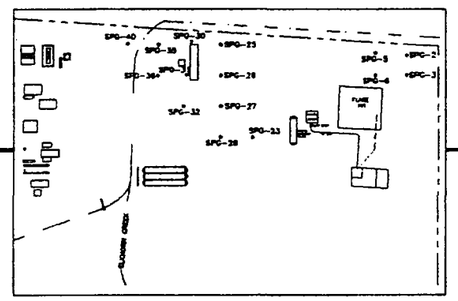


NOVEMBER | DECEMBER | JANUARY | FEBRUARY | MARCH | APRIL | MAY

1993

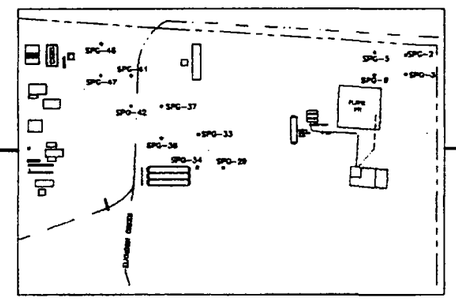
GROUP 3

JUN. 28, 1994 - AUG. 27, 1994



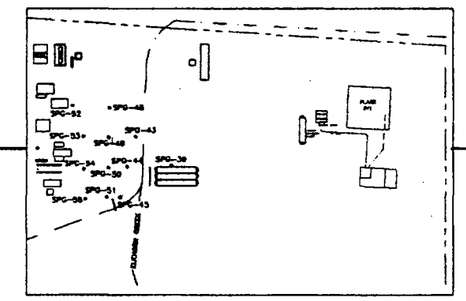
GROUP 4

AUG. 28, 1994 - OCT. 25, 1994



GROUP 5

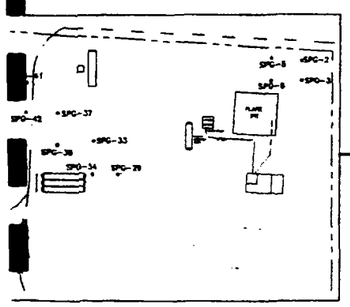
OCT. 25, 1994 - MAR. 10,



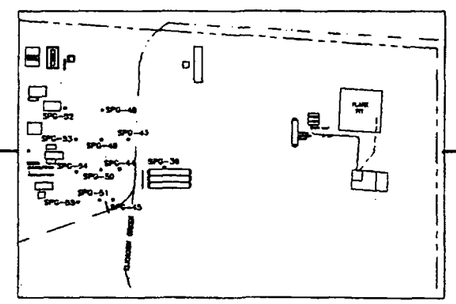
JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER | JANUARY

1994

GROUP 4
1994 – OCT. 25, 1994



GROUP 5
OCT. 25, 1994 – MAR. 10, 1995



ABER | OCTOBER | NOVEMBER | DECEMBER | JANUARY | FEBRUARY | MARCH

1995

ADRIAN BROWN CONSULTANTS, INC.
KN ENERGY
AIR SPARGE WELLS
IN OPERATION
DURING AIR SPARGING PROGRAM