

LONGHORN ARMY AMMUNITION PLANT

KARNACK, TEXAS

ADMINISTRATIVE RECORD

VOLUME 3 of 13

1994

**Bate Stamp Numbers
008071 - 008384**

Prepared for:

**Department of the Army
Longhorn Army Ammunition Plant
Marshall, Texas 75671-1059**

1995

**LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
ADMINISTRATIVE RECORD - CHRONOLOGICAL INDEX**

VOLUME 3 of 13

1994

- A. **Title:** Letter - Subject: Draft Field Investigation Summary For Site 1A
 Group(s): 1
 Site(s): LHAAP-1 Inert Burning Grounds
 Location: Longhorn Army Ammunition Plant, Marshall, Texas
 Agency: Department Of The Army, Longhorn Army Ammunition Plant
 Author(s): Lawrence J. Sowa, Lieutenant Colonel, U.S. Army
 Recipient: Lisa Marie Price, Environmental Protection Agency
 Date: May 11, 1994
 Bate Stamp: 008071
- B. **Title:** Letter - Subject: EPA's Comments On Draft DERMIS Resolution Document
 Attach(s): Comments
 Group(s): All
 Site(s): General
 Location: Longhorn Army Ammunition Plant, Marshall, Texas
 Agency: Environmental Protection Agency
 Author(s): Ms. Lisa M. Price, Environmental Protection Agency
 Recipient: Mr. David Tolbert, Longhorn Army Ammunition Plant
 Date: May 17, 1994
 Bate Stamp: 008072 - 008074
- C. **Title:** Letter - Subject: EPA's Response To Separate Schedules For Groups #,2,3 and For
 Group # 4 IRAs At Unlined Evaporation Pond / Burning Ground #3 And Landfills
 Group(s): 1,2,3 And 4
 Site(s): LHAAP-1 Inert Burning Grounds
 LHAAP-11 Suspected TNT Burial Site At Avenues P & Q
 LHAAP-12 Active Landfill
 LHAAP-13 Suspected TNT Burial Site Between Old & Active Landfills
 LHAAP-14 Area 54 Burial Ground
 LHAAP-16 Old Landfill
 LHAAP-17 Burning Ground No. 2 / Flashing Area,
 LHAAP-18 & LHAAP-24 Burning Ground / Washout Pond & Evaporation Pond
 LHAAP-27 South Test Area
 LHAAP-29 Former TNT Production Area
 LHAAP-32 Former TNT Disposal Plant
 LHAAP-54 or LHAAP-XX Ground Signal Test Area
 LHAAP-35 Process Wastewater Sumps
 Location: Longhorn Army Ammunition Plant, Marshall, Texas
 Agency: Environmental Protection Agency
 Author(s): Ms. Lisa M. Price, Environmental Protection Agency
 Recipient: Mr. David Tolbert, Longhorn Army Ammunition Plant

July 12, 1995

**LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
ADMINISTRATIVE RECORD - CHRONOLOGICAL INDEX**

VOLUME 3 of 13 (Continued)

1994

**Date: May 23, 1994
Bate Stamp: 008075 - 008076**

- D. Title: Letter - Subject: DERMIS List / RMIS Cross-Reference Table
Attach(s): Comments
Group(s): All
Site(s): General
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Agency: Department Of The Army, Longhorn Army Ammunition Plant
Author(s): Lawrence J. Sowa, Lieutenant Colonel, U.S. Army
Recipient: Ms. Lisa M. Price, Environmental Protection Agency
Date: May 31, 1994
Bate Stamp: 008077 - 008080**
- E. Title: Conference Call - Contact: Kathleen Buci, Major John German, Joe Kang
Subject: Ask AEC Legal Whether Or Not EPA Should Get Two Separate Packages;
One For FFA And The Other For Planning Purpose Only
Group(s): All
Site(s): General
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Agency: Department Of The Army, Longhorn Army Ammunition Plant
Author(s): W. C. Nathan
Recipient: File
Date: June 1, 1994
Bate Stamp: 008081**
- F. Title: Final Report - Biotreatability Study
Group(s): Early Interim Action At Burning Ground No. 3
Site(s): LHAAP-18 & LHAAP-24 Burning Ground / Washout Pond & Evaporation Pond
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Company: Bioscience, Inc.
Author(s): Bioscience, Inc.
Recipient: AWD Laboratories, Inc.
Date: June 3, 1994
Bate Stamp: 008082 - 008130**
- G. Title: Letter - Subject: Draft Initial Screening Of Alternatives
Group(s): 1,2,&3
Site(s): LHAAP-1 Inert Burning Grounds
LHAAP-11 Suspected TNT Burial Site At Avenues P & Q
LHAAP-12 Active Landfill**

July 12, 1995

**LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
ADMINISTRATIVE RECORD - CHRONOLOGICAL INDEX**

VOLUME 3 of 13 (Continued)

1994

LHAAP-13 Suspected TNT Burial Between Active Landfill And Old Landfill
LHAAP-14 Area 54 Burning Ground
LHAAP-16 Old Landfill
LHAAP-17 No. 2 Flashing Area / Burning Ground
LHAAP-18 & LHAAP-24 Burning Ground / Washout Pond & Evaporation Pond
LHAAP-27 South Test Area
LHAAP-29 Former TNT Production Area
LHAAP-32 Former TNT Disposal Plant
LHAAP-54 or LHAAP-XX Ground Signal Test Area

Location: Longhorn Army Ammunition Plant, Marshall, Texas
Agency: Department Of The Army, Longhorn Army Ammunition Plant
Author(s): Lawrence J. Sowa, Lieutenant Colonel, U.S. Army
Recipient: Ms. Lisa Marie Price, Environmental Protection Agency
Date: June 6, 1994
Bate Stamp: 008131

- H. Title:** Letter - Subject: EPA's Comments On Monitoring Well Survey At Unlined Evaporation Pond At Burning Ground No. 3
Group(s): Early Interim Action At Burning Ground No. 3
Site(s): LHAAP-18 & LHAAP-24 Burning Ground / Washout Pond & Unlined Evaporation Pond
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Agency: Department Of The Army, Longhorn Army Ammunition Plant
Author(s): Lisa Marie Price, Environmental Protection Agency
Recipient: David Tolbert, Longhorn Army Ammunition Plant
Date: June 7 1994
Bate Stamp: 008132 - 008133
- I. Title:** Letter - Subject: EPA's Comments On Draft Field Investigation Summary For Site 1A
Group(s): 1
Site(s): LHAAP-1 Inert Burning Grounds
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Agency: Environmental Protection Agency
Author(s): Lisa Marie Price, Environmental Protection Agency
Recipient: David Tolbert, Longhorn Army Ammunition Plant
Date: June 8, 1994
Bate Stamp: 008134 - 008135
- J. Title:** Letter - Subject: Meeting, LHAAP, for Technical Review Committee - June 22, 1994
Attach(s): Meeting Agenda
Group(s): All

July 12, 1995

**LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
ADMINISTRATIVE RECORD - CHRONOLOGICAL INDEX**

VOLUME 3 of 13 (Continued)

1994

Site(s): General
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Agency: Department Of The Army, Longhorn Army Ammunition Plant
Author(s): Lawrence J. Sowa, Lieutenant Colonel, U.S. Army
Recipient: Ms. Lisa M. Price, Environmental Protection Agency
Date: June 13, 1994
Bate Stamp: 008136 - 008137

K. Title: Letter - Subject: EPA's Comments On Draft DERMIS Resolution Document
Attach(s): Comments
Group(s): All
Site(s): General
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Agency: Environmental Protection Agency
Author(s): Ms. Lisa M. Price, Environmental Protection Agency
Recipient: Mr. David Tolbert, Longhorn Army Ammunition Plant
Date: June 14, 1994
Bate Stamp: 008138 - 008144

L. Title: Letter - Subject: Draft Remedial Design Investigations Work Plan For Landfills
Group(s): Landfill Caps Interim Action
Site(s): LHAAP-12 Active Landfill
LHAAP-16 Old Landfill
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Agency: U.S. Army Corps Of Engineers, Tulsa District
Author(s): Lawrence J. Sowa, Lieutenant Colonel, U.S. Army
Recipient: Ms. Lisa Marie Price, Environmental Protection Agency
Date: June 16, 1994
Bate Stamp: 008145

M. Title: Meeting Agenda - LHAAP Technical Review Committee Meeting, June 22, 1994
Attach(s): Status Report - LHAAP Environmental Projects Status (as of June 17, 1994)
Status Report - Regulators' Milestones Status Update
Group(s): All
Site(s): General
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Agency: U.S. Army
Author(s): U.S. Army Corps of Engineers, Tulsa District
Recipient: Meeting Participants
Date: June 22, 1994
Bate Stamp: 008146 - 008170

July 12, 1995

**LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
ADMINISTRATIVE RECORD - CHRONOLOGICAL INDEX**

VOLUME 3 of 13 (Continued)

1994

- N.** **Title:** **Letter - Subject: Draft Work Plan And Chemical Acquisition Plan Addendum For Phase II Group #1**
 Group(s): **1**
 Site(s): **LHAAP-1 Inert Burning Grounds**
 LHAAP-11 Suspected TNT Burial Site At Avenues P & Q
 LHAAP-54 Or LHAAP-XX Ground Signal Test Area
 Location: **Longhorn Army Ammunition Plant, Marshall, Texas**
 Agency: **Department Of The Army, Longhorn Army Ammunition Plant**
 Author(s): **Lawrence J. Sowa, Lieutenant Colonel, U.S. Army**
 Recipient: **Ms. Lisa Marie Price, Environmental Protection Agency**
 Date: **June 28, 1994**
 Bate Stamp: **008171**
- O.** **Title:** **Letter - Subject: Draft Work Plan For Soil And Ground Water Background Concentration Study**
 Group(s): **1**
 Site(s): **LHAAP-1 Inert Burning Grounds**
 LHAAP-11 Suspected TNT Burial Site At Avenues P & Q
 LHAAP-27 South Test Area
 LHAAP-XX Ground Signal Test Area
 Location: **Longhorn Army Ammunition Plant, Marshall, Texas**
 Agency: **Department Of The Army, Longhorn Army Ammunition Plant**
 Author(s): **Lawrence J. Sowa, Lieutenant Colonel, U.S. Army**
 Recipient: **Lisa Marie Price, Environmental Protection Agency**
 Date: **June 29, 1994**
 Bate Stamp: **008172**
- P.** **Title:** **Final Report - Biotreatability Report**
 Group(s): **Early Interim Action At Burning Ground No. 3**
 Site(s): **LHAAP-18 & LHAAP-24 Burning Ground / Washout Pond & Evaporation Pond**
 Location: **Longhorn Army Ammunition Plant, Marshall, Texas**
 Company: **Bioscience, Inc.**
 Author(s): **Bioscience, Inc.**
 Recipient: **AWD Laboratories, Inc.**
 Date: **July 1, 1994**
 Bate Stamp: **008173 - 008366**
- Q.** **Title:** **Letter - Subject: Natural Resource Trustee Responsibilities**
 Attach(s): **Letter - From Lawrence J. Sowa, Lieutenant Colonel, U.S. Army**
 Group(s): **All**
 Site(s): **General**

July 12, 1995

**LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
ADMINISTRATIVE RECORD - CHRONOLOGICAL INDEX**

VOLUME 3 of 13 (Continued)

1994

Location: Longhorn Army Ammunition Plant, Marshall, Texas
Agency: Environmental Protection Agency
Author(s): Ms. Lisa M. Price, Environmental Protection Agency
Recipient: Mr. David Tolbert, Longhorn Army Ammunition Plant
Date: July 11, 1994
Bate Stamp: 008367 - 008371

R. Title: Letter - Subject: EPA's Comments On Draft Remedial Design Investigations Work Plan For Landfills
Group(s): Landfill Caps Interim Action
Site(s): LHAAP-12 Active Landfill
LHAAP-16 Old Landfill
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Agency: U.S. Army Corps Of Engineers, Tulsa District
Author(s): Ms. Lisa Marie Price, Environmental Protection Agency
Recipient: David Tolbert, Longhorn Army Ammunition Plant
Date: July 13, 1994
Bate Stamp: 008372 - 008374

S. Title: Letter - Subject: Request For Extension On Submission Of Draft RI / FS For Sites No. 13 & 14 And Proposed Plan For IRA At Unlined Evaporation Pond / Burning Ground # 3
Group(s): 3
Site(s): LHAAP-13 Suspected TNT Burial Site Between Active And Old Landfills
LHAAP-14 Area 54 Burial Ground
LHAAP-18 & LHAAP-24 Burning Ground / Washout Pond & Unlined Evaporation Pond
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Agency: Department Of The Army, Longhorn Army Ammunition Plant
Author(s): Lawrence J. Sowa, Lieutenant Colonel, U.S. Army
Recipient: Ms. Lisa Marie Price, Environmental Protection Agency
Date: July 27, 1994
Bate Stamp: 008375 - 008377

T. Title: Letter - Subject: Draft Proposed Plan For Interim Remedial Action At Burning Ground No. 3
Group(s): Early Interim Action At Burning Ground No. 3
Site(s): LHAAP-18 & LHAAP-24 Burning Ground / Washout Pond & Unlined Evaporation Pond
Location: Longhorn Army Ammunition Plant, Marshall, Texas

July 12, 1995

**LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
ADMINISTRATIVE RECORD - CHRONOLOGICAL INDEX**

VOLUME 3 of 13 (Continued)

1994

Agency: Department of the Army
Author(s): Lawrence J. Sowa, Lieutenant Colonel, U.S. Army
Recipient: Ms. Lisa Marie Price, Environmental Protection Agency
Date: July 29, 1994
Bate Stamp: 008378

U. Title: Letter - Subject: EPA's Comments And Conditional Approval Of Draft Work Plan For Soil And Ground Water Background Concentration Study
Attach(s): Comments
Group(s): 1
Site(s): LHAAP-1 Inert Burning Grounds
LHAAP-11 Suspected TNT Burial Site At Avenues P & Q
LHAAP-27 South Test Area
LHAAP-54 or LHAAP-XX Ground Signal Test Area
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Agency: Environmental Protection Agency
Author(s): Lisa Marie Price, Environmental Protection Agency
Recipient: David Tolbert, Longhorn Army Ammunition Plant
Date: July 29, 1994
Bate Stamp: 008379 - 008381

V. Title: Letter - Subject: EPA's Comments And Conditional Approval Of Draft Work Plan Addendum For Phase II Group #1 Sites 11,1,xx,27 (Group #1)
Attach(s): Comments
Group(s): 1
Site(s): LHAAP-1 Inert Burning Grounds
LHAAP-11 Suspected TNT Burial Site At Avenues P & Q
LHAAP-27 South Test Area
LHAAP-54 or LHAAP-XX Ground Signal Test Area
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Agency: Environmental Protection Agency
Author(s): Lisa Marie Price, Environmental Protection Agency
Recipient: David Tolbert, Longhorn Army Ammunition Plant
Date: July 29, 1994
Bate Stamp: 008382 - 008384

July 12, 1995



DEPARTMENT OF THE ARMY

LONGHORN ARMY AMMUNITION PLANT
MARSHALL, TEXAS 75671-1059

REPLY TO
ATTENTION OF

May 11, 1994

RECEIVED
EPA REGION VI 008071
1994 MAY 12 AM 8 12
SUPERFUND BRANCH

Environmental Department
Longhorn Army Ammunition Plant

Ms. Lisa Price
Superfund Reinforcement
U. S. Environmental Protection Agency
1445 Ross Avenue
Dallas, Texas 75202

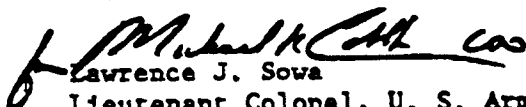
Dear Ms. Price:

Enclosed are two copies of the Draft Final Field Investigation
Summary Report for Area 1A of Longhorn Army Ammunition Plant.

Please review and send your comments back to us by 10 June 1994.

If there are any questions, please contact Mr. David Tolbert at
903-679-2728.

Sincerely,


Lawrence J. Sowa
Lieutenant Colonel, U. S. Army
Commanding Officer

Enclosures



008072

MAY 17 1994

CERTIFIED MAIL: RETURN RECEIPT REQUESTED

Y104 195 134

David Tolbert, Project Manager
Longhorn Army Ammunition Plant
Attn: SMCLO-EN
Marshall, Texas 75671-1059

Re: Draft DERPMS/RMIS Resolution Document for
Longhorn Army Ammunition Plant

Dear David:

Pursuant to the Federal Facility Agreement for the Longhorn Army Ammunition Plant, EPA is submitting comments on the Draft DERPMS/RMIS Resolution Document for Longhorn Army Ammunition Plant. EPA's comments are as follows:

1. The Draft DERPMS/RMIS Resolution Document dated April 1994 that was submitted to EPA does not meet the intent of EPA's October 1992, (Refer to EPA's October 13, 1992 letter) request to resolve the sites listed on the DERPMS list.

In order to completely characterize Longhorn AAP, each site identified on the DERPMS list, excluding those currently included under the FFA, must be investigated and 1) eliminated based on existing information that no release or threat of release of hazardous substances exists at the site, 2) eliminated based on information generated during the investigation that documents that no release or threat of release of hazardous substances exists, or 3) included under the FFA for investigation and possible response actions. The results of such investigations and the determination that releases or potential releases are or are not occurring must be formally conveyed to EPA and [TNRCC]. Therefore, EPA requests formal resolution of the DERPMS list. EPA October 13, 1992, letter to Lynn Muckelrath.

Not only is there no reference to the DERPMS list except for the Preface, the RMIS list does not appear to cover all of the sites listed in the original DERPMS list. A cross reference of DERPMS/RMIS sites may substantiate the claim that all of the sites on the DERPMS list have been identified and/or addressed, however, until such reference has been included, the report is deficient.

64-ET
H.H. 54 5/16/94

2. The presentation and content of the information is inadequate for its intent. EPA spoke with Army on several occasions regarding the presentation and the content of the information, however, what EPA received is a portion of the Army's IAP along with reports or portions of reports supposedly included to substantiate the determinations made in the IAP.

EPA during its several conversations with the Army specifically requested that all substantive documentation should either be included in the report or referenced in the report. EPA was lead to believe that Preliminary Assessments (Army version or CERCLA version) had been conducted on many of these sites. If that is the case, those forms should have been included in the report. If some of the sites were investigated in conjunction with other site investigations or studies, a bibliography of these reports or studies should have been compiled, the bibliography included, and the bibliography referenced in the report where appropriate.

A common phrase that EPA found throughout the document is problematic. "...the TNRCC determined that there was no contamination present." In fact, the determination made on the RCRA Facility Assessment information included in the report was much less decisive. *"Upon visual inspection...there was no [visual and olfactory evidence, dead vegetation, etc.] that suggests any spillage or leakage attributable to this unit...seems unlikely that this unit would contribute to any significant groundwater contamination..."* Please more accurately reflect the characterization of the situation.

3. What is the source of the Waste Site Characterization Study? For what purpose was it included? If it was intended to substantiate claims included in the RMIS portion of the report, a cross reference between its numbering sequence, the RMIS sequence and the DERPMIS sequence should have been included.

4. The scope of the Federal Facility Agreement (FFA) covers all aspects of CERCLA corrective action and RCRA corrective action obligations (Refer to Section II. Scope of Agreement) on the Longhorn Army Ammunition Plant, therefore, it is inappropriate to state which sites are included in the FFA because all sites are subject to the requirements of the FFA. Therefore, delete the sentence *"The FFA specifies that remedial activities be conducted at 13 areas on LHAAP."* from II. C. of the report. The FFA only states that *"[t]he following [13] areas located at LHAAP have been identified as having threatened releases of hazardous substances or pollutants or contaminants..."* Refer to Section VII. Findings of Fact.

5. A map identifying all of the site locations with reference to the cross reference of sites would be helpful.

If you have any questions about EPA's comments or any other matter, please contact me at (214) 655-6744.

Sincerely,

Lisa Marie Price
Remedial Project Manager
Superfund Texas Enforcement

cc: Lieutenant Colonel Lawrence J. Sowa
Commanding Officer, U.S. Army
Longhorn Army Ammunition Plant
Marshall, Texas 75671-1059

Tulsa District Corps of Engineers
P.O. Box 61
Attn: Mr. Ross Nguyen
CESWT-PP-E
Tulsa, OK 74121-0061

Mike Moore, Superfund
Texas Natural Resource Conservation Commission
P.O. Box 13087
Capital Station
1700 N. Congress Avenue
Austin, TX 78711-3087

008075

MAY 23 1994

CERTIFIED MAIL: RETURN RECEIPT REQUESTED

David Tolbert, Project Manager
Longhorn Army Ammunition Plant
Attn: SMCLO-EN
Marshall, Texas 75671-1059

Re: Draft Updated Schedule for
Longhorn Army Ammunition Plant

Dear David:

Pursuant to the Federal Facility Agreement (FFA) for the Longhorn Army Ammunition Plant, EPA is submitting comments on the Draft Updated Schedule for Longhorn Army Ammunition Plant dated April 21, 1994.

This Draft Updated Schedule was submitted to replace the original schedule approved by EPA on May 29, 1992. The Army submitted a previous draft of the revised schedule to EPA for comment on December 2, 1993. EPA commented on the previous draft on January 19, 1994. For the reasons set forth below, EPA has determined that the Draft Updated Schedule is inadequate and may assess stipulated penalties pursuant to Section XXIV (Stipulated Penalties) of the FFA.

The Draft Updated Schedule submitted to EPA contains two separate schedules for review and comment: one with sites and activities subject to the requirements of the FFA, and the other submitted "...for planning purposes only." EPA is concerned that the two schedules indicate confusion on the part of the Army as to the scope of the FFA. It appears that the Army may be under the impression that some releases or threats of releases of hazardous substances at the Site do not fall within the scope of the FFA. If that is the case, the Army is wrong.

It is EPA's position that the FFA applies to the investigation, development, selection, and implementation of response actions for all releases or threatened releases of hazardous substances, contaminants, hazardous wastes, hazardous constituents, or pollutants from the Longhorn Army Ammunition Plant. The Agreement covers all phases of remediation for these releases, bringing together in one document the requirements for remediation as well as the process to be used to determine and accomplish remediation. The FFA also addresses all corrective action obligations related to the release of hazardous wastes at the Longhorn Army Ammunition Plant arising pursuant to the Resource Conservation and Recovery Act, with the exception of compliance issues associated with the facility's permit. See Section II (Scope of Agreement) of the FFA.

Therefore, the Army should submit a revised schedule with all releases and response actions identified. Until such time as the revised, updated schedule is submitted, EPA considers the Army to be in violation of the FFA.

If you have any questions about EPA's comments or any other matter, please contact me at (214) 655-6744.

Sincerely,

Lisa Marie Price
Remedial Project Manager
Superfund Texas Enforcement

cc: Michael C. Barra
Assistant Regional Counsel
EPA Region 6

Lieutenant Colonel Lawrence J. Sowa
Commanding Officer, U.S. Army
Longhorn Army Ammunition Plant
Marshall, Texas 75671-1059

Tulsa District Corps of Engineers
P.O. Box 61
Attn: Mr. Ross Nguyen
CESWT-PP-E
Tulsa, OK 74121-0061

Mike Moore, Superfund
Texas Natural Resource Conservation Commission
P.O. Box 13087
Capital Station
1700 N. Congress Avenue
Austin, TX 78711-3087



DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
MARSHALL TEXAS 75671-1059

008077

REPLY TO
ATTENTION OF

May 31, 1994

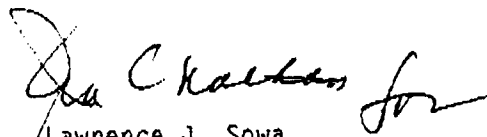
Engineering Division

Ms. Lisa Price
Superfund Enforcement
U. S. Environmental Protection Agency
1445 Ross Avenue
Dallas, TX 75202

Dear Ms. Price:

As agreed at our May 19, 1994 meeting concerning the DERPMS/RMIS Resolution Document, Longhorn Army Ammunition Plant requests your office to list the sites requiring additional justification to support Response Complete (no further action). Please provide specific comments on the type of information needed. This request is intended to speed resolution of this matter. Also, attached is the DERPMS/RMIS cross reference that you requested.

If there are any questions, please contact Mr. David Tolbert at 903-679-2728.


Lawrence J. Sowa
Lieutenant Colonel, U. S. Army
Commanding Officer

Enclosure



008078

DERPMIS/RMIS CROSS REFERENCE

SITE DESCRIPTION	DERPMIS (92) LHAAP#	RMIS (94) LHAAP#
Inert Burning Ground	001	1
Vacuum Truck Overnite Parking Lot	002	2
Building 722-Paint Shop	003	3
Pilot Wastewater Treatment Plant	004	4
Power House Boiler Pond	005	5
Building 54F Solvent	006	6
Building 50G Drum Processing	007	7
sewage Treatment Plant	008	8
Building 31-W Drum Storage	009	9
Suspected TNT Burial Site at P&Q Avenue	010	11
Active Landfill	011	12
Suspected TNT BET Active & Old Landfill	012	13
Area 54W Burial Site	013	14
Area 49W Drum Storage	014	15
Old Landfill	015	16
No. 2 Flashing area Burning Ground	016	17
Burning Ground/Rocket Motor wash-out Pond	017	18
Construction Materials Landfill	018	19
South Test Area/Bomb Test Area	019	27
Former TNT Production Area	021	29
TNT Red Water Pipeline	022	29
Building 707-Storage Area PCBS	023	23
Former TNT Waste Disposal Plant	024	32
Building 701 PCB Storage	034	34
Sumps Various	035	35
Explosive Waste Pads	036	36

008079

Quality Assurance Laboratory Building 29-A	037	37
24X Holding Area	038	38
25X Washout Pad	039	39
Air Curtain Destructor	040	18 & 24
Open Burning Cage	041	18 & 24
Open Burning Pan	042	18 & 24
Former Unlined Evaporation Pond	043	24
Building #41-X	044	44
Magazine Area	045	45
Plant 2/Pyrotechnic Operation	046	46
Plant 3/Produces Motor Assemblies	047	47
Y Area/Produces Hand Signal Assemblies	048	48
Former Acid Plant	049	49
Former Waste Disposal Facility	050	50
Photographic Laboratory/Bldg #60B	051	51
Magazine Area	052	52
Static Test Area	053	53
Ground Signal Test Area	054	54
Septic Tank	055	55
Vehicle Wash Rack & Oil/Water Separator	056	56
Rubble Burial Site	057	57
Maintenance Complex	058	58
Storage Building #725	059	59
Former Storage Building #411 & #714	060	60
Water Treatment Plant	061	61
Building #43X	062	62
Burial Pits	063	63
Transformer Storage	064	64
Building #209	065	65

008080

Transformers	066	66
Above Ground Storage Tank	067	67
Mobile Storage Tank	068	68
Underground Storage Tank	069	69

FAX TRANSMITTAL

of pages ▶

TO <i>LISA PRICE</i>	FROM <i>IRA NA...</i>
Dept./Agency <i>USEPA</i>	Phone <i>903-679-2...</i>
Fax <i>903-655-6460</i>	<i>903-679-2...</i>
NSN 7540-01-317-7358	5090-101
GENERAL SERVICES ADMINISTRATION	

008081

MINUTEMAN FOR RECORD

The undersigned placed a conference call at 1000 hours,
1 June 1994, to the following:

Kathleen Buchi,
Major John German, AEC Legal
Joe Kang, AMCCOM Legal

Present in my office was:

Mike Cobb
David Tolbert
Lynn Mucklerath

The purpose of this call was to ask AEC legal, in response to EPA's letter of 23 May 1994, whether or not EPA should get two separate packages: one for the FFA and the other for planning purposes only.

AMCCOM legal in their 24 May 1994 letter, gave their opinion that EPA is entitled to all schedules under the FFA.

After some discussion, Major John German said that it was in his opinion, that according to the FFA agreement, there is no issue, EPA should get all the schedules. (No planning purpose schedule.)

C. Nathan
C. Nathan
Chief, Eng. & Env. Div.

CF: Lisa M. Price, USEPA



Bioscience, Inc.
Environmental Products and Services

008082

**BIOTREATABILITY
REPORT
PRESENTED TO
AWD TECHNOLOGIES
FOR
USACE CONTRACT NO.
DFACA56-93-D-0016**

**PREPARED BY:
BIOSCIENCE, INC.
BETHLEHEM, PA**

JUNE 3, 1994

EXECUTIVE SUMMARY

Treatability screening was performed in two stages. In the first stage acclimation reactors were used to develop biomass capable of degrading methylene chloride and trichloroethylene. In the second stage biomass accumulated from the acclimation reactors was used to seed batch reactors to measure the rate and extent of biodegradation.

Analytical results from the acclimation stage of testing indicated slow growth of the microbial population, measured by the increase in turbidity of the culture, and limited degradation of the target compounds, as indicated by the increase in inorganic chloride. Biomass decreased with increased groundwater addition indicating that microbial growth rate did not increase as rapidly as the substrate concentration. The magnitude of the inorganic increase was more consistent with degradation of trichloroethylene than degradation of methylene chloride. Carbon dioxide evolution increased with the rate of groundwater addition to the reactors indicating positive correlation between microbial degradative activity and the amount of degradable substrate available. Determination of microbial count indicated that a viable population was maintained through out the acclimation stage. The population was sufficient to effect significant degradation but did not reach the level expected (and required) for a viable bioremediation process.

In the second stage of testing, all measures of biodegradation confirmed that the biomass was not capable of degrading the target chlorinated compounds at significant rates. Net oxygen consumption attributed to biodegradation of reactor components was very low. Compound specific analyses confirmed that at least some biodegradation of TCE occurred but that MEC biodegradation was negligible.

Bioscience can not recommend biotreatment of this groundwater on the basis of results obtained using indigenous microbes and inoculum from a municipal wastewater treatment plant.

INTRODUCTION

Bioscience, Inc of Bethlehem, Pennsylvania was awarded a subcontract from AWD Technologies, Rockville, MD. for determination of the biodegradability of contaminants in groundwater at the Longhorn Army Ammunition Plant, Karnack, TX. The study described is part of the Interim Remedial Action being performed for the Army Corps of Engineers by AWD Technologies. The Bioscience, Inc. treatability study described below was designed as a bioremediation screening level determination of the biodegradability of the contaminants in the samples. The groundwater was described in the Request for Proposal (RFP) as containing trichloroethylene (TCE), methylene chloride (MEC), trace amounts of semivolatile organics, and heavy metals (primarily barium). These contaminants were confirmed in initial analyses performed by Benchmark Analytics (certified analytical laboratory sub-contracted by Bioscience, Inc.). The bioremediation screening study targeted the organic contaminants with the primary focus on MEC and TCE.

The goal of bioremediation screening was to determine whether bioremediation is a viable treatment technology for meeting cleanup standards. A minimum of 20% reduction in target contaminants (MEC and TCE) due to biodegradation is considered to be a positive result suggesting further evaluation of the technology. Ex-situ bioremediation was simulated and evaluated in two stages: fed-batch bioreactor acclimation and batch bioreactor kinetic evaluation. Co-substrate (propane) was added to one of the acclimation reactors to stimulate TCE degrading bacteria. This type of biotreatment was judged to be the technology most appropriate for full-scale bioremediation. The Stage 2 batch bioreactor evaluation permitted more accurate and cost effective kinetic evaluation, i.e. biodegradation rate determination. Various additives including nutrients, pH buffers, and co-substrates were added to enhance biodegradation rate and degree of completion. In the testing described below, groundwater from the site was monitored for volatile halogenated hydrocarbons to determine biodegradation and volatilization of target contaminants.

In addition to monitoring specific analytes, environmental conditions during treatment were also monitored and recorded.

Experience has shown that MEC is biodegraded aerobically (in the presence of oxygen) and that TCE

is biodegraded both aerobically and anaerobically (in the absence of oxygen). However, anaerobic TCE biodegradation is typically much slower than the aerobic process. Since successful aerobic degradation is documented for both major contaminants, it is was used in this screening study. Aerobic TCE biodegradation is co-oxidative and requires an extremely strong oxidizing enzyme to initiate degradation. These enzymes are induced only by aliphatic hydrocarbons (methane and similar compounds) and a few other substrates. Liquefied propane (LP) gas was used in these studies to stimulate specific bacteria to grow and produce the required enzymes.

SAMPLING AND INITIAL ANALYSES

Representative contaminated groundwater samples (4 5-gallon containers) from the contaminated area and a sample of clean, background, groundwater (5 gallons) were received on December 4, 1993. The sample containers were filled completely with minimal exposure to the atmosphere. The five metal containers were marked EW-1, MW-1, MW-2(container 1), MW-2(container 2), and C-1. The containers were sealed and intact when received at Bioscience Inc.'s laboratory. The samples were be stored in a refrigerated sample storage area until used. Chain of custody procedures were followed throughout the study.

The contaminated groundwater from the monitoring wells was composited on December 9, 1993 into a laboratory cleaned large glass container prior to initial analysis. Six liters from each of the containers EW-1, MW-1, MW-2(1), and MW-2(2) were siphoned into the glass container. The composited groundwater was also kept refrigerated for the duration of the study. Substantial precipitation (probably iron salts) occurred. Samples withdrawn for bioremediation studies were removed by siphoning clear liquid from above the sediment to minimize interference with analytical determinations.

The groundwater was analyzed prior to biodegradation testing for:

<u>Parameter</u>	<u>Method</u>
Volatile Chlorinated	
Hydrocarbons	EPA ³ 601
Ammonium-N	STD. METH. ⁴ 417B
Nitrate-N	STD. METH. 418C
ortho-Phosphate-P	STD. METH. 424E

Chloride	EPA 325.1
Specific Conductivity	STD. METH. 205
pH	STD. METH. 423
Total Organic Carbon	EPA 415.2
Total Bacterial Count	STD. METH. 907
19 Metals Screening Test	EPA 200.7

Results of the initial analyses are summarized in Tables 1-5.

STAGE 1 - ACCLIMATION

Bioscience, Inc. operated two continuous culture bioreactors to produce seed organisms capable of biodegrading the TCE and MEC (Figures 1 and 2, Photographs 1 and 2). These bioreactors were designed to allow for the buildup of a microbial population adapted to the relatively high solvent concentrations present in the groundwater. The bioreactor configuration was designed to generate a sufficient quantity of biomass to simulate the conditions of an operational groundwater biotreatment process (approximately 1 to 2 g/L biomass concentration) in Stage 2. The biomass quantity generated was less than expected. The apparent inhibition by the high concentrations of contaminants in the groundwater was not conducive to rapid biological growth in the reactors. During the acclimation period two bioreactors were used. One reactor had propane and oxygen added to the air stream and one reactor had only oxygen added. Previous work has shown that TCE biodegradation requires a co-substrate, such as propane, to generate the strongly oxidizing enzymes required for initial attack on this compound. It was not known whether MEC or other possible contaminants in the groundwater would provide the necessary co-substrate. The biomass generation and monitoring data for each bioreactor was evaluated to determine the set-up of reactors in Stage 2.

APPARATUS AND PROCEDURES

Acclimation bioreactors consisted of glass filter flasks, nominal 1 liter capacity, fitted with rubber stoppers containing aeration tubes. Magnetic stirrers were used to maintain complete mixing of reactor contents. Bioreactors were filled to below the side-arm with representative groundwater from the site. Lightly contaminated soil from the site, 10 g per reactor, and 10 ml activated sludge from a wastewater

Table 1

008087

Report to : AWD Technologies
Rockville, MD 20850
Attn: Mr. Amine Bou Onk

Bill to: AWD Technologies
Rockville, MD 20850
Attn: Mr. Amine Bou Onk

Date: January 3, 1994
Sample Source: Army Corps Project
Sample collected: 12/14/93 by Kevin Held
Sample delivered to Bioscience: 12/15/93 received by John V. Forsyth III
Sample preparation: Groundwater samples in five gallon containers labeled MW-C, MW-1, MW-2, and EW-1
MW-C is the composite from MW-1, MW-2, and EW-1.

BI project # AWD 9302
AWD project # 9302
Site Location: Texas

ANALYTICAL RESULTS

Test	Sample ID.	Result	Method No.
Available Nutrient			
Ammonium-N	MW-C	0.1 mg/kg	STD. METH. 417E
Nitrate	MW-C	3.0 mg/kg	STD. METH. 418C
Orthophosphate	MW-C	< 0.2 mg/kg	STD. METH. 424E
Total Bacterial Plate Count	MW-C	9.7E+01 cfu/ml	STD. METH. 907
Total Organic Carbon	MW-C	373 mg/L	EPA 415.2
Chloride	MW-C	844 mg/L	EPA 325.1
pH	MW-C	6.5	STD. METH. 423
Specific Conductivity	MW-C	3215 umho	

NOTES:

Nutrients (ammonium-N, nitrate-N, and phosphate-P) are "available" not total.

cfu/ml = colony forming units per milliliter

Std. Meth. = Standard Methods for the Examination of Water and Wastewater

SW-846 = Test Methods for Evaluating Solid Waste, USEPA, 1986

EPA = (U.S.) Environmental Protection Agency Methods for Chemical Analysis of Water and Wastes

Sample analyzed: 12/30/93 to 1/03/94
Jeanne McHugh
Bioscience, Inc.

Yung Margaret Tsao, Laboratory Manager

Approved by:

Richard Bleam
Director of Technical Service
Bioscience Inc.

Date:

Date:

Report to : AWD Technologies
Rockville, MD 20850

Bill to: AWD Technologies
Rockville, MD 20850

Attn: Mr. Amine Bou Onk

Attn: Mr. Amine Bou Onk

Date: January 3, 1994

BI project # AWD 9302

Sample Source: Army Corps Project

AWD project # 9302

Sample collected: 12/14/93 by Kevin Held

Site Location: Texas

Sample delivered to Bioscience: 12/15/93 received by John V. Forsyth III

Sample preparation: Groundwater samples in five gallon containers labeled MW-C, MW-1, MW-2, and EW-1
MW-C is the composite from MW-1, MW-2, and EW-1.

ANALYTICAL RESULTS

<u>Test</u>	<u>Sample ID.</u>	<u>Result</u>	<u>Method No.</u>
<u>Available Nutrient</u>			
Ammonium-N	C-1	0.3 mg/kg	STD. METH. 417E
Nitrate	C-1	0.8 mg/kg	STD. METH. 418C
Orthophosphate	C-1	< 0.2 mg/kg	STD. METH. 424E
Total Bacterial Plate Count	C-1	1.1E+04 cfu/ml	STD. METH. 907
Total Organic Carbon	C-1	15.6 mg/L	EPA 415.2
Chloride	C-1	784 mg/L	EPA 325.1
pH	C-1	6.8	STD. METH. 423
Specific Conductivity	C-1	2840 umho	

NOTES:

Nutrients (ammonium-N, nitrate-N, and phosphate-P) are 'available' not total.

cfu/ml = colony forming units per milliliter

Std. Meth. = Standard Methods for the Examination of Water and Wastewater

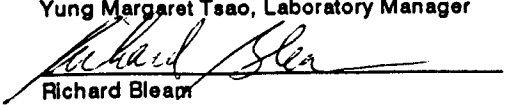
SW-846 = Test Methods for Evaluating Solid Waste, USEPA, 1986

EPA = (U.S.) Environmental Protection Agency Methods for Chemical Analysis of Water and Wastes

Sample analyzed: 12/30/93 to 1/03/94
Jeanne McHugh
Bioscience, Inc.

Yung Margaret Tsao, Laboratory Manager

Approved by:


Richard Bleam
Director of Technical Service
Bioscience Inc.

Date:

1/4/94
Date:

Table 3

INITIAL CLEAN GROUNDWATER METAL RESULTS 1/19/94

PARAMETER (mg/L)	SAMPLE MW Composite 44,610 Groundwater
aluminum	0.062
antimony	< 0.050
arsenic	< 0.050
barium	< 0.018
beryllium	< 0.001
boron	0.28
cadmium	< 0.005
calcium	61.0
chromium	< 0.010
cobalt	< 0.010
iron	15.8
lead	< 0.050
magnesium	51.3
manganese	0.17
molybdeum	< 0.020
potassium	3.88
selenium	< 0.100
silver	< 0.010
copper	0.057
sodium	274
nickel	< 0.025
thallium	< 0.050
vanadium	< 0.010
zinc	0.12

Table 4

INITIAL COMPOSITE GROUNDWATER METAL RESULTS 1/19/94

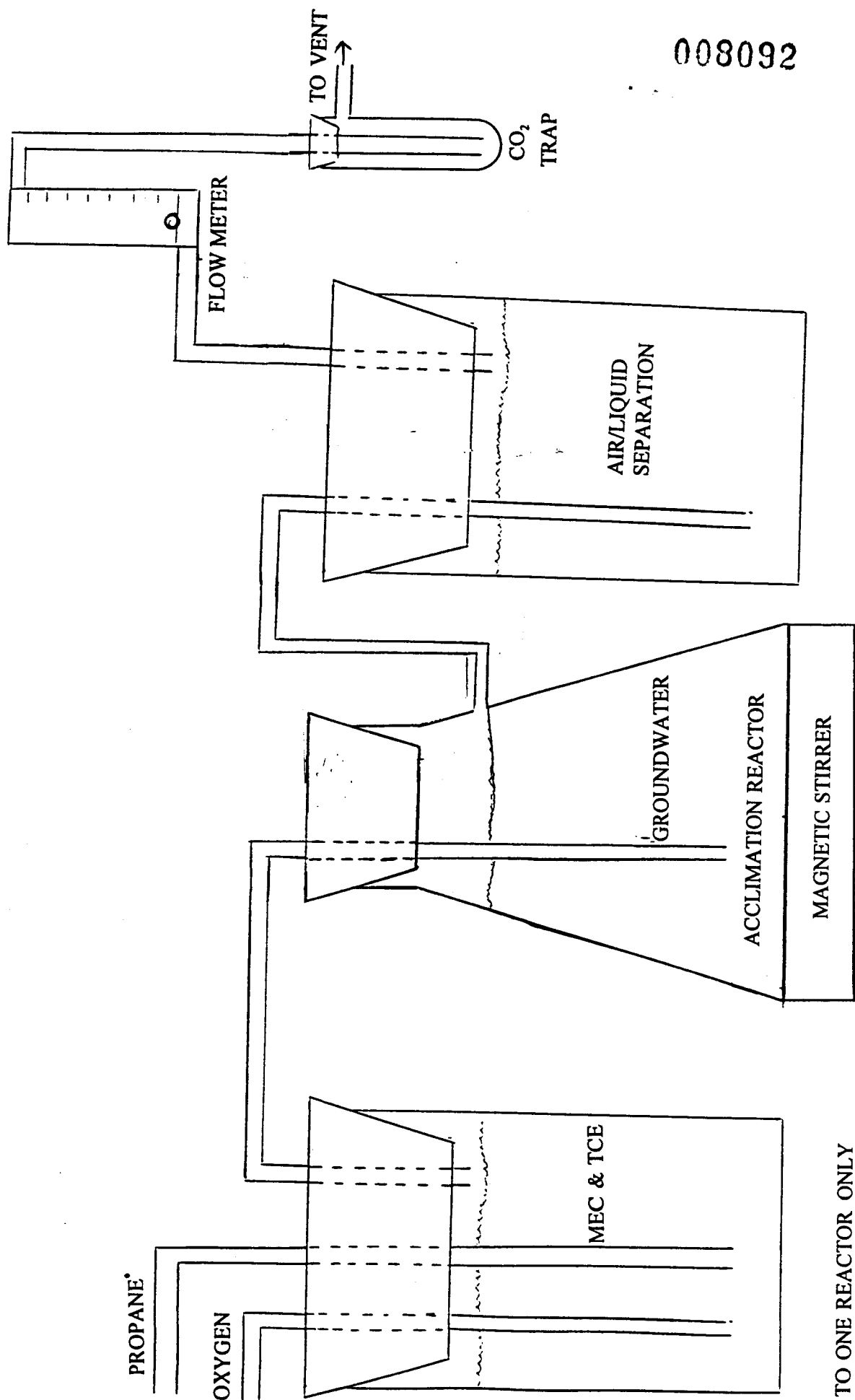
PARAMETER (mg/L)	SAMPLE MW Composite 44,610 Groundwater
aluminum	0.280
antimony	< 0.050
arsenic	< 0.050
barium	0.074
beryllium	< 0.001
boron	0.63
cadmium	< 0.005
calcium	77.8
chromium	< 0.010
cobalt	< 0.010
iron	16.3
lead	< 0.050
magnesium	70.4
manganese	1.21
molybdeum	< 0.020
potassium	5.16
selenium	< 0.100
silver	< 0.010
copper	0.11
sodium	272
nickel	0.040
thallium	< 0.050
vanadium	< 0.010
zinc	0.14

Table 5

INITIAL GROUNDWATER RESULTS 2/03/94

PARAMETER (mg/L)	SAMPLE 34936 MW-C Groundwater
chloromethane	< 100
vinyl chloride	< 100
bromomethane	< 100
chloroethane	< 100
trichlorofluoromethane	< 10
1,1-dichloroethene	< 10
methylene chloride	8400
trans-1,2-dichloroethene	< 10
1,1-dichloroethane	< 10
chloroform	< 10
1,2-dichloroethane	< 10
1,1,1-trichloroethane	< 10
carbon tetrachloride	< 10
benzene	< 10
trichloroethene	220
1,2-dichloropropane	< 10
bromodichloromethane	< 10
cis-1,3-dichloropropene	< 10
trans-1,3-dichloropropene	< 10
1,1,2-trichloroethane	< 10
dibromochloromethane	< 10
bromoform	< 10
toluene	< 10
tetrachloroethene	< 10
chlorobenzene	< 10
ethylbenzene	< 10
m/p-xylene	< 10
o-xylene	< 10
1,1,2,2-tetrachloroethane	< 10
1,3-dichlorobenzene	< 10
1,4-dichlorobenzene	< 10
1,2-dichlorobenzene	< 10

STAGE 1 - ACCLIMATION APPARATUS



008092

* TO ONE REACTOR ONLY
TWO SET-UPS REQUIRED

FIGURE 1

STAGE 1 - ACCUMULATION AT TUE WITH CONTINUOUS GROUNDWATER FLOW

008093

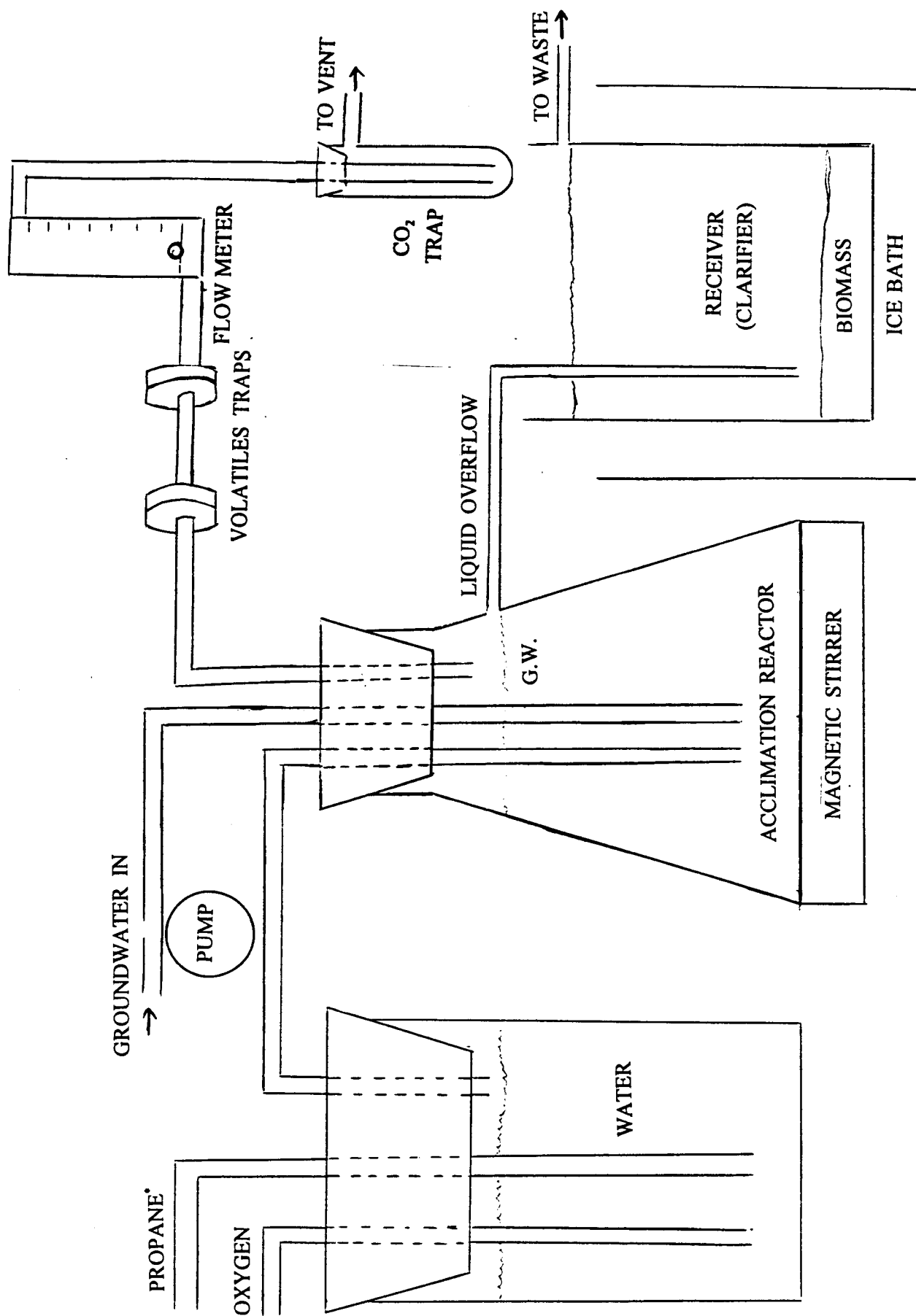
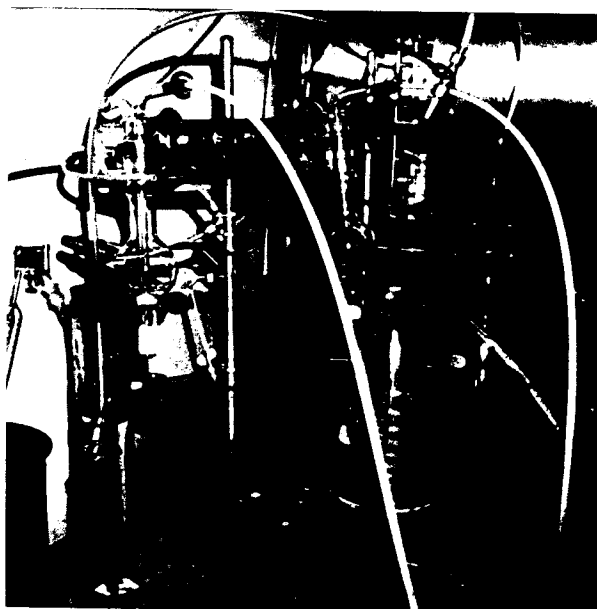
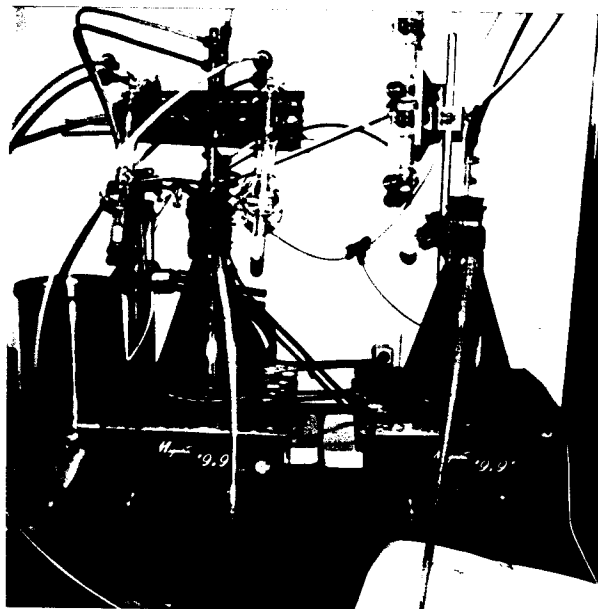


FIGURE 2

008094



treatment plant were used to supplement indigenous organisms present in the groundwater. Pure oxygen was bubbled through a separate reactor vessel, then introduced into each bioreactor. Reactor 1 had propane added to the gas stream. Gas flows were initially 60 ml/min. oxygen and 0.5 ml/min. propane (reactor 1). Flows were varied during acclimation as noted in the following section.

The pH of the groundwater was adjusted and maintained at pH 6.5 to 7.5 (see Table 6 and 7). Inorganic nutrients were added and monitored to maintain at least 10 mg nitrogen per liter and 1 mg phosphorus per liter. Gas exiting the bioreactor passed through a carbon dioxide trap to monitor carbon dioxide evolution. Chloride concentration in the bioreactor was monitored to assess chlorinated solvent biodegradation. When microbial growth and chloride release indicated substantial biodegradation, greater concentrations of groundwater were added into the bioreactors. Harvested biomass was stored in a refrigerator until sufficient biomass was available to begin Stage 2.

The contaminant loss due to volatilization was also evaluated by placing contaminant recovery tubes (traps) in the effluent air stream from the reactor vessels. Two traps were placed in series (to determine trapping efficiency) at each sampling interval (see Intermediate Analyses). The traps were exposed for 24 hours (actual exposure time was calculated using the capacity of the trap, contaminant concentration in the groundwater, and air flow rate through the trap), then removed, inserted into their protective containers, and shipped to the contract analytical laboratory. Control tubes were used to determine background contaminant concentrations. The direct measurement of volatilization can be used for estimating volatile emission control requirements for the full-scale bioremediation as well as performing a mass balance on the system.

MONITORING ANALYSES

Bioreactors were monitored daily for :

Chloride	EPA 325.1
pH	STD. METH. 423
Carbon Dioxide (Evolution)	EPA 415.2
Turbidity	In-house

Bioreactors were monitored twice per week for:

Ammonia-Nitrogen	STD. METH. 417B
Orthophosphate	STD. METH. 424E

TABLE 6: AWD 9302 GROUNDWATER TEST STAGE I -- ACCLIMATION

REACTOR 1 MONITORING DATA

Date	Day No.	pH Initial	pH adjt to	Chloride (mg/l)	CO2 (mg)	Turbidity 420mu	Turbidity 660mu	NH3-N (mg/l)	NO3-N (mg/l)	PO4-P (mg/l)	PLATE CT. (CFU/ml)	GW added (ml)
02/17/94	1	6.50	6.50				SET-UP	SET-UP	SET-UP	SET-UP	SET-UP	
02/18/94	2	8.35	6.90	802.0	1.8	0.301	0.147	0.3	5.4	3.6	na	0
02/19/94	3	8.20	7.40	806.5	11.0	0.321	0.185	na	na	na	na	0
02/20/94	4	8.25	7.30	804.1	39.3	0.408	0.185	na	na	na	na	0
02/21/94	5	8.25	7.30	792.5	21.8	0.427	0.251	10.3	6.2	29.2	na	0
02/22/94	6	8.25	7.00	811.1	21.2	0.473	0.276	na	na	na	na	0
02/23/94	7	8.05	6.95	785.5	46.4	0.488	0.306	na	na	na	na	0
02/24/94	8	8.05	7.00	776.2	23.9	0.531	0.336	14.3	5.8	57.6	na	0
02/25/94	9	7.90	7.00	792.5	21.1	0.564	0.355	na	na	na	na	0
02/26/94	10	7.65	7.00	778.5	17.4	0.601	0.366	na	na	na	na	0
02/27/94	11	7.60	7.00	780.8	20.6	0.609	0.392	na	na	na	na	0
02/28/94	12	7.40	6.90	811.1	17.4	0.579	0.364	13.7	6.6	72.2	1.11E+07	0
03/01/94	13	7.05	7.05	815.8	1.0	0.585	0.379	na	na	na	na	0
03/02/94	14	7.15	7.15	820.5	5.2	0.614	0.378	na	na	na	na	100
03/03/94	15	7.40	7.40	834.4	26.8	0.583	0.363	na	na	na	na	100
03/04/94	16	7.70	7.05	813.5	24.8	0.605	0.393	na	na	na	na	100
03/05/94	17	7.70	6.90	778.5	29.8	0.525	0.309	na	na	na	na	100
03/06/94	18	7.50	6.90	818.1	28.6	0.572	0.343	na	na	na	na	100
03/07/94	19	7.55	7.25	834.4	23.4	0.483	0.292	9.4	5.3	50.8	na	100
03/08/94	20	7.70	7.05	841.4	24.8	0.534	0.337	na	na	na	na	100
03/09/94	21	7.50	7.00	841.1	32.4	0.502	0.296	na	na	na	na	100
03/10/94	22	7.55	6.95	827.4	26.0	0.463	0.280	8.5	6.0	44.8	na	100
03/11/94	23	7.55	6.90	806.5	28.0	0.444	0.273	na	na	na	na	100
03/12/94	24	7.80	7.40	843.8	29.0	0.450	0.307	na	na	na	na	100
03/13/94	25	7.70	7.10	813.5	27.6	0.458	0.318	na	na	na	na	100
03/14/94	26	7.75	7.00	827.4	21.4	0.418	0.270	11.4	5.6	44.8	na	100
03/15/94	27	7.80	7.00	855.4	31.8	0.370	0.276	na	na	na	na	100
03/16/94	28	7.70	6.95	869.4	32.0	0.398	0.281	na	na	na	na	100
03/17/94	29	7.70	6.95	867.1	15.0	0.408	0.284	11.9	4.5	50.1	na	100
03/18/94	30	7.60	7.05	848.4	30.4	0.411	0.279	na	na	na	na	100
03/19/94	31	7.70	7.20	827.4	33.0	0.368	0.292	na	na	na	na	100
03/20/94	32	7.80	7.10	829.8	39.8	0.418	0.316	na	na	na	na	200
03/21/94	33	7.70	6.90	864.7	19.8	0.318	0.243	9.1	5.6	46.5	5.07E+06	200
03/22/94	34	7.80	6.90	850.8	41.6	0.248	0.202	na	na	na	na	200
03/23/94	35	7.95	7.00	841.4	40.4	0.381	0.280	na	na	na	na	200
03/24/94	36	8.00	7.00	832.1	37.6	0.287	0.217	4.9	5.7	32.5	na	200
03/25/94	37	8.00	7.00	834.4	32.4	0.247	0.188	na	na	na	na	200
03/26/94	38	8.10	7.30	855.4	60.7	0.232	0.175	na	na	na	na	200
03/27/94	39	8.10	7.40	829.8	26.0	0.215	0.147	na	na	na	na	200
03/28/94	40	8.40	7.00	813.5	10.8	0.230	0.170	5.1	5.3	31.4	na	200
03/29/94	41	8.25	7.00	839.1	39.4	0.213	0.164	na	na	na	na	200
03/30/94	42	8.30	7.00	862.4	43.5	0.150	0.112	na	na	na	na	250
03/31/94	43	8.40	7.00	825.1	33.0	0.203	0.155	12.9	6.1	33.5	na	250
04/01/94	44	8.10	7.25	846.1	58.9	0.144	0.112	na	na	na	na	300
04/02/94	45	7.80	6.90	867.1	78.9	0.172	0.138	na	na	na	na	300
04/03/94	46	7.60	7.00	855.4	89.3	0.115	0.096	na	na	na	na	0
04/04/94	47	7.90	6.90	848.4	63.1	0.214	0.140	1.7	5.2	29.4	na	150
04/05/94	48	7.90	7.00	874.1	82.2	0.177	0.125	na	na	na	na	225
04/06/94	49	7.90	6.70	853.1	96.3	0.151	0.105	na	na	na	na	300
04/07/94	50	7.90	7.00	853.1	98.9	0.139	0.094	1.8	4.7	26.7	na	300
04/08/94	51	8.20	6.90	822.2	96.5	0.143	0.093	na	na	na	na	100
04/09/94	52	na	na	na	112.0	na	na	na	na	na	na	0
04/10/94	53	8.20	7.30	844.7	76.4	0.154	0.091	na	na	na	na	100
04/11/94	54	8.10	7.25	854.7	53.7	0.405	0.258	na	na	na	na	100
04/12/94	55	7.80	7.00	842.2	79.6	0.358	0.218	na	na	na	na	100
04/13/94	56	7.95	7.10	857.2	97.4	0.462	0.288	na	na	na	na	100
04/15/94	58	7.80	7.00	847.2	na	0.452	0.293	8.0	6.0	80.0	na	0
04/18/94	61	7.90	6.90	na	na	na	na	na	na	na	na	200
04/19/94	62	8.00	6.90	864.7	43.0	0.389	0.262	na	na	na	na	100
04/20/94	63	7.70	6.90	na	na	na	na	na	na	na	na	100
04/21/94	64	7.40	7.10	na	na	na	na	na	na	na	na	100
04/22/94	65	7.15	7.15	879.7	na	na	na	na	na	na	na	0
04/25/94	68	7.25	7.25	na	na	na	na	na	na	na	na	200
04/26/94	69	7.60	6.50	892.2	na	na	na	na	na	na	na	100
04/27/94	70	6.90	6.90	na	na	na	na	na	na	na	na	100
04/28/94	71	6.50	6.90	na	na	na	na	na	na	na	na	100
04/29/94	72	6.30	6.80	989.7	na	na	na	na	na	na	na	100
05/03/94	76	6.10	6.70	na	na	na	na	na	na	na	na	100
05/04/94	77	5.70	6.90	979.7	37.46	0.76	0.518	6.9	na	na	na	100
05/05/94	78	5.80	7.40	na	na	na	na	na	na	na	na	50
05/09/94	82	6.10	7.30	1022.2	na	0.92	0.63	na	na	na	na	200
05/10/94	83	5.10	7.10	1032.2	50.73	0.81	0.5	na	na	na	na	100
05/11/94	84	5.40	7.00	na	na	na	na	na	na	na	na	100
05/12/94	85	4.00	7.00	1049.7	na	na	na	na	na	na	na	100

TABLE 7: AWD 9302 GROUNDWATER TEST STAGE I - ACCLIMATION

REACTOR 2 MONITORING DATA

Date	Day No.	pH Initial	pH adjt to	Chloride (mg/l)	CO2 (mg)	Turbidity 420mu	Turbidity 660mu	NH3-N (mg/l)	NO3-N (mg/l)	PO4-P (mg/l)	PLATE CT. (CFU/ml)	GW added (ml)
02/17/94	1	6.50	6.50		SET-UP	SET-UP	SET-UP	SET-UP	SET-UP	SET-UP	SET-UP	SET-UP
02/18/94	2	8.55	7.00	793.0	1.9	0.307	0.152	0.3	5.1	3.0	na	0
02/19/94	3	8.35	7.40	783.2	5.4	0.332	0.183	na	na	na	na	0
02/20/94	4	8.30	7.30	790.2	32.4	0.428	0.183	na	na	na	na	0
02/21/94	5	8.25	7.10	808.8	16.0	0.430	0.252	8.7	5.5	27.5	na	0
02/22/94	6	8.25	7.15	804.1	22.2	0.493	0.294	na	na	na	na	0
02/23/94	7	8.05	7.00	785.5	29.0	0.464	0.273	na	na	na	na	0
02/24/94	8	7.90	7.00	799.5	23.1	0.488	0.298	12.6	5.8	55.9	na	0
02/25/94	9	7.65	7.00	804.1	18.5	0.445	0.287	na	na	na	na	0
02/26/94	10	7.60	7.00	801.8	24.8	0.578	0.344	na	na	na	na	0
02/27/94	11	7.55	7.00	808.8	26.6	0.573	0.356	na	na	na	na	0
02/28/94	12	7.45	7.60	797.1	na	0.557	0.327	16.9	5.9	64.6	5.77E+06	0
03/01/94	13	7.20	7.20	808.8	9.4	0.577	0.338	na	na	na	na	0
03/02/94	14	7.25	7.25	808.8	7.6	0.522	0.345	na	na	na	na	100
03/03/94	15	7.40	7.40	801.8	14.8	0.530	0.325	na	na	na	na	100
03/04/94	16	7.70	7.05	813.5	27.0	0.524	0.318	na	na	na	na	100
03/05/94	17	7.70	7.00	792.5	22.0	0.440	0.270	na	na	na	na	100
03/06/94	18	7.50	6.80	811.1	36.6	0.518	0.322	na	na	na	na	100
03/07/94	19	7.45	7.25	818.1	19.2	0.403	0.240	8.6	5.4	51.2	na	100
03/08/94	20	7.70	7.10	797.1	20.6	0.441	0.257	na	na	na	na	100
03/09/94	21	7.25	7.05	815.8	19.0	0.406	0.231	na	na	na	na	100
03/10/94	22	7.70	7.00	820.5	32.0	0.377	0.227	8.5	5.3	46.7	na	100
03/11/94	23	7.55	6.95	820.5	26.6	0.385	0.237	na	na	na	na	100
03/12/94	24	7.80	7.40	797.1	30.4	0.436	0.275	na	na	na	na	100
03/13/94	25	7.80	7.20	804.1	22.0	0.443	0.296	na	na	na	na	100
03/14/94	26	7.75	7.00	801.8	20.2	0.405	0.266	12.3	5.8	45.8	na	100
03/15/94	27	7.80	7.05	834.4	28.8	0.404	0.282	na	na	na	na	100
03/16/94	28	7.80	7.05	829.8	27.8	0.382	0.276	na	na	na	na	100
03/17/94	29	7.90	6.90	832.1	16.4	0.401	0.274	14.5	4.7	56.1	na	100
03/18/94	30	7.60	7.10	822.8	31.8	0.402	0.275	na	na	na	na	100
03/19/94	31	7.60	7.20	839.1	34.6	0.378	0.274	na	na	na	na	100
03/20/94	32	7.80	7.10	839.1	na	0.415	0.322	na	na	na	na	200
03/21/94	33	7.80	7.00	836.8	16.2	0.349	0.252	10.4	5.6	47.3	3.70E+06	200
03/22/94	34	7.80	7.00	829.8	36.4	0.306	0.225	na	na	na	na	200
03/23/94	35	7.90	7.00	848.4	34.8	0.342	0.244	na	na	na	na	200
03/24/94	36	7.80	7.00	829.8	31.6	0.260	0.181	5.9	5.7	28.9	na	200
03/25/94	37	7.80	6.80	850.8	25.6	0.227	0.157	na	na	na	na	200
03/26/94	38	7.70	7.10	829.8	58.5	0.218	0.149	na	na	na	na	200
03/27/94	39	8.00	7.30	839.1	54.7	0.208	0.144	na	na	na	na	200
03/28/94	40	7.80	7.10	825.1	4.8	0.204	0.135	10.7	6.2	27.0	na	200
03/29/94	41	8.20	7.00	843.8	21.2	0.218	0.140	na	na	na	na	200
03/30/94	42	8.40	7.00	841.4	49.5	0.237	0.172	na	na	na	na	250
03/31/94	43	8.40	7.00	822.8	40.8	0.212	0.150	11.9	6.4	36.3	na	250
04/01/94	44	8.10	7.10	804.1	57.3	0.217	0.162	na	na	na	na	300
04/02/94	45	7.70	7.00	843.8	65.9	0.190	0.136	na	na	na	na	300
04/03/94	46	7.60	7.00	862.4	75.1	0.162	0.112	na	na	na	na	0
04/04/94	47	8.00	7.00	853.1	53.5	0.194	0.121	1.4	5.4	23.9	na	150
04/05/94	48	7.55	7.00	839.1	30.0	0.153	0.100	na	na	na	na	225
04/06/94	49	7.70	7.00	869.4	42.4	0.138	0.089	na	na	na	na	300
04/07/94	50	7.90	6.80	804.1	90.3	0.167	0.104	1.1	4.4	24.9	na	300
04/08/94	51	8.10	7.10	819.7	100.0	0.209	0.126	na	na	na	na	100
04/09/94	52	na	na	na	63.2	na	na	na	na	na	na	0
04/10/94	53	8.20	7.40	837.2	53.3	0.297	0.166	na	na	na	na	100
04/11/94	54	7.90	7.25	832.2	36.4	0.344	0.2	na	na	na	na	100
04/12/94	55	7.90	7.00	877.2	51.4	0.373	0.2	na	na	na	na	100
04/13/94	56	7.80	7.00	894.7	65.1	0.421	0.2	na	na	na	na	100
04/15/94	58	7.40	7.10	907.2	na	0.566	0.3	4.0	4.0	80.0	na	0
04/18/94	61	7.70	6.70	na	na	na	na	na	na	na	na	200
04/19/94	62	6.80	na	897.2	46.2	0.490	0.3	na	na	na	na	100
04/20/94	63	6.40	na	na	na	na	na	na	na	na	na	100
04/21/94	64	5.40	7.00	na	na	na	na	na	na	na	na	100
04/22/94	65	5.60	7.10	969.7	44.3	0.404	0.236	8.0	4.0	80.0	na	0
04/25/94	68	6.85	6.85	na	na	na	na	na	na	na	na	200
04/26/94	69	5.60	6.70	989.7	37.5	0.326	0.201	na	na	na	na	100
04/27/94	70	5.00	7.00	na	na	na	na	na	na	na	na	100
04/28/94	71	5.90	6.70	na	na	na	na	na	na	na	na	100
04/29/94	72	3.90	7.20	na	na	na	na	na	na	na	na	100
05/03/94	76	3.50	6.70	1054.7	na	0.501	0.315	na	6.9	21.5	na	100
05/04/94	77	6.60	7.00	na	na	na	na	na	na	na	na	100
05/05/94	78	6.40	7.30	1084.7	38.7	0.800	0.520	6.3	na	na	na	50
05/09/94	82	6.90	7.40	1092.2	na	na	na	na	na	na	na	200
05/10/94	83	5.70	7.40	1012.2	18.6	0.802	0.556	na	na	na	na	100
05/11/94	84	4.30	7.40	na	na	0.714	0.500	na	na	na	na	100
05/12/94	85	3.00	7.20	1142.1	na	na	na	< 1	6.0	50.0	na	100

Nitrate-Nitrogen

STD. METH. 418C

The effluent gas stream from the bioreactors was analyzed for:

Volatile Chlorinated Hydrocarbons

SW-846⁵ 0030,5030

A complete compilation of monitoring analyses is presented in Appendix B. Graphical data summaries are presented in Figures 3 through 11.

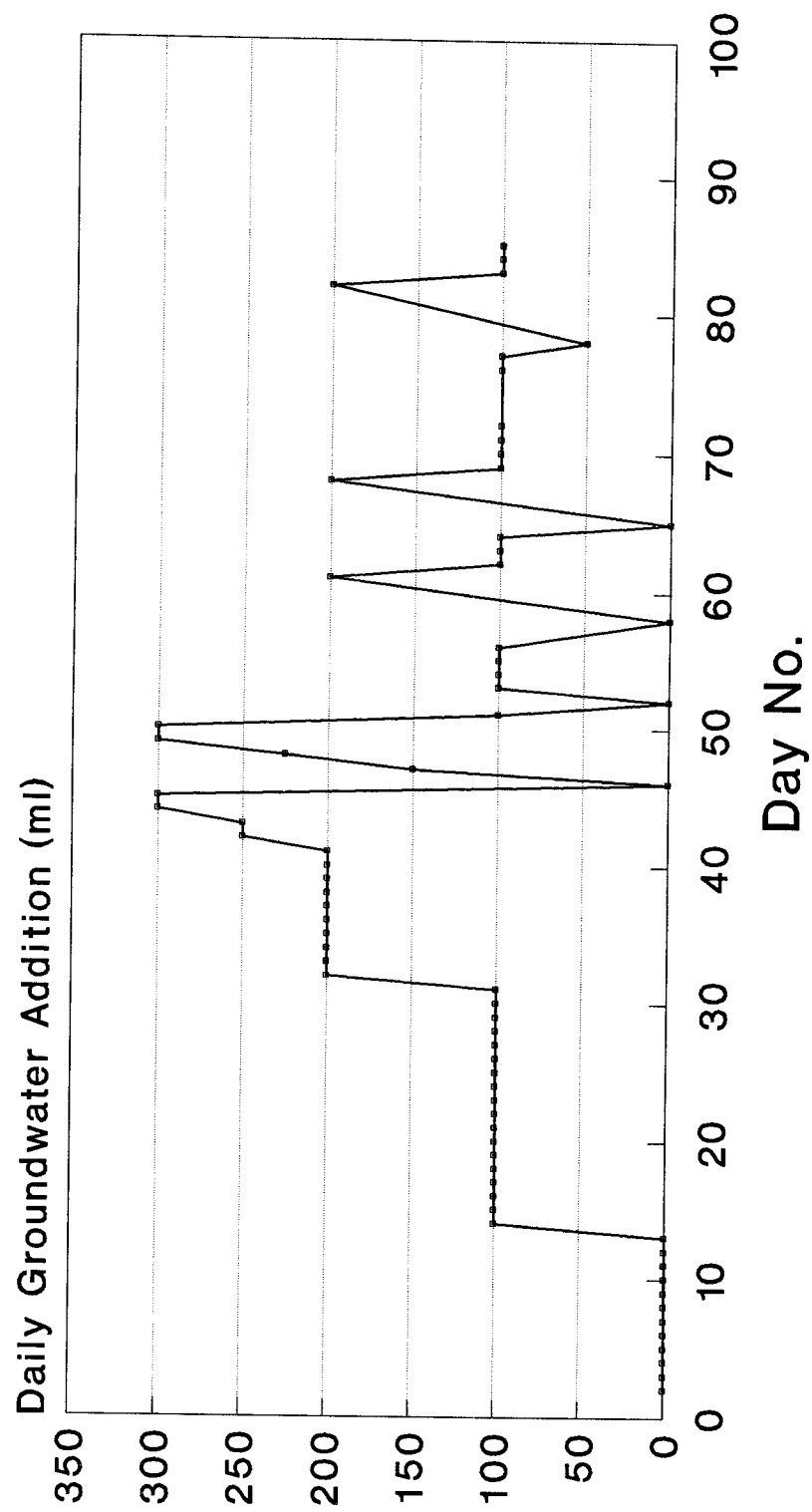
RESULTS AND DISCUSSION

Interpretation of Monitoring Results

Figure 3 shows the amount of groundwater added to each acclimation reactor daily. Groundwater addition was started after turbidity had peaked in both reactors (see figures 4 and 5, day 12). At this point carbon dioxide evolution also dropped off indicating that the biodegradable substrate originally present in the groundwater was nearly consumed (see figures 6 and 7). Groundwater addition was begun at a rate of 100 ml per day. Turbidity decreased at this groundwater addition rate but carbon dioxide evolution remained constant (reactor 2) or increased slightly (reactor 1). Chloride concentration remained constant for reactor 2 but increased slightly in reactor 1. The rate of propane addition to reactor 1 was doubled on day 27. Carbon dioxide evolution increased slightly in reactor 1 but chloride concentration decreased.

The amount of groundwater added daily was increased to 200 ml on day 31. Turbidity dropped in both reactors but carbon dioxide evolution increased. Chloride levels in both reactors continued to trend upward. On day 41 the amount of groundwater added daily was increased to 250 ml and on day 43 increased again to 300 ml. Turbidity dropped rapidly in both reactors but carbon dioxide evolution remained constant or increased. Propane addition to reactor 1 was also increased on day 42 by 30% and air replaced pure oxygen to both reactors on day 44. Propane rate was increased in order to supply additional co-substrate as the TCE level increased with groundwater addition. Air was tried to determine if a slightly higher level of carbon dioxide would stimulate the biomass. The turbidity continued to drop, however. Groundwater addition was deleted one day, then gradually increased again to 300 ml. Turbidity increased slightly, then dropped again as the groundwater added increased. It was

FIGURE 3: GROUNDWATER ADDITION
TO ACCLIMATION BIOREACTORS



—●— Reactor 1 and 2

008099

FIGURE 4
ACCLIMATION REACTOR 1 BIOMASS

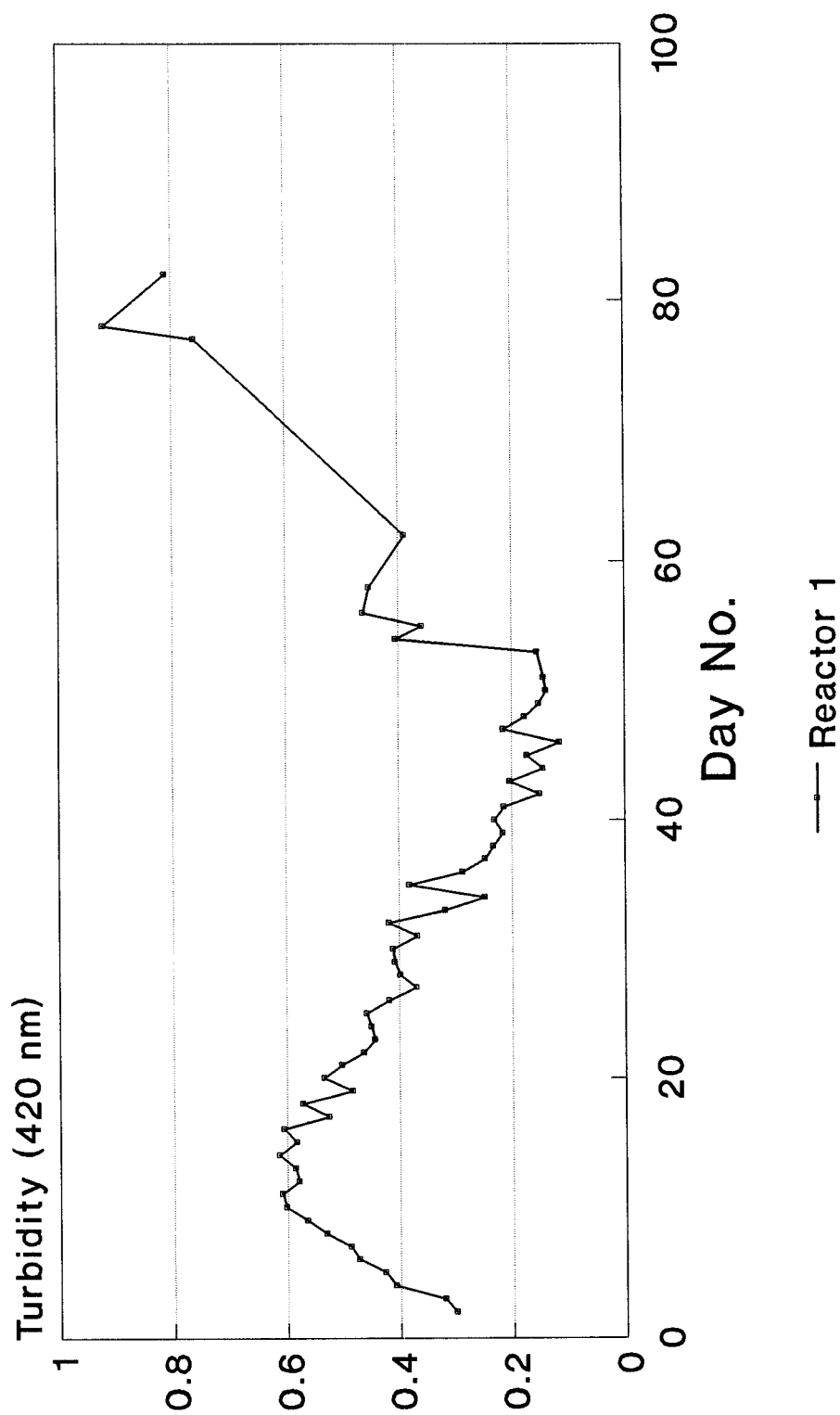


FIGURE 5
ACCLIMATION REACTOR 2 BIOMASS

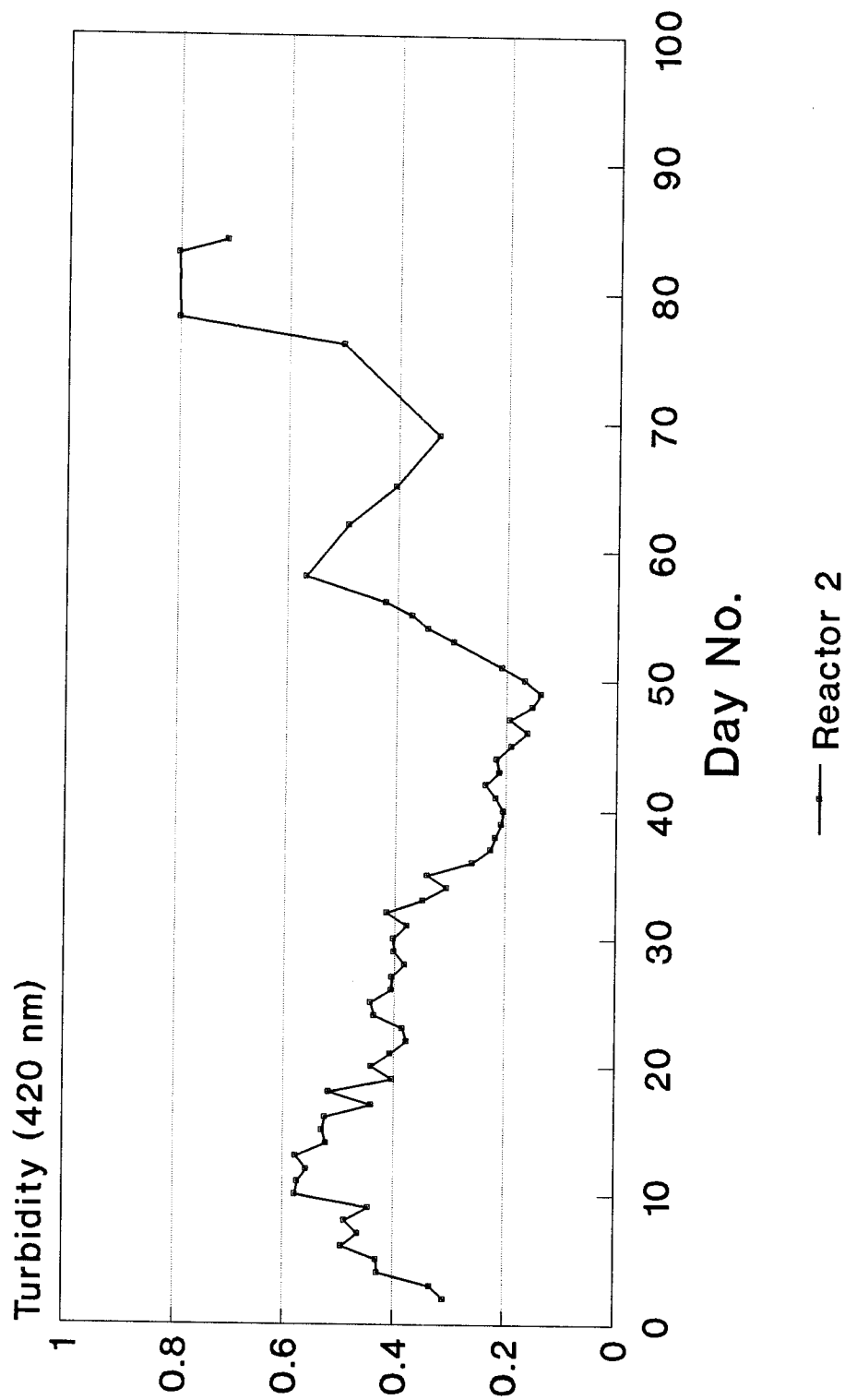


FIGURE 6: ACCLIMATION REACTOR 1
CARBON DIOXIDE EVOLUTION

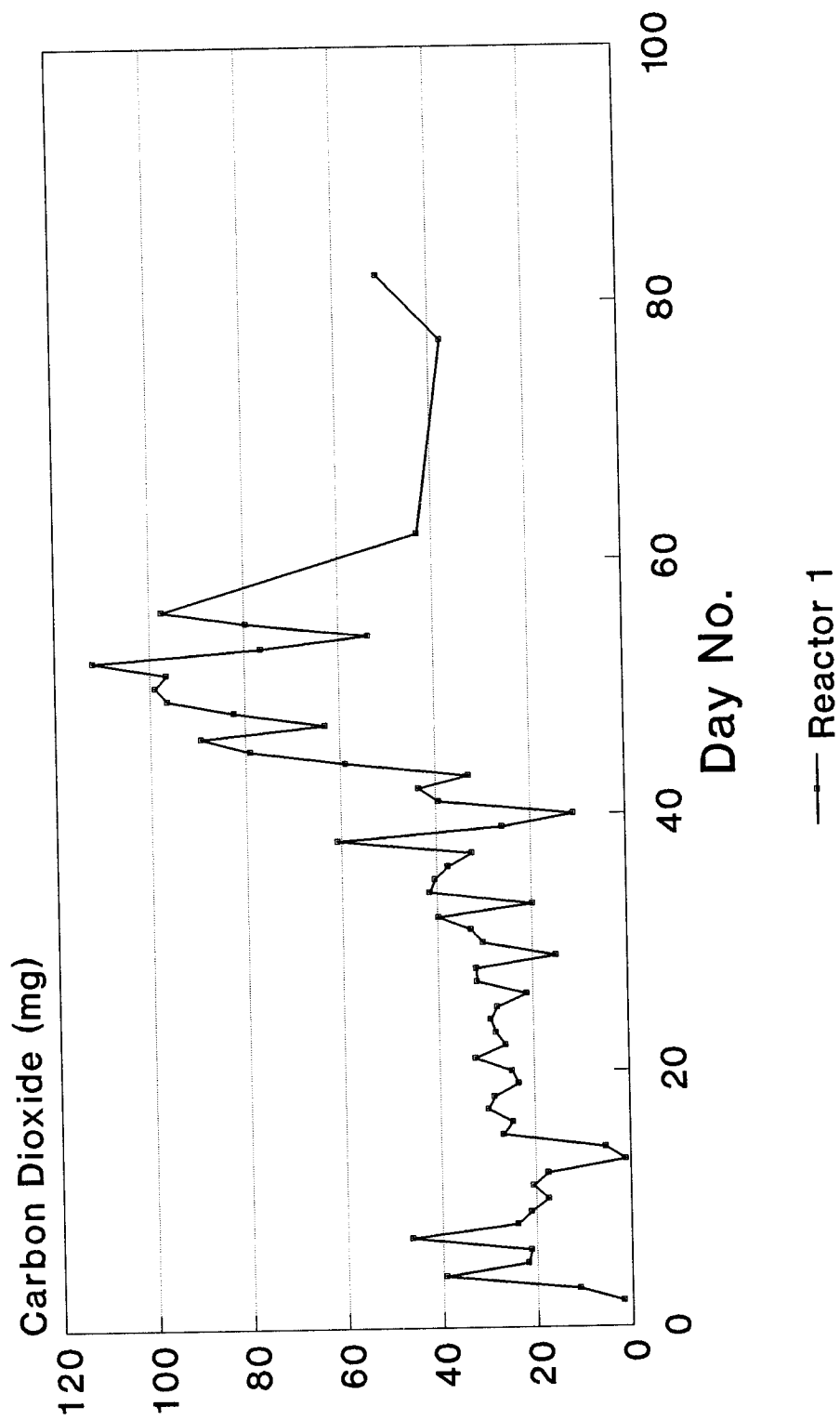


FIGURE 7: ACCLIMATION REACTOR 2
CARBON DIOXIDE EVOLUTION

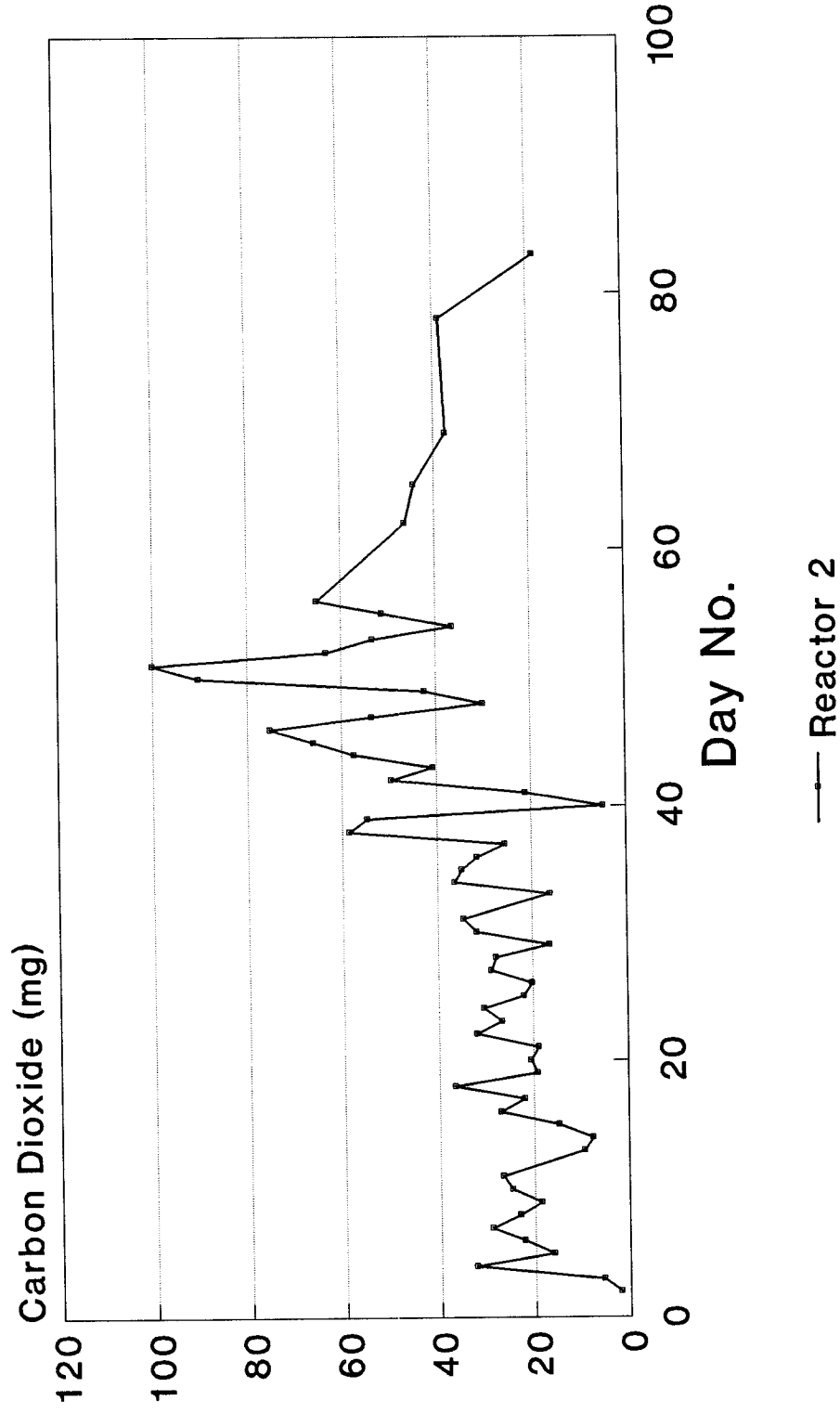


FIGURE 8: ACCLIMATION REACTOR 1
CHLORIDE CONCENTRATION

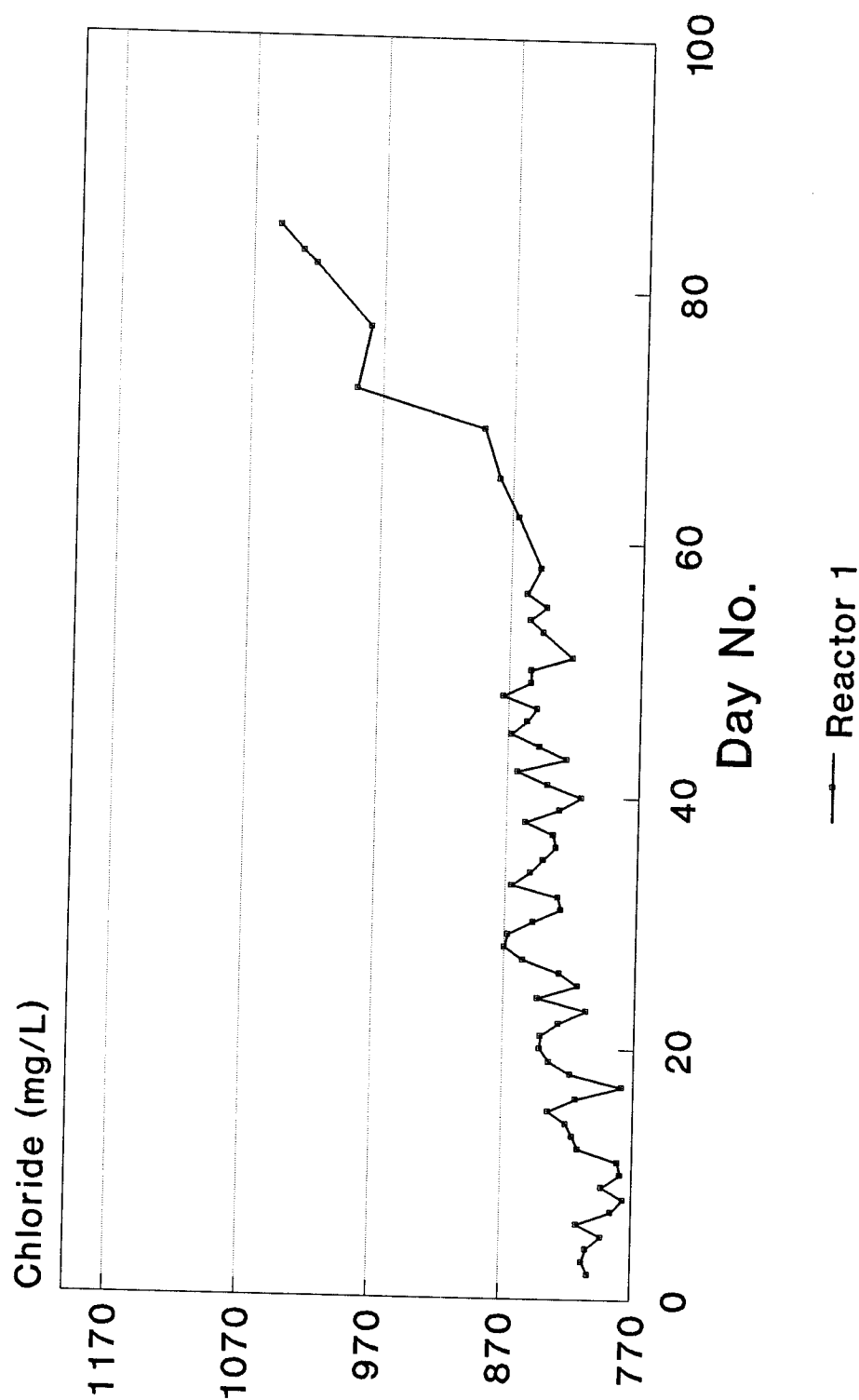


FIGURE 9: ACCLIMATION REACTOR 2
CHLORIDE CONCENTRATION

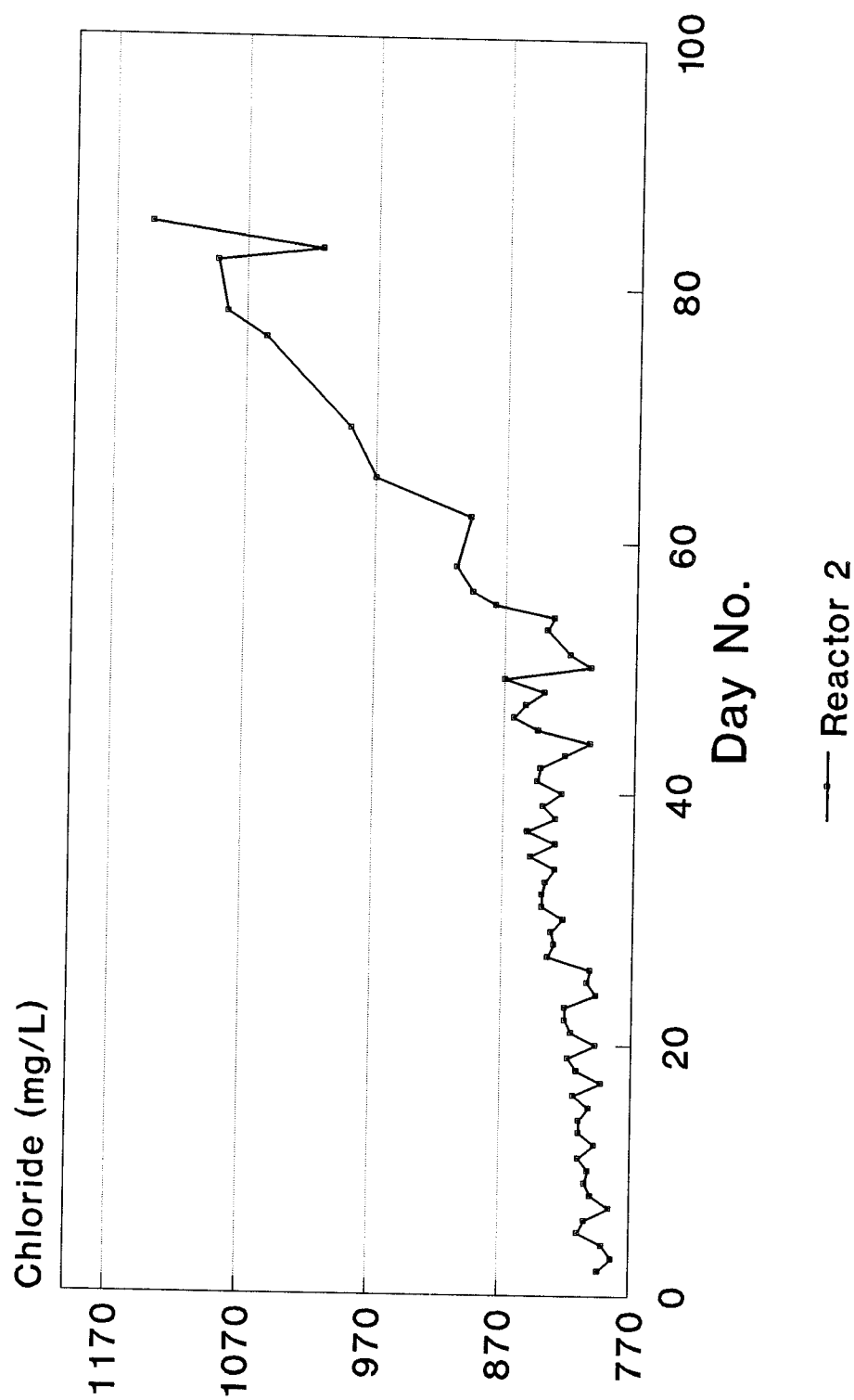


FIGURE 10: ACCLIMATION REACTOR 1
pH CONCENTRATION

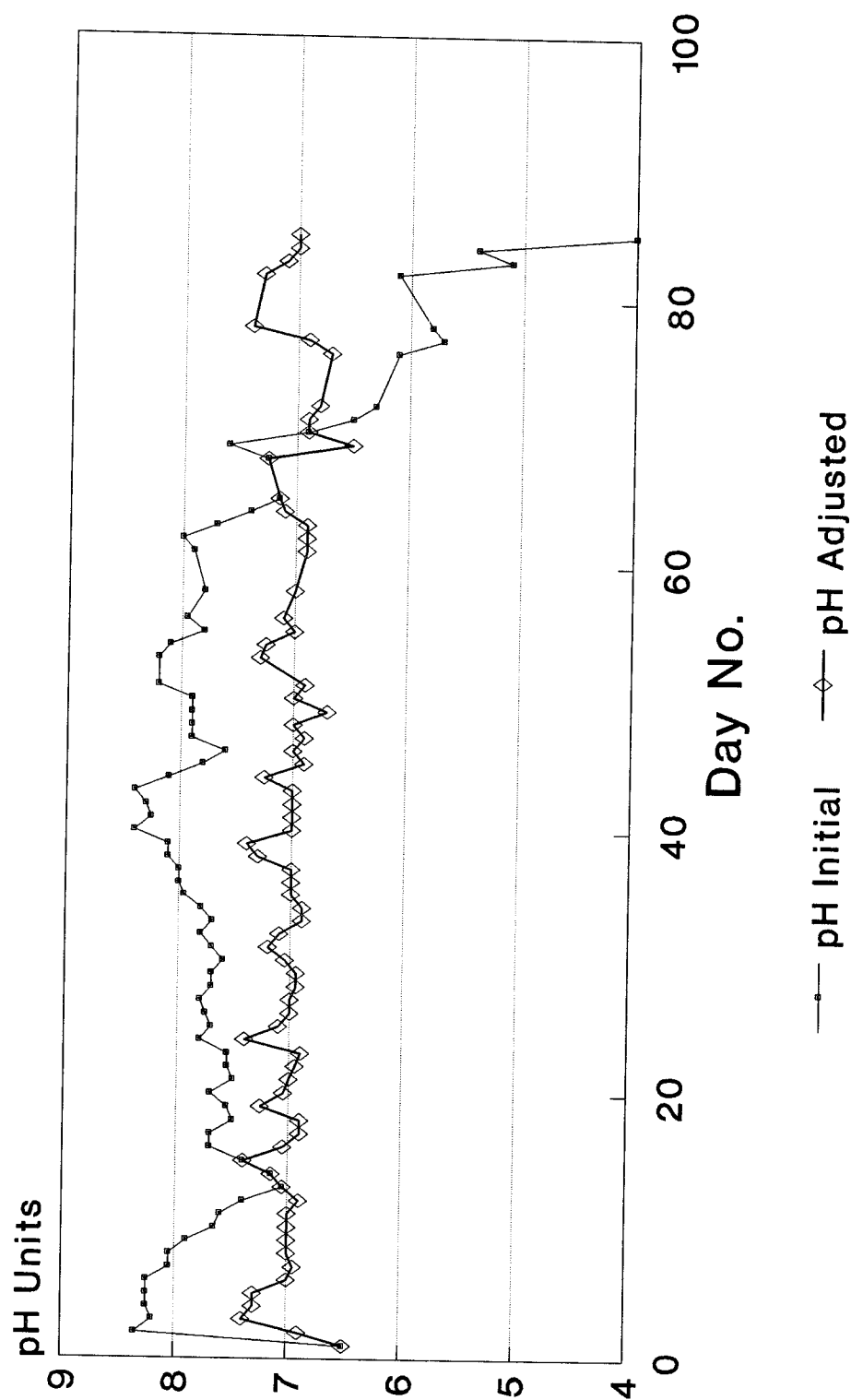
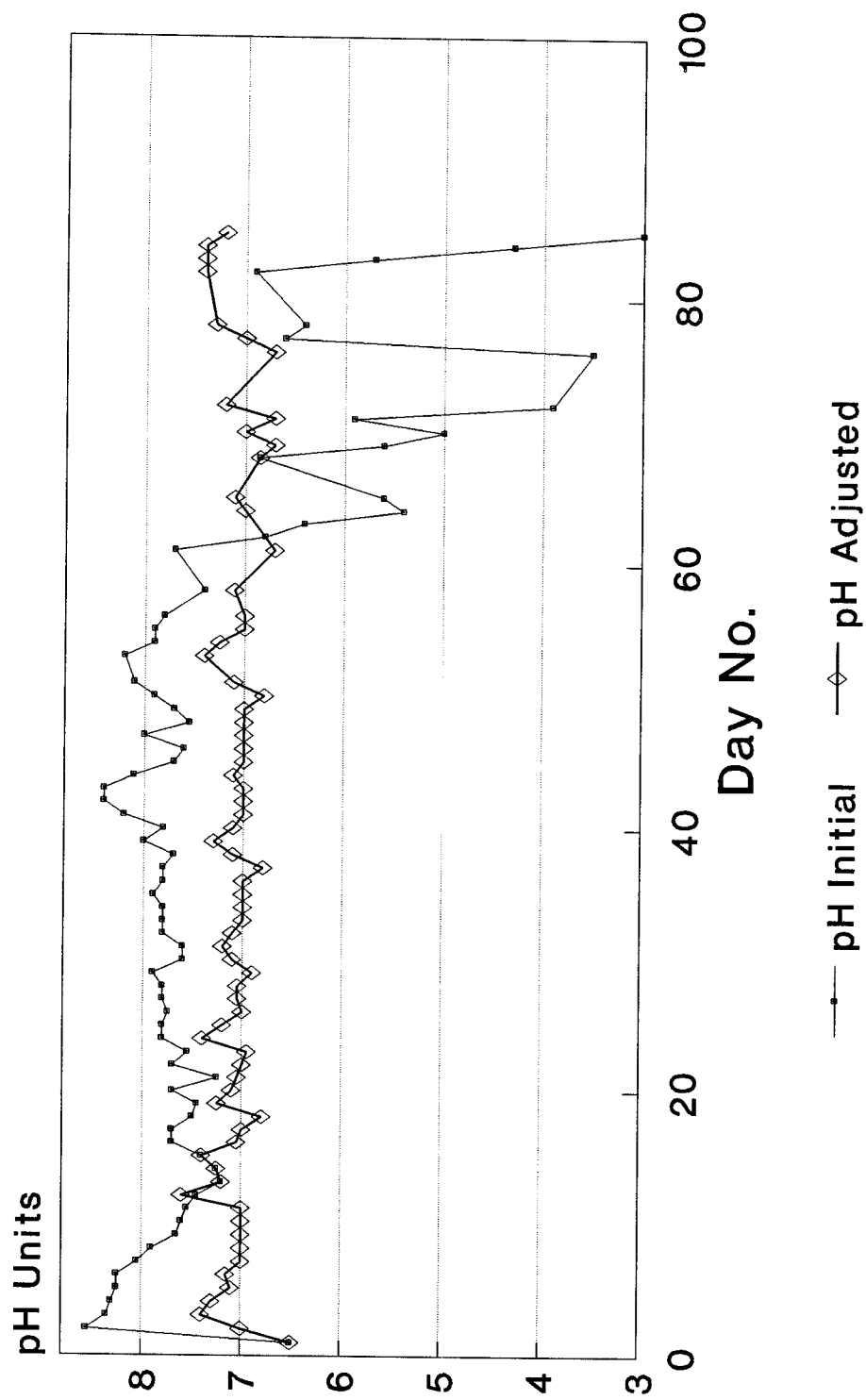


FIGURE 11: ACCLIMATION REACTOR 2
pH CONCENTRATION



concluded that the biomass could not tolerate the 300 ml per day addition of groundwater. From day 50 the amount was reduced to an average of 100 ml per day. Turbidity increased dramatically from day 50. Reactor 1 carbon dioxide evolution has fluctuated around 80 mg per day and reactor 2 about 60 mg per day from day 50. Chloride concentration has increased in both reactors. Reactor 2 has shown a more dramatic increase of about 350 mg/l since day 50 while reactor 1 has increased about 250 mg/l.

Chloride content of the contaminants was calculated as 0.809 mg Cl/mg TCE and 0.835 mg Cl/mg MEC. At 100 ml groundwater per day, the daily loading was 840 mg MEC and 22 mg TCE. Initial inorganic chloride content of the groundwater was 800 mg/l. Therefore, ignoring volatilization, total degradation of the TCE only would result in a steady state concentration of 815 mg Cl/l based on total liquid volume of 1200 ml. Total degradation of MEC only would result in a steady state concentration of 1385 mg Cl/l. Until day 55, inorganic chloride results were more consistent with TCE degradation than with extensive MEC degradation. After day 55, inorganic chloride increased in reactor 2 to about 1150 mg/l which corresponds to more than 50% degradation of TCE and MEC. Samples were taken on day 77 to perform a shake flask batch experiment to confirm MEC removal.

The pH of both reactors tended to rise 0.5 to 1.0 pH unit daily from the beginning of the experiment to day 57. The pH was adjusted each day with phosphoric acid to maintain the 6.5 to 7.5 pH range. The pH was expected to drop if extensive dechlorination was occurring with production of HCl. Note the 3 to 4 pH unit decrease in reactor 2 (and to a lesser extent in reactor 1) from day 58. The production of acid with concurrent rise in inorganic chloride is presumptive evidence of biological dechlorination and is consistent with the results of other investigators^{1,2}.

Volatilization Losses

Results of analyses of volatile traps are presented in Tables 8 and 9. The first set of volatile traps were installed for 24 hours (day 40) and the daily fresh groundwater addition was 200 ml. The daily addition added 1680 mg MEC and 44 mg TCE. Total measured loss due to volatilization was less than 4% (61 mg/day) of the amount of MEC added but over 30% (13.8 mg/day) of the TCE added. The MEC results are underestimates due to the larger amount of MEC found in the second of the two traps used and MEC recovery from the back sorbent section greater than 10% of the recovery from the front sorbent. The second set of volatile traps was installed for 6 hours (day 70) and the daily fresh

TABLE 8

GROUNDWATER REACTORS AIR SAMPLING

AWD PROJECT 9301

(24 hr., 3/28/94 to 3/29/94)

PARAMETER	REACTOR 1 SAMPLE 37108 1-1 VO3284	REACTOR 1 SAMPLE 37109 1-2 VO3284	REACTOR 2 SAMPLE 37110 1-3 VO3284	REACTOR 2 SAMPLE 37111 1-4 VO3285	SAMPLE 37112 1-5 BLANK
methylene chloride (mg)*	11	12	20	41	< 0.01
trichloroethylene (mg)**	13	0.8	5.3	< 0.01	< 0.01

* NIOSH METHOD 1055

** NIOSH METHOD 1022

Note:

Analyte concentration in back sorbent section greater than 10% of front sorbent section indicating break through and possible sample loss in all methylene chloride analyses.

TABLE 9

GROUNDWATER REACTORS AIR SAMPLING
AWD PROJECT 9301

(6 hr., 4/27/94 to 4/27/94)

PARAMETER	REACTOR 1 SAMPLE 38410 1-1 VO3284	REACTOR 1 SAMPLE 38411 1-2 VO3284	REACTOR 2 SAMPLE 38412 1-3 VO3284	REACTOR 2 SAMPLE 38413 1-4 VO3285
methylene chloride (mg)*	2.10	8.9	0.6	6.0
trichloroethylene (mg)**	0.5	< 0.1	0.2	< 0.01

* NIOSH METHOD 1055

** NIOSH METHOD 1022

Note:

Analyte concentration in back sorbent section greater than 10% of front sorbent section indicating break through and possible sample loss in all methylene chloride analyses.

groundwater addition was 100 ml. The daily addition added 840 mg MEC and 22 mg TCE. Total measured loss due to volatilization was less than 5% (44 mg/day) of the amount of MEC added but over 9% (2.0 mg/day) of the TCE added. Again the MEC results are underestimates due to the larger amount of MEC found in the second of the two traps used and MEC recovery from the back sorbent section greater than 10% of the recovery from the front sorbent. The two sets of analyses agree qualitatively, but the differences between the results from reactor 1 and reactor 2 in each set vary by more than 50%.

Accumulated biomass collected through day 50 was used to seed the batch respirometry reactors for the second stage of testing. Biomass from both bioreactors was used since both reactors showed increased chloride concentrations. Propane addition was used in the batch bioreactors since turbidity, carbon dioxide evolution and chloride concentration were all slightly higher in reactor 1.

A second batch experiment was conducted on May 4, 1994 to confirm MEC degradation. After daily addition of the 100 ml fresh groundwater to each acclimation reactor and 30 minutes of stirring to equilibrate, mixed liquor was removed from each reactor and transferred to 500 ml Erlenmeyer flasks. These flasks were sealed and incubated on a shaker for 24 hours in order to minimize the volatilization loss and determine MEC biodegradation. Experimental details are presented in the next section under "Shake Flasks".

STAGE 2 - BIODEGRADATION MEASUREMENT

Respirometry

Bioscience, Inc. monitored microbial oxygen uptake (as measured by electrolytic respirometry) and as confirmed by inorganic chloride concentration, CO₂ evolution, and compound specific analyses to determine the biodegradability of components of the groundwater. The net oxygen uptake was calculated by subtracting the average oxygen uptake for the endogenous controls (without test compounds) from the uptake from the test compound reactors. In order to obtain endogenous respiration rates, a reactor containing seed organisms, inorganic nutrients, and clean groundwater from the site was used as a seed blank. Volatilization (and other potential abiotic compound losses or degradation) was determined using a killed control, i.e. a reactor containing all components of the test reactors with a sterilization agent, mercuric chloride, added. Test reactors contained seed organisms from Stage 1, inorganic nutrients, contaminated groundwater (containing the test compounds). Biodegradation was assessed by comparing analytical results for the killed controls and test reactors.

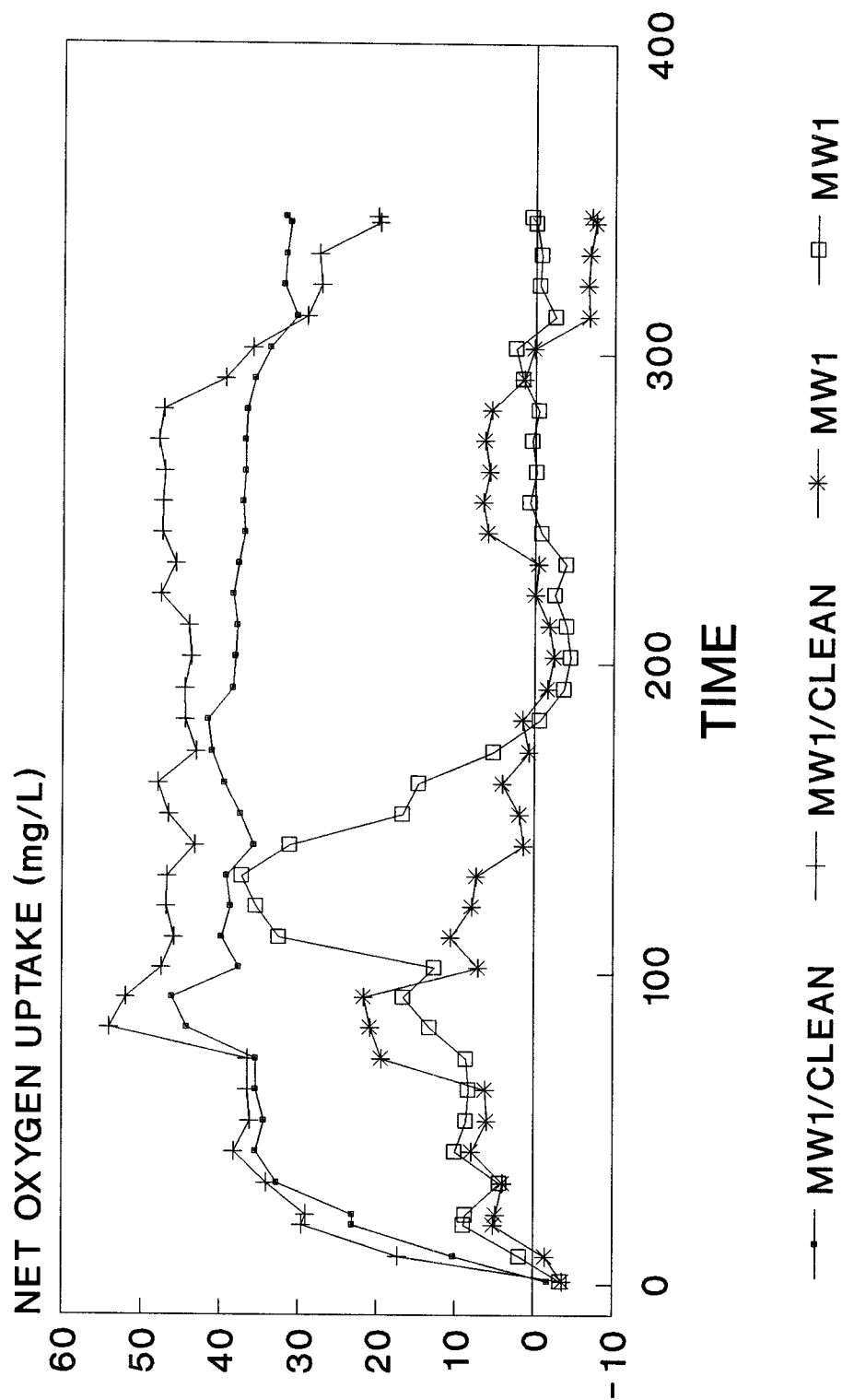
Net oxygen consumption, the difference between oxygen consumption for the seed blanks and test reactors, was used to estimate biodegradation progress continuously. Oxygen consumption monitoring allowed for selection of the optimum sampling points to verify degradation.

Automated respirometry instrumentation (see data sheet in Appendix) directly measures the oxygen microbes consume as they biodegrade organic compounds. The microbial oxygen consumption is proportional to the aerobic metabolism of the organic components of the sample. Oxygen consumption was monitored continuously for all test cells and controls. Oxygen consumption in the control reactor was subtracted from the oxygen consumption in the test reactors to yield the net oxygen consumption due to biodegradation of the test compounds. A net positive oxygen consumption indicates that at least some of the constituents of the sample are biodegradable.

Electrolytic respirometers rely upon the electrolysis of water to provide the oxygen necessary for biodegradation of a sample seeded with microorganisms. Each respirometer assembly consisted of a closed, one-liter reaction vessel and an electrolytic cell for oxygen supply. As oxygen was consumed by the biological activity in the reaction vessel (and metabolically produced carbon dioxide is absorbed by a KOH scrubber solution) a slight vacuum lowered the electrolyte level in the electrolysis cell triggering oxygen production. Oxygen was produced by the cell and fed to the reaction vessel until the original internal pressure was restored. An electrical control unit monitored the amount of oxygen produced to equalize the pressure. Thus, a continuous readout of cumulative oxygen demand readout was obtained. This was expressed as a concentration (mg/L).

The electrical control unit measured and recorded the biochemical oxygen demand exerted by each cell for the study period, while maintaining the oxygen gas content in the reaction vessel. The results were automatically downloaded to the personal computer at regular intervals and are displayed as a cumulative oxygen demand curve (Figure 13). Calculation of the net cumulative oxygen uptake curve allowed determination of the biodegradation rate and percent biodegraded (completion).

FIGURE 13
AWD RESPIROMETRY STUDIES



Eight respirometric cells were set up and monitored simultaneously. The following configuration of reactors were run:

- Reactor #1: Killed control (100 mg biomass in 50 ml water, 550 ml representative groundwater, 2.5 g mercuric chloride, nutrients)
- Reactor #2: Duplicate of Reactor #1
- Reactor #3: Seed blank (100 mg biomass in 50 ml water, 550 ml "clean" groundwater, nutrients)
- Reactor #4: Duplicate of Reactor #3
- Reactor #5: 50% strength test reactor (100 mg biomass in 50 ml water, 275 ml representative groundwater, 275 ml "clean" groundwater, nutrients)
- Reactor #6: Duplicate of Reactor #5
- Reactor #7: 100% strength test reactor (100 mg biomass in 50 ml water, 550 ml representative groundwater, nutrients)
- Reactor #8: Duplicate of Reactor #7

Propane was added to the headspace gas of reactors 3 through 8 via gas-tight syringe through a septum side port of the test reactors based upon the acclimation data from Stage 1. Propane addition was 10 ml/day for the first 7 days, then 50 ml/day for the remainder of the experiment. Biomass amounts added were on a dry weight basis.

MONITORING ANALYSES

Respirometry

Because carbon dioxide is quantitatively absorbed and trapped in the KOH solution, trapping solution was removed at suitable intervals for determination of evolved carbon dioxide. Samples from each reactor was analyzed at the beginning, after one week and at the end of incubation (two weeks) for specific compounds. Samples were also taken after one, four, thirteen and fifteen days of incubation and analyzed for chloride. Final samples from even numbered reactors were analyzed for bacterial count. Initial and final samples were analyzed for COD. Analytical methods used are:

<u>Parameter</u>	<u>Method</u>
Volatile Chlorinated	EPA 601
Hydrocarbons	
Chloride	EPA 325.1
Carbon Dioxide (Evolution)	EPA 415.2

Results are summarized in Tables 10 - 14.

Oxygen consumption and other parameters analyzed for the test reactors was compared to the inhibited (abiotic) controls at each sampling interval to determine if aerobic biological degradation has occurred as described by Glaser⁶.

Shake Flasks

Four 500 ml Erlenmeyer flasks were used in this experiment. Two flasks each received 100 ml from acclimation reactor 1; the other two flasks received 100 ml from reactor 2. The mixed liquor was transferred after the normal addition of 100 ml fresh groundwater to each reactor and 30 minutes stirring to assure complete mixing. Samples were also taken at the time of transfer and sent to the laboratory for volatiles analysis. Two flasks, containing mixed liquor from the respective acclimation reactor, contained 1 g mercuric chloride to serve as killed controls.

RESULTS AND DISCUSSION

Respirometry

The respirometry experiment tested the ability of the accumulated biomass to grow and degrade contaminants in full strength and 50% diluted groundwater. These levels were used based on the original start-up of the acclimation reactors using full strength groundwater in which growth occurred, and the relatively high level of acclimated biomass added to each reactor.

Oxygen uptake results showed slight increases in oxygen uptake in the representative groundwater reactors compared to the seed blanks. Total carbon dioxide evolution indicated that carbon dioxide evolution in the test reactors did not exceed controls. However, soluble COD measurements indicated a substantial reduction (26%) in the reactors containing representative groundwater while the soluble COD in controls showed no reduction. Note that the soluble COD does not include volatile compounds lost during filtration. Total microbial count at the conclusion of the experiment indicated no biological activity in the killed control, counts of 3 million bacteria per ml in the seed blank and 50% strength

TABLE 10: RESPIROMETER STUDY RESULTS 4/07/94

PARAMETER (mg/L)	SAMPLE 37384 C0407 R1	SAMPLE 37385 C0407 R2	SAMPLE 37386 C0407 R3	SAMPLE 37387 C0407 R4	SAMPLE 37388 C0407 R5	SAMPLE 37389 C0407 R6	SAMPLE 37390 C0407 R7	SAMPLE 37391 C0407 R8	SAMPLE 37392 C0407 BLANK (ug/L)
chloromethane	< 500	< 500	< 10	< 10	< 500	< 500	< 500	< 500	< 10
vinyl chloride	< 500	< 500	< 10	< 10	< 500	< 500	< 500	< 500	< 10
bromomethane	< 500	< 500	< 10	< 10	< 500	< 500	< 500	< 500	< 10
chloroethane	< 500	< 500	< 10	< 10	< 500	< 500	< 500	< 500	< 10
trichlorofluoromethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1
1,1-dichloroethene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1
methylene chloride	6800 B	4400 B	44 B	47 B	2400 B	2400 B	4100 B	5900 B	13 B
trans-1,2-dichloroethene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1
1,1-dichloroethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1
chloroform	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	43
1,2-dichloroethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1
1,1,1-trichloroethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1
carbon tetrachloride	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1
benzene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1
trichloroethene	100	80	3	3	40 J	50 J	50 J	90	< 1
1,2-dichloropropane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1
bromodichloromethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	5
cis-1,3-dichloropropene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1
trans-1,3-dichloropropene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1
1,1,2-trichloroethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1
tribromochloromethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	0.6 J
bromoform	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1
toluene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1
tetrachloroethene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1
chlorobenzene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1
ethylbenzene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1
m/p-xylene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1
o-xylene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1
1,1,2,2-tetrachloroethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1
1,3-dichlorobenzene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1
1,4-dichlorobenzene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1
1,2-dichlorobenzene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1

J = Indicates an estimated value. Result is less than the sample quantification limit and greater than the method detection limit.

B = See Method Blank Report.

008117

TABLE 11: RESPIROMETER STUDY RESULTS 4/15/94

PARAMETER (mg/L)	SAMPLE 37703 RC0415 R1	SAMPLE 37704 RC0415 R2	SAMPLE 37705 RC0415 R3	SAMPLE 37706 RC0415 R4	SAMPLE 37707 RC0415 R5	SAMPLE 37708 RC0415 R6	SAMPLE 37709 RC0415 R7	SAMPLE 37710 RC0415 R8	SAMPLE 37711 RC0415 BLANK (ug/L)	SAMPLE METHOD BLANK (ug/L)
chloromethane	< 500	< 500	< 10	< 10	< 500	< 500	< 500	< 500	< 10	< 10
vinyl chloride	< 500	< 500	< 10	< 10	< 500	< 500	< 500	< 500	< 10	< 10
bromomethane	< 500	< 500	< 10	< 10	< 500	< 500	< 500	< 500	< 10	< 10
chloroethane	< 500	< 500	< 10	< 10	< 500	< 500	< 500	< 500	< 10	< 10
trichlorofluoromethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
1,1-dichloroethene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
methylene chloride	6500 B	5000 B	51 B	44 B	2800 B	2800 B	4200 B	5000 B	13 B	7
trans-1,2-dichloroethene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
1,1-dichloroethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
chloroform	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	12 B	< 1
1,2-dichloroethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
1,1,1-trichloroethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
carbon tetrachloride	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
benzene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
trichloroethene	20 J	10 J	0.6 J	0.4 J	< 50	< 50	< 50	< 50	< 1	< 1
1,2-dichloropropane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
bromodichloromethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
cis-1,3-dichloropropene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
trans-1,3-dichloropropene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
1,1,2-trichloroethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
dibromochloromethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
bromoform	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
toluene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
tetrachloroethene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
chlorobenzene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
ethylbenzene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
m/p-xylene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
o-xylene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
1,1,2,2-tetrachloroethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
1,3-dichlorobenzene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
1,4-dichlorobenzene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
1,2-dichlorobenzene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1

J = Indicates an estimated value. Result is less than the sample quantification limit and greater than the method detection limit.
 B = See Method Blank Report.

TABLE 12: RESPIROMETER STUDY RESULTS 4/22/94

PARAMETER (mg/L)	SAMPLE 38115 C0422 R1	SAMPLE 38116 C0422 R2	SAMPLE 38117 C0422 R3	SAMPLE 38118 C0422 R4	SAMPLE 38119 C0422 R5	SAMPLE 38120 C0422 R6	SAMPLE 38121 C0422 R7	SAMPLE 38122 C0422 R8	SAMPLE 38123 C0422 BLANK (ug/L)	SAMPLE METHOD BLANK (ug/L)
chloromethane	< 500	< 500	< 10	< 10	< 500	< 500	< 500	< 500	< 10	< 10
vinyl chloride	< 500	< 500	< 10	< 10	< 500	< 500	< 500	< 500	< 10	< 10
bromomethane	< 500	< 500	< 10	< 10	< 500	< 500	< 500	< 500	< 10	< 10
chloroethane	< 500	< 500	< 10	< 10	< 500	< 500	< 500	< 500	< 10	< 10
trichlorofluoromethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
1,1-dichloroethene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
methylene chloride	2900 B	2200 B	14 B	13 B	650 B	780 B	1200 B	1700 B	1 B	1
trans-1,2-dichloroethene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
1,1-dichloroethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
chloroform	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
1,2-dichloroethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
1,1,1-trichloroethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
carbon tetrachloride	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
benzene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
trichloroethene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
1,2-dichloropropane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
bromodichloromethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
cis-1,3-dichloropropene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
trans-1,3-dichloropropene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
1,1,2-trichloroethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
dibromochloromethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
bromoform	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
toluene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
tetrachloroethene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
chlorobenzene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
ethylbenzene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
m/p-xylene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
o-xylene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
1,1,2,2-tetrachloroethane	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
1,3-dichlorobenzene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
1,4-dichlorobenzene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1
1,2-dichlorobenzene	< 50	< 50	< 1	< 1	< 50	< 50	< 50	< 50	< 1	< 1

B = See Method Blank Report.

Table 13

008119

Groundwater

Date started: 04/07/94

Reactor #	Biomass (ml)	dH ₂ O (ml)	3% urea (ml)	3% DAP (ml)	MW1 (ml)	Clean (ml)	HgCl (g)	Conc. H ₂ SO ₄ (ml) (added 4/8/94)
1	8	42	2	1	550	0	2.5	2
2	8	42	2	1	550	0	2.5	2
3	8	42	0	0.5	0	550	0	2 **
4	8	42	0	0.5	0	550	0	0
5	8	42	1	0.75	275	275	0	0
6	8	42	1	0.75	275	275	0	0
7	8	42	2	1	550	0	0	0
8	8	42	2	1	550	0	0	0

Chloride concentration (mg/l)

Reactor #	04/08/94	04/11/94	04/20/94	4/22/94
1	849.7	na	na	na
2	849.7	na	na	na
3	734.8	na	na	na
4	712.3	719.8	717.3	719.8
5	794.8	787.3	794.8	749.8
6	777.3	779.8	777.3	747.3
7	839.7	839.7	832.2	812.2
8	839.7	809.7	849.7	822.2

CO₂ evolution (mg)

Reactor #	04/08/94	04/09/94	04/10/94	04/11/94	04/12/94	04/13/94
1	52.2	1.5	1.28	1.49	1.1	5.2
2	47.1	6.2	3.64	2.57	1.7	0.2
3	34.9	51.4	0.43	2.14	1.9	10.1
4	27.4	11.99	5.99	1.71	5.4	0.2
5	32.1	17.1	16.91	0.21	11.8	6.9
6	40.5	11.99	8.13	4.92	2.8	1.9
7	30.2	1.5	4.49	5.78	14.3	6.0
8	42.4	40.9	5.99	3.64	17.1	6.8

Reactor #	04/14/94	04/15/94	04/18/94*	04/19/94	04/20/94	04/22/94**
1	0.4	6.6	0.4	0.2	0.2	4.5
2	0.2	3.6	0.6	0.2	0.2	0.6
3	0.2	7.1	0.4	0.2	1.1	0.2
4	0.6	5.1	2.8	0.4	1.1	2.4
5	2.2	9.8	5.8	0.2	3.4	2.4
6	3.0	8.8	1.5	3.6	3.2	5.6
7	0.9	5.1	9.4	2.8	0.9	4.9
8	1.7	7.9	3.9	1.1	1.1	4.7

* 3 day reading

** 2 day reading

Table 13 (cont.)

Accumulated Oxygen Uptake (mg/L)

Final Plate Count (4/22/94)

Reactor #	131 hr	273 hr	320 hr	Count
1	199.9	263.9	244.4	< 10
2	202.8	288.3	269.0	< 10
3	244.9	329.3	341.7	na
4	176.4	259.4	267.7	3.43E +06
5	223.5	304.9	308.8	na
6	226.9	310.4	298.7	3.23E +06
7	207.0	288.0	283.5	na
8	233.6	280.8	288.7	1.96E +07

COD

Initial VOC

Reactor #	Initial COD (mg/l)	Final COD (mg/l)	Methylene Chloride (mg/l)	Trichloroethene (mg/l)
1	756.1	960	6800	100
2	801.3	790.8	4400	80
3	104.3	90.75	44	3
4	39.1	90.75	47	3
5	405.4	311.96	2400	40
6	440.2	311.96	2400	50
7	711	593.02	4100	50
8	736.1	478.5	5900	90
Blank	0	0	0.013	<0.001

TABLE 14

AWD 9302 RESPIROMETRY REACTORS FINAL PLATE COUNT

04/25/94

Sample ID.	Std.Meth.907 Plate Count	Average Count	Dilution	CFU/ml
R2	0 0 0	0	1.00E +00	0.00E +00
R3	42 32 29	34.3333	1.00E -04	3.43E +06
R4	32 39 26	32.3333	1.00E -04	3.23E +06
R5	161 230	195.5000	1.00E -04	1.96E +07
R6	0	0	1.00E +00	0

reactors, and 20 million bacteria per ml in the full strength reactors. These parameters may be summarized as indicating slight growth and metabolic activity of the acclimated biomass under the test conditions.

Two parameters served as indicators of chlorinated hydrocarbon reduction. Inorganic chloride remained essentially unchanged over the course of the experiment. Volatile organic analysis indicated possible TCE biodegradation as indicated by the traces of TCE found in the killed controls but not in the 50% or full strength representative groundwater reactors after 8 days. However, since all TCE results for this date were below quantitation limits (due to the high MEC concentrations) and since substantial reductions occurred in all reactors including the killed controls, the results are not conclusive. After 8 days incubation, MEC results were not significantly different from the time zero results (averages for duplicate reactors were calculated and compared). After 15 days, all reactors showed a 60 to 70% reduction in MEC. Although the biologically active reactors all showed a slightly higher percent reduction in MEC compared to the killed controls, the difference was not statistically significant and was not corroborated by inorganic chloride analysis. The cause for the reduction was assumed to be volatilization, although the lack of reduction during the first 8 days is anomalous.

Shake Flasks

Shake flasks were set up to determine if MEC degradation could be confirmed under the higher dilution rates used in the acclimation reactors. The pattern of inorganic chloride increases and pH decreases in the acclimation reactors gave presumptive evidence that significant MEC degradation was occurring at this stage of the acclimation.

Volatile organic analysis was performed on time zero samples and samples taken after 24 hours of incubation. Again, no significant reduction was observed between the biologically active reactors and the killed controls. About 70% reduction in MEC concentration and over 90% reduction in TCE was found for the killed controls. Sufficient oxygen was present in the headspace to degrade about 300 mg of MEC (equivalent to 3000 mg/l). Inorganic chloride content of the acclimation reactors indicated that the MEC reduction to be expected in 24 hours was about 200 and 400 mg/l for acclimation reactors 1 and 2 respectively. Therefore, residual MEC should have been significantly lower in the biologically active shake flasks (see Table 15).

TABLE 15: GROUNDWATER FLASK TESTS
5/04/94 - 5/05/94 (24 HOUR)

PARAMETER (mg/L)	SAMPLE 38746 CO504 GW 1	SAMPLE 38747 CO504 GW 2	SAMPLE 38748 CO505 GW 1-1	SAMPLE 38749 CO505 GW 1-2	SAMPLE 38750 CO505 GW 2-1	SAMPLE 38751 CO505 GW 2-2
chloromethane	< 1	< 1	< 1	< 1	< 1	< 1
vinyl chloride	< 1	< 1	< 1	< 1	< 1	< 1
bromomethane	< 1	< 1	< 1	< 1	< 1	< 1
chloroethane	< 1	< 1	< 1	< 1	< 1	< 1
trichlorofluoromethane	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
1,1-dichloroethene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
methylene chloride	430 B	510 B	85 B	130 B	180 B	150 B
trans-1,2-dichloroethene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
1,1-dichloroethane	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
chloroform	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
1,2-dichloroethane	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
1,1,1-trichloroethane	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
carbon tetrachloride	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
benzene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
trichloroethene	5.1	5.9	0.2	0.9	0.5	0.7
1,2-dichloropropane	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
bromodichloromethane	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
cis-1,3-dichloropropene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
trans-1,3-dichloropropene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
1,1,2-trichloroethane	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
dibromochloromethane	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
bromoform	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
toluene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
tetrachloroethene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
chlorobenzene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
ethylbenzene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
m/p-xylene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
o-xylene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
1,1,2,2-tetrachloroethane	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
1,3-dichlorobenzene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
1,4-dichlorobenzene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
1,2-dichlorobenzene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

B = Methylene chloride found in blank at 1 ug/L.

CONCLUSION

The inability to confirm MEC degradation is not understood at this time, but these results certainly cannot support any other conclusion than that biological treatment of this groundwater is not feasible at this time.

Volatilization has been shown to be a major factor in loss of the target contaminants even under conditions designed to maximize biodegradation and minimize volatilization. Therefore air-stripping appears to be a more viable technology for this groundwater than biological treatment.

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1. Kleck, Gary M., 1982., "Fate and Effects of Methylene Chloride in Activated Sludge"., Applied Environmental Microbiology., 44: 701-707.
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3. EPA Methods for Chemical Analysis of Water and Wastes.
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5. SW-846 Test Methods for Evaluating Solid Waste, U.S. EPA 1986.
6. Glaser, John A. "Determination of Aerobic Degradation Potential for Hazardous Organic Wastes in Soil; Interim Protocol"

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1. Kleck, Gary M., 1982., "Fate and Effects of Methylene Chloride in Activated Sludge"., Applied Environmental Microbiology., 44: 701-707.
2. Stucki, Gerhard., 1990., "Biological Decomposition of Dichloromethane from a Chemical Process Effluent"., Biodegradation 1: 221-228.
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5. SW-846 Test Methods for Evaluating Solid Waste, U.S. EPA 1986.
6. Glaser, John A. "Determination of Aerobic Degradation Potential for Hazardous Organic Wastes in Soil; Interim Protocol"

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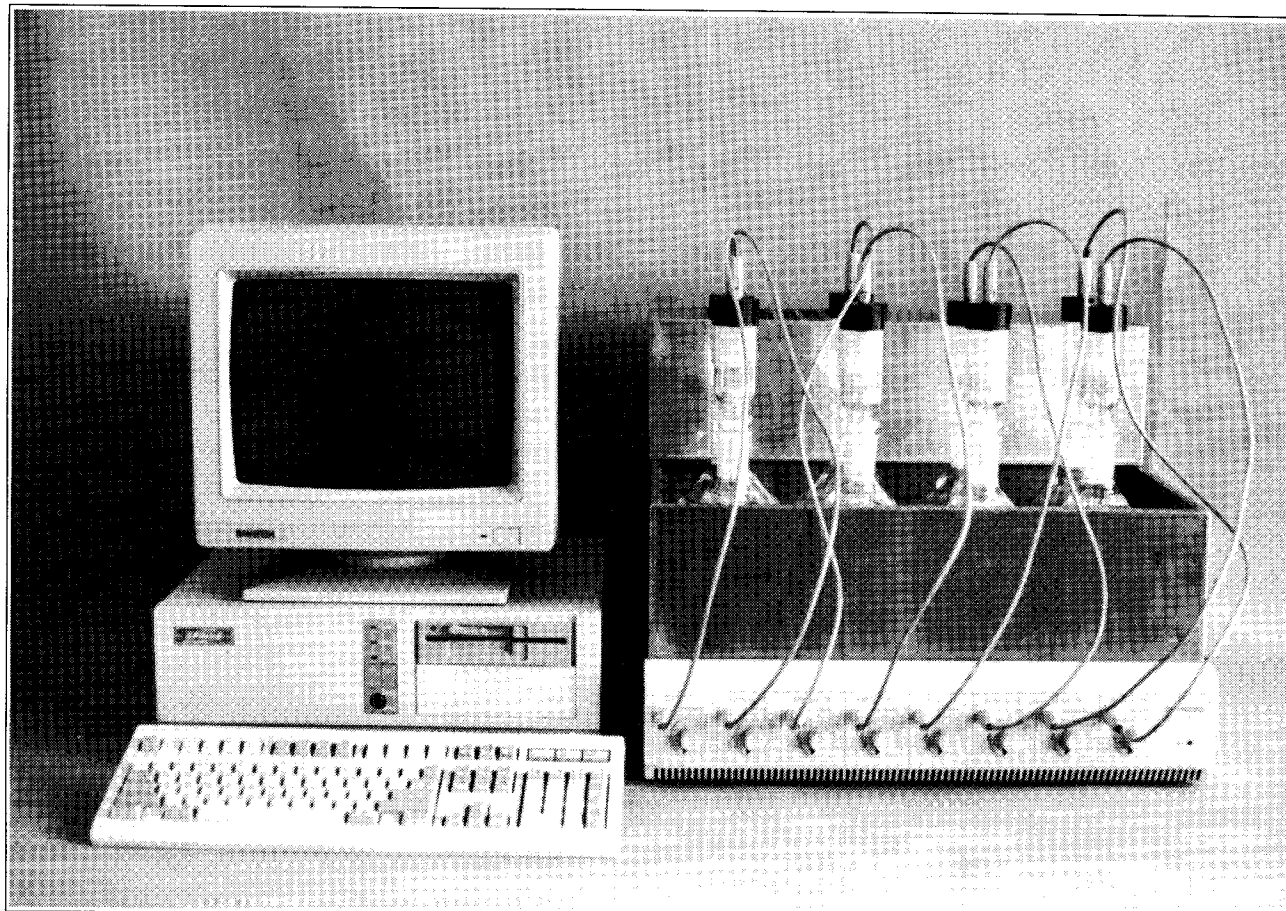
APPENDIX



Bioscience, Inc.
Environmental Products and Services

BI-1000

ELECTROLYTIC RESPIROMETER



PROVEN RELIABILITY AND ACCURACY HAS MADE THE BI-1000
THE RESPIROMETER OF CHOICE FOR:

- Toxicity Screening Tests
- Treatability Testing
- Bioaugmentation and
Sludge Activity Studies
- Biodegradability / OECD Tests
- Bioremediation Studies
- Soil Remediation Studies
- Biological Process Modeling

FLEXIBLE DESIGN AND SPECIALIZED ACCESSORIES
PROVIDE THE CAPABILITY TO TEST:

- Soil Samples
- Volatile Components
- High Strength Waste

BI-1000 FEATURES

- Individual Reactor Control
- Individual Reactor Oxygen Supply
- Automatic, Real-Time Graphic and Numeric Data Presentation
- Automatic Atmospheric Pressure Data Compensation
- Automatic Data Preservation
- Individual Reactor Mixing Control
- Expandability—Up to 32 Reactors
- Automatic Temperature Control
- Built-In Reactor Leak Testing
- Software Windowing
(Run the BI-1000 and perform advance data manipulations simultaneously)
- Specialized Reactors designed for Testing Soil, Large Volume Samples, High Oxygen Requiring Samples and Ultra-Low Oxygen Requiring Samples

→ Optional Biokinetic Software Model and Custom Data Templates Available

SPECIFICATIONS BI-1000 ELECTROLYTIC RESPIROMETER

Physical Characteristics:

	Reactor Module	Including Temperature
Width	21 $\frac{3}{4}$ Inches	21 $\frac{3}{4}$ Inches
Height	4 $\frac{7}{8}$ Inches	16 $\frac{3}{4}$ Inches
Depth	21 $\frac{1}{8}$ Inches	21 $\frac{1}{8}$ Inches
Weight	38.5 Lbs.	90 Lbs.

Requirements:

- *Minimum Bench Space 50" x 30"
- *Three Standard 115 volt / 50 Hz Grounded Outlets

Performance:

- *Accuracy of Oxygen Delivery: $\pm 0.5\%$
- *Oxygen Generation Rate up to 150 Mg. / Hr.
- *Temperature Control ± 0.5 °C over Range of 15°C to 40°C

Design:

- *Painted Aluminum and Stainless Steel Module
- *Individual Control of Reactors
- *Standard 8 Reactor Design Expandable to 32 Reactors on One Computer
- *Water Bath Temperature Control Optional
- *Control Unit: 486, 25 MHz PC Including:
 - 20 or 40 MB Hard Drive
 - 2 MB RAM
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DEPARTMENT OF THE ARMY

LONGHORN ARMY AMMUNITION PLANT
MARSHALL, TEXAS 75671-1059

REPLY TO
ATTENTION OF

008131

JUN -7 11 10 94
CHIEF OF BRANCH

6 June 1994

Engineering Division

Ms. Lisa Price
Superfund Enforcement
U.S. Environmental Protection Agency
1445 Ross Avenue
Dallas, Texas 75202

Dear Ms. Price:

Enclosed are two copies of the Draft Final Initial Screening of Alternatives Workplan for Longhorn Army Ammunition Plant in Karnack, Texas.

Please review and send your comments back to us by 6 July 1994. If comments are not received by this date, a "no response" is assumed.

If there are any questions, please contact Mr. David Tolbert at (903) 679-2728.

Sincerely,


Lawrence J. Sowa
Lieutenant Colonel, U.S. Army
Commanding Officer

Encls



008132

JUN 6 7 1994

CERTIFIED MAIL: RETURN RECEIPT REQUESTED P104 195155

David Tolbert, Project Manager
Longhorn Army Ammunition Plant
Attn: SMCLO-EN
Marshall, Texas 75671-1059

Re: Existing Monitoring Well Condition Survey
UEP/Burning Ground No.3 Sites

Dear David:

During the April 1994 monthly Project Coordinators meeting held in Tulsa, OK, EPA and TNRCC requested an evaluation of the monitoring wells in the UEP/Burning Ground No.3 area be conducted to determine the integrity, utility, and/or necessity of the all of the monitoring wells in this area and to classify the monitoring wells based on this evaluation. During the May 1994 monthly Project Coordinators meeting held on May 10, 1994, at the Longhorn Army Ammunition Plant, the Existing Monitoring Well Condition Survey was distributed.

EPA agrees with the Existing Monitoring Well Condition Survey that the BH-3, 4, 7, 11, and 22 monitoring wells should be closed since they are over 14 years old and have already been replaced with monitoring wells MW-1, 2, 3, 4, 5, and 6. Monitoring well 124 should be closed due to erosion around the well casing and should be replaced with a monitoring well constructed with materials consistent with the "MW" monitoring wells. EPA agrees also with the repairs to existing wells identified in the survey. Monitoring well MW-15 should be abandoned, however, EPA recommends that the monitoring well be replaced with a monitoring well installed and constructed using state-of-art materials and techniques to prevent downward migration of the dense nonaqueous phase liquid (DNAPL) contamination. EPA feels that replacement of this well is essential in order to assess the DNAPL contamination in the area of and at the depth of monitoring well MW-15. Furthermore, EPA requests that a workplan (i.e. an amendment to the approved Chemical Data Acquisition Plan dated June 1992, possibly entitled "DNAPL Contingency Plan") be presented to EPA and TNRCC prior to the initiation of the field work pursuant to this well survey. The workplan should detail the installation, construction, and sampling materials and techniques to be used for monitoring wells on the facility.

In addition to the information contained in the survey, EPA anticipated a more thorough evaluation of the monitoring wells in the UEP/Burning Ground No.3 area. EPA expected the evaluation to include not only such criteria as a damage assessment, but also a

construction integrity evaluation given the groundwater contamination and a well utility and/or necessity evaluation based on placement and screen intervals. Furthermore, EPA expected a classification of the monitoring wells based on the evaluation (eg. monitoring wells with screen intervals at x depth, monitoring wells with free-phase liquids, etc.) in order to qualify information and/or data obtained from the monitoring wells based on, for example, the well's limitations.

Regarding the issue of monitoring well construction materials and the criteria for closure set at 1,000,000 parts per billion organic contaminants for PVC wells, EPA recommends the establishment of an arbitrary concentration of a contaminant not be used to determine closure criteria for a PVC monitoring well. EPA does recommend, however, that the PVC monitoring wells (i.e., 120 and 129) be monitored closely to verify that the wells have not collapsed or are not showing signs of pending physical collapse (i.e., sand pack materials detected in the bottom of the well, or when sampled the bailer is unable to reach the bottom of the well), and that the utility of this well is limited to water quality and water level data. Furthermore, EPA recommends that the dedicated bailers from at least well 120 be removed due to the possibility of the fusion of the bailer to the well casing.

If you have any questions about these comments or any other matter, please contact me at (214) 655-6744.

Sincerely,

Lisa Marie Price
Remedial Project Manager
Superfund Texas Enforcement

cc: Lieutenant Colonel Lawrence J. Sowa
Commanding Officer, U.S. Army
Longhorn Army Ammunition Plant
Marshall, Texas 75671-1059

Tulsa District Corps of Engineers
P.O. Box 61
Attn: Mr. Ross Nguyen
CESWT-PP-E
Tulsa, OK 74121-0061

Mike Moore, Superfund
Texas Natural Resource Conservation Commission
P.O. Box 13087
Capital Station
1700 N. Congress Avenue
Austin, TX 78711-3087

008134

JUN 0 3 1994

JUN 0 3 1994

CERTIFIED MAIL: RETURN RECEIPT REQUESTED

JUN 0 8 1994

P 104 195 156

David Tolbert, Project Manager
Longhorn Army Ammunition Plant
Attn: SMCLO-EN
Marshall, Texas 75671-1059

Re: Draft Field Investigation Summary Report for
Area LHAAP-1 at Longhorn Army Ammunition Plant

Dear David:

Pursuant to the Federal Facility Agreement for the Longhorn Army Ammunition Plant, EPA is submitting comments on the Draft Field Investigation Summary Report for Area LHAAP-1 at Longhorn Army Ammunition Plant. EPA's comments are include as an enclosure to this letter.

If you have any questions about EPA's comments or any other matter, please contact me at (214) 655-6744.

Sincerely,

Lisa Marie Price
Remedial Project Manager
Superfund Texas Enforcement

cc: Lieutenant Colonel Lawrence J. Sowa
Commanding Officer, U.S. Army
Longhorn Army Ammunition Plant
Marshall, Texas 75671-1059

Tulsa District Corps of Engineers
P.O. Box 61
Attn: Mr. Ross Nguyen
CESWT-PP-E
Tulsa, OK 74121-0061

Mike Moore, Superfund
Texas Natural Resource Conservation Commission
P.O. Box 13087
Capital Station
1700 N. Congress Avenue
Austin, TX 78711-3087

EPA Comments on the Draft Field Investigation Summary Report for Area LHAAP-1 at Longhorn Army Ammunition Plant, dated May 1994

Page 4-5, Table 4-1: The determination of the 95% Upper Confidence Limit (UCL) when detection limits (i.e., nondetects and percentage of nondetects) are in question is inappropriate. Refer to the Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance, April 1989 (EPA/530-SW-89-026); and Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance, July 1992. In both of these documents, the statistical analysis method when dealing with nondetects is identified and discussed. Refer to EPA's letters to the Army dated April 12 and April 19, 1994.

Section 3.4: The Remedial Investigation Report should contain more detail geologic cross-sections for the site.



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
MARSHALL, TEXAS 75671-1059

13 June, 1994

008136
RECEIVED
EPA REGION VI
1994 JUN 21 PM 9:48
SUPERFUND BRANCH

SMCLO-EN-EV

SUBJECT: Meeting, Longhorn Army Ammunition Plant, for Technical
Review Committee (TRC) - June 22, 1994.

Environmental Protection Agency
ATTN: Lisa M. Price (6H-ET)
1445 Ross Avenue
Dallas, Texas 75202

Dear Ms. Price:

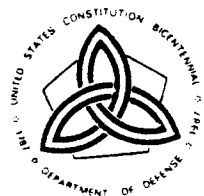
Enclosed is a tentative agenda for the TRC Meeting. We hope you will be able to attend.

If you have any questions or suggestions regarding the meeting or agenda, contact Mr. David Tolbert (903) 679-2728.

Sincerely,

Lawrence J. Sowa
Lieutenant Colonel, U. S. Army
Commanding Officer

Enclosure



TECHNICAL REVIEW COMMITTEE MEETING

LONGHORN ARMY AMMUNITION PLANT

LOCATION: Longhorn Army Ammunition Plant
Karnack, Texas
Building 703 - Conf. Room

DATE/TIME: June 22, 1994
9:30 A.M.

SIGN IN: Please sign in at the guard house located at the entrance to the plant. The guard will issue a temporary badge. If you wish to bring a camera onto the facility, please request a camera permit when signing in.

AGENDA:

- Welcome
- Project Updates
- Total Program Schedules/Milestones
- Burning Ground Issues
 - Sampling Results
 - Remediation time frame at the Burning Ground
 - Treatment method of IRA derived waste
 - Existing Monitoring Well Condition Survey
- DERPMS Issues
- Schedule Future Monthly/TRC Meetings

008138

JUN 14 1994

CERTIFIED MAIL: RETURN RECEIPT REQUESTED

P104 195 157

David Tolbert, Project Manager
Longhorn Army Ammunition Plant
Attn: SMCLO-EN
Marshall, Texas 75671-1059

Re: Draft DERPMIS/RMIS Resolution Document for
Longhorn Army Ammunition Plant

Dear David:

Pursuant to the Federal Facility Agreement for the Longhorn Army Ammunition Plant, EPA is submitting comments on the Draft DERPMIS/RMIS Resolution Document for Longhorn Army Ammunition Plant.

EPA's position remains as it was stated in EPA's May 17, 1994, letter. The Draft DERPMIS/RMIS Resolution Document for Longhorn Army Ammunition Plant does meet the intent of EPA's request for resolution of the sites identified on the DERPMIS list. However, as EPA agreed to during our May 19, 1994, meeting, EPA is submitting specific comments on the Draft DERPMIS/RMIS Resolution Document for Longhorn Army Ammunition Plant. EPA's comments and EPA's requests for additional action/investigation are included as an enclosure to this letter.

If you have any questions about EPA's comments or any other matter, please contact me at (214) 655-6744.

Sincerely,

Lisa Marie Price
Remedial Project Manager
Superfund Texas Enforcement

enclosure

cc: Lieutenant Colonel Lawrence J. Sowa
Commanding Officer, U.S. Army
Longhorn Army Ammunition Plant
Marshall, Texas 75671-1059

Tulsa District Corps of Engineers
P.O. Box 61
Attn: Mr. Ross Nguyen
CESWT-PP-E
Tulsa, OK 74121-0061

008139

Mike Moore, Superfund
Texas Natural Resource Conservation Commission
P.O. Box 13087
Capital Station
1700 N. Congress Avenue
Austin, TX 78711-3087

General Comments:

- #1 The final version of this document must contain the cross-reference for the DERPMIS and the RMIS lists. Refer to EPA's May 17, 1994, letter.
- #2 It is inappropriate to state in the final version of this document that the Texas Natural Resource Conservation Commission (TNRCC) made a "no contamination" determination with reference to the status of many of the sites. Refer to EPA's May 17, 1994, letter.
- #3 The purpose of the Waste Characterization Study is unclear. Not only is the document vague, the scoring system (and the basis for it) is one unfamiliar to EPA. Please remove the document from the final version of this document. Refer to EPA's May 17, 1994, letter.
- #4 A map should be included that identifies the location of each of the sites on the DERPMIS/RMIS lists. Refer to EPA's May 17, 1994, letter.
- #5 The sites identified as being included in the investigation into the waste process sumps in this draft DERPMIS/RMIS Resolution Document are LHAAP 35, 46, 47, 48, and 50. Also according to this draft document, LHAAP 35 includes LHAAP 56, 59, and 65. Are the sumps associated with LHAAP 36 and 39 also included in the sump investigation? Please revise the text of the document as well as the Site Summary Chart to reflect that LHAAP 50 is under investigation, that LHAAP 56, 59, and 65 are under investigation (not deleted), and confirm that all waste process and rack sumps (145 total) are accounted for when investigating the sites identified.
- #6 According to the February 1980 Installation Assessment, Appendix A of this document, it appears that allowing waste, wastewaters (including explosives), etc. to discharge to, flow into and/or mix with the surface water of Goose Prairie (North) Bayou was customary. Given the fact that Central Bayou (Caddo Lake Creek) and Harrison Bayou run through production areas on facility, the potential for releases of hazardous substances seems likely. Therefore, it is imperative that a thorough site risk assessment be conducted.
- #7 Was there an investigation into the reported dumping on TCE and methylene chloride east of the old landfill? EPA requests a Preliminary Assessment be conducted to more accurately describe the location of this dumping and to determine the potential impact of such a release.

EPA's Comments
 Draft DERPMIS/RMIS Resolution Document
 6/14/94

Site Description	DERPMIS/ RMIS #	Requested Action
Building 722- Paint Shop	003/3	Preliminary Assessment in order to provide adequate description of this unit, including the potential for the release of hazardous substances onto the gravel and into the soil.
Pilot Wastewater Treatment Plant	004/4	Preliminary Assessment in order to provide adequate description of this unit.
Power House Boiler Pond	005/5	Preliminary Assessment that must include an analysis of the backwash water and inspection reports regarding integrity of the PVC liner in this earthen lagoon.
Building 54F	006/6	Preliminary Assessment in order to provide adequate description of this solvent collection point.
Building 50G - Drum Processing	007/7	Is the sump (Sump No.70) associated with this building included with the wasteprocess/ wastewater sumps investigation? If not, include it.
Sewage Treatment Plant	008/8	Preliminary Assessment in order to provide adequate description of this unit.
Construction Materials Landfill	018/19	Preliminary Assessment in order to determine if any asbestos containing materials (i.e.,transite, floor tiles, etc) or any other inappropriate materials (i.e., hazardous waste, ash, drums, etc.) have been disposed in the landfill.

EPA's Comments
 Draft DERPMIS/RMIS Resolution Document
 6/14/94

Explosive Waste Pads	036/36	Are the sumps associated with this unit included with the wasteprocess/ wastewater sumps investigation? If not, include it.
24X Holding Area	038/38	Unclear as to what area within the UEP/Burning Ground No. 3 areas this is.
25X Washout Pad	039/39	Is the sump (Sump No.114) associated with this unit included with the wasteprocess/ wastewater sumps investigation? If not, include it.
Building 41X	044/44	Unclear as to what area within the UEP/Burning Ground No. 3 areas this is.
Former Waste Disposal Facility	050/50	Draft DERPMIS/RMIS Resolution Document includes this site with other sites involved with the sump investigation, however, a Preliminary Assessment should be conducted in order to provide adequate description of this unit and to determine the potential affect of site's activities on Goose Prairie Bayou. Reference site 7, page 22, Appendix A (Installation Assessment, February 1980).
Magazine Area Washout	052/52	Draft DERPMIS/RMIS Resolution Document calls for further investigation.

EPA's Comments
 Draft DERPMIS/RMIS Resolution Document
 6/14/94

Static Test Area	053/53	Preliminary Assessment in order to provide adequate description of this unit and to determine the likelihood of the release of hazardous substances under CERCLA jurisdiction.
Septic Tank	055/55	Preliminary Assessment in order to provide adequate description of this unit.
Rubble Burial Site	057/57	Preliminary Assessment in order to provide adequate description of this unit.
Former Storage Building 411 and 714	060/60	Draft DERPMIS/RMIS Resolution Document calls for further investigation.
Water Treatment Plant Effluent Settling Pond	061/61	Preliminary Assessment in order to provide adequate description of the potential contaminants in this unit and include inspection reports for "synthetic waterproof sheeting with soil cover".
Building 43X	062/62	Unclear as to what area within the UEP/Burning Ground No. 3 areas this is.
Burial Pits	063/63	Draft DERPMIS/RMIS Resolution Document calls for further investigation.
Transformer Storage	064/64	Preliminary Assessment in order to provide adequate description of this unit.
Transformer at Building 401	066/66	Preliminary Assessment in order to provide adequate description of this unit and describe any and all remediation activities associated with the cleanup.

EPA's Comments
Draft DERPMIS/RMIS Resolution Document
6/14/94

Service Station Underground Storage Tanks	069/69	Information regarding the cleanup should be included with a reference to any other documentation regarding the site.
Loading Dock Magazine Areas	70	Draft DERPMIS/RMIS Resolution Document calls for further investigation.
Oil Spill at Building 813	71	Draft DERPMIS/RMIS Resolution Document calls for further investigation.



DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
MARSHALL, TEXAS 75671-1089

008145



REPLY TO
ATTENTION OF

16 June 1994

Engineering Division

Ms. Lisa Price
Superfund Enforcement
U.S. Environmental Protection Agency
1445 Ross Avenue
Dallas, Texas 75202

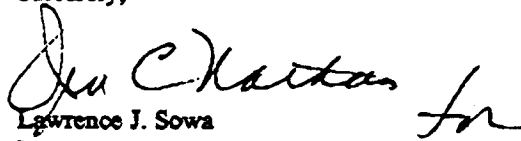
Dear Ms. Price:

Enclosed are two copies of the Draft Final Remedial Design Investigations Work Plan, Landfill Caps, for Longhorn Army Ammunition Plant in Karnack, Texas.

Please review and send your comments back to us by 18 July 1994.

If there are any questions, please contact Mr. David Tolbert at (903) 679-2728.

Sincerely,


Lawrence J. Sowa
Lieutenant Colonel, U.S. Army
Commanding Officer

Encls



TECHNICAL REVIEW COMMITTEE MEETING

LONGHORN ARMY AMMUNITION PLANT

LOCATION: Longhorn Army Ammunition Plant
Karnack, Texas
Building 703 - Conf. Room

DATE/TIME: June 22, 1994
9:30 A.M.

SIGN IN: Please sign in at the guard house located at the entrance to the plant. The guard will issue a temporary badge. If you wish to bring a camera onto the facility, please request a camera permit when signing in.

AGENDA:

- Welcome
- Project Updates
- Total Program Schedules/Milestones
- Burning Ground Issues
 - Sampling Results
 - Remediation time frame at the Burning Ground
 - Treatment method of IRA derived waste
 - Existing Monitoring Well Condition Survey
- DERPMIS Issues
- Schedule Future Monthly/TRC Meetings

LONGHORN AAP
ENVIRONMENTAL PROJECTS STATUS
(as of 17 June 1994)

008147

PROJECT NAME	A-E CONTRACTOR (LEAD TM)	LHAAP No.	PROJECT STATUS
Remedial Investigation (RI)	SVERDRUP (Scott Henderson)	1,11,XX,27 (Group #1)	Draft Phase II Work Plan is under review by Army with comments due on 19 Jun 94. Revised work plan due to Regulators on 17 Jul 94.
	SVERDRUP (Scott Henderson)	12,16,17, 18,24,29,3 2 (Group #2)	Contractor's proposal is due 17 Jun 94. This contract is scheduled to be awarded on or before 25 Jul 94.
	TULSA DISTRICT (Jonna Polk)	13,14 (Group #3)	Draft RI/FS Report is under review by Army with comments due on 30 Jun 94. Draft Final RI/FS is scheduled for the Regulators to review on 29 Jul 94.
Interim Remedial Action (IRA)	AWD (Wendy Lanier)	18 & 24	The Vertical Extraction Well (VEW) test was completed on 24 May 94 with noticeable improvement to the flow rate using Vacuum Enhanced Liquid Extraction (VELE). Interceptor Collector Trench (ICT) flow test began on 13 Jun 94. A current schedule of completion is 28 Jun 94.
SUMPS (125+20)	TULSA DISTRICT (Bernice Perez)	all	Draft Final Phase II Work Plan is scheduled for the Regulators to review on 11 Jul 94.

Investigative Derived Wastes (IDW)	AWD (Walt Kneib)	all	All Phase I IDW are labeled and stored in a designated storage building. The complete evaluation of IDW is awaiting the definition of background concentrations for metals.
RI for Area 1A	WESTON (Scott Henderson)	1A	Waiting for TNRCC comments on the Draft Final FISR. Received EPA comments on 8 Jun 94. A Scope Meeting is scheduled on 23 Jun 94.
Initial Screening of Alternatives (ISA)	WESTON (Scott Henderson)	all	The Draft Final ISA was sent to the regulators on 6 Jun 94.
Landfill Caps	TULSA DISTRICT (Wade Anderson)	12 & 16	Draft Final Remedial Design Work Plan was sent to the regulators on 16 Jun 94.
Hydrogeologic Assessment (Soil and Groundwater Background Study)	TULSA DISTRICT (Cliff Murray)	all	The Draft Final work plan for additional sampling for background soil and groundwater is scheduled for the Regulators to review on 30 Jun 94. Draft Hydrogeology Assessment work plan is scheduled for Army to review on 26 Oct 94.

008148

REGULATORS' MILESTONES STATUS UPDATE

- I. Within 14 Days
- * 30 Jun 94 - Background Soil & Groundwater Assessment Work Plan (S)
- II. Within 30 Days
- * 11 Jul 94 - Phase II Sumps Work Plan (S).
 - * 17 Jul 94 - Phase II Group #1 Work Plan (S).
- III. Within 60 Days
- * 29 Jul 94 - Group #3 RI/FS Report (P).
- IV. Within 90 Days None at this time.

008150

Schedule Name : GROUP #1 (LHAAP #1, 11, XX, 27)

Responsible : CPT. NGUYEN

-of Date : 13-May-94 9:00a

Schedule File : GROUP#1

Task Name	Start Date	Duration	End Date
GROUP #1	16-Dec-93	760.4 day	15-Jan-96
INVESTIGATION & ANALYSIS	16-Dec-93	430.4 day	19-Feb-95
Prepare scope Phase I	16-Dec-93	30.0 days	14-Jan-94
Procure A-E Contract	15-Jan-94	90.0 days	14-Apr-94
Prepare DF Ph II WP	14-Apr-94	45.0 days	29-May-94
Army Review Draft Ph	29-May-94	21.0 days	19-Jun-94
Comment Resolution	19-Jun-94	14.0 days	3-Jul-94
Prepare DF Ph II WP	3-Jul-94	14.0 days	17-Jul-94
Regulators Review Dra	17-Jul-94	30.0 days	16-Aug-94
Comment Resolution	16-Aug-94	14.0 days	30-Aug-94
Final Ph II Work Plan	30-Aug-94	1.0 day	31-Aug-94
Mob for PH II FW	31-Aug-94	7.0 days	7-Sep-94
Perform Ph II FW	7-Sep-94	60.0 days	6-Nov-94
Ph II Sample Analysis	6-Nov-94	75.0 days	20-Jan-95
Rev/Sum Ph II Data	20-Jan-95	30.0 days	19-Feb-95
SITE CHARAC SUMMARY	19-Feb-95	154.0 day	23-Jul-95
Prepare Draft SCS Rep	19-Feb-95	60.0 days	20-Apr-95
Army Review Draft SCS	20-Apr-95	21.0 days	11-May-95
Comment Resolution	11-May-95	14.0 days	25-May-95
Prep DF SCS Report	25-May-95	14.0 days	8-Jun-95
Regulators Rev DF CS	8-Jun-95	30.0 days	8-Jul-95
Comment Resolution	8-Jul-95	14.0 days	22-Jul-95
Final SCS Report Appr	22-Jul-95	1.0 day	23-Jul-95
RISK ASSESSMENT	19-Feb-95	236.0 day	13-Oct-95
Prepare Draft RA	19-Feb-95	120.0 day	19-Jun-95
Army Rev Draft RA Ass	19-Jun-95	30.0 days	19-Jul-95
Comment Resolution	19-Jul-95	14.0 days	2-Aug-95
Prep DF RA Report	2-Aug-95	14.0 days	16-Aug-95
Reg Rev DF RA Rep	16-Aug-95	30.0 days	15-Sep-95
Comment Resolution	15-Sep-95	14.0 days	29-Sep-95
Finl Risk Assmt Rept	29-Sep-95	14.0 days	13-Oct-95
RI REPORT	23-Jul-95	176.0 day	15-Jan-96
Prepare Draft RI Repo	23-Jul-95	60.0 days	21-Sep-95
Army Review Draft RI	21-Sep-95	30.0 days	21-Oct-95
Comment Resolution	21-Oct-95	14.0 days	4-Nov-95
Prepare DF RI Report	4-Nov-95	14.0 days	18-Nov-95
Reg. Review DF RI Rep	18-Nov-95	30.0 days	18-Dec-95
Comment Resolution	18-Dec-95	14.0 days	1-Jan-96
Final RI Report	1-Jan-96	14.0 days	15-Jan-96

TIME LINE Task Report

008151

Schedule Name : GROUP #2 (LHAAP #12, 16, 17, 18, 24, 29, 32)

Responsible : CAPT. NGUYEN

As-of Date : 21-Jun-94 9:00a

Schedule File : GROUP#2

Dependencies :

Task Name	Start Date	Duration	End Date
GROUP #2	21-Feb-94	916.0 day	24-Aug-96
INVESTIGATION & ANALYSI	21-Feb-94	586.0 day	29-Sep-95
Reg Rev DF FSR	21-Feb-94	30.0 days	22-Mar-94
Comment Resolution	23-Mar-94	14.0 days	5-Apr-94
Final Phase I FSR App	6-Apr-94	1.0 day	7-Apr-94
Prepare Scope for Pha	28-Mar-94	30.0 days	26-Apr-94
Procure A-E Contracto	27-Apr-94	90.0 days	25-Jul-94
Prepare Draft Ph II W	26-Jul-94	45.0 days	8-Sep-94
Army Rev Draft Phase	9-Sep-94	21.0 days	29-Sep-94
Comment Resolution	30-Sep-94	14.0 days	13-Oct-94
Prepare DF Ph II WP	14-Oct-94	14.0 days	27-Oct-94
Reg Rev DF WP	28-Oct-94	30.0 days	26-Nov-94
Comment Resolution	27-Nov-94	14.0 days	10-Dec-94
Final Ph II Work Plan	11-Dec-94	1.0 day	11-Dec-94
Mob for Ph II FW	12-Dec-94	7.0 days	18-Dec-94
Perform Phase II Fiel	19-Dec-94	180.0 day	16-Jun-95
Phase II Sample Analy	17-Jun-95	75.0 days	30-Aug-95
Rev/Sum Ph II Data	31-Aug-95	30.0 days	29-Sep-95
SITE CHARAC SUMMARY	30-Sep-95	154.0 day	1-Mar-96
Prepare Draft SCS Rep	30-Sep-95	60.0 days	28-Nov-95
Army Rev D SCS Report	29-Nov-95	21.0 days	19-Dec-95
Comment Resolution	20-Dec-95	14.0 days	2-Jan-96
Prep DF SCS Report	3-Jan-96	14.0 days	16-Jan-96
Reg Rev DF SCS Rpt	17-Jan-96	30.0 days	15-Feb-96
Comment Resolution	16-Feb-96	14.0 days	29-Feb-96
Final SCS Report Appr	1-Mar-96	1.0 day	1-Mar-96
RISK ASSESSMENT	30-Sep-95	236.0 day	22-May-96
Prep D RA Report	30-Sep-95	120.0 day	27-Jan-96
Army Rev D RA	28-Jan-96	30.0 days	26-Feb-96
Comment Resolution	27-Feb-96	14.0 days	11-Mar-96
Prep DF RA Report	12-Mar-96	14.0 days	25-Mar-96
Reg Rev DF RA Rpt	26-Mar-96	30.0 days	24-Apr-96
Comment Resolution	25-Apr-96	14.0 days	8-May-96
Final Risk Assessment	9-May-96	14.0 days	22-May-96
RI REPORT	2-Mar-96	176.0 day	24-Aug-96
Prepare Draft RI Repo	2-Mar-96	60.0 days	30-Apr-96
Army Rev Draft RI Rep	1-May-96	30.0 days	30-May-96
Comment Resolution	31-May-96	14.0 days	13-Jun-96
Prep DF RI Report	14-Jun-96	14.0 days	27-Jun-96
Reg Rev DF RI	28-Jun-96	30.0 days	27-Jul-96
Comment Resolution	28-Jul-96	14.0 days	10-Aug-96
Final RI Report	11-Aug-96	14.0 days	24-Aug-96

008152

Schedule Name : GROUP #3 (LHAAP #13, 14)

Responsible : CAPT NGUYEN

As-of Date : 21-Jun-94 2:00p

Schedule File : GROUP3

Task Name	Start Date	Duration	End Date
GROUP #3	1-Feb-94	516.0 day	1-Jul-95
RI/FS REPORT	1-Feb-94	236.0 day	24-Sep-94
PREPARE DRAFT RI REPO	1-Feb-94	120.0 day	31-May-94
ARMY REVIEW DRAFT RI	1-Jun-94	30.0 days	30-Jun-94
COMMENT RESOLUTION	1-Jul-94	14.0 days	14-Jul-94
PREPARE DRAFT FINAL R	15-Jul-94	14.0 days	28-Jul-94
REGULATORS REV DRAFT	29-Jul-94	30.0 days	27-Aug-94
COMMENT RESOLUTION	28-Aug-94	14.0 days	10-Sep-94
FINAL RI REPORT	11-Sep-94	14.0 days	24-Sep-94
PROPOSED PLAN	29-Jul-94	192.0 day	5-Feb-95
PREP DRAFT PP	29-Jul-94	45.0 days	11-Sep-94
ARMY REV DRAFT PP	12-Sep-94	30.0 days	11-Oct-94
COMMENT RESOLUTION	12-Oct-94	14.0 days	25-Oct-94
PREPARE DF PP	26-Oct-94	14.0 days	8-Nov-94
REGULATORS REV DF PP	9-Nov-94	30.0 days	8-Dec-94
COMMENT RESOLUTION	9-Dec-94	14.0 days	22-Dec-94
FINAL PROPOSED PLAN A	23-Dec-94	14.0 days	5-Jan-95
PUBLIC MEETING	6-Jan-95	1.0 day	6-Jan-95
PUBLIC COMMENT PERIOD	7-Jan-95	30.0 days	5-Feb-95
RESPONSIVENESS SUMMARY	6-Feb-95	146.0 day	1-Jul-95
PREPARE D SUMMARY	6-Feb-95	30.0 days	7-Mar-95
ARMY REVIEW DRAFT RS	8-Mar-95	30.0 days	6-Apr-95
COMMENT RESOLUTION	7-Apr-95	14.0 days	20-Apr-95
PREPARE DF RS	21-Apr-95	14.0 days	4-May-95
REGULATORS REV DF RS	5-May-95	30.0 days	3-Jun-95
COMMENT RESOLUTION	4-Jun-95	14.0 days	17-Jun-95
FINAL RS	18-Jun-95	14.0 days	1-Jul-95
RECORD OF DECISION	6-Feb-95	146.0 day	1-Jul-95
PREPARE DRAFT ROD	6-Feb-95	30.0 days	7-Mar-95
ARMY REVIEW DRAFT ROD	8-Mar-95	30.0 days	6-Apr-95
COMMENT RESOLUTION	7-Apr-95	14.0 days	20-Apr-95
PREPARE DF ROD	21-Apr-95	14.0 days	4-May-95
REGULATORS REV DF ROD	5-May-95	30.0 days	3-Jun-95
COMMENT RESOLUTION	4-Jun-95	14.0 days	17-Jun-95
FINAL ROD	18-Jun-95	14.0 days	1-Jul-95

008153

Schedule Name : GROUP #4 - SUMPS
 Responsible : CAPT. NGUYEN
 As-of Date : 21-Jun-94 9:00a

Schedule File : SUMPS

Task Name	Start Date	Duration	End Date
SUMPS	22-Feb-94	806.0 day	7-May-96
INVESTIGATION AND ANALY	22-Feb-94	476.0 day	12-Jun-95
REGULATOR REV DRAFT F	22-Feb-94	30.0 days	23-Mar-94
COMMENT RESOLUTION	24-Mar-94	14.0 days	6-Apr-94
FINAL PHASE I FSR APP	7-Apr-94	1.0 day	7-Apr-94
PREPARE DRAFT PHASE I	8-Apr-94	45.0 days	22-May-94
ARMY REV DRAFT PHSE I	23-May-94	21.0 days	12-Jun-94
COMMENT RESOLUTION	13-Jun-94	14.0 days	26-Jun-94
PREPARE DRAFT FINAL P	27-Jun-94	14.0 days	10-Jul-94
REGULATORS REV DRAFT	11-Jul-94	30.0 days	9-Aug-94
COMMENT RESOLUTION	10-Aug-94	14.0 days	23-Aug-94
FINAL PHASE II WRKPLN	24-Aug-94	1.0 day	24-Aug-94
MOBILIZE FOR PHSE II	25-Aug-94	7.0 days	31-Aug-94
PERFORM PHASE II FIEL	1-Sep-94	180.0 day	27-Feb-95
PHASE II SAMPLE ANALY	28-Feb-95	75.0 days	13-May-95
REVIEW/SUMMARIZE PHAS	14-May-95	30.0 days	12-Jun-95
SITE CHARACTERIZATION S	13-Jun-95	154.0 day	13-Nov-95
PREPARE DRAFT SCS REP	13-Jun-95	60.0 days	11-Aug-95
ARMY REVIEW DRAFT SCS	12-Aug-95	21.0 days	1-Sep-95
COMMENT RESOLUTION	2-Sep-95	14.0 days	15-Sep-95
PREPARE DRAFT FINAL S	16-Sep-95	14.0 days	29-Sep-95
REGULATORS REV DRAFT	30-Sep-95	30.0 days	29-Oct-95
COMMENT RESOLUTION	30-Oct-95	14.0 days	12-Nov-95
FINAL SCS REPORT APPR	13-Nov-95	1.0 day	13-Nov-95
RISK ASSESSMENT	13-Jun-95	236.0 day	3-Feb-96
PREPARE DRAFT RISK AS	13-Jun-95	120.0 day	10-Oct-95
ARMY REV DRAFT RA REP	11-Oct-95	30.0 days	9-Nov-95
COMMENT RESOLUTION	10-Nov-95	14.0 days	23-Nov-95
PREPARE DRAFT FINAL R	24-Nov-95	14.0 days	7-Dec-95
REGULATORS REV DRAFT	8-Dec-95	30.0 days	6-Jan-96
COMMENT RESOLUTION	7-Jan-96	14.0 days	20-Jan-96
FINAL RISK ASSESSMENT	21-Jan-96	14.0 days	3-Feb-96
RI REPORT	14-Nov-95	176.0 day	7-May-96
PREPARE DRAFT RI REPO	14-Nov-95	60.0 days	12-Jan-96
ARMY REVIEW DRAFT RI	13-Jan-96	30.0 days	11-Feb-96
COMMENT RESOLUTION	12-Feb-96	14.0 days	25-Feb-96
PREPARE DRAFT FINAL R	26-Feb-96	14.0 days	10-Mar-96
REGULATORS REV DRAFT	11-Mar-96	30.0 days	9-Apr-96
COMMENT RESOLUTION	10-Apr-96	14.0 days	23-Apr-96
FINAL RI REPORT APPRO	24-Apr-96	14.0 days	7-May-96

008154

Schedule Name : GROUP #5 (SITE INVESTIGATION)

Responsible : CAPT. ROSS NGUYEN

s-of Date : 13-May-94 9:00a

Schedule File : GROUP5

Task Name	Start Date	Duration	End Date
GROUP 5 LHAAP SITE INVEST	17-Oct-94	506.0 day	6-Mar-96
Rec Srch/Rev xst rep	17-Oct-94	21.0 days	7-Nov-94
Prepare Draft WP	7-Nov-94	45.0 days	22-Dec-94
Army Review Draft WP	22-Dec-94	21.0 days	12-Jan-95
Comments Resolution	12-Jan-95	14.0 days	26-Jan-95
Prepare Draft Final WP	26-Jan-95	30.0 days	25-Feb-95
Regulators Rev DF WP	25-Feb-95	30.0 days	27-Mar-95
Comments Resolution	27-Mar-95	14.0 days	10-Apr-95
Final WP Approval	10-Apr-95	14.0 days	24-Apr-95
Mobil for Field Work	24-Apr-95	14.0 days	8-May-95
Perform Site Invest	8-May-95	60.0 days	7-Jul-95
Laboratory Analysis	7-Jul-95	45.0 days	21-Aug-95
Data Validation	21-Aug-95	30.0 days	20-Sep-95
Pre DF Sum Rep FSR	20-Sep-95	45.0 days	4-Nov-95
Army rev Draft FSR	4-Nov-95	21.0 days	25-Nov-95
Comments Resolution	25-Nov-95	14.0 days	9-Dec-95
Prep Draft Final FSR	9-Dec-95	30.0 days	8-Jan-96
Regltors rev DF FSR	8-Jan-96	30.0 days	7-Feb-96
Comments Resolution	7-Feb-96	14.0 days	21-Feb-96
Final FSR Approval	21-Feb-96	14.0 days	6-Mar-96

008155

Schedule Name : IRA AT 18 & 24
 Responsible : CAPT. ROSS NGUYEN
 Date of Date : 9-Jan-94 9:00am

Schedule File : IRA18&24

Dependencies :

Task Name	Start Date	Duration	End Date
IRA AT 18 & 24	9-Jan-94	735.0 day	13-Jan-96
INVEST & ANALYSIS	9-Jan-94	303.0 day	7-Nov-94
Ph I Treatability Tes	9-Jan-94	80.0 days	29-Mar-94
Data Validation	30-Mar-94	30.0 days	28-Apr-94
Review/Summarize Phas	29-Apr-94	14.0 days	12-May-94
Mobil Ph II Field Wor	21-Feb-94	7.0 days	27-Feb-94
Ph II Field Work	28-Feb-94	120.0 day	27-Jun-94
Ph II Sample Anal	28-Jun-94	21.0 days	18-Jul-94
Rev/Sum Ph II Data	19-Jul-94	14.0 days	1-Aug-94
Prep Draft Ph II FSR	2-Aug-94	14.0 days	15-Aug-94
Army Rev D Ph II FSR	16-Aug-94	14.0 days	29-Aug-94
Comment Resolution	30-Aug-94	14.0 days	12-Sep-94
Prep DF Ph II FSR	13-Sep-94	14.0 days	26-Sep-94
Reg Rev DF Final FSR	27-Sep-94	14.0 days	10-Oct-94
Comment Resolution	11-Oct-94	14.0 days	24-Oct-94
Final Phase II FSR	25-Oct-94	14.0 days	7-Nov-94
PROPOSED PLAN	28-Jun-94	192.0 day	5-Jan-95
Prep Draft PP	28-Jun-94	45.0 days	11-Aug-94
Review Draft PP	12-Aug-94	30.0 days	10-Sep-94
Comment Resolution	11-Sep-94	14.0 days	24-Sep-94
Prepare DF PP	25-Sep-94	14.0 days	8-Oct-94
Reg Review DF PP	9-Oct-94	30.0 days	7-Nov-94
Comment Resolution	8-Nov-94	14.0 days	21-Nov-94
Final PP Approval	22-Nov-94	14.0 days	5-Dec-94
Public Meeting	6-Dec-94	1.0 day	6-Dec-94
Pub Comment Period	7-Dec-94	30.0 days	5-Jan-95
RESPONSIVENESS SUMMARY	6-Jan-95	137.0 day	22-May-95
Prepare Draft RS	6-Jan-95	21.0 days	26-Jan-95
Army Rev Draft RS	27-Jan-95	30.0 days	25-Feb-95
Comment Resolution	26-Feb-95	14.0 days	11-Mar-95
Prepare DF RS	12-Mar-95	14.0 days	25-Mar-95
Reg Review DF RS	26-Mar-95	30.0 days	24-Apr-95
Comment Resolution	25-Apr-95	14.0 days	8-May-95
Final RS Approval	9-May-95	14.0 days	22-May-95
RECORD OF DECISION	7-Dec-94	167.0 day	22-May-95
Prepare Draft ROD	7-Dec-94	51.0 days	26-Jan-95
Army Rev Draft Rod	27-Jan-95	30.0 days	25-Feb-95
Comment Resolution	26-Feb-95	14.0 days	11-Mar-95
Prepare DF ROD	12-Mar-95	14.0 days	25-Mar-95
Reg Review DF ROD	26-Mar-95	30.0 days	24-Apr-95
Comment Resolution	25-Apr-95	14.0 days	8-May-95
Final ROD Approval	9-May-95	14.0 days	22-May-95
IRA WORK PLAN	9-May-95	236.0 day	30-Dec-95
Procure Contractor	9-May-95	60.0 days	7-Jul-95
Prep Draft IRA WP	8-Jul-95	60.0 days	5-Sep-95
Army Rev D IRA WP	6-Sep-95	30.0 days	5-Oct-95
Comment Resolution	6-Oct-95	14.0 days	19-Oct-95

008156

Prep DF IRA WP	20-Oct-95	14.0 days	2-Nov-95
Reg Rev DF IRA WP	3-Nov-95	30.0 days	2-Dec-95
Comment Resolution	3-Dec-95	14.0 days	16-Dec-95
Final IRA WP	17-Dec-95	14.0 days	30-Dec-95
IRA FINAL DES/CONSTRUCT	31-Dec-95	14.0 days	13-Jan-96
Mobilize for IRA	31-Dec-95	14.0 days	13-Jan-96
IRA Begin	14-Jan-96	0.0	14-Jan-96

Schedule Name : OLD & ACTIVE LANDFILL CAPS

Responsible : CAPT. ROSS NGUYEN

Issued Date : 13-May-94 9:00a

Schedule File : LANDFILL

008157

Dependencies :

Task Name	Start Date	Duration	End Date
LANDFILL CAPS	7-Mar-94	342.0 day	11-Feb-95
Rev Existing Reports	7-Mar-94	14.0 days	20-Mar-94
RD Invest WP	21-Mar-94	32.0 days	21-Apr-94
Army Review Workplans	22-Apr-94	30.0 days	21-May-94
Resolve Comments	22-May-94	14.0 days	4-Jun-94
Revise Workplans	5-Jun-94	14.0 days	18-Jun-94
Regulatory Review	19-Jun-94	30.0 days	18-Jul-94
Resolve Comments	19-Jul-94	14.0 days	1-Aug-94
Final Workplans	2-Aug-94	14.0 days	15-Aug-94
RD Investigations	16-Aug-94	60.0 days	14-Oct-94
Borrow Testing	15-Oct-94	120.0 day	11-Feb-95
DECISION DOCUMENT	15-Oct-94	161.0 day	24-Mar-95
Prep Draft PP	15-Oct-94	45.0 days	28-Nov-94
Army Rev Draft PP	29-Nov-94	30.0 days	28-Dec-94
Comment Resolution	29-Dec-94	14.0 days	11-Jan-95
Prepare DF PP	12-Jan-95	14.0 days	25-Jan-95
Reg Review DF PP	26-Jan-95	30.0 days	24-Feb-95
Comment Resolution	25-Feb-95	14.0 days	10-Mar-95
Final PP Approval	11-Mar-95	14.0 days	24-Mar-95
PLANS & SPECS	15-Oct-95	244.0 day	14-Jun-96
60% Plans and Specs	15-Oct-95	90.0 days	12-Jan-96
Army Review	13-Jan-96	30.0 days	11-Feb-96
Resolve Comments	12-Feb-96	14.0 days	25-Feb-96
Rev 60% Plans & Specs	26-Feb-96	21.0 days	17-Mar-96
Reg Rev 60% Plns & Spec	18-Mar-96	30.0 days	16-Apr-96
Resolve Reg. Comments	17-Apr-96	14.0 days	30-Apr-96
Dev Final Pln & Spec	1-May-96	45.0 days	14-Jun-96
IRA WORK PLAN	18-Apr-95	250.0 day	23-Dec-95
Adver/Award Construc	18-Apr-95	60.0 days	16-Jun-95
Prepare Draft IRA WP	17-Jun-95	60.0 days	15-Aug-95
Army Rev D IRA WP	16-Aug-95	30.0 days	14-Sep-95
Resolve Comment	15-Sep-95	14.0 days	28-Sep-95
Prep DF IRA WP	29-Sep-95	14.0 days	12-Oct-95
Reg Rev DF IRA WP	13-Oct-95	30.0 days	11-Nov-95
Resolve Comment	12-Nov-95	14.0 days	25-Nov-95
Final IRA WP	26-Nov-95	14.0 days	9-Dec-95
Mobilize for IRA	10-Dec-95	14.0 days	23-Dec-95
IRA Begin	24-Dec-95	0.0	24-Dec-95

Schedule Name : BACKGROUND/HYDROGEOLOGY ASSESSMENT

Responsible : CAPT. NGUYEN

Start Date : 13-May-94 9:00a

Schedule File : BGD-HA

008158

Dependencies :

Task Name	Start Date	Duration	End Date
BD SOIL CONC REPORT	21-Apr-94	285.0 day	31-Jan-95
Prep of WP for addition	21-Apr-94	21.0 days	12-May-94
Rev of WP by Army	12-May-94	21.0 days	2-Jun-94
Comments Resolution	2-Jun-94	14.0 days	16-Jun-94
Draft Final WP	16-Jun-94	14.0 days	30-Jun-94
Regulator Review of WP	30-Jun-94	30.0 days	30-Jul-94
Comment Resolution	30-Jul-94	7.0 days	6-Aug-94
M & S for additnl soil	6-Aug-94	14.0 days	20-Aug-94
Lab analysis of addtl so	20-Aug-94	14.0 days	3-Sep-94
Data validation by Chem	3-Sep-94	21.0 days	24-Sep-94
Statistic eval of chem	24-Sep-94	14.0 days	8-Oct-94
Prep of drft field Summ	8-Oct-94	21.0 days	29-Oct-94
Army Rev Draft FSR	29-Oct-94	21.0 days	19-Nov-94
Comments Resolution	19-Nov-94	14.0 days	3-Dec-94
Prep of DF FSR	3-Dec-94	14.0 days	17-Dec-94
Reg Rev DF FSR	17-Dec-94	30.0 days	16-Jan-95
Comment Resolution	16-Jan-95	14.0 days	30-Jan-95
Final FSR Approval	30-Jan-95	1.0 day	31-Jan-95

008159

Schedule Name : BACKGROUND GROUNDWATER CONCENTRATION REPORT
 Responsible : CPT ROSS NGUYEN
 Date : 13-May-94 9:00a Schedule File : BDGWCONR

Task Name	Start Date	Duration	End Date
BD GW CONC REPORT	22-Apr-94	350.0 day	7-Apr-95
Prep of WP for Addtl mo	22-Apr-94	21.0 days	13-May-94
Rev of WP by Army	13-May-94	21.0 days	3-Jun-94
Comnts Res Draft WP	3-Jun-94	14.0 days	17-Jun-94
Preparation of DF WP	17-Jun-94	14.0 days	1-Jul-94
Reg Rev of DF WP	1-Jul-94	30.0 days	31-Jul-94
Revision of DF WP	31-Jul-94	14.0 days	14-Aug-94
Mob/Ins & Samp of Adtl	14-Aug-94	14.0 days	28-Aug-94
Lab anasis of addtl wat	28-Aug-94	30.0 days	27-Sep-94
Data valid by Chem/IH	27-Sep-94	21.0 days	18-Oct-94
Rev & Input of data	18-Oct-94	21.0 days	8-Nov-94
Stat eval GW BD data	8-Nov-94	14.0 days	22-Nov-94
Prepare Draft GW BD Rep	22-Nov-94	42.0 days	3-Jan-95
Army rev D GW BD Rep	3-Jan-95	21.0 days	24-Jan-95
Comment Resolution	24-Jan-95	14.0 days	7-Feb-95
Prep DF GW BD Report	7-Feb-95	14.0 days	21-Feb-95
Reg rev DF GW BD Report	21-Feb-95	30.0 days	23-Mar-95
Comment Resolution	23-Mar-95	14.0 days	6-Apr-95
Final GW BD Report	6-Apr-95	1.0 day	7-Apr-95

TIME LINE Task Report

008160

Schedule Name : HYDROGEOLOGICAL ASSESSMENT

Responsible : CPT ROSS NGUYEN

Start Date : 13-May-94 9:00a

Schedule File : HYDROGEO

Task Name	Start Date	Duration	End Date
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HYDROGEOLOGICAL ASSESSMEN	31-May-94	242.0 day	27-Jan-95
Acqui & Rev of Geo Data	31-May-94	21.0 days	20-Jun-94
Acqui of addtl FD	21-Jun-94	14.0 days	4-Jul-94
Anasis of sub data & X-	5-Jul-94	28.0 days	1-Aug-94
Prep hydro & geochem ma	2-Aug-94	35.0 days	5-Sep-94
Prep Drft Hydro Assessm	6-Sep-94	50.0 days	25-Oct-94
Army rev Drft Hydro Ass	26-Oct-94	21.0 days	15-Nov-94
Comment Resolution	16-Nov-94	14.0 days	29-Nov-94
Pre DF Hydro Assess	30-Nov-94	14.0 days	13-Dec-94
Regltrs rev DF Hydrogeo	14-Dec-94	30.0 days	12-Jan-95
Comment Resolution	13-Jan-95	14.0 days	26-Jan-95
Final Hydrogeo Assessmt	27-Jan-95	1.0 day	27-Jan-95

WELL SAMPLING SUMMARY

units
µg/kg

TCE

	MW 10	MW 13	MW 16	C 2	C 4	C 4A	C5	C6
Nov-92	<5	581	9390	<5	<5	<5	<5	<5
* Mar-93	ND	ND	no sample	ND	ND	no sample	ND	no sample
* Jun-93	ND	ND	no sample	ND	ND	no sample	ND	no sample
* Sep-93	ND	ND	no sample	ND	ND	no sample	ND	no sample
Nov-93	130	28	27	28	<5	930	<5	139
* Dec-93	ND	ND	no sample	ND	ND	no sample	ND	no sample
* Mar-94	14	100	no sample	5	ND	no sample	ND	no sample
Apr-94	<250	<50	<5	210	50	<250	130	90
May-94	14	3	3	5	6	8	2	17
* ANAL LAB	8	ND	ND	ND	ND	ND	ND	7.6
PDP	10	ND	ND	ND	4	ND	ND	7
SWD LAB	8.3	<5	<5	<5	<5	<5	<5	7.3

MEC

	MW 10	MW 13	MW 16	C 2	C 4	C 4A	C5	C6
Nov-92	<10	<10	<10	<10	<10	<10	<5	<10
* Mar-93	ND	ND	no sample	ND	ND	no sample	ND	no sample
* Jun-93	ND	ND	no sample	ND	ND	no sample	ND	no sample
* Sep-93	ND	ND	no sample	ND	ND	no sample	ND	no sample
Nov-93	61	34	10	12	<10	2630	6	210
* Dec-93	ND	ND	no sample	ND	ND	no sample	ND	no sample
* Mar-94	ND	ND	no sample	ND	ND	no sample	ND	no sample
Apr-94	2100	590	<5	480	270	2000	1800	300
May-94	1	ND	ND	1	3	5	2	30
* ANAL LAB	ND	ND	ND	ND	ND	22	ND	ND
PDP	4	ND	ND	4	7	21	5	ND
SWD LAB	5.3	<5	7.7	<5	<5	19.3	<5	<5

* designates results from Thiokol's sampling

PRELIMINARY DATA ANALYSIS			
TCE & MEC SUMMARY TABLE			
1994 GROUNDWATER MONITORING			
VOLATILE ORGANICS			
WITH % INCREASE IN CONCENTRATION FROM 11/92 TO 4/94			
LONGHORN ARMY AMMUNITION PLANT			
JUNE 1994			
MW #A	DATE	TCE ug/l	MEC ug/l
C-1	4/94	30	33
	1/94	339	990
	11/93	475	5000E
	11/92	<5	<10
C-2	8/94	<5	4
	5/94	5	1J
	4/94	210	480
	11/93	26	12
	11/92	<5	<10
C-3	4/94	45	15
	11/93	<5	7
	11/92	<5	<10
C-4	6/94	4	7
	5/94	8	3J
	4/94	60	270
	11/93	<5	<10
	11/92	<5	<10
C-4A	8/94	<5	21
	5/94	5	58J
	4/94	<250	2000
	1/94	590	3615
	11/93	930	2630
	11/92	<5	<10
C-5	8/94	<5	5

TCE = Trichloroethene

MEC = Methylene chloride

PRELIMINARY DATA ANALYSIS			
TCE & MEC SUMMARY TABLE			
1994 GROUNDWATER MONITORING			
VOLATILE ORGANICS			
WITH % INCREASE IN CONCENTRATION FROM 11/82 TO 4/94			
LONGHORN ARMY AMMUNITION PLANT			
JUNE 1994			
MW #A	DATE	TCE ug/l	MEC ug/l
	5/94	7	2J
	4/94	130	1800
	11/83	<5	8
	11/82	<5	<10
C-6	6/94	7	<5
	5/94	17	30
	4/94	90	300
	11/83	139	210
	11/82	<5	<10
C-7	4/94	10	7
	11/83	150	820
	11/82	<5	<10
C-8	4/94	9	4
	11/83	<5	<5
	11/82	<5	<10
C-9	4/94	6	28
	11/83	420	6,680
	11/82	<5	<10
C-10	4/94	122	690
	11/83	440	5,970
	11/82	<5	<10
MW-1	4/94	17,100	444,000
	11/83	16,500	328,400
	11/82	24,300	251,000
MW-2	4/94	1,520,000	10,550,000

TCE = Trichloroethene

MEC = Methylene chloride

PRELIMINARY DATA ANALYSIS TCE & MEC SUMMARY TABLE 1994 GROUNDWATER MONITORING VOLATILE ORGANICS WITH % INCREASE IN CONCENTRATION FROM 11/92 TO 4/94 LONGHORN ARMY AMMUNITION PLANT JUNE 1994			
MW #A	DATE	TCE ug/l	MEC ug/l
	11/83	238,000	8,000,000
	11/92	199,000	9,080,000
MW-3	4/94	4,500	243,000
	11/93	740	280
	11/92	315	<10
MW-4	4/94	1,100	80
	11/93	780	180
	11/92	513	51
MW-5	4/94	126	32
	11/93	140	73
	11/92	78	<10
MW-6	4/94	40	22
	11/93	190	110
	11/92	80	<10
MW-7	4/94	15,500	2,100
	1/94	12,647	1,574
	11/93	18,300	<5
	11/92	11,300	<10
MW-8	4/94	8,200	390
	11/93	7100	250
	11/92	6580	<10
MW-9	4/94	3,800	850
	11/93	3535	<250
	11/92	3720	<10
MW-10	6/94	10	4

TCE = Trichloroethene

MEC = Methylene chloride

PRELIMINARY DATA ANALYSIS
TCE & MEC SUMMARY TABLE
1994 GROUNDWATER MONITORING
VOLATILE ORGANICS
WITH % INCREASE IN CONCENTRATION FROM 11/92 TO 4/94
LONGHORN ARMY AMMUNITION PLANT

JUNE 1994

MW #A	DATE	TCE ug/l	MEC ug/l
	5/84	14	1J
	4/94	<250	2,100
	11/93	130	61
	11/92	<5	<10
MW-11	4/94	82	58
	11/93	300E	340
	11/92	581	<10
MW-12	4/94	4,000	140
	11/93	3,650	630
	11/92	8,180	<10
MW-13	6/94	<5	<5
	5/94	2J	<5
	4/94	<50	590
	11/93	28	34
	11/92	<5	<10
MW-14	4/94	12,400	2,200
	11/93	2,800	108J
	11/92	1,540	<10
MW-15	4/94	<500	645
	1/94	150	885
	11/93	130	806
	11/92	8,390	88,000
MW-18 * SURFACE WATER INFILTRATION	6/94	<5	7.7
	5/94	3J	<5
	4/94	<5	<5
	11/93	27	10

TCE = Trichloroethene

MEC = Methylene chloride

PRELIMINARY DATA ANALYSIS			
TCE & MEC SUMMARY TABLE			
1994 GROUNDWATER MONITORING			
VOLATILE ORGANICS			
WITH % INCREASE IN CONCENTRATION FROM 11/92 TO 4/94			
LONGHORN ARMY AMMUNITION PLANT			
JUNE 1994			
MW #A	DATE	TCE ug/l	MEC ug/l
	11/82	<5	<10
MW-17	4/84	32	10
	11/93	34	12
	11/92	<5	<10
MW-18	4/94	<5	9
	11/93	150	56
	11/82	<5	<10
MW-19	4/84	<5	8
	11/93	59	61
	11/82	<5	<10
MW-20	4/84	13	6
	11/93	8	16
	11/92	<5	<10
MW-21	4/94	8,400	1,270,000
	11/93	4,850	432,000
	11/92	5270*	31200*
MW-22	4/94	6,900	1,900
	1/94	1,358	3,244
	11/93	408E	213E
	11/82	227	10
MW-23	4/94	980	820
	11/93	2,930	6,530
	11/92	487	<10
101	4/94	30	18
	1/88	ND	30

TCE = Trichloroethene

MEC = Methylene chloride

PRELIMINARY DATA ANALYSIS			
TCE & MEC SUMMARY TABLE			
1994 GROUNDWATER MONITORING			
VOLATILE ORGANICS			
WITH % INCREASE IN CONCENTRATION FROM 11/92 TO 4/94			
LONGHORN ARMY AMMUNITION PLANT			
JUNE 1994			
MW #A	DATE	TCE ug/l	MEC ug/l
102	4/94	5	3
	11/93	<5	<5
	11/92	<5	<10
109	4/94	250	400
	11/93	94	8
	11/92	204	<10
120	4/94	42,000	273,000
	11/93	58,600	284,000
	11/92	67,500	684,000
123	4/94	16	40
	11/93	<5	<5
124 - SURFACE WATER INFILTRATION	4/94	3	31
	11/93	<5	<5
	11/92	<5	<10
125	4/94	<250	600
	1/94	22	<5
	11/93	<5	<10
126	4/94	3	13
	11/93	31	<10
	11/92	<5	<10
129	4/94	1,560	28
	11/93	2,400	380
	11/92	1,370	84
130	4/94	12	<5
	11/93	<5	<5

TCE = Trichloroethene

MEC = Methylene chloride

PRELIMINARY DATA ANALYSIS			
TCE & MEC SUMMARY TABLE			
1994 GROUNDWATER MONITORING			
VOLATILE ORGANICS			
WITH % INCREASE IN CONCENTRATION FROM 11/82 TO 4/94			
LONGHORN ARMY AMMUNITION PLANT			
JUNE 1994			
MW #A	DATE	TCE ug/l	MEC ug/l
	11/92	<5	<10
AWD-1	4/94	59,000	189,000
	11/93	81,200	81,800
AWD-2	4/94	11,400	28,000
	11/93	6,600	18,200
AWD-3	4/94	775	175
	11/93	3,000	3,750
AWD-4	4/94	25	58
	11/93	83	48
EW-1	4/94	8,800	87,000
	11/93	8,000	63,190E

TCE = Trichloroethene

MEC = Methylene chloride



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

008169

CERTIFIED MAIL: RETURN RECEIPT REQUESTED

JUN 07 1994

David Tolbert, Project Manager
Longhorn Army Ammunition Plant
Attn: SMCLO-EN
Marshall, Texas 75671-1059

Re: Existing Monitoring Well Condition Survey
UEP/Burning Ground No.3 Sites

Dear David:

During the April 1994 monthly Project Coordinators meeting held in Tulsa, OK, EPA and TNRCC requested an evaluation of the monitoring wells in the UEP/Burning Ground No.3 area be conducted to determine the integrity, utility, and/or necessity of the all of the monitoring wells in this area and to classify the monitoring wells based on this evaluation. During the May 1994 monthly Project Coordinators meeting held on May 10, 1994, at the Longhorn Army Ammunition Plant, the Existing Monitoring Well Condition Survey was distributed.

EPA agrees with the Existing Monitoring Well Condition Survey that the BH-3, 4, 7, 11, and 22 monitoring wells should be closed since they are over 14 years old and have already been replaced with monitoring wells MW-1, 2, 3, 4, 5, and 6. Monitoring well 124 should be closed due to erosion around the well casing and should be replaced with a monitoring well constructed with materials consistent with the "MW" monitoring wells. EPA agrees also with the repairs to existing wells identified in the survey. Monitoring well MW-15 should be abandoned, however, EPA recommends that the monitoring well be replaced with a monitoring well installed and constructed using state-of-art materials and techniques to prevent downward migration of the dense nonaqueous phase liquid (DNAPL) contamination. EPA feels that replacement of this well is essential in order to assess the DNAPL contamination in the area of and at the depth of monitoring well MW-15. Furthermore, EPA requests that a workplan (i.e. an amendment to the approved Chemical Data Acquisition Plan dated June 1992, possibly entitled "DNAPL Contingency Plan") be presented to EPA and TNRCC prior to the initiation of the field work pursuant to this well survey. The workplan should detail the installation, construction, and sampling materials and techniques to be used for monitoring wells on the facility.

In addition to the information contained in the survey, EPA anticipated a more thorough evaluation of the monitoring wells in the UEP/Burning Ground No.3 area. EPA expected the evaluation to include not only such criteria as a damage assessment, but also a

construction integrity evaluation given the groundwater contamination and a well utility and/or necessity evaluation based on placement and screen intervals. Furthermore, EPA expected a classification of the monitoring wells based on the evaluation (eg. monitoring wells with screen intervals at x depth, monitoring wells with free-phase liquids, etc.) in order to qualify information and/or data obtained from the monitoring wells based on, for example, the well's limitations.

Regarding the issue of monitoring well construction materials and the criteria for closure set at 1,000,000 parts per billion organic contaminants for PVC wells, EPA recommends the establishment of an arbitrary concentration of a contaminant not be used to determine closure criteria for a PVC monitoring well. EPA does recommend, however, that the PVC monitoring wells (i.e., 120 and 129) be monitored closely to verify that the wells have not collapsed or are not showing signs of pending physical collapse (i.e., sand pack materials detected in the bottom of the well, or when sampled the bailer is unable to reach the bottom of the well), and that the utility of this well is limited to water quality and water level data. Furthermore, EPA recommends that the dedicated bailers from at least well 120 be removed due to the possibility of the fusion of the bailer to the well casing.

If you have any questions about these comments or any other matter, please contact me at (214) 655-6744.

Sincerely,



Lisa Marie Price
Remedial Project Manager
Superfund Texas Enforcement

cc: Lieutenant Colonel Lawrence J. Sowa
Commanding Officer, U.S. Army
Longhorn Army Ammunition Plant
Marshall, Texas 75671-1059

✓ Tulsa District Corps of Engineers
P.O. Box 61
Attn: Mr. Ross Nguyen
CESWT-PP-E
Tulsa, OK 74121-0061

Mike Moore, Superfund
Texas Natural Resource Conservation Commission
P.O. Box 13087
Capital Station
1700 N. Congress Avenue
Austin, TX 78711-3087



DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
MARSHALL, TEXAS 75671-1059

008171



REPLY TO
ATTENTION OF

June 28, 1994

Engineering Division

Ms. Lisa Price
Superfund Enforcement
U.S. Environmental Protection Agency
1445 Ross Avenue
Dallas, Texas 75202

Dear Ms. Price:

Enclosed are two copies of the Draft Final Work Plan and Chemical Data Acquisition Plan Addendum for Phase II Group #1 (LHAAP 11, 1/1A, XX, 27) of Longhorn Army Ammunition Plant in Karnack, Texas.

Please review and send your comments back to us by 28 July 1994.

If there are any questions, please contact Mr. David Tolbert at 903-679-2728.

Sincerely,

Lawrence J. Sowa
Lieutenant Colonel, U.S. Army
Commanding Officer

Encls





DEPARTMENT OF THE ARMY
LONGHORN/LOUISIANA ARMY AMMUNITION PLANTS
MARSHALL, TEXAS 75671-1059

008172



REPLY TO
ATTENTION OF

29 June 1994

SMCLO-EN

Ms. Lisa Price
Superfund Enforcement
U.S. Environmental Protection Agency
1445 Ross Avenue
Dallas, Texas 75202

Dear Ms. Price:

Enclosed are two copies of the Draft Final Work Plan Addendum Soil and Groundwater Background Concentration Study of Longhorn Army Ammunition Plant in Karnack, Texas.

Please review and send your comments back to us by 29 July 1994.

If there are any questions, please contact Mr. David Tolbert at 903-679-2728.

Sincerely,

Lawrence J. Sowa
Lieutenant Colonel, U. S. Army
Commanding Officer

Enclosures

008173

**BIOTREATABILITY
REPORT
PRESENTED TO
AWD TECHNOLOGIES
FOR
USACE CONTRACT NO.
DFACA56-93-D-0016**

**PREPARED BY:
BIOSCIENCE, INC.
BETHLEHEM, PA**

JULY 1, 1994

EXECUTIVE SUMMARY

The results of the present study do not allow recommendation of either biopile or bioslurry remediation methods for the Longhorn Army Ammunition Plant site at Karnack, TX. Neither process simulation achieved biodegradation of at least 20% of the target contaminants (methylene chloride, MEC, or trichloroethylene, TCE) in both of the soil samples tested. Loss of MEC occurred in killed controls at similar rates to the biologically treated soils. The primary loss mechanism appears to be volatilization. Evidence was obtained for biodegradation of TCE and several other compounds in the biopile process simulation.

Related work performed on groundwater from this site found that development of MEC degrading microbial populations was not successful. Microbial growth was slow and volatilization was rapid such that volatilization was the dominant removal mechanism¹.

Soil characterization data indicates that the soil is amenable to bioremediation in that no factors were found that precluded either growth of microbial populations or delivery of essential factors such as nutrients or oxygen. Populations of 1 to 100 million bacteria per gram of soil were obtained in both biopile and bioslurry simulations for both soils (substantially higher than the initial soil populations).

The failure to demonstrate biodegradation in these soils is attributed to the ease of air-stripping the relatively low concentrations of MEC and TCE from these soils, the presence of substantial amounts of organic compounds which may be preferred substrates of the microbes present, and the difficulty in stimulating indigenous microbes to attack the target contaminants within the short time span before volatilization depleted the concentration to below detection limits.

INTRODUCTION

Bioscience, Inc of Bethlehem, Pennsylvania was awarded a subcontract from AWD, Rockville, MD. for determination of the biodegradability of contaminants in soils at the Longhorn Army Ammunition Plant, Karnack, TX. The work described is part of the Interim Remedial Action being performed for the Army Corps of Engineers by AWD Technologies. The Bioscience, Inc. treatability study described below is designed as a bioremediation screening level determination of the biodegradability of the contaminants in the samples. The soil is described in the Request for Proposal (RFP) as containing trichloroethylene (TCE), methylene chloride (MEC), trace amounts of semivolatile organics, and heavy metals (primarily barium). Bioremediation will target the organic contaminants with the primary focus on MEC and TCE.

The goal of bioremediation screening is to determine whether bioremediation is a viable treatment technology for meeting cleanup standards. A minimum of 20% reduction in target contaminants (MEC and TCE) due to biodegradation is considered to be a positive result suggesting further evaluation of the technology. Two bioremediation technologies were simulated and evaluated: biopile (land treatment) and bioslurry (suspension treatment). Biopile technology uses contained soil cells with air forced through the soil to maintain aerobic conditions for biotreatment. Bioslurry uses an enclosed reactor with efficient mixing and aeration to maintain the soil in water suspension. Various additives including nutrients, pH buffers, and co-substrates may be added to enhance biodegradation rate and degree of completion in both processes. In the testing described below, soil from the site was monitored for volatile halogenated hydrocarbons to determine biodegradation and volatilization of target contaminants.

In addition to monitoring specific analytes, environmental conditions during treatment were also monitored. The procedure followed guidelines outlined in the "Guide for Conducting Treatability Studies under CERCLA: Aerobic Biodegradation Remedy Screening"².

Experience has shown that MEC is biodegraded aerobically (in the presence of oxygen) and that TCE is biodegraded both aerobically and anaerobically (in the absence of oxygen). However, anaerobic TCE biodegradation is typically much slower than the aerobic process. Since aerobic degradation is documented for both major contaminants, it is used in this screening study. Aerobic TCE biodegradation is co-oxidative and requires an extremely strong oxidizing enzyme to initiate

degradation. These enzymes are induced only by aliphatic hydrocarbons (methane and similar compounds) and a few other substrates. Liquefied propane gas was used in these studies to stimulate specific bacteria to grow and produce the required enzymes.

SAMPLE HANDLING

Two composite samples of soil from contaminated areas of the site were received on December 4, 1993. The samples were labelled MS-1 and MS-2. The concentration of target contaminants was determined to be too low for the purposes of this study (results are presented in Appendix B). A second set of samples was received by Bioscience, Inc. on January 26, 1994. Five gallons of each type of soil (labelled TP1A and TP3A, respectively) were received for the study. Because the second set of samples was taken from locations analagous to the first set, particle size and metal analyses were not performed on the second sample set (data from the first set was considered representative of the site).

The sample containers were completely filled and sealed. The containers were shipped to Bioscience Inc.'s laboratory by overnight express delivery. Upon receipt at Bioscience Inc.'s laboratory, the samples were stored in a refrigerated sample storage area until used. Chain of custody procedures were followed throughout (see Appendix A for chain of custody documents).

Prior to initial characterization, each container of soil was deposited on a polyethylene sheet, large stones were removed, and the soil was manually mixed and put through a soil splitter to obtain representative portions for analysis. Soil as received was too wet to allow sieving and drying would have allowed excessive volatilization of contaminants. All procedures were performed in a cold room at less than 10°C.

INITIAL ANALYSES

The soil samples were analyzed prior to biodegradation testing for:

<u>Parameter</u>	<u>Method</u>
Chlorinated Volatile Organics*	SW-846 8010,5030
Metals Screening	SW-846 6010
Moisture	ASTM D2216
pH	SW-846 9045
Ammonia-Nitrogen	STD. METH. 417B
Nitrate-Nitrogen	STD. METH. 418C
Orthophosphate	STD. METH. 424E
Total Plate Count	STD. METH. 907B
Total Organic Carbon	SW-846 9060
Water Holding Capacity	ASTM D425

**** Analyzed in Triplicate***

Results are shown in Tables 1 through 4.

TABLE 1

INITIAL CHARACTERIZATION OF SOILS

<u>Parameter</u>	<u>Result TP1A</u>	<u>Result TP3A</u>
<u>Available Nutrient</u>		
Ammonium–N	394 mg/kg	19 mg/kg
Nitrate	< 2.5 mg/kg	< 2.5 mg/kg
Orthophosphate	12 mg/kg	14 mg/kg
Total Bacterial Plate Count	4.2E+04 cfu/g	1.4E+07 cfu/g
Total Moisture Percent Dry Weight	18.54 %	21.63 %
pH	6.2	4.6
Specific Conductivity	846 umho	69 umho
Water Holding Capacity Percent Dry Weight	24.8 %	12 %
Total Organic Carbon	6810 mg/kg	4360 mg/kg

TABLE 2

INITIAL CHARACTERIZATION OF SOILS

<u>Parameter</u>	<u>Result MS-1</u>	<u>Result MS-2</u>
Particle Size		
Gravel (Passing 3-in. and retained on No. 4 Sieve)	25.8 %	42.7 %
Sand		
A. Coarse Sand (Passing No.4 Sieve and retained on No. 10 Sieve)	38.2 %	31.9 %
B. Medium Sand (Passing No.10 Sieve and retained on No. 40 Sieve)	21.6 %	16.4 %
C. Fine Sand (Passing No. 40 Sieve and retained on No. 200 Sieve)	12.7 %	8.8 %
Silt Size (0.074 to 0.005 mm)	1.2 %	0.2 %
Clay Size (0.005 to 0.001 mm)	0.5 %	< 0.1 %
Colloids (less than 0.001 mm)	< 0.1 %	< 0.1 %

Table 3

INITIAL SOIL METAL RESULTS 1/19/94

PARAMETER (mg/kg)	SAMPLE TP1A 43210 SOIL	SAMPLE TP3A 43211 SOIL
aluminum	29,200	45,300
antimony	1.88	0.93
arsenic	33.6	19.4
barium	1,200	962
beryllium	0.13	0.11
boron	28.5	15.3
cadmium	0.47	0.49
chromium	10.7	12.5
cobalt	2.3	3.05
iron	10,100	17,500
lead	19.4	20.5
magnesium	653	1,640
manganese	358	161
mercury	0.045	0.024
molybdeum	0.86	0.52
potassium	5,020	3,920
selenium	1.75	1.11
silver	0.35	0.42
copper	15.4	9.51
sodium	481	677
nickel	12.1	11.5
thallium	0.037	0.041
vanadium	7.03	4.96
zinc	88.4	106

Table 4

AWD PROJECT 9301 INITIAL CHARACTERIZATION OF SOILS

PARAMETER (ug/kg)	Initial 3A-1	Initial 3A-2	Initial 3A-3	Initial 1A-1	Initial 1A-2	Initial 1A-3
chloromethane	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000
vinyl chloride	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000
bromomethane	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000
chloroethane	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000
trichlorofluoromethane	< 100	< 100	< 100	< 100	< 100	< 100
1,1-dichloroethene	< 100	< 100	< 100	< 100	< 100	< 100
methylene chloride	2700	2500	1500	2000	2400	1600
trans-1,2-dichloroethene	< 100	< 100	< 100	< 100	< 100	< 100
1,1-dichloroethane	< 100	< 100	< 100	< 100	< 100	< 100
chloroform	< 100	< 100	< 100	< 100	< 100	< 100
1,2-dichloroethane	< 100	< 100	< 100	< 100	< 100	< 100
1,1,1-trichloroethane	< 100	< 100	< 100	< 100	< 100	< 100
carbon tetrachloride	< 100	< 100	< 100	< 100	< 100	< 100
benzene	< 100	< 100	< 100	< 100	< 100	< 100
trichloroethene	100	100	200	1000	860	1700
1,2-dichloropropane	< 100	< 100	< 100	< 100	< 100	< 100
bromodichloromethane	< 100	< 100	< 100	< 100	< 100	< 100
cis-1,3-dichloropropene	< 100	< 100	< 100	< 100	< 100	< 100
trans-1,3-dichloropropene	< 100	< 100	< 100	< 100	< 100	< 100
1,1,2-trichloroethane	< 100	< 100	< 100	< 100	< 100	< 100
dibromochloromethane	< 100	< 100	< 100	< 100	< 100	< 100
bromoform	< 100	< 100	< 100	< 100	< 100	< 100
toluene	< 100	< 100	< 100	< 100	< 100	< 100
tetrachloroethene	< 100	< 100	< 100	< 100	< 100	< 200
chlorobenzene	< 100	< 100	< 100	< 100	< 100	< 100
ethylbenzene	300	300	400	< 100	< 100	< 100
m/p-xylene	< 100	< 100	< 100	< 100	< 100	< 100
o-xylene	< 100	< 100	< 100	< 100	< 100	< 100
1,1,2,2-tetrachloroethane	< 100	< 100	< 100	< 100	< 100	< 100
1,3-dichlorobenzene	< 100	< 100	< 100	< 100	< 100	< 100
1,4-dichlorobenzene	< 100	< 100	< 100	< 100	< 100	< 100
1,2-dichlorobenzene	< 100	< 100	< 100	< 100	< 100	< 100

AEROBIC SCREENING

Ten reactor cells were set-up for each process simulation and monitored simultaneously. The following configuration of reactors were run for each simulation:

Reactor #1	Abiotic Control, Representative Soil, TP3A
Reactor #2	Abiotic Control, Representative Soil, TP3A
Reactor #3	Abiotic Control, Representative Soil, TP3A
Reactor #4	Test Reactor, Representative Soil, TP3A
Reactor #5	Test Reactor, Representative Soil, TP3A
Reactor #6	Test Reactor, Representative Soil, TP3A
Reactor #7	Test Reactor, Highest Concentration Soil, TP1A
Reactor #8	Test Reactor, Highest Concentration Soil, TP1A
Reactor #9	Test Reactor, Highest Concentration Soil, TP1A
Reactor #10	Blank, No Soil

The microbial seed for degradation during the study was the indigenous microbial population found in the tested soils. No deficiencies in number for the indigenous population were found; therefore no exogenous microbial cultures were deemed necessary.

Nutrient content was adjusted in the reactor cells based on nutrient analysis of the soil as received. The pH was adjusted prior to initiation of the study.

EXPERIMENTAL PROCEDURES

BIOPILE SIMULATION

The laboratory-scale aerobic biopile treatability testing was undertaken utilizing ten borosilicate glass flask reactors approximately one (1) liter in size (see Figure 4 for equipment diagram). Apparatus is similar to that described by Glaser³. A glass aeration tube was placed in the bottom of each flask and covered with two layers of geofabric. Mixed and screened (<10 mm) soil (1000 g) was placed into the reactors. Reactors 1-6 received representative composite soil, TP3A, and Reactors 7-9 received soil with maximum contaminant concentration, TP1A. Deionized water was added to Reactors 1-3 sufficient to achieve 90% of water holding capacity along with 2.5 g mercuric chloride and 5 ml concentrated sulfuric acid per reactor. Deionized water amended with nutrients was added to Reactors 4-9. The amount of nutrient required was calculated based on contaminant and nutrient analytical results from the initial characterization. All reactors were sealed with a rubber stopper wrapped in aluminum foil and containing air inlet and outlet tubes. All tubing exposed to contaminants was glass, rubber, or teflon. Rubber tubing was used only at the end of the exit glass tubing to attach and seal the volatiles traps. Approximately 1 cm of rubber was exposed to the gas stream prior to the volatiles trap.

A continuous low air flow was supplied by compressed air filtered through an activated charcoal trap. Liquefied propane (LP) was added to the air stream to stimulate TCE degrading bacteria. The flow rate of the air was 0.1 liter per minute (lpm) based on the contaminant concentration of the representative soil. The same flow rate was used for all reactors. Air flow to the reactors passed through a water column to keep the soil moist but not saturated. The proportion of LP gas to air was 0.2% (less than 10% of the lower explosive limit (LEL)). Airflow through each reactor was monitored via flow meters. Exit air was exhausted by a vacuum pump with the flow rate from each reactor maintained at a 0.2 lpm in order to prevent volatiles loss.

The reactors were sampled at intervals listed under Intermediate Testing. Soil cores were removed using glass tubes pressed into the soil to the bottom of the reactor. Each sample consisted of 100 g and was immediately placed in glass volatile vials. Two vials were shipped to the contract analytical lab for volatiles analysis. Another was used by Bioscience for the remaining tests. The test reactors were compared to the inhibited (abiotic) controls at each sampling interval to determine if aerobic biological degradation had occurred as described by Glaser³.

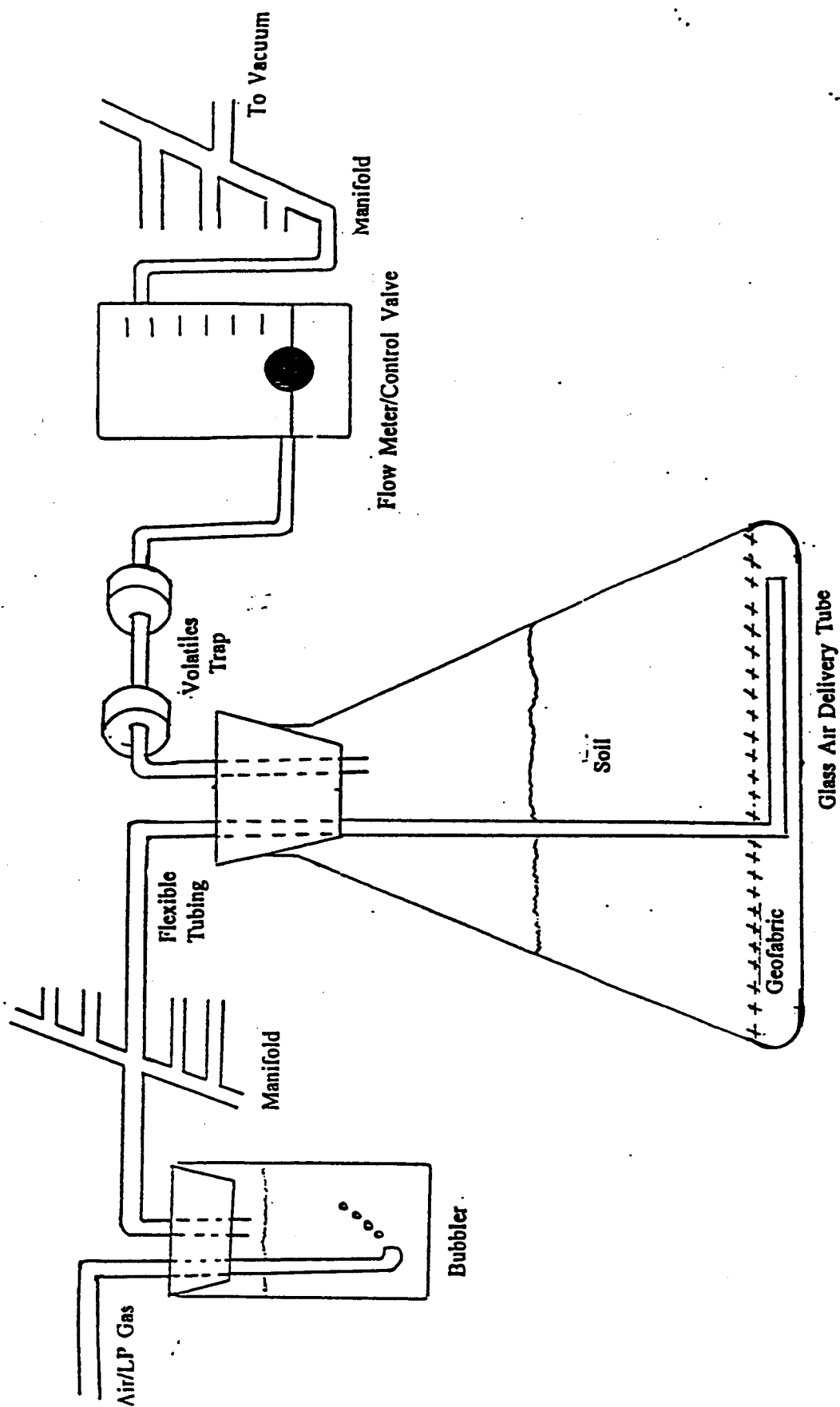


Figure 5. Biopile Simulation Apparatus

The contaminant loss due to volatilization was also evaluated by placing contaminant recovery tubes (traps) in the effluent air stream from the reactor vessels. Two traps were placed in series (to determine trapping efficiency) at each sampling interval (see Intermediate Analyses). The traps were exposed for up to 24 hours (actual exposure time reported with the analytical results), then removed, inserted into their protective containers, and shipped to the contract analytical laboratory. A flask containing no soil but otherwise identical to the soil reactors was used to determine background contaminant concentrations in the air stream. The direct measurement of volatilization is used for estimating volatile emission control requirements for the full-scale bioremediation as well as performing a mass balance on the system.

BIOSLURRY SIMULATION

The laboratory-scale aerobic bioslurry treatability testing also utilized ten glass reactors. These reactors were 10 liter capacity (see Figure 5). Soil was suspended in reagent grade deionized water. The soil:water ratio was 1:6 and was determined by preliminary tests to determine the amount which could be suspended by the mixers used. A continuous air flow (supplemented with LP gas) was bubbled through the suspension. The flow rate was the same as described for the Biopile Simulation. Bioscience, Inc. adjusted the slurry pH, then set-up abiotic control reactors and test reactors as described for the Biopile Simulation.

The reactors were sampled at intervals described under Intermediate Testing. Samples were removed with a ladle and immediately placed in centrifuge tubes. The samples were centrifuged (refrigerated) and decanted. The recovered wet soil was transferred to volatile vials, weighed, and supernatant added to obtain the soil:water ratio in the reactors. Two vials were shipped to the contract analytical lab for volatiles analysis and a third was used for in-house analyses. The test reactors were compared to the inhibited (abiotic) controls at each sampling interval point to determine if aerobic biological degradation had occurred as described previously.

The contaminant loss due to volatilization was also evaluated in this study by placing traps in the effluent air stream from the reactor vessels as described previously.

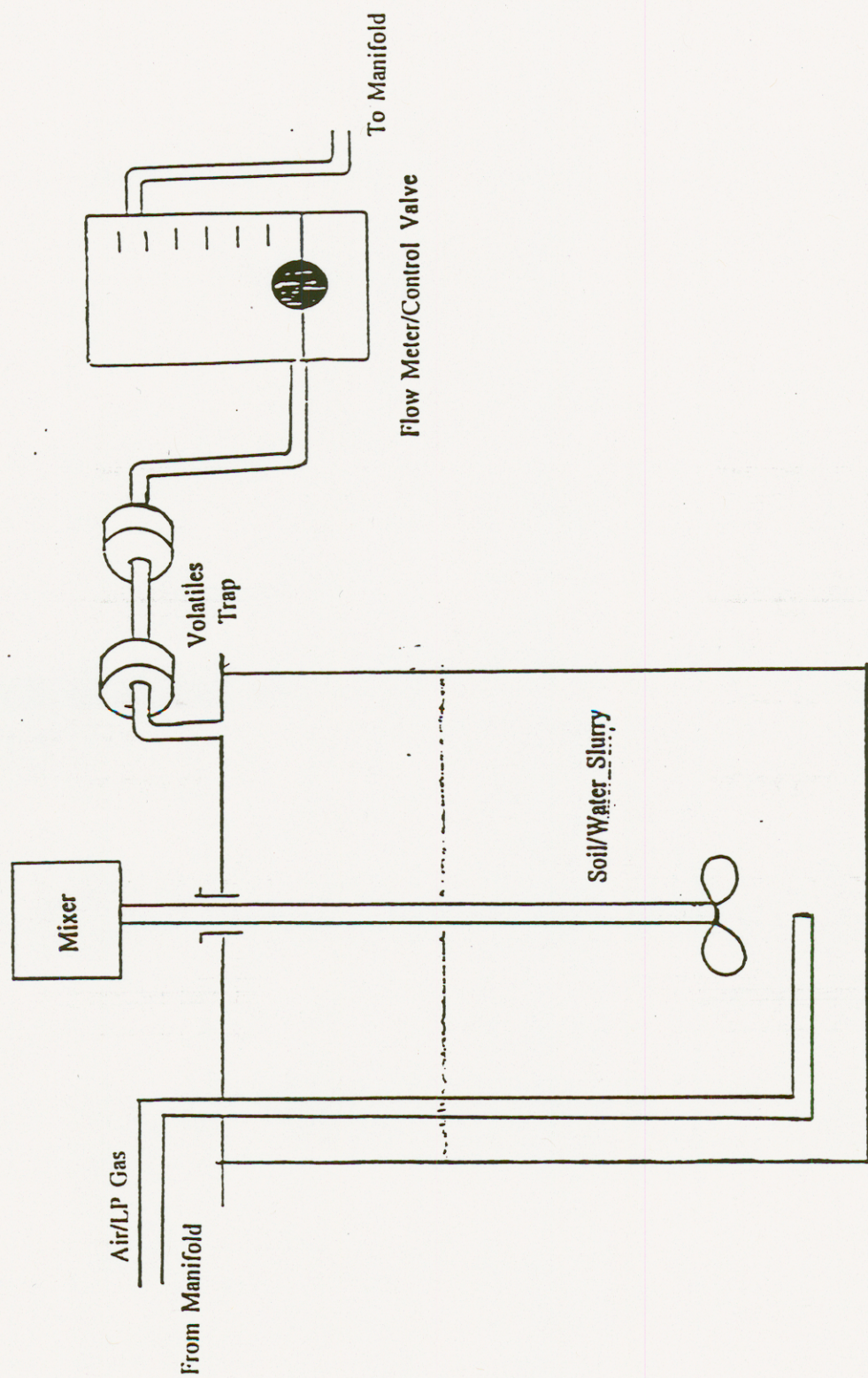


Figure 6. Bioslurry Simulation Apparatus

INTERMEDIATE ANALYSIS

The contents of each biopile reactor were analyzed after one week for chlorinated volatile organics. Subsequent volatile organic analyses were not performed due to the low concentrations of volatile organics determined in this sampling. The other monitoring analyses were performed after 7 and 13 days. The contents of each bioslurry reactor were analyzed after 3 and 7 days. Further testing was discontinued due to the low concentrations of volatile organics determined. The analyses performed at each sampling time were:

<u>Parameter</u>	<u>Method</u>
Chlorinated Volatile Organics	SW-846 8010,5030
Moisture	ASTM D2216
pH	SW-846 9045
Total Plate Count	STD. METH. 907B
Ammonia-Nitrogen	STD. METH. 417B
Nitrate-Nitrogen	STD. METH. 418C
Orthophosphate	STD. METH. 424E

Volatile emissions from each reactor were analyzed using SW-846 0030 and 5040.

Samples were taken during the first 24 hours and after 7 days for the Biopile Simulation.

Volatile emissions samples were taken during the first 24 hours and after 3 and 7 days for the Bioslurry Simulation.

Table 7

AWD PROJECT 9301 BIOPILE REACTORS 3/25/94

[illegible]

J = Indicates an estimated value. Result is less than the sample quantification limit and greater than the method detection limit.

008189

AWD PROJECT 9301 BIOPILE REACTORS AIR SAMPLING (23 hr., 3/17/94 to 3/18/94)

[illegible]

AWD PROJECT 9301 BIOPILE REACTORS AIR SAMPLING (27 hr., 3/24/94 to 3/25/94)

[illegible][illegible]

TABLE 9
BIOPILE REACTOR

03/24/94

Reactor	Moisture (% dry wt)	pH (std. units)	Total Plate Ct. (CFU/g dry wt.)	NH3-N (mg/Kg dry wt.)	NO3-N (mg/Kg dry wt.)	PO4-P (mg/Kg dry wt.)
1	21.6	2.1	<5.00E+02	58.5	7.6	96.7
2	22.8	3.2	6.14E+02	66.1	8.8	28.2
3	22.8	2.3	<5.00E+02	66.1	7.1	70.1
4	25.3	9.4	2.26E+06	66.1	18.7	33.7
5	23.3	9.6	1.17E+06	23.7	17.1	44.6
6	24.1	9.1	3.39E+07	29.1	17.3	44.3
7	26.2	8.7	4.38E+07	629.4	12.1	92.5
8	23.0	8.2	3.76E+07	948.1	10.7	106.1
9	25.9	8.9	4.01E+07	1029.1	11.6	332.7
10	na	na	na	na	na	na

TABLE 10
BIOPILE REACTOR

3/30/94

Reactor	Moisture (% dry wt.)	pH (std. units)	Total Plate Ct. (CFU/g dry wt.)	NH3-N (mg/kg dry wt.)	NO3-N (mg/kg dry wt.)	PO4-P (mg/kg dry wt.)
1	20.7	2.5	<5.00E+02	10.0	2.38	71.0
2	22.1	2.5	<5.00E+02	29.6	2.85	43.1
3	23.3	2.4	2.06E+02	29.6	2.38	58.1
4	23.3	9.0	4.71E+07	42.3	9.63	25.1
5	23.5	9.5	5.44E+06	19.2	16.41	53.2
6	24.0	9.3	1.18E+07	36.8	15.47	42.8
7	22.5	8.2	2.74E+07	397.8	5.19	106.4
8	20.8	7.4	2.03E+07	397.8	4.72	48.0
9	22.9	8.3	7.58E+06	493.9	4.72	236.9
10	na	na	na	na	na	na

Table 11

AWD PROJECT 9301 BIOSLURRY REACTORS 3/21/94

Day 3 Slurry Samples

PARAMETER (ug/kg)	SAMPLE	SAMPLE	SAMPLE	SAMPLE	SAMPLE	SAMPLE	SAMPLE	SAMPLE	SAMPLE	SAMPLE
	36741 BS-1 3A+Hg	36741 BS-2 3A+Hg	36741 BS-3 3A+Hg	36741 BS-4 3A	36741 BS-5 3A	36741 BS-6 3A	36741 BS-7 1A	36741 BS-8 1A	36741 BS-9 1A	SAMPLE Blank
chloromethane	< 10	< 10	< 10	< 100	< 100	< 100	< 100	< 100	< 100	< 10
vinyl chloride	< 10	< 10	< 10	< 100	< 100	< 100	< 100	< 100	< 100	< 10
bromomethane	< 10	< 10	< 10	< 100	< 100	< 100	< 100	< 100	< 100	< 10
chloroethane	< 10	< 10	< 10	< 100	< 100	< 100	< 100	< 100	< 100	< 10
trichlorofluoromethane	< 1	< 1	< 1	< 10	< 10	< 10	< 10	< 10	< 10	< 10
1,1-dichloroethene	< 1	< 1	< 1	< 10	< 10	< 10	< 10	< 10	< 10	< 1
methylene chloride	1	< 1	< 1	< 1	< 10	< 10	< 10	< 10	< 10	< 1
trans-1,2-dichloroethene	< 1	< 1	< 1	20	< 10	< 10	< 10	< 10	< 10	< 1
1,1-dichloroethane	< 1	< 1	< 1	< 10	< 10	< 10	< 10	< 10	< 10	< 2
chloroform	< 1	< 1	< 1	< 10	< 10	< 10	< 10	< 10	< 10	< 1
1,2-dichloroethane	< 1	< 1	< 1	< 10	< 10	< 10	< 10	< 10	< 10	< 1
1,1,1-trichloroethane	2	37	39	< 10	< 10	< 10	< 10	< 10	< 10	< 1
carbon tetrachloride	< 1	< 1	< 1	< 10	< 10	< 10	< 10	< 10	< 10	< 1
benzene	< 1	< 1	< 1	< 10	< 10	< 10	< 10	< 10	< 10	< 1
trichloroethene	2	3	3	< 10	< 10	< 10	< 10	< 10	< 10	< 1
1,2-dichloropropane	< 1	< 1	< 1	< 10	< 10	< 10	< 10	< 10	< 10	< 1
bromodichloromethane	< 1	< 1	< 1	< 10	< 10	< 10	< 10	< 10	< 10	< 1
cis-1,3-dichloropropene	< 1	< 1	< 1	< 10	< 10	< 10	< 10	< 10	< 10	< 1
trans-1,3-dichloropropene	< 1	< 1	< 1	< 10	< 10	< 10	< 10	< 10	< 10	< 1
1,1,2-trichloroethane	< 1	< 1	< 1	< 10	< 10	< 10	< 10	< 10	< 10	< 1
dibromochloromethane	< 1	< 1	< 1	< 10	< 10	< 10	< 10	< 10	< 10	< 1
bromoform	< 1	< 1	< 1	< 10	< 10	< 10	< 10	< 10	< 10	< 1
toluene	29	35	44	< 10	< 10	< 10	< 10	< 10	< 10	< 1
tetrachloroethene	< 1	< 1	< 1	< 10	< 10	< 10	< 10	< 10	< 10	< 1
chlorobenzene	37	42	48	< 10	< 10	< 10	< 10	< 10	< 10	< 1
ethylbenzene	< 1	< 1	< 1	< 10	< 10	< 10	< 10	< 10	< 10	< 1
m/p-xylene	< 1	< 1	< 1	< 10	< 10	< 10	< 10	< 10	< 10	< 1
o-xylene	< 1	< 1	< 1	< 10	< 10	< 10	< 10	< 10	< 10	< 1
1,1,2,2-tetrachloroethane	15	18	21	< 10	< 10	< 10	< 10	< 10	< 10	< 1
1,3-dichlorobenzene	< 1	< 1	< 1	< 10	< 10	< 10	< 10	< 10	< 10	< 1
1,4-dichlorobenzene	2	8	16	< 10	< 10	< 10	< 10	< 10	< 10	< 1
1,2-dichlorobenzene	< 1	< 1	< 1	120	20	10	< 10	< 10	< 10	< 1

Table 12

AWD PROJECT 9301 BIOSLURRY REACTORS 3/25/94
Day 7 Slurry Samples

PARAMETER (ug/kg)	SAMPLE 36912 CO325 BS-1	SAMPLE 36913 CO325 BS-2	SAMPLE 36914 CO325 BS-3	SAMPLE 36915 CO325 BS-4	SAMPLE 36916 CO325 BS-5	SAMPLE 36917 CO325 BS-6	SAMPLE 36918 CO325 BS-7	SAMPLE 36919 CO325 BS-8	SAMPLE 36920 CO325 BS-9	SAMPLE 36921 CO325 BS-10
chloromethane	< 20	< 20	< 20	< 1000	< 1000	< 1000	< 1000	< 20	< 20	< 10
vinyl chloride	< 20	< 20	< 20	< 1000	< 1000	< 1000	< 1000	< 20	< 20	< 10
bromomethane	< 20	< 20	< 20	< 1000	< 1000	< 1000	< 1000	< 20	< 20	< 10
chloroethane	< 20	< 20	< 20	< 1000	< 1000	< 1000	< 1000	< 20	< 20	< 10
trichlorofluoromethane	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
1,1-dichloroethane	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
methylene chloride	4	5	4	100	1100	1000	400	5	4	2
trans-1,2-dichloroethene	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
1,1-dichloroethane	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
chloroform	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
1,2-dichloroethane	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
1,1,1-trichloroethane	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
carbon tetrachloride	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
benzene	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
trichloroethene	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
1,2-dichloropropane	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
bromodichloromethane	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
cis-1,3-dichloropropene	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
trans-1,3-dichloropropene	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
1,1,2-trichloroethane	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
dibromochloromethane	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
bromoform	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
toluene	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
tetrachloroethene	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
chlorobenzene	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
ethylbenzene	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
m/p-xylene	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
o-xylene	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
1,1,2,2-tetrachloroethane	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
1,3-dichlorobenzene	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
1,4-dichlorobenzene	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1
1,2-dichlorobenzene	< 2	< 2	< 2	< 100	< 100	< 100	< 100	< 2	< 2	< 1

008194

AWD PROJECT 9301 BIOSLURRY REACTORS AIR SAMPLING (53 hr, 3/18/94 to 3/21/94)

	SAMPLE 36723 <u>BS-1</u>	SAMPLE 36724 <u>BS-2</u>	SAMPLE 36725 <u>BS-3</u>	SAMPLE 36726 <u>BS-4</u>	SAMPLE 36727 <u>BS-5</u>	SAMPLE 36728 <u>BS-6</u>	SAMPLE 36729 <u>BS-7</u>	SAMPLE 36730 <u>BS-8</u>	SAMPLE 36731 <u>BS-9</u>	SAMPLE 36732 <u>BS-10</u>
methylene chloride (mg)	< 0.01	< 0.03	< 0.01	0.06	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
nitrilobutylene (mg)	< 0.01	< 0.01	< 0.01	<	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

AWD PROJECT 9301 BIOSLURRY REACTORS AIR SAMPLING (26 hr, 3/21/94 to 3/22/94)

[illegible]

AWD PROJECT 9301 BIOSLURRY REACTORS AIR SAMPLING (26 hr, 3/25/94 to 3/26/94)

[illegible][illegible]

Table 14

BIOSLURRY REACTORS

(3/21/94)

Reactor	Dry soil/slurry (g/kg)	pH (std. units)	Total Plate Ct. (CFU/g dry wt.)	NH3-N (mg/L)	NO3-N (mg/L)	PO4-P (mg/L)
	(g/Kg)	(std. unit)	(CFU/g dry wt.)	(mg/l)	(mg/l)	(mg/l)
1	104.1	2.9	<10	NA	NA	NA
2	116.6	3.0	<10	NA	NA	NA
3	107.6	3.0	<10	NA	NA	NA
4	111.6	7.0	3.45e+08	NA	NA	NA
5	109.5	7.3	1.30e+08	NA	NA	NA
6	94.9	7.4	1.91e+08	NA	NA	NA
7	118.5	7.2	1.20e+08	NA	NA	NA
8	107.2	7.2	9.49e+07	NA	NA	NA
9	95.2	7.2	1.03e+08	NA	NA	NA
10	na	6.1	3.85e+03	NA	NA	NA

Table 15

BIOSLURRY REACTORS

(3/25/94)

Reactor	Dry soil/slurry (g/kg)	pH (std. units)	Total Plate Ct. (CFU/g dry wt.)	NH3-N (mg/L)	NO3-N (mg/L)	PO4-P (mg/L)
1	71.1	3.0	<10	6.1	<1	3.4
2	70.8	3.1	<10	5.1	<1	3.5
3	62.5	3.0	<10	5.1	<1	3.3
4	63.6	7.5	1.86e+08	2	<1	2
5	64.8	7.4	2.40e+08	1	<1	2.1
6	58.8	7.4	3.73e+08	1.2	<1	1.6
7	55.3	7.3	8.69e+08	13.8	<1	2.1
8	37.7	7.2	5.73e+08	15.5	<1	1.6
9	41.7	7.1	1.25e+08	26.9	<1	1.8
10	na	6.1	5.61e+08	0.3	<1	<0.5

008197

RESULTS AND DISCUSSION

INITIAL CHARACTERIZATION

The initial characterization data presented in Tables 1-3 is generally favorable for bioremediation. All samples received were very moist ranging from 18.5 to 25.3% water. The moisture holding capacity (FMC) results varied widely among the samples. TP1A had an FMC about 25%, while the comparable MS-1 was measured at about 42%. The 42% value is extremely high for the soil texture observed and the 25% value was used for adjusting soil moisture. TP3A and the corresponding MS-2 were determined to have similar FMC values of 12-14%. Since both soils had moisture levels (as received) of 20-25% and no free liquid drainage was observed on standing, 25% was used as the FMC for this soil as well. Thus biopile simulation reactors were adjusted to 90% of FMC or 22.5% moisture.

Particle distribution data (Table 2) were obtained for samples MS-1 and MS-2 only. The results indicate both soils are gravelly sand with very low fine particle content. TP3A and TP1A both exhibited hand texture suggestive of higher fines content and low gravel content. In addition, the contents of the bioslurry reactors at the end of the study, after stirring was terminated, maintained a substantial amount of soil in suspension indicative of a higher fine particle content. The organic carbon content was high enough to modify the soil properties such that "clayey" texture and water holding capacity were higher than typical for this soil texture class.

The organic carbon content (see Table 1) was 0.7% and 0.4% for TP1A and TP3A, respectively, as measured by Total Organic Carbon, TOC, (SW-846 method 9060). Carbon is typically 45 to 55% of the total organic matter by weight. Thus total organic matter in the soil is estimated at 1.4% and 0.8% for the two samples. The TOC values are higher than is typical for deep sand subsoils which is consistent with the identification of organic contamination.

The pH of all soil samples was less than 7 with TP3A (and MS-2) below pH 6. Lime was added to all soils to attain a pH above 7.

All samples contained low but significant phosphate concentrations between 10 and 30 mg/kg. TP1A (and MS-1) contained a high concentration of ammonium nitrogen of about 400 mg/kg. TP3A and

(MS-1) contained less than 20 mg/kg ammonium nitrogen and ammonium nutrient was added to this soil. None of the soil samples contained significant nitrate nitrogen.

Total microbial counts in all samples were determined to be adequate and within the normal range for subsoils. TP1A had the lowest count (4×10^4 cfu/g) and TP3A had the highest (1×10^7 cfu/g). The original samples, MS-1 and MS-2, had intermediate counts.

Conductivity indicated that soluble salts were not excessive; in fact, TP3A had an extremely low conductivity indicating a very low soluble salt content in the soil solution.

Metals analyses performed on the original soil samples, MS-1 and MS-2 (see Table 5), showed no metals likely to cause inhibition of the microbial population. Barium was present at high concentrations for this element and is of concern from a regulatory standpoint, but it is not likely to impact microbial activity.

The volatile organic analyses for each soil were performed in triplicate. The average MEC concentrations for TP3A and TP1A were 2230 ug/kg and 2000 ug/kg, respectively. The standard deviations were 640 ug/kg (RSD=29%) and 400 ug/kg (RSD=20%), respectively. The average TCE concentrations were 130 ug/kg and 1190 ug/kg, with standard deviations of 58 ug/kg (RSD=45%) and 450 ug/kg (RSD=38%), respectively. Ethylbenzene was also detected in TP3A (330 ug/kg average) and toluene was detected in TP1A (100 ug/kg average). Volatile organic scans performed by a different laboratory showed MEC and TCE values ranging over 3 orders of magnitude between replicates. These results were discounted because they did not agree with independent analyses by an AWD contracted laboratory and the subsequent re-analysis by Benchmark Analytics.

BIOPILE SIMULATION

Results of the volatile organics analysis are presented in Table 7. Both MEC and TCE were reduced to below or near quantitation limits in nearly all samples. The remaining MEC was less than 10% of the original concentration in all reactors including the killed controls. Results for MEC are not significantly lower (or significantly different by Student's t testing at the 90% confidence level) in the biologically treated reactors compared to the killed controls. (Nondetected compounds were treated as present at 1/2 the quantitation limit for statistical analyses.) The average concentration in the killed

controls was 40 ug/kg (SD=17) while the average for biologically treated soil TP3A was 113 ug/kg (SD=76) and for soil TP1A was 47 ug/kg (SD=29).

Results for TCE are suggestive of biological TCE removal. The TCE results were not significantly different (at the 90% confidence level by Student's t test) between killed controls and biologically treated soil TP3A. Approximately 56% of the original TCE concentration was lost in the killed controls versus 73% in the biologically treated TP3A soil. Because of the much higher initial concentration of TCE in soil TP1A, the removal of 96% of the TCE in the biologically treated reactors compared to removal of 56% in the controls approaches significance at the 80% confidence level. In addition, the removal from soil TP1A also meets the 20% in excess of the control criterion².

Ethylbenzene was detected in two of the killed controls and xylene was detected in one killed control. Trichlorofluoromethane was detected in one killed control and one biologically treated TP3A reactor. No other compounds were detected. No statistical inferences can be drawn from this data. However, the absence of toluene in TP1A and the presence of ethylbenzene in two killed controls but not in the biologically treated soil is suggestive of biodegradation.

Volatile emissions from the reactors showed extremely variable results. Biopile reactors contained 1 kg of soil, therefore each reactor contained about 2 mg MEC initially. Reactors containing soil TP3A contained only 0.13 mg TCE while reactors with TP1A contained 1.2 mg initially. The loss of MEC through volatilization is confirmed from the amount of MEC recovered in the volatiles traps (see Table 8). Average recovery from the killed controls was 0.32 mg for the initial 24 hours while averages for the biologically treated soils were 0.10 mg (TP3A) and 0.33 mg (TP1A). As MEC was found in the back section of the trap indicating breakthrough and thus incomplete trapping for reactors 2,3,6,7, and 8, these results are low estimates of the MEC volatilized. Thus, over a 7 day period, loss of 2 mg MEC is reasonable.

No TCE was recovered in the volatile traps from any reactor. TCE was collected in the groundwater study¹ under similar conditions with higher MEC loadings and no breakthrough. TCE volatilization may have been occurring at a rate too low to be detected in the TP3A soil reactors due to the low initial concentration (total loss was only 0.07 mg over 7 days for the killed controls). However, in soil TP1A over 1.1 mg per reactor was lost over 7 days. Therefore, significant volatilization should have been detectable unless the TCE was biodegraded rather than volatilized. This data thus supports the

conclusion that TCE was significantly biodegraded.

Moisture levels (see Tables 9 and 10) were maintained near the target level of 22.5%. The pH was less than 3.5 for the killed controls over the course of the experiment to minimize biological activity. The pH of biologically treated soils rose to between 7.4 and 8.9 (TP1A) or between 9.0 and 9.6 (TP3A) as a result of lime addition and biological activity. The pH also tended to rise in the companion groundwater study¹. However, no significant correlation existed between total microbial count and the pH.

Microbial counts for TP3A were similar to the initial characterization values while counts for TP1A were increased two to three orders of magnitude. The average count for TP1A was an order of magnitude higher than for TP3A after 7 days but was equal after 13 days. Counts for the killed controls were less than 1000 cfu/g which is sufficiently low to ensure that biological degradation in the controls was insignificant.

Adequate nutrients were present in all reactors. Initially high ammonia concentrations in TP1A were gradually reduced over the two week incubation.

BIOSLURRY SIMULATION

Results of volatile organic analysis of bioslurry simulation samples are presented in Tables 11 and 12. Both MEC and TCE were completely gone after 3 days. Two killed controls were reported to contain 1 ug/kg MEC and one TP3A biologically treated reactor was reported to contain 20 ug/kg MEC. All other results for these compounds were below detection limit. Thus there could be no significant comparison between killed controls and the biologically treated soils. Concentrations of MEC reported at or near the detection limit were not deemed significant as traces of MEC were found in the method blank. All results are reported as ug compound per kg of slurry, not on a dry weight of soil basis. Thus, calculated initial concentrations for MEC are 319 ug/kg (TP3A) and 286 ug/kg (TP1A) and for TCE are 19 ug/kg (TP3A) and 170 ug/kg (TP1A) on a slurry basis.

It should be noted, however, that 1,2-dichloroethane, chlorobenzene, and 1,1,2,2-tetrachloroethane were all detected in the killed controls (average values in ug/kg were 26, 42, and 18, respectively) but were not detected in the biologically treated soils (detection limit = 10 ug/kg for each compound). Thus

biological degradation of chlorinated compounds was indicated. In addition, toluene was found in the killed controls (average concentration was 36 ug/kg) but not in the biologically treated TP3A soil. Toluene was detected in two of the TP1A samples (average concentration was 25 ug/kg). Traces of benzene were detected in the killed controls but at a level below the detection limit for the biologically treated soils. All TP3A samples also contained 1,4-dichlorobenzene.

Volatile trap data is presented in Table 13. Recovery of MEC was sporadic with only two detectable quantities recovered (reactors 2 and 4) over the first two days and six detectable quantities (reactors 1,3,4,6,8, and 9) on the third day. A significant amount of MEC was reported in the blank for the day 3 samples. No TCE was recovered from any reactor.

Each reactor contained 1 kg of soil, thus the total quantities of MEC and TCE were the same, per reactor, as in the biopile simulation. Therefore, similar amounts of volatiles should have been recovered. Two possible reasons for sporadic recoveries may be noted. Covers for the bioslurry reactors (6 mm PVC plastic with Teflon film on the reactor side) warped and created a gap between the cover and the glass container. Although vacuum flow rates were twice the aeration rate in order to maintain a net inflow of "leakage" air to the reactors, some loss of volatiles was possible from this source. The other reason is the possible entry of water into the traps. The air entering the traps was near saturation for both simulations, but the bioslurry reactors were vigorously agitated as well as aerated through the liquid. Entrainment of liquid in the airstream may have sporadically affected recovery. None of the traps showed visible moisture, however. At least two of the results (reactors 3 and 8, day 3 sampling) are high enough to support the conclusion that MEC loss was due to volatilization.

The failure to recover TCE is due in part to the low concentration in the TP3A soil. However, low trapping efficiency due to the reasons described above may also be responsible, as loss from the killed controls must have exceeded 0.04 mg/day in order to completely disappear in three days. Biodegradation may have contributed to the failure to recover TCE from soil TP1A as discussed for the biopile simulation.

In conjunction with the biopile simulation data and the groundwater data from the companion study¹, the above data was considered sufficient to rule out bioslurry treatment of site soils due to the rapid nonbiological loss of target compounds in a time frame that will not support biological adaptation and

growth.

Monitoring data for the bioslurry simulation is presented in Tables 14 and 15. The pH of killed controls was maintained at about 3 pH units while biological reactors were maintained between 7.0 and 7.5. Control of pH was easier to maintain in the well mixed bioslurry reactors than in the solid phase biopile reactors.

Total microbial count data indicated nondetectable microbial content in the killed controls and significant stimulation of microbial content of both soils in the biological reactors. All biological reactors had similar counts in range of the 100 million bacteria per g of soil. These counts indicate a substantial growth of the biomass with an increase of one order of magnitude for TP3A and four orders of magnitude for TP1A.

Nutrients were analyzed after 7 days. Both ammonium-nitrogen and soluble phosphate were present in all reactors. Significant nitrogen and phosphorus utilization was apparent for both soils. These data show that these nutrients were not growth limiting in this experiment and that significant microbial growth and substrate degradation were occurring.

CONCLUSIONS

The results of the present study (as well as the results of the companion groundwater study¹) support the following conclusions:

1. Soil characteristics in general are suitable for bioremediation.
2. Microbial degradation of both chlorinated and nonchlorinated contaminants was observed in the biopile simulation.
3. Evidence for TCE biodegradation in the biopile simulation was suggestive but not conclusive.
4. No evidence of MEC biodegradation was obtained in either process simulation.
5. Volatilization of MEC and TCE were major loss mechanisms. MEC was completely volatilized in 3 days (bioslurry) to 7 days (biopile).

Neither the biopile process nor the bioslurry process can be recommended for treatment of the Longhorn Army Ammunition Plant site soils. MEC is the major problem for biological treatment. This compound volatilized rapidly and the microbial population present in the soil either contained few organisms capable of MEC degradation or the capable organisms degraded other available compounds preferentially. Other studies^{4,5} have shown that MEC degrading bacteria are somewhat difficult to grow and adapt in mixed cultures and that the ability to degrade MEC is easily lost (in the absence of MEC) or suppressed (in the presence of other biodegradable compounds). The results presented here are consistent with these findings.

REFERENCES

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- ⁴ Klecka, Gary M. Fate and Effects of Methylene Chloride in Activated Sludge. Appl. and Environ. Microbiol. 44:701-707. 1982.
- ⁵ Stucki, Gerhard. Biological Decomposition of Dichloromethane from a Chemical Process Effluent. Biodegradation 1:221-228. 1990.

APPENDIX A

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APPENDIX B

APPENDIX A. CHAIN OF CUSTODY FORMS

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LMAF/SS/EM/27JAN92

Relinquished by		Received by		Date		Time	
				Dec 4/93		9:15	
		130 9743647635 DEC 93					

CUSTODY RECORD

* Containers: () = Wide Mouth Glass Jars w/Teflon Liner.

TERMINAL UTILITY UTILIZATION	MTAL STAG, L. 247702						

PARAMETERS SAMPLED

bars	(2)	each	Sample No. (s)	Total #	Chest #	C/Seal #
	MS-1			1	3	

CONTAINERS 5 GALLON BUCKET

Project: Longhorn AAP Proj/Engr:	Site: 18+24	Boxing: TEST PIT #1	Sample depths: 3 to 9	Start: 3 DEC 93 1305	to 3 DEC 93 1305
Ext:					

U.S. Army Corps of Engineers
Tulsa District, Tulsa, OKla.

SOIL SAMPLE
CHAIN OF CUSTODY

MIRP #	SWD LAB #	Chest #	C/Seal	Temp.

This form must accompany samples until received by laboratory sample custodian. Attach bill of lading if shipped by Common Carrier.

Client: AWD Containers Prepped By: Hean Date: 12/17/93
 Project: AWD Samples Collected By: RDB/IVF Date: 12/15/93
 Proj. No.: AWD 9301 Sampler Affiliation: Bioscience Inc.

-----Sample Container Description-----

Enter number of containers of each type in table.	BACTERIOL.	NUTRIENTS	METALS	ORGANICS	VOC	SEMI-VOL	OTHER	TOTAL NO. CONTAINERS	Comments
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

Cont. Prep Hean Date: 12/17/93 Time: _____ Seal No: _____
 Cooler sealed? Y N

Presampling custody Bioscience From Date: 12/14/93 Time: 9:15 AM
 Seals intact when relinquished? ☒ N To Date: 12/15/93 Time: 2:50 PM

Sample Collector: RDB/IVF From Date: 12/15/93 Time: 2:30
 Samples sealed? ☒ N Cooler sealed? ☒ N To Date: 12/15/93 Time: 4:30

Transferred to: J. H. Stank Date: 12/16/93 Time: 11:30 AM
 Affiliation: Hean

Transferred to: _____ Date: _____ Time: _____
 Affiliation: _____

Laboratory Sample Receipt Record

Rec'd By: _____
 Lab sample custodian

Date: _____ Time: _____

Cooler seal intact? Y N
 Sample seals intact? Y N

CHAIN-OF-CUSTODY RECORD

This form must accompany samples until received by laboratory sample custodian. Attach bill of lading if shipped by Common Carrier.

Client: AWD Containers Prepped By: Hess Date: 12/17/93
 Project: AWD Samples Collected By: RDB Date: 12/19/93
 Proj. No. AWD 9301 Sampler Affiliation: _____

Enter number of containers of each type in table.		-----Sample Container Description-----							TOTAL NO.
Sample #	Sample ID	BACTERIOL.	NUTRIENTS	METALS	ORGANICS	VOC	SEMI-VOL	OTHER	CONTAINERS
1	8010 H51a							Soil	1
2	b							S	1
3	c							S	1
4	H52a							S	1
5	b							S	1
6	c							S	1
7	Field Blank							S	1
8								d H2O	1
9									
10									

Cont. Prep Hess Date: 12/15/93 Time: NA
 Cooler sealed? Y N Seal No: _____

Presampling custody Bioscience From Date: 12/19/93 Time: 8:15 AM
 Seals Intact when relinquished? Y N To Date: 12/19/93 Time: 2:50 PM

Sample Collector: RDB/JVF From Date: 12/19/93 Time: 2:30
 Samples sealed? Y N Cooler sealed? Y N To Date: 12/19/93 Time: 4:30

X Transferred to: Hess - JVF Date: 12/10/93 Time: 10:35 AM
 Affiliation: Hess

Transferred to: _____ Date: _____ Time: _____
 Affiliation: _____

Laboratory Sample Receipt Record

Rec'd By: _____
 Lab sample custodian

Date: _____ Time: _____

Cooler seal Intact? Y N
 Sample seals Intact? Y N

008212

CHAIN-OF-CUSTODY RECORD

This form must accompany samples until received by laboratory sample custodian. Attach bill of lading if shipped by Common Carrier.

Client: AWD Containers Prepped By: Hess Date: 12/23/93
 Project: AWD 3302 Samples Collected By: RDB/JVF Date: 12/28/93
 Proj.No. Sampler Affiliation: BUSINESS

-----Sample Container Description-----									
Enter number of containers of each type in table.	BACTERIOL.	NUTRIENTS	METALS	ORGANICS	VOC	SEMI-VOL	OTHER	TOTAL NO.	CONTAINERS Comments
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

Cont. Prep Hess Date: 12/23/93 Time:
 Cooler sealed? ☒ Y ☐ N Seal No: NA

Presampling custody YMT
 Seals Intact when relinquished? ☒ Y ☐ N
 From Date: 12/19/93 Time: 10:50AM
 To Date: 12/28/93 Time: 4:45PM

Sample Collector: RDB/JVF
 Samples sealed? ☒ Y ☐ N Cooler sealed? ☒ Y ☐ N
 From Date: 12/28/93 Time: 4:45PM
 To Date: 12/29/93 Time: 10:00AM

Transferred to: James
 Affiliation: Hess
 Date: 12/29/93 Time: 1246

Transferred to:
 Affiliation:
 Date: Time:

Laboratory Sample Receipt Record

Rec'd By:
 lab sample custodian
 Date: Time:
 Cooler seal intact? ☐ Y ☐ N
 Sample seals intact? ☐ Y ☐ N

Remarks: **CONTACT: AMINAH BOY ONK**
AWD TECHNOLOGIES INC.
45204 PARKWAY DRIVE SUITE 200
ROCKVILLE MD 20850
301 710 2000

CHAIN-OF-CUSTODY RECORD

This form must accompany samples until received by laboratory sample custodian. Attach bill of lading if shipped by Common Carrier.

Client: AND Containers Prepared By: Hess Date: 2/1/94
 Project: AND 9301 Samples Collected By: RDB/JVF Date: 2/3/94
 Sampler Affiliation: Bioscience, Inc.

Smpl #	Sample ID	Sample Container Description										TOTAL NO.
		BACTERIOL.	NUTRIENTS	METALS	ORGANICS	VOC	SEMI-VOL	OTHER	CONTAINERS	Comments		
1	8240-Test Pit 1A-a											1
2	-b											1
3												1
4	Test Pit 3A-a											1
5	-b											1
6	-c											1
7	Field Blank											1
8												1
9												1
10												1

Cont. Prep Hess Date: 2/1/94 Time: _____ Seal No: _____
 Cooler sealed? Y N

Presampling custody Bioscience From Date: 1/26/94 Time: 11:30 AM
 Seals intact when relinquished? Y N To Date: 2/3/94 Time: 11:30 AM

Sample Collector: RDB/JVF From Date: 2/3/94 Time: 11:30 AM
 Samples sealed? Y N Cooler sealed? Y N To Date: 2/4/94 Time: 11:00 AM

Transferred to: Brian K. Berry Date: 2/4/94 Time: 13:05
 Affiliation: Hess

Transferred to: _____ Date: _____ Time: _____
 Affiliation: _____

Laboratory Sample Receipt Record

Rec'd By: _____
 lab sample custodian

Date: _____ Time: _____

Cooler seal intact? Y N

Sample seals intact? Y N

CHAIN-OF-CUSTODY RECORD

This form must accompany samples until received by laboratory sample custodian. Attach bill of lading if shipped by Common Carrier.

Client: AWD
 Project: AWD9301
 Proj.No. AWD9301

Containers Prepared By: Hess
 Samples Collected By: RDB/JVF
 Sampler Affiliation: Bioscience, Inc.

Date: 2/1/94
 Date: 2/3/94

-----Sample Container Description-----										TOTAL NO.	
Smpl #	Sample ID	BACTERIOL.	NUTRIENTS	METALS	ORGANICS	VOC	SEMI-VOL	OTHER	CONTAINERS	Comments	
1	5030/8010-Test Pit 1A-a									Soil	1
2	-b									Soil	1
3	-c									Soil	1
4	Test Pit 3A-a									Soil	1
5	-b									Soil	1
6	-c									Soil	1
7	Field Blank									at 40	1
8											
9											
10											

Cont. Prep Hess Date: 2/1/94 Time: _____
 Cooler sealed? Y N Seal No: _____

Presampling custody Bioscience From Date: 1/26/94 Time: 11:30AM
 Seals intact when relinquished? Y N To Date: 2/3/94 Time: 11:30AM

Sample Collector: RDB/JVF From Date: 2/3/94 Time: 11:30AM
 Samples sealed? Y N Cooler sealed? Y N To Date: 2/4/94 Time: 10:00AM

Transferred to: Bruce K. Burgel Date: 2/4/94 Time: 13:05
 Affiliation: Hess

Transferred to: _____ Date: _____ Time: _____
 Affiliation: _____

Laboratory Sample Receipt Record

Rec'd By: _____
 lab sample custodian

Date: _____ Time: _____

Cooler seal intact? Y N
 Sample seals intact? Y N

CHAIN-OF-CUSTODY RECORD

This form must accompany samples until received by laboratory sample custodian. Attach bill of lading if shipped by Common Carrier.

Client: AWD
 Project: AWD 9301
 Proj. No. AWD 9301

Containers Prepared By: Hess
 Samples Collected By: RDB/JVF
 Sampler Affiliation: Bioscience, Inc.

Date: 2/1/94
 Date: 2/3/94

-----Sample Container Description-----									
Enter number of containers of each type in table.									
Smpl #	Sample ID	BACTERIOL.	NUTRIENTS	METALS	ORGANICS	VOC	SEMI-VOL	OTHER	TOTAL NO.
1	TOC Test Pit 1A							5011	1
2	Test Pit 3A							5011	1
3	field Blank							1150	1
4									
5									
6									
7									
8									
9									
10									

Cont. Prep Hess Date: 2/1/94 Time: _____
 Cooler sealed? Y N Seal No: _____

Presampling custody Bioscience From Date: 2/26/94 Time: 11:30 AM
 Seals intact when relinquished? Y N To Date: 2/3/94 Time: 11:30 AM

Sample Collector: RDB/JVF From Date: 2/3/94 Time: 11:30 AM
 Samples sealed? Y N Cooler sealed? Y N To Date: 2/4/94 Time: 10:00 AM

Transferred to: Bruce K. Berg Date: 2/4/94 Time: 13:05
 Affiliation: _____

Transferred to: _____ Date: _____ Time: _____
 Affiliation: _____

Laboratory Sample Receipt Record

Rec'd By: _____
 lab sample custodian

Date: _____ Time: _____

Cooler seal intact? Y N
 Sample seals intact? Y N

CHAIN OF CUSTODY RECORD

40

[illegible]

Benchmark Analytics
1776 MAIN STREET
HELLERTOWN, PA 18055
PHONE (215) 974-8100

1776 MAIN STREET
HELLERTOWN, PA 18055

Relinquished by: (Sig.) [Signature]	Date: 3/28/94	Time: 4:28	Received by: (Sig.) [Signature]	Date:	Time:	Relinquished by: (Sig.)	Date:	Time:	Received by: (Sig.)
Relinquished by: (Sig.)			Received by: (Sig.)	Date:	Time:	Relinquished by: (Sig.)	Date:	Time:	Received by: (Sig.)
Relinquished by: (Sig.)			Received for Laboratory by: (Sig.) [Signature]	Date: 3/28/94	Time: 4:28	Remarks			

[illegible]

6138

Client: Bioscience Inc		Project Number: A1UD 9301		Project Name: A1UD			
Task Number:		Task Name:		Remarks			
Samplers Signature: [Signature]		Date: 3/25/94		No. of Containers			
Site Number	Date	Time	G	C	Sample Identification	Site Description	
NA	3/25/94	12:00 PM			V0324 B P1-1		
					" 1-2		
					" 2-1		
					" 2-2		
					" 3-1		
					" 3-2		
					" 4-1		
					" 4-2		
					" 5-1		
					" 5-2		
					" 6-1		
					" 6-2		
					" 7-1		
					" 7-2		
Relinquished by: [Signature]		Date: 3/28/94	Time: 4:29	Received by: [Signature]		Date: 3/28/94	Time: 4:29
Relinquished by: [Signature]		Date:	Time:	Received by: [Signature]		Date:	Time:
Relinquished by: [Signature]		Date:	Time:	Received for Laboratory by: [Signature]		Date:	Time:

~~008221~~

6154

CHAIN OF CUSTODY RECORD

[illegible]

008222

Benchmark Analytics

1776 MAIN STREET
HELLERTOWN, PA 18055
PHONE (215) 974-8100

CHAIN OF CUSTODY RECORD

6137

[illegible]

Benchark Analytics
1776 MAIN STREET
HELLERTOWN, PA 18055
PHONE (215) 974-8100

CHAIN OF CUSTODY RECORD

6142

Client: <u>BioScience</u>		Project Number: <u>AWD 9301</u>		Project Name: <u>AWD 9301</u>		
Task Number: <u>37038</u>		Task Name: <u>6:00pm 3/26/94</u>		Remarks		
Samplers Signature: <u>Jeffrey W. Isaac</u>						
Site Number	Date	Time	G	C	Sample Identification	Site Description
NA	3/26/94				V0325-B51-1, 1-2	
					V0325-B52-1, 2-2	
					V0325-B53-1, 3-2	
					V0325-B54-1, 4-2	
					V0325-B55-1, 5-2	
					V0325-B56-1, 6-2	
					V0325-B57-1, 7-2	
					V0325-B58-1, 8-2	
					V0325-B59-1, 9-2	
					V0325-B510-1, 10-2	
Relinquished by: (Sig.) <u>[Signature]</u> Date: <u>3/28/94</u> Time: <u>4:29</u> Received by: (Sig.) <u>[Signature]</u> Date: <u>3/28/94</u> Time: <u>4:29</u>						
Relinquished by: (Sig.) <u>[Signature]</u> Date: <u>3/28/94</u> Time: <u>4:29</u> Received by: (Sig.) <u>[Signature]</u> Date: <u>3/28/94</u> Time: <u>4:29</u>						
Relinquished by: (Sig.) <u>[Signature]</u> Date: <u>3/28/94</u> Time: <u>4:29</u> Received by: (Sig.) <u>[Signature]</u> Date: <u>3/28/94</u> Time: <u>4:29</u>						

008226

1776 MAIN STREET
HELLERTOWN, PA 18055
PHONE (215) 974-8100

CHAIN OF CUSTODY RECORD

6143

Client:

Biosciences

Task Number:	Task Name:

Project Number:	9301	Project Name:
-----------------	------	---------------

Product Number: 730
A WG ~~9400~~

Project Name:

Name: AUG

Samplers Signature:

Yvonne M. Isard

Site Number	Date	Time	G	C	Sample Identification	Site Description
	4/21/94	3:00pm			20421BS-1 20421B	
					20421BS-2	
					3	
					4	
					5	
					6	
					7	
					8	
					9	
					10	

Relinquished by (Sig.)

Received by: (Sig.)

Date: _____ Time: _____

Relinquished by: (Sig.)

Received by: (Sig.)

Date: Time:

Relinquished by: (Sig.)

Received for Laboratory by: (Sig.)

Date: , Time:

Relinquished by: (Sig.)

Date: _____ Time: _____

Received by: (Sig.)

Relinquished by: (Sig.)

Date: _____ Time: _____

Received by: (Sig.)

Date:	Time:	Re:
-------	-------	-----

1

Date:	Time:	Remarks
-------	-------	---------

1

008227

Benchmark Analytics
1776 MAIN STREET
HELLERTOWN, PA 18055
PHONE (215) 974-8100

CHAIN OF CUSTODY RECORD

6151

Client: Bioscience				Project Number: KWD 9301				Project Name:			
Task Number:				Task Name:				Remarks			
Samplers Signature: <i>Jay M. Isaac</i>											
Site Number	Date	Time	G	C	Sample Identification	Site Description	No. of Containers	Remarks			
	4/1/94	2:45pm			V0421 BS-1-1	38173	1	Volatile emissions			
					1-2	38174	1	SID #4 to 0030/5040			
					2-1	38175	1				
					2-2	38176	1				
					3-1	38177	1				
					3-2	38178	1				
					4-1	38179	1				
					4-2	38180	1				
					5-1	38181	1				
					5-2	38182	1				
					6-1	38183	1				
					6-2	38184	1				
					7-1	38185	1				
					7-2	38186	1				
					8-1	38187	1				
					8-2	38188	1				
					9-1	38189	1				
					9-2	38190	1				
					10-1	38191	1				
					10-2	38192	1				
Relinquished by: (Sig.) <i>[Signature]</i>								Date: 4/25/94		Time: 8:16	
Relinquished by: (Sig.) <i>[Signature]</i>								Date: 4/25/94		Time: 8:16	
Relinquished by: (Sig.) <i>[Signature]</i>								Date: 4/25/94		Time: 8:16	

008230

APPENDIX B. ANALYTICAL REPORTS

INITIAL CHARACTERIZATION

Report to : AWD Technologies
Rockville, MD 20850

Bill to: AWD Technologies
Rockville, MD 20850

Attn: Mr. Amine Bou Onk

Attn: Mr. Amine Bou Onk

Date: January 25, 1994

BI project # AWD 9301

Sample Source: Army Corps Project

AWD project # 9301

Sample collected: 1/25/94 by Chris Edgmon, AWD

Site Location: Texas

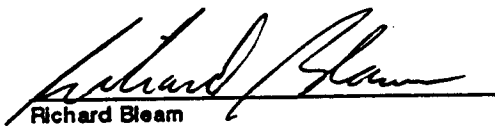
Sample delivered
to Bioscience: 1/26/94 received by John V. Forsyth III

Sample preparation: Soil samples in five gallon containers labeled TP1A and TP3A.

ANALYTICAL RESULTS

<u>Test</u>	<u>Sample ID.</u>	<u>Result</u>	<u>Method No.</u>
Particle Size			
Gravel (Passing 3-in. and retained on No. 4 Sieve)	TP3A	42.7 %	ASTM D422
Sand			
A. Coarse Sand (Passing No.4 Sieve and retained on No. 10 Sieve)	TP3A	31.9 %	ASTM D422
B. Medium Sand (Passing No.10 Sieve and retained on No. 40 Sieve)	TP3A	16.4 %	ASTM D422
C. Fine Sand (Passing No. 40 Sieve and retained on No. 200 Sieve)	TP3A	8.8 %	ASTM D422
Silt Size (0.074 to 0.005 mm)	TP3A	0.2 %	ASTM D422
Clay Size (0.005 to 0.001 mm)	TP3A	< 0.1 %	ASTM D422
Colloids (less than 0.001 mm)	TP3A	< 0.1 %	ASTM D422

Approved by:


Richard Bleam
Director of Technical Service
Bioscience Inc.

2/11/94
Date:

008234

Report to : AWD Technologies
Rockville, MD 20850
Attn: Mr. Amine Bou Onk

Bill to: AWD Technologies
Rockville, MD 20850
Attn: Mr. Amine Bou Onk

Date: January 25, 1994 BI project # AWD 9301
Sample Source: Army Corps Project AWD project # 9301
Sample collected: 1/25/94 by Chris Edgmon, AWD Site Location: Texas
Sample delivered to Bioscience: 1/26/94 received by John V. Forsyth III
Sample preparation: Soil samples in five gallon containers labeled TP1A and TP3A.

ANALYTICAL RESULTS

<u>Test</u>	<u>Sample ID.</u>	<u>Result</u>	<u>Method No.</u>
Particle Size			
Gravel (Passing 3-in. and retained on No. 4 Sieve)	TP1A	25.8 %	ASTM D422
Sand			
A. Coarse Sand (Passing No.4 Sieve and retained on No. 10 Sieve)	TP1A	38.2 %	ASTM D422
B. Medium Sand (Passing No.10 Sieve and retained on No. 40 Sieve)	TP1A	21.6 %	ASTM D422
C. Fine Sand (Passing No. 40 Sieve and retained on No. 200 Sieve)	TP1A	12.7 %	ASTM D422
Silt Size (0.074 to 0.005 mm)	TP1A	1.2 %	ASTM D422
Clay Size (0.005 to 0.001 mm)	TP1A	0.5 %	ASTM D422
Colloids (less than 0.001 mm)	TP1A	< 0.1 %	ASTM D422

Approved by:


Richard Bleam
Director of Technical Service
Bioscience Inc.

2/10/94
Date:

Report to : AWD Technologies
Rockville, MD 20850

Attn: Mr. Amine Bou Onk

Bill to: AWD Technologies
Rockville, MD 20850

Attn: Mr. Amine Bou Onk

Date: January 25, 1994 BI project # AWD 9301
Sample Source: Army Corps Project AWD project # 9301
Sample collected: 1/25/94 by Chris Edgmon, AWD Site Location: Texas
Sample delivered to Bioscience: 1/26/94 received by John V. Forsyth III
Sample preparation: Soil samples in five gallon containers labeled TP1A and TP3A.

ANALYTICAL RESULTS

Test	Sample ID.	Result	Method No.
Available Nutrient			
Ammonium-N	TP3A	19 mg/kg	STD. METH. 417F
Nitrate	TP3A	< 2.5 mg/kg	STD. METH. 418C
Orthophosphate	TP3A	14 mg/kg	STD. METH. 424E
Total Bacterial Plate Count	TP3A	1.4E+07 cfu/g	STD. METH. 907B
Total Moisture	TP3A	21.63 %	ASTM D2216-80
Percent Dry Weight			
pH	TP3A	4.6	SW-846-9045
Specific Conductivity	TP3A	69 umho	SW-846 9050
Water Holding Capacity	TP3A	12 %	ASTM D425-79
Percent Dry Weight			

NOTES:

Nutrients (ammonium-N, nitrate-N, and phosphate-P) are 'available' not total.

cfu/ml = colony forming units per milliliter

Std. Meth. = Standard Methods for the Examination of Water and Wastewater

SW-846 = Test Methods for Evaluating Solid Waste, USEPA, 1986

EPA = (U.S.) Environmental Protection Agency Methods for Chemical Analysis of Water and Wastes

Sample analyzed: 2/4/94 to 2/10/94
Jeanne McHugh
Bioscience, Inc.

Approved by:


Richard Bleam
Director of Technical Service
Bioscience Inc.

Date:

2/10/94

008236

Report to : AWD Technologies
Rockville, MD 20850
Attn: Mr. Amine Bou Onk

Bill to: AWD Technologies
Rockville, MD 20850
Attn: Mr. Amine Bou Onk

Date: January 25, 1994 BI project # AWD 9301
Sample Source: Army Corps Project AWD project # 9301
Sample collected: 1/25/94 by Chris Edgmon, AWD Site Location: Texas
Sample delivered to Bioscience: 1/26/94 received by John V. Forsyth III
Sample preparation: Soil samples in five gallon containers labeled TP1A and TP3A.

ANALYTICAL RESULTS

<u>Test</u>	<u>Sample ID.</u>	<u>Result</u>	<u>Method No.</u>
<u>Available Nutrient</u>			
Ammonium-N	TP1A	394 mg/kg	STD. METH. 417F
Nitrate	TP1A	< 2.5 mg/kg	STD. METH. 418C
Orthophosphate	TP1A	12 mg/kg	STD. METH. 424E
Total Bacterial Plate Count	TP1A	4.2E+04 cfu/g	STD. METH. 907B
Total Moisture	TP1A	18.54 %	ASTM D2216-80
Percent Dry Weight			
pH	TP1A	6.2	SW-846-9045
Specific Conductivity	TP1A	846 umho	SW-846 9050
Water Holding Capacity	TP1A	24.8 %	ASTM D425-79
Percent Dry Weight			

NOTES:

Nutrients (ammonium-N, nitrate-N, and phosphate-P) are 'available' not total.

cfu/ml = colony forming units per milliliter

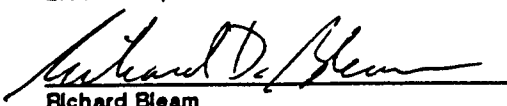
Std. Meth. = Standard Methods for the Examination of Water and Wastewater

SW-846 = Test Methods for Evaluating Solid Waste, USEPA, 1986

EPA = (U.S.) Environmental Protection Agency Methods for Chemical Analysis of Water and Wastes

Sample analyzed: 2/4/94 to 2/10/94
Jeanne McHugh
Bioscience, Inc.

Approved by:


Richard Bleam
Director of Technical Service
Bioscience Inc.

2/10/94
Date:

Hess Environmental Laboratories

Environmentalists and Laboratory Analysts
112 North Courtland Street, P.O. Box 268, East Stroudsburg, Pennsylvania 18301
Phone (717) 421-1550, Fax (717) 421-6720



January 19, 1994

Attn: Mr. J.V. Forsyth III
Bioscience, Inc.
1550 Valley Center Parkway Suite 140
Bethlehem, PA 18017

Re: Analytical Results

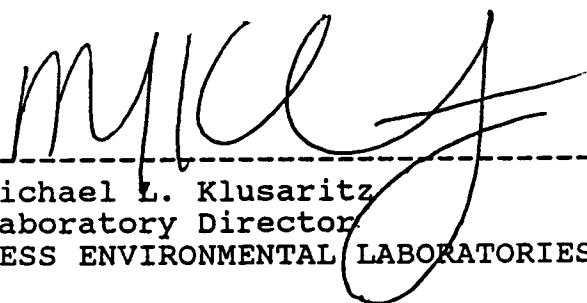
Date Sampled : 12/28/93 @ 1645
Sampled By : RDB/JVF
Sample Type : Soil
Sample I.D. : MS-1
Lab No. : 44,608

RESULTS

I. Soil Particle Size - ASTM Method No. D422

SEE TABLE I

NOTE: Results reported on an as received basis.



Michael L. Klusaritz
Laboratory Director
HESS ENVIRONMENTAL LABORATORIES

MLK/32/dm



Bioscience, Inc.
January 19, 1994
Sample I.D.: MS-1 (44,608)

TABLE I

<u>Particle Size</u>	<u>Result(%)</u>
Gravel (Passing 3-in. and retained on No. 4 Sieve)	25.8
Sand	
A. Coarse Sand (Passing No.4 Sieve and retained on No. 10 Sieve)	38.2
B. Medium Sand (Passing No. 10 Sieve and retained on No. 40 Sieve)	21.6
C. Fine Sand (Passing No. 40 Sieve and retained on No. 200 Sieve)	12.7
Silt Size (0.074 to 0.005 mm)	1.2
Clay Size (0.005 to 0.001 mm)	0.5
Colloids (less than 0.001 mm)	<0.1

Hess Environmental Laboratories

Environmentalists and Laboratory Analysts
112 North Courtland Street, P.O. Box 268, East Stroudsburg, Pennsylvania 18301
Phone (717) 421-1550, Fax (717) 421-6720

008239



January 19, 1994

Attn: Mr. J.V. Forsyth III
Bioscience, Inc.
1550 Valley Center Parkway Suite 140
Bethlehem, PA 18017

Re: Analytical Results

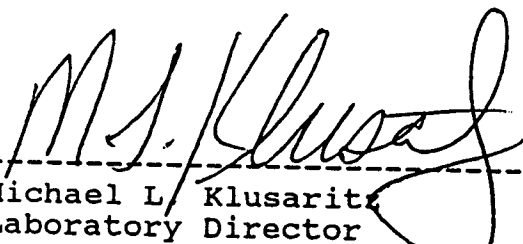
Date Sampled : 12/28/93 @ 1645
Sampled By : RDB/JVF
Sample Type : Soil
Sample I.D. : MS-2
Lab No. : 44,609

RESULTS

I. Soil Particle Size - ASTM Method No. D422

SEE TABLE I

NOTE: Results reported on an as received basis.



Michael L. Klusaritz
Laboratory Director
HESS ENVIRONMENTAL LABORATORIES

MLK/32/dm

008240



Bioscience, Inc.
January 19, 1994
Sample I.D.: MS-2 (44,609)

TABLE I

<u>Particle Size</u>	<u>Result(%)</u>
Gravel (Passing 3-in. and retained on No. 4 Sieve)	42.7
Sand	
A. Coarse Sand (Passing No.4 Sieve and retained on No. 10 Sieve)	31.9
B. Medium Sand (Passing No. 10 Sieve and retained on No. 40 Sieve)	16.4
C. Fine Sand (Passing No. 40 Sieve and retained on No. 200 Sieve)	8.8
Silt Size (0.074 to 0.005 mm)	0.2
Clay Size (0.005 to 0.001 mm)	<0.1
Colloids (less than 0.001 mm)	<0.1

008241

Hess Environmental Laboratories

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January 5, 1993

Attn: Mr. J.V. Forsyth III
Bioscience, Inc.
1550 Valley Center Parkway Suite 140
Bethlehem, PA 18017

Re: Analytical Results

Date Sampled : 12/9/93
Sampled By : Client
Sample Type : Soil
Sample I.D. : AWD, MS-1-A
Lab No. : 43,216

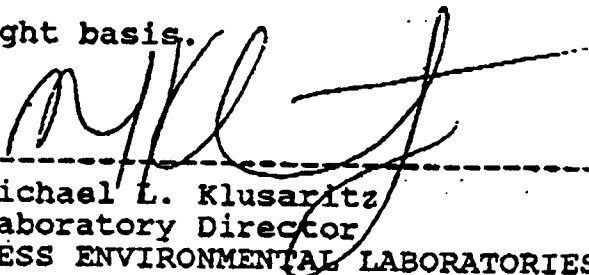
RESULTS

I. Purgeable Halocarbons - US EPA Method Nos. 5030/8010

See TABLE I

II. Moisture Loss @105°C - 15.4 wt%

Note: Results reported on a dry weight basis.



Michael L. Klusaritz
Laboratory Director
HESS ENVIRONMENTAL LABORATORIES

MLK/32/d40/dm



Bioscience, Inc.
January 5, 1994
Sample I.D. : MS-1A

TABLE I

PURGEABLE HALOCARBONS - EPA METHOD NO. 8010

<u>PARAMETER</u>	<u>RESULTS (mg/kg)</u>
Chloromethane	
Bromomethane	<0.010
Dichlorodifluoromethane	<0.010
Vinyl chloride	<0.010
Chloroethane	<0.010
Methylene chloride	<0.005
Trichlorofluoromethane	0.084
1,1-Dichloroethene	<0.005
1,1-Dichloroethane	0.012
1,2-Dichloroethene (Total)	<0.005
Chloroform	<0.005
1,2-Dichloroethane	<0.005
1,1,1-Trichloroethane	<0.005
Carbon tetrachloride	0.009
Bromodichloromethane	<0.005
1,2-Dichloropropane	<0.005
trans-1,3-Dichloropropene	<0.005
Trichloroethene	<0.005
Dibromochloromethane	0.680
1,1,2-Trichloroethane	<0.005
Cis-1,3-dichloropropane	<0.005
2-Chloroethylvinyl ether	<0.005
Bromoform	<0.025
1,1,2,2-Tetrachloroethane	<0.005
Tetrachloroethene	0.007
Chlorobenzene	0.006
	<0.005

MLK/165/dm

008243

Hess Environmental Laboratories

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January 5, 1993

Attn: Mr. J.V. Forsyth III
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1550 Valley Center Parkway Suite 140
Bethlehem, PA 18017

Re: Analytical Results

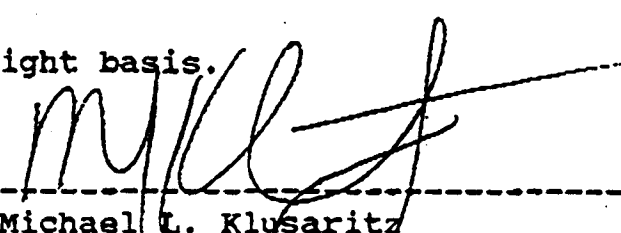
Date Sampled : 12/9/93
Sampled By : Client
Sample Type : Soil
Sample I.D. : AWD, MS-1-B
Lab No. : 43,217

RESULTS**I. Purgeable Halocarbons - US EPA Method Nos. 5030/8010**

See TABLE I

II. Moisture Loss @105°C - 14.2 wt%

Note: Results reported on a dry weight basis.



Michael L. Klusaritz
Laboratory Director
HESS ENVIRONMENTAL LABORATORIES

MLK/32/d40/dm



Bioscience, Inc.
January 5, 1994
Sample I.D. : MS-1B

TABLE I

PURGEABLE HALOCARBONS - EPA METHOD NO. 8010

<u>PARAMETER</u>	<u>RESULTS (mg/kg)</u>
Chloromethane	<0.010
Bromomethane	<0.010
Dichlorodifluoromethane	<0.010
Vinyl chloride	<0.010
Chloroethane	<0.010
Methylene chloride	<0.005
Trichlorofluoromethane	0.047
1,1-Dichloroethene	<0.005
1,1-Dichloroethane	0.009
1,2-Dichloroethene(Total)	<0.005
Chloroform	<0.005
1,2-Dichloroethane	<0.005
1,1,1-Trichloroethane	<0.005
Carbon tetrachloride	0.006
Bromodichloromethane	<0.005
1,2-Dichloropropane	<0.005
trans-1,3-Dichloropropene	<0.005
Trichloroethene	<0.005
Dibromochloromethane	0.893
1,1,2-Trichloroethane	<0.005
Cis-1,3-dichloropropane	<0.005
2-Chloroethylvinyl ether	<0.005
Bromoform	<0.025
1,1,2,2-Tetrachloroethane	<0.005
Tetrachloroethene	<0.005
Chlorobenzene	0.015
	<0.005

MLK/165/dm

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January 5, 1993

Attn: Mr. J.V. Forsyth III
Bioscience, Inc.
1550 Valley Center Parkway Suite 140
Bethlehem, PA 18017

Re: Analytical Results

Date Sampled : 12/9/93
Sampled By : Client
Sample Type : Soil
Sample I.D. : AWD, MS-1-C
Lab No. : 43,218

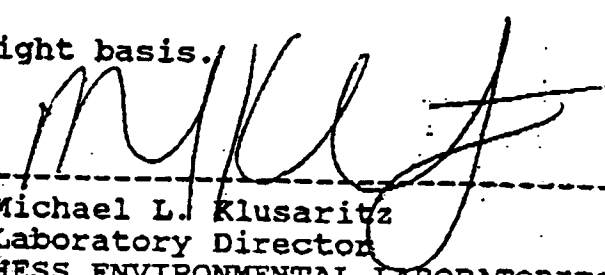
RESULTS

I. Purgeable Halocarbons - US EPA Method Nos. 5030/8010

See TABLE I

II. Moisture Loss @105°C - 14.9 wt%

Note: Results reported on a dry weight basis.



Michael L. Klusaritz
Laboratory Director
HESS ENVIRONMENTAL LABORATORIES

MLK/32/d40/dm

008246



Bioscience, Inc.
January 5, 1994
Sample I.D. : MS-1C

TABLE IPURGEABLE HALOCARBONS - EPA METHOD NO. 8010

<u>PARAMETER</u>	<u>RESULTS (mg/kg)</u>
Chloromethane	<0.010
Bromomethane	<0.010
Dichlorodifluoromethane	<0.010
Vinyl chloride	<0.010
Chloroethane	<0.010
Methylene chloride	<0.005
Trichlorofluoromethane	0.125
1,1-Dichloroethene	<0.005
1,1-Dichloroethane	<0.005
1,2-Dichloroethene (Total)	<0.005
Chloroform	<0.005
1,2-Dichloroethane	0.008
1,1,1-Trichloroethane	<0.005
Carbon tetrachloride	<0.005
Bromodichloromethane	<0.005
1,2-Dichloropropane	<0.005
trans-1,3-Dichloropropene	<0.005
Trichloroethene	<0.005
Dibromochloromethane	0.714
1,1,2-Trichloroethane	<0.005
Cis-1,3-dichloropropane	<0.005
2-Chloroethylvinyl ether	<0.005
Bromoform	<0.025
1,1,2,2-Tetrachloroethane	<0.005
Tetrachloroethene	<0.005
Chlorobenzene	0.006
	<0.005

MLK/165/dm

Hess Environmental Laboratories

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008247



January 5, 1993

Attn: Mr. J.V. Forsyth III
Bioscience, Inc.
1550 Valley Center Parkway Suite 140
Bethlehem, PA 18017

Re: Analytical Results

Date Sampled	:	12/9/93
Sampled By	:	Client
Sample Type	:	Soil
Sample I.D.	:	AWD, MS-2-A
Lab No.	:	43,219

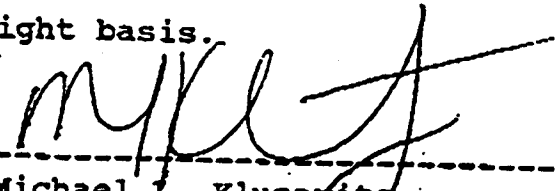
RESULTS

I. Purgeable Halocarbons - US EPA Method Nos. 5030/8010

See TABLE I

II. Moisture Loss @105°C - 18.6 wt%

Note: Results reported on a dry weight basis.



Michael L. Klusaritz
Laboratory Director
HESS ENVIRONMENTAL LABORATORIES

MLK/32/d40/dm



Bioscience, Inc.
January 5, 1994
Sample I.D. : MS-2A

TABLE I

PURGEABLE HALOCARBONS - EPA METHOD NO. 8010

<u>PARAMETER</u>	<u>RESULTS (mg/kg)</u>
Chloromethane	
Bromomethane	<0.010
Dichlorodifluoromethane	<0.010
Vinyl chloride	<0.010
Chloroethane	<0.010
Methylene chloride	<0.005
Trichlorofluoromethane	<0.005
1,1-Dichloroethene	<0.005
1,1-Dichloroethane	0.008
1,2-Dichloroethene (Total)	<0.005
Chloroform	<0.005
1,2-Dichloroethane	<0.005
1,1,1-Trichloroethane	<0.005
Carbon tetrachloride	<0.005
Bromodichloromethane	<0.005
1,2-Dichloropropane	<0.005
trans-1,3-Dichloropropene	<0.005
Trichloroethene	<0.005
Dibromochloromethane	0.011
1,1,2-Trichloroethane	<0.005
Cis-1,3-dichloropropane	<0.005
2-Chloroethylvinyl ether	<0.005
Bromoform	<0.025
1,1,2,2-Tetrachloroethane	<0.005
Tetrachloroethene	<0.005
Chlorobenzene	<0.005

MLK/163/dm

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008249



January 5, 1993

Attn: Mr. J.V. Forsyth III
Bioscience, Inc.
1550 Valley Center Parkway Suite 140
Bethlehem, PA 18017

Re: Analytical Results

Date Sampled : 12/9/93
Sampled By : Client
Sample Type : Soil
Sample I.D. : AWD, MS-2-B
Lab No. : 43,220

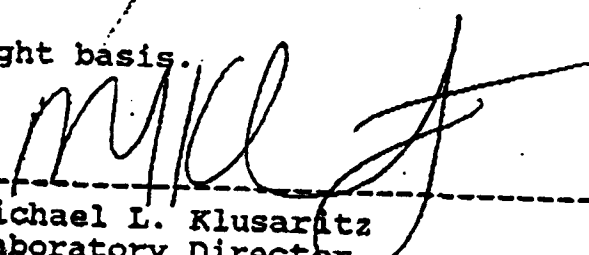
RESULTS

I. Purgeable Halocarbons - US EPA Method Nos. 5030/8010

See TABLE I

II. Moisture Loss @105°C - 19.3 wt%

Note: Results reported on a dry weight basis.



Michael L. Klusaritz
Laboratory Director
HESS ENVIRONMENTAL LABORATORIES

MLK/32/d40/dm



Bioscience, Inc.
January 5, 1994
Sample I.D. : MS-2B

TABLE I

PURGEABLE HALOCARBONS - EPA METHOD NO. 8010

<u>PARAMETER</u>	<u>RESULTS (mg/kg)</u>
Chloromethane	<0.010
Bromomethane	<0.010
Dichlorodifluoromethane	<0.010
Vinyl chloride	<0.010
Chloroethane	<0.005
Methylene chloride	<0.005
Trichlorofluoromethane	<0.005
1,1-Dichloroethene	<0.005
1,1-Dichloroethane	0.006
1,2-Dichloroethene (Total)	<0.005
Chloroform	<0.005
1,2-Dichloroethane	<0.005
1,1,1-Trichloroethane	<0.005
Carbon tetrachloride	<0.005
Bromodichloromethane	<0.005
1,2-Dichloropropane	<0.005
trans-1,3-Dichloropropene	<0.005
Trichloroethene	0.018
Dibromochloromethane	<0.005
1,1,2-Trichloroethane	<0.005
Cis-1,3-dichloropropane	<0.005
2-Chloroethylvinyl ether	<0.025
Bromoform	<0.005
1,1,2,2-Tetrachloroethane	<0.005
Tetrachloroethene	<0.005
Chlorobenzene	<0.005

MLK/165/dm

008251

Hess Environmental Laboratories

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one (717) 421-1550, Fax (717) 421-6720



January 5, 1993

Attn: Mr. J.V. Forsyth III
Bioscience, Inc.
1550 Valley Center Parkway Suite 140
Bethlehem, PA 18017

Re: Analytical Results

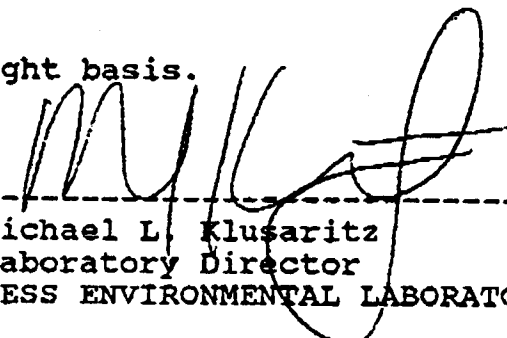
Date Sampled : 12/9/93
Sampled By : Client
Sample Type : Soil
Sample I.D. : AWD, MS-2-C
Lab No. : 43,221

RESULTS**I. Purgeable Halocarbons - US EPA Method Nos. 5030/8010**

See TABLE I

II. Moisture Loss @105°C - 18.0 wt%

Note: Results reported on a dry weight basis.



Michael L. Klusaritz
Laboratory Director
HESS ENVIRONMENTAL LABORATORIES

MLK/32/d40/dm

008252



Bioscience, Inc.
January 5, 1994
Sample I.D. : MS-2C

TABLE IPURGEABLE HALOCARBONS - EPA METHOD NO. 8010

<u>PARAMETER</u>	<u>RESULTS (mg/kg)</u>
Chloromethane	<0.010
Bromomethane	<0.010
Dichlorodifluoromethane	<0.010
Vinyl chloride	<0.010
Chloroethane	<0.005
Ethylene chloride	<0.005
Trichlorofluoromethane	<0.005
1,1-Dichloroethene	<0.005
1,1-Dichloroethane	<0.005
1,2-Dichloroethene (Total)	<0.005
Chloroform	<0.005
1,2-Dichloroethane	<0.005
1,1,1-Trichloroethane	<0.005
Carbon tetrachloride	<0.005
Bromodichloromethane	<0.005
1,2-Dichloropropane	<0.005
trans-1,3-Dichloropropene	<0.005
Trichloroethene	<0.005
Dibromochloromethane	<0.005
1,1,2-Trichloroethane	<0.005
Cis-1,3-dichloropropane	<0.005
2-Chloroethylvinyl ether	<0.025
Bromoform	<0.005
1,1,2,2-Tetrachloroethane	<0.005
Tetrachloroethene	<0.005
Chlorobenzene	<0.005

MLK/165/dm

Hess Environmental Laboratories

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008253



January 5, 1993

Attn: Mr. J.V. Forsyth III
Bioscience, Inc.
1550 Valley Center Parkway Suite 140
Bethlehem, PA 18017

Re: Analytical Results

Date Sampled : 12/9/93
Sampled By : Client
Sample I.D. : See Below
Lab I.D. Nos. : 43,213, 43,214 and 43,215

RESULTS

<u>SAMPLE I.D.</u>	<u>SAMPLE TYPE</u>	<u>Total Organic Carbon</u>	<u>Moisture Loss @ 105°C (wt%)</u>
MS-1	Soil	27.6 mg/kg	15.2
MO 2	Soil	19.2 mg/kg	17.1
Field Blank	Water	0.41 mg/l	----

Note: Samples analyzed using US EPA Method No. 9060 and solids reported on a dry weight basis.



Michael L. Klusaritz
Laboratory Director
HESS ENVIRONMENTAL LABORATORIES

MLK/40/dm

A Division of R.K.R. Hess Associates

Hess Environmental Laboratories

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Phone (717) 421-1550, Fax (717) 421-6720

008254



January 5, 1993

Attn: Mr. J.V. Forsyth III
Bioscience, Inc.
1550 Valley Center Parkway Suite 140
Bethlehem, PA 18017

Re: Analytical Results

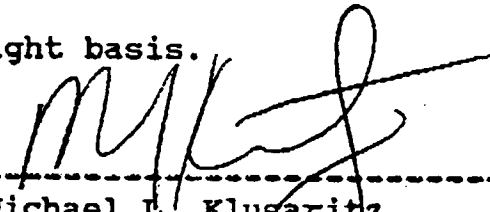
Date Sampled : 12/9/93
Sampled By : Client
Sample Type : Soil
Sample I.D. : AWD, MS-1
Lab No. : 43,210

RESULTS**I. Total Metals - US EPA Method Nos. 3050/6010**

See TABLE I

II. Moisture Loss @105°C - 16.1 wt%

Note: Results reported on a dry weight basis.



Michael L. Klusaritz
Laboratory Director
HESS ENVIRONMENTAL LABORATORIES

MLK/32/d40/dm

008255



Bioscience, Inc.
January 5, 1994
Sample I.D.: MS-1 (43,210)

TABLE I

<u>Parameter</u>	<u>Result (mg/kg)</u>
Aluminum	29,200
Antimony	1.88
Arsenic	33.6
Barium	1,200
Beryllium	0.13
Boron	28.5
Cadmium	0.47
Chromium	10.7
Cobalt	2.30
Iron	10,100
Lead	19.4
Magnesium	653.
Manganese	358.
Mercury	0.045
Molybdeum	0.86
Potassium	5,020
Selenium	1.75
Silver	0.35
Copper	15.4
Sodium	481.
Nickel	12.1
Thallium	0.037
Vanadium	7.03
Zinc	88.4

Note : Results reported on a dry weight basis.

MLK/46/kc

Hess Environmental Laboratories

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008256



January 5, 1993

Attn: Mr. J.V. Forsyth III
Bioscience, Inc.
1550 Valley Center Parkway Suite 140
Bethlehem, PA 18017

Re: Analytical Results

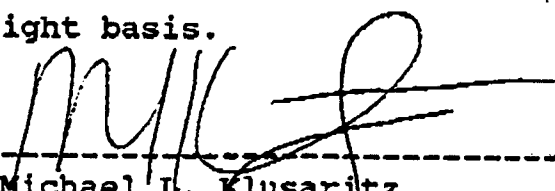
Date Sampled : 12/9/93
Sampled By : Client
Sample Type : Soil
Sample I.D. : AWD, MS-2
Lab No. : 43,211

RESULTS**I. Total Metals - US EPA Method Nos. 3050/6010**

See TABLE I

II. Moisture Loss @105°C - 19.1 wt%

Note: Results reported on a dry weight basis.



Michael L. Klusaritz
Laboratory Director
HESS ENVIRONMENTAL LABORATORIES

MLK/32/d40/dm

008257



Bioscience, Inc.
January 5, 1994
Sample I.D.: MS-2 (43,211)

TABLE I

<u>Parameter</u>	<u>Result (mg/kg)</u>
Aluminum	45,300
Antimony	0.93
Arsenic	19.4
Barium	962.
Beryllium	0.11
Boron	15.3
Cadmium	0.49
Chromium	12.5
Cobalt	3.05
Iron	17,500
Lead	20.5
Magnesium	1,640
Manganese	161.
Mercury	0.024
Molybdeum	0.52
Potassium	3,920
Selenium	1.11
Silver	0.42
Copper	9.51
Sodium	677.
Nickel	11.5
Thallium	0.041
Vanadium	4.96
Zinc	106.

Note : Results reported on a dry weight basis.

MLK/46/kc

Hess Environmental Laboratories

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008258



January 5, 1993

Attn: Mr. J.V. Forsyth III
Bioscience, Inc.
1550 Valley Center Parkway Suite 140
Bethlehem, PA 18017

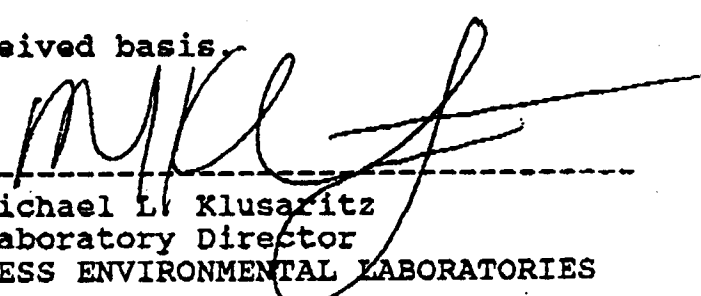
Re: Analytical Results

Date Sampled : 12/9/93
Sampled By : Client
Sample Type : Water
Sample I.D. : AWD, Field Blank
Lab No. : 43,212

RESULTS**I. Total Metals - US EPA Method Nos. 3050/6010**

See TABLE I

Note: Results reported on an as received basis.



Michael L. Klusaritz
Laboratory Director
HESS ENVIRONMENTAL LABORATORIES

MLK/32/d40/dm

008259



Bioscience, Inc.
January 5, 1994
Sample I.D.: Field Blank (43,212)

TABLE I

<u>Parameter</u>	<u>Result (mg/l)</u>
Aluminum	<0.050
Antimony	<0.050
Arsenic	<0.050
Barium	<0.050
Beryllium	<0.005
Boron	<0.001
Cadmium	<0.010
Chromium	<0.005
Cobalt	<0.010
Iron	<0.010
Lead	<0.010
Magnesium	<0.050
Manganese	0.049
Mercury	<0.005
Molybdeum	<0.0002
Potassium	<0.020
Selenium	<0.050
Silver	<0.100
Copper	<0.010
Sodium	<0.010
Nickel	0.077
Thallium	<0.025
Vanadium	<0.050
Zinc	<0.010
	<0.005

Note : Results reported on a dry weight basis.

MLK/46/kc

Hess Environmental Laboratories

Environmentalists and Laboratory Analysts
12 North Courtland Street, P.O. Box 268, East Stroudsburg, Pennsylvania 18301
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008260



February 22, 1994

Attn: Mr. J.V. Forsyth III
Bioscience, Inc.
1550 Valley Center Parkway Suite 140
Bethlehem, PA 18017

Re: Analytical Results

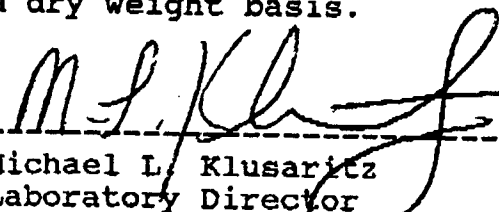
Date Sampled : 2/3/94
Sampled By : RDB/JFF (Bioscience)
Sample Type : Soil
Sample I.D. : Test Pit - 1A - Comp. A (AWD)
Lab No. : 45,744

RESULTSI. Volatile Organic Chemicals - US EPA Method No. 8240

See TABLE I & II

II. Moisture Loss @105°C - 13.9 wt%

Note: Results reported on a dry weight basis.



Michael L. Klusaritz
Laboratory Director
HESS ENVIRONMENTAL LABORATORIES

MLK/XXXXX-DONNA-BIOSCIENCE-BLANK.DM

008261



Bioscience, Inc.

Sample I.D.: Test Pit 1A - Comp A (45,744)

TABLE I

<u>VOLATILES</u>	<u>RESULTS (ug/kg)</u>
Acrolein	<100.
Acrylonitrile	<100.
Benzene	<5.0
Bromoform	<5.0
Bromomethane	<10.
Carbon Tetrachloride	<5.0
Chlorobenzene	<5.0
Chlorodibromomethane	<5.0
Chloroethane	<10.
2-Chloroethylvinyl ether	<25.
Chloromethane	<10.
Chloroform	<5.0
cis-1,3-Dichloropropylene	<5.0
Dichlorobromomethane	<5.0
1,1-Dichloroethane	11.
1,2-Dichloroethane	<5.0
1,1-Dichloroethylene	<5.0
1,2-Dichloroethylene (Total)	<5.0
1,2-Dichloropropane	<5.0
Ethylbenzene	<5.0
Methylene chloride	1.32
1,1,2,2-Tetrachloroethane	<5.0
Tetrachloroethylene	<5.0
Toluene	<5.0
trans,1,3-Dichloropropylene	<5.0
1,1,1-Trichloroethane	<5.0
1,1,2-Trichloroethane	<5.0
Trichloroethylene	2.88
Trichlorofluoromethane	<5.0
Vinyl Chloride	<5.0
Xylenes - Total	<10.

Note: No other Peaks detected.

MLK/OKB300:(DONNA)VOLATILES-BLANK-TABLE1.DM

Hess Environmental Laboratories

Environmentalists and Laboratory Analysts
2 North Courtland Street, P.O. Box 268, East Stroudsburg, Pennsylvania 18301
Phone (717) 421-1550, Fax (717) 421-6720

008262



February 22, 1994

Attn: Mr. J.V. Forsyth III
Bioscience, Inc.
1550 Valley Center Parkway Suite 140
Bethlehem, PA 18017

Re: Analytical Results

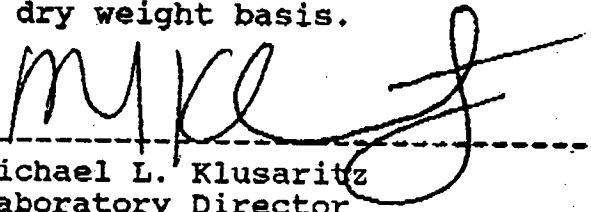
Date Sampled : 2/3/94
Sampled By : RDB/JVF (Bioscience)
Sample Type : Soil
Sample I.D. : Test Pit - 1A - Comp. B (AWD)
Lab No. : 45,745

RESULTSI. Purgeable Halocarbons - US EPA Method Nos. 5030/8240

See TABLES I & II

II. Moisture Loss @105°C - 14.7 wt%

Note: Results reported on a dry weight basis.



Michael L. Klusaritz
Laboratory Director

HESS ENVIRONMENTAL LABORATORIES

MLK/DKB300-[DONNA]BIOSCIENCEBLANK.DM

008263



Bioscience, Inc.

Sample I.D.: Test Pit 1A - Comp B (45,745)

TABLE I

<u>VOLATILES</u>	<u>RESULTS (ug/kg)</u>
Acrolein	<100.
Acrylonitrile	<100.
Benzene	<5.0
Bromoform	<5.0
Bromomethane	<10.
Carbon Tetrachloride	<5.0
Chlorobenzene	<5.0
Chlorodibromomethane	<5.0
Chloroethane	<10.
2-Chloroethylvinyl ether	<25.
Chloromethane	<10.
Chloroform	<5.0
cis-1,3-Dichloropropylene	<5.0
Dichlorobromomethane	<5.0
1,1-Dichloroethane	11.
1,2-Dichloroethane	<5.0
1,1-Dichloroethylene	<5.0
1,2-Dichloroethylene (Total)	<5.0
1,2-Dichloropropane	<5.0
Ethylbenzene	<5.0
Methylene chloride	34.
1,1,2,2-Tetrachloroethane	<5.0
Tetrachloroethylene	<5.0
Toluene	<5.0
trans,1,3-Dichloropropylene	<5.0
1,1,1-Trichloroethane	<5.0
1,1,2-Trichloroethane	<5.0
Trichloroethylene	95.
Trichlorofluoromethane	<5.0
Vinyl Chloride	<5.0
Xylenes - Total	<10.

Note: No other Peaks detected.

MLK/ DKE300:IDONNAVOLATILES-BLANK-TABLE1.DM

Hess Environmental Laboratories

Environmentalists and Laboratory Analysts
12 North Courtland Street, P.O. Box 268, East Stroudsburg, Pennsylvania 18301
Phone (717) 421-1550, Fax (717) 421-6720

008264



February 22, 1994

Attn: Mr. J.V. Forsyth III
Bioscience, Inc.
1550 Valley Center Parkway Suite 140
Bethlehem, PA 18017

Re: Analytical Results

Date Sampled : 2/3/94
Sampled By : RDB/JFF (Bioscience)
Sample Type : Soil
Sample I.D. : Test Pit - 1A - Comp. C (AWD)
Lab No. : 45,746

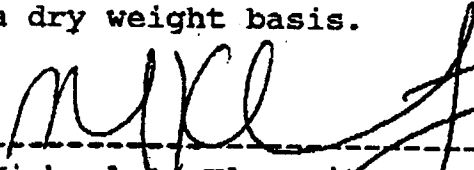
RESULTS

I. Volatile Organic Chemicals - US EPA Method No. 8240

See TABLE I & II

II. Moisture Loss @105°C - 12.8 wt%

Note: Results reported on a dry weight basis.



Michael L. Klusaritz
Laboratory Director
HESS ENVIRONMENTAL LABORATORIES

MLK/DK300/DONNA/BIOSCIENCE-BLANK.DM

008265



Bioscience, Inc.

Sample I.D.: Test Pit 1A - Comp C (45,746)

TABLE I

<u>VOLATILES</u>	<u>RESULTS (ug/kg)</u>
Acrolein	<100.
Acrylonitrile	<100.
Benzene	<5.0
Bromoform	<5.0
Bromomethane	<10.
Carbon Tetrachloride	<5.0
Chlorobenzene	<5.0
Chlorodibromomethane	<5.0
Chloroethane	<10.
2-Chloroethylvinyl ether	<25.
Chloromethane	<10.
Chloroform	<5.0
cis-1,3-Dichloropropylene	<5.0
Dichlorobromomethane	<5.0
1,1-Dichloroethane	11.
1,2-Dichloroethane	<5.0
1,1-Dichloroethylene	<5.0
1,2-Dichloroethylene (Total)	<5.0
1,2-Dichloropropane	<5.0
Ethylbenzene	<5.0
Methylene chloride	95.
1,1,2,2-Tetrachloroethane	<5.0
Tetrachloroethylene	<5.0
Toluene	<5.0
trans,1,3-Dichloropropylene	<5.0
1,1,1-Trichloroethane	<5.0
1,1,2-Trichloroethane	<5.0
Trichloroethylene	144.
Trichlorofluoromethane	<5.0
Vinyl Chloride	<5.0
Xylenes - Total	<10.

Note: No other Peaks detected.

MLK/DK300:00NNAVOLATILES-BLANK-TABLE1.DM

Hess Environmental Laboratories

Environmentalists and Laboratory Analysts
112 North Courtland Street, P.O. Box 268, East Stroudsburg, Pennsylvania 18301
Phone (717) 421-1550. Fax (717) 421-6720

008266



February 22, 1994

Attn: Mr. J.V. Forsyth III
Bioscience, Inc.
1550 Valley Center Parkway Suite 140
Bethlehem, PA 18017

Re: Analytical Results

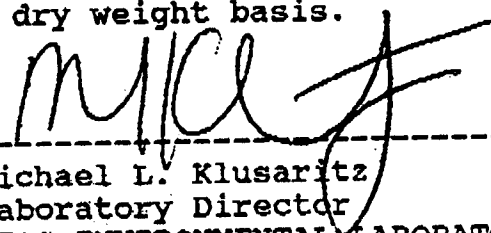
Date Sampled : 2/3/94
Sampled By : RDB/JFF (Bioscience)
Sample Type : Soil
Sample I.D. : Test Pit - 3A - Comp. A (AWD)
Lab No. : 45,737

RESULTS**I. Volatile Organic Chemicals - US EPA Method No. 8240**

See TABLE I & II

II. Moisture Loss @105°C - 16.8 wt%

Note: Results reported on a dry weight basis.



Michael L. Klusaritz
Laboratory Director
HESS ENVIRONMENTAL LABORATORIES

MLK/DKX00:(DONNA)BIOSCIENCE-BLANK.DM

008267



Bioscience, Inc.

Sample I.D.: Test Pit 3A - Comp A (45,737)

TABLE I

<u>VOLATILES</u>	<u>RESULTS (ug/kg)</u>
Acrolein	<100.
Acrylonitrile	<100.
Benzene	<5.0
Bromoform	<5.0
Bromomethane	<10.
Carbon Tetrachloride	<5.0
Chlorobenzene	<5.0
Chlorodibromomethane	<5.0
Chloroethane	<10.
2-Chloroethylvinyl ether	<25.
Chloromethane	<10.
Chloroform	<5.0
cis-1,3-Dichloropropylene	<5.0
Dichlorobromomethane	<5.0
1,1-Dichloroethane	<5.0
1,2-Dichloroethane	<5.0
1,1-Dichloroethylene	<5.0
1,2-Dichloroethylene (Total)	<5.0
1,2-Dichloropropane	<5.0
Ethylbenzene	<5.0
Methylene chloride	10.
1,1,2,2-Tetrachloroethane	<5.0
Tetrachloroethylene	<5.0
Toluene	<5.0
trans,1,3-Dichloropropylene	<5.0
1,1,1-Trichloroethane	<5.0
1,1,2-Trichloroethane	<5.0
Trichloroethylene	24.
Trichlorofluoromethane	<5.0
Vinyl Chloride	<5.0
Xylenes - Total	<10.

Note: No other Peaks detected.

MLK/DK300/DONNA/VOLATILES-BLANK-TABLE.DM

Hess Environmental Laboratories

Environmentalists and Laboratory Analysts
112 North Courtland Street, P.O. Box 268, East Stroudsburg, Pennsylvania 18301
Phone (717) 421-1550, Fax (717) 421-5720

008268



February 22, 1994

Attn: Mr. J.V. Forsyth III
Bioscience, Inc.
1550 Valley Center Parkway Suite 140
Bethlehem, PA 18017

Re: Analytical Results

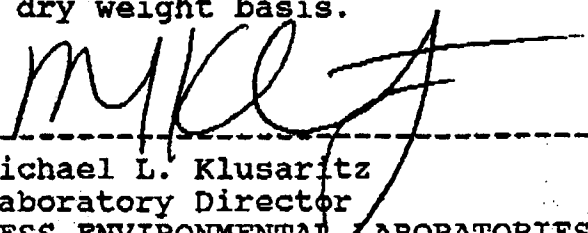
Date Sampled : 2/3/94
Sampled By : RDB/JFF (Bioscience)
Sample Type : Soil
Sample I.D. : Test Pit - 3A - Comp. B (AWD)
Lab No. : 45,738

RESULTS**I. Volatile Organic Chemicals - US EPA Method No. 8240**

See TABLE I & II

II. Moisture Loss @105°C - 17.9 wt%

Note: Results reported on a dry weight basis.



Michael L. Klusaritz
Laboratory Director
HESS ENVIRONMENTAL LABORATORIES

MLK/DK300:(DONNA)BIOSCIENCE-BLANK.DM

008269



Bioscience, Inc.

Sample I.D.: Test Pit 3A - Comp B (45,738)

TABLE I

<u>VOLATILES</u>	<u>RESULTS (ug/kg)</u>
Acrolein	<100.
Acrylonitrile	<100.
Benzene	<5.0
Bromoform	<5.0
Bromomethane	<10.
Carbon Tetrachloride	<5.0
Chlorobenzene	<5.0
Chlorodibromomethane	<5.0
Chloroethane	<10.
2-Chloroethylvinyl ether	<25.
Chloromethane	<10.
Chloroform	<5.0
cis-1,3-Dichloropropylene	<5.0
Dichlorobromomethane	<5.0
1,1-Dichloroethane	<5.0
1,2-Dichloroethane	<5.0
1,1-Dichloroethylene	<5.0
1,2-Dichloroethylene (Total)	<5.0
1,2-Dichloropropane	<5.0
Ethylbenzene	<5.0
Methylene chloride	40.
1,1,2,2-Tetrachloroethane	<5.0
Tetrachloroethylene	<5.0
Toluene	<5.0
trans,1,3-Dichloropropylene	<5.0
1,1,1-Trichloroethane	<5.0
1,1,2-Trichloroethane	<5.0
Trichloroethylene	65.
Trichlorofluoromethane	<5.0
Vinyl Chloride	<5.0
Xylenes - Total	<10.

Note: No other Peaks detected.

MLK/DK300/DONNA/VOLATILES-BLANK-TABLET.DM

Hess Environmental Laboratories

Environmentalists and Laboratory Analysts
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Phone (717) 421-1550, Fax (717) 421-6720

008270



February 22, 1994

Attn: Mr. J.V. Forsyth III
Bioscience, Inc.
1550 Valley Center Parkway Suite 140
Bethlehem, PA 18017

Re: Analytical Results

Date Sampled : 2/3/94
Sampled By : RDB/JFF (Bioscience)
Sample Type : Soil
Sample I.D. : Test Pit - 3A - Comp. C (AWD)
Lab No. : 45,739

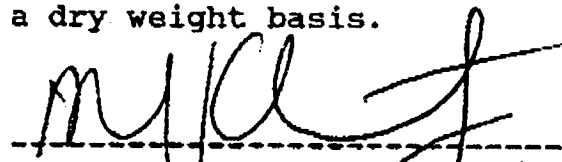
RESULTS

I. Volatile Organic Chemicals - US EPA Method No. 8240

See TABLE I & II

II. Moisture Loss @105°C - 17.3 wt%

Note: Results reported on a dry weight basis.



Michael L. Klusaritz
Laboratory Director
HESS ENVIRONMENTAL LABORATORIES

MLK/DK000/DONNA/BIOSCIENCE-BLANK.DM

008271



Bioscience, Inc.

Sample I.D.: Test Pit 3A - Comp C (45,739)

TABLE I

<u>VOLATILES</u>	<u>RESULTS (ug/kg)</u>
Acrolein	<100.
Acrylonitrile	<100.
Benzene	<5.0
Bromoform	<5.0
Bromomethane	<10.
Carbon Tetrachloride	<5.0
Chlorobenzene	<5.0
Chlorodibromomethane	<5.0
Chloroethane	<10.
2-Chloroethylvinyl ether	<25.
Chloromethane	<10.
Chloroform	<5.0
cis-1,3-Dichloropropylene	<5.0
Dichlorobromomethane	<5.0
1,1-Dichloroethane	<5.0
1,2-Dichloroethane	8.0
1,1-Dichloroethylene	<5.0
1,2-Dichloroethylene (Total)	<5.0
1,2-Dichloropropane	<5.0
Ethylbenzene	<5.0
Methylene chloride	32.
1,1,2,2-Tetrachloroethane	<5.0
Tetrachloroethylene	<5.0
Toluene	<5.0
trans,1,3-Dichloropropylene	<5.0
1,1,1-Trichloroethane	<5.0
1,1,2-Trichloroethane	<5.0
Trichloroethylene	40.
Trichlorofluoromethane	<5.0
Vinyl Chloride	<5.0
Xylenes - Total	<10.

Note: No other Peaks detected.

MLK/ DMB300: (DONNA) VOLATILES-BLANK TABLE.DM

008272

Bioscience, Inc.

Sample I.D. : Test Pet 1A - CompA(45, 744)

TABLE II

<u>TEST NUMBER</u>	<u>COMPOUND NAME</u>	<u>RT(Min)</u>	<u>EST CONC (ug/Kg)</u>
67641	2-Propanone	5.48	390,
67630	Iso propanol	5.76	42,
1066406	Silanol, Trimethyl	8.69	219,
116861	Pyridine	12.81	903,
---	Unknown Aromatic Isomer	18.01	142,
---	C ₁₀ H ₁₄ " "	18.69	113,
---	" " "	19.32	211,
---	C ₁₁ H ₁₆ " "	21.62	74,
91203	Naphthalene	22.01	203,
91576	Naphthalene, 2-Methyl	23.17	56,

RT - Retention Time ~~Sample~~

EST CONC - Estimated Concentration

Bioscience, Inc.

008273

Sample I.D. : Test Pet 1A - CompB(45, 745)

TABLE II

<u>NUMBER</u>	<u>COMPOUND NAME</u>	<u>RT(Min)</u>	<u>EST CONC (ug/Kg)</u>
67641	2-Propanone	5.50	230.
1066406	Silanol, Trimethyl	8.74	160.
110861	Pyridene	12.84	630.
-----	C ₉ H ₁₂ Aromatic Isomer	17.82	58.
-----	C ₁₀ H ₁₄ Aromatic Isomer	18.77	32.
-----	C ₁₀ H ₁₄ Aromatic Isomer	19.32	38.
-----	C ₁₀ H ₁₄ Aromatic Isomer	20.84	54.
-----	Unknown	20.94	64.
-----	C ₁₁ H ₁₆ Aromatic Isomer	21.54	33.
91203	Naphthalene	22.06	51.

RT - Retention Time ~~Sample~~
 EST CONC - Estimated Concentration

Bioscience, Inc.

Sample I.D. : Test Pet 1A - CompC(45,746) 008274

TABLE II

<u>AS. NUMBER</u>	<u>COMPOUND NAME</u>	<u>RT(Min)</u>	<u>EST CONC (ug/Kg)</u>
67641	2-Propanone	5.47	184,
110861	Pyridine	12.79	410,
71363	Butanol	13.11	36,
- - -	Unknown Aromatic Isomer	17.35	75,
- - -	C ₉ H ₁₂ " "	17.86	32,
- - -	C ₁₀ H ₁₄ " "	19.27	76,
- - -	" " "	20.68	88,
- - -	C ₁₁ H ₁₆	21.59	101,
91203	Naphthalene	21.93	95.4,
- - -	Unknown Aromatic Isomer	22.87	43,

RT - Retention Time ~~Sample~~
 EST CONC - Estimated Concentration

Bioscience, Inc.

008275

Sample I.D. : Test Pet 3A - CompA(45, 737)

TABLE II

<u>VS NUMBER</u>	<u>COMPOUND NAME</u>	<u>R.T.(Min)</u>	<u>EST CONC (ug/Kg)</u>
---	Unknown	11.21	12,
---	C ₇ H ₁₄ O	14.38	19,
---	C ₁₀ H ₁₄ Aromatic Isomer	17.92	26,
---	C ₁₀ H ₁₄ " "	18.16	72,
---	C ₁₀ H ₁₆ Isomer	20.86	25,
---	Unknown Alkane	21.03	104,
---	Unknown Siloxane	19.70	26,
---	C ₁₁ H ₁₆ Aromatic Isomer	21.59	72,
---	C ₁₁ H ₁₆ Aromatic Isomer	21.84	28,
---	Unknown Alkane	22.48	30,

T - Retention Time ~~Comp~~
 EST CONC - Estimated Concentration

Bioscience, Inc.

Sample I.D.: Test Pit 3A - Comp B (45,738) 008276

TABLE II

(ug/l)

<u>CAS NUMBER</u>	<u>Compound Name</u>	<u>RT (Min)</u>	<u>EST. CONC.</u>
76131	Ethane, 1,1,2-Trichloro	5.30	23.
-----	C ₁₀ H ₁₆ Aromatic Isomer	16.39	22.
-----	Unknown Alkane	17.25	26.
-----	C ₉ H ₁₂ Aromatic Isomer	17.81	12.
-----	C ₁₀ H ₁₄ Aromatic Isomer	18.20	12.
-----	Benzene, ethyl-dimethyl-Iso	18.87	13.
-----	Unknown Siloxane	19.62	15.
-----	Unknown Alkane	20.74	57.
47082	Cineole	21.52	16.
-----	Unknown Alkane	22.21	20.

RT - Retention Time ~~(Time)~~
 EST CONC - Estimated Concentration

Bioscience, Inc.

Sample I.D. : Test Pet 3A - Comp C(45,739) 008277

TABLE II

<u>AS NUMBER</u>	<u>COMPOUND NAME</u>	<u>RT(Min)</u>	<u>EST CONC (ug/Kg)</u>
- - -	Unknown	4.96	11,
76131	Ethane, 1,1,2-Trichloro	5.34	38,
- - -	C ₁₀ H ₁₆ Isomer	16.33	25,
- - -	C ₁₀ H ₁₄ Aromatic Isomer	17.62	31,
- - -	C ₁₀ H ₁₄ " "	18.21	17,
- - -	Benzene, ethyl dimethyl, Iso	18.74	58,
- - -	C ₁₁ H ₁₆ Aromatic Isomer	21.02	45,
47082	Cineole	21.54	19,
- - -	Unknown Alkane	21.87	21,
- - -	Unknown Alkane	22.20	48,

RT - Retention Time ~~Sample~~
 EST CONC - Estimated Concentration

MOISTURE CALCULATION

SAMPLE SOURCE AWD 9301
 DATE 12/17/93
 TECH JMM

SAMPLE ID	TARE	TARE+ WET SOIL	TARE+ DRY SOIL	NET DRY	NET WET	DRY/WET	MOISTURE % DRY WT	Average
MS-1	3.9	26.4	22.7	18.8	22.5	0.83556	19.68	19.84
MS-1(duplicate)	3.8	25.4	21.8	18	21.6	0.83333	20.00	
MS-2	4.1	26.4	21.9	17.8	22.3	0.79821	25.28	
blank	4.2	4.2	4.2	0	0	ERR		

008278

008279

ELECTROCHEMICAL ANALYSIS DATA CALCULATION

SOURCE: AWD 9301
 METHOD #STAND. METH. 417F, 16th ed.

TECH: YMT/JMM
 DATE: 12/23/93

STANDARD CURVE CALCULATION

(Enter data in a12..a16 and c12..c16, then /DRG to calculate) Constant

Regression Output:

STANDARD CONCENTRATION	METER READING (MV)	LR
0.1	-1	115
1	0	73
10	1	25
100	2	-35

Std Err of Y Est
 R Squared
 No. of Observations
 Degrees of Freedom

69.4
 6.434283
 0.993367
 4
 2

X Coefficient(s)
 Std Err of Coef.

-49.8
 2.877499

SAMPLES ID	<enter> MV	APPARENT CONCENTRATION	<enter> DILUTION FACTOR	REPORTED CONCENTRATION (MG/L)
MS-1	-20	62.39944	10	623.9944
MS-1 spike, before	-20	62.39944	10	623.9944
MS-2	75	0.771881	10	7.718807
MS-2d	78	0.671907	10	6.719071
MS-2 spike	42	3.549775	10	35.49775
Blank, extracted	120	0.096369	1	0.096369
Blank, not extracted	135	0.048165	1	0.048165
MS-1 spike, after	-20	62.39944	10	623.9944

extracted 12/23/93
 sample returned
 with 1 drop
 conc. H₂SO₄
 added

QUALITY CONTROL

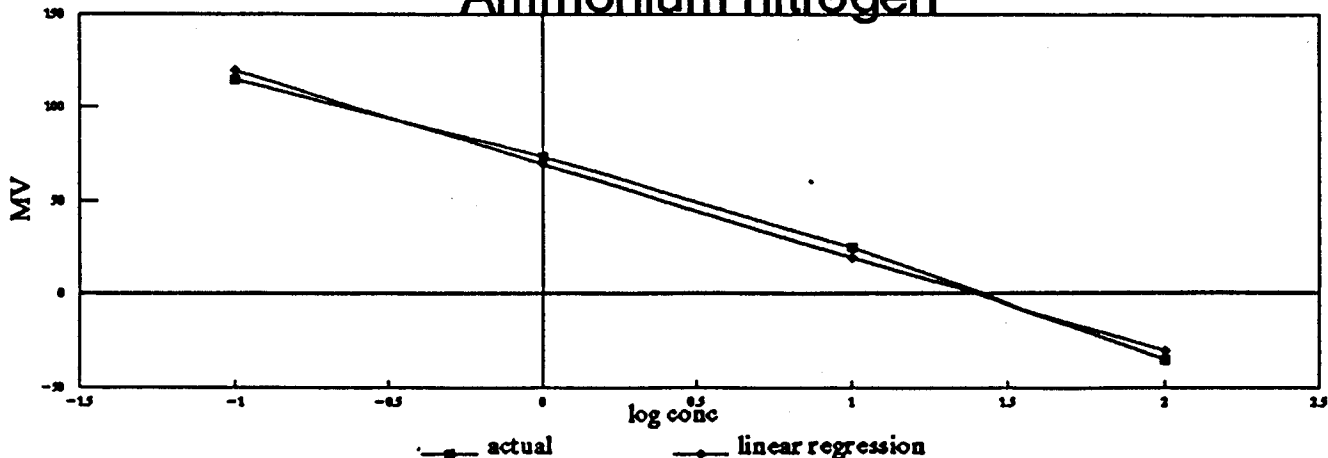
Duplicate recovery

ID	Sample concentration	Duplicate concentration	% recovery of duplicate
1	7.718807	6.719071	87.04805

Spike recovery

ID	Conc. spike	Volume sample	Conc. sample	Volume Standard	Conc. standard	Volume total	% recovery of spike
MS1 before	62.39944	100	62.39944	10	100	110	62.39944
MS2	3.549775	100	0.671907	5	100	105	61.10713
MS-1 after	62.39944	50	62.39944	5	100	55	62.39944

Ammonium nitrogen



008280

ELECTROCHEMICAL ANALYSIS DATA CALCULATION

SOURCE: AWD 9301
 METHOD: STAND METH. 4171, 16th ed.

TECH: JMM
 DATE: 12/28/93

STANDARD CURVE CALCULATION

(Enter data in a12..a16 and c12..c16, then /DRG to calculate.)

Regression Output:

STANDARD CONCENTRATION	METER READING (MV)	LR	Constant	Std Err of Y Est	R Squared	No. of Observations	Degrees of Freedom	X Coefficient(s)	Std Err of Coef.
0.1	-1	115	119	65.5	5.361903	0.995998	4	-53.5	2.397916
1	0	70	65.5						
10	1	15	12						
100	2	-45	-41.5						

SAMPLES ID	<enter> MV	APPARENT CONCENTRATION	<enter> DILUTION FACTOR	REPORTED CONCENTRATION (MG/L)
MS-1	-23	45.10302	10	451.0302
MS-1d	-24	47.08659	10	470.8659
MS-2	72	0.75597	10	7.559702
MS-2d	82	0.491574	10	4.915739
MS-1 spike	-48	132.2803	10	1322.803
(10 mL 1000 ppm added to 100 mL before extraction)				
MS-1 spike	-47	128.7079	10	1287.079
(5 mL 1000 ppm added to 50 mL after extraction)				
blank	130	0.062286	1	0.062286

sample extracted
 12/28/93

QUALITY CONTROL

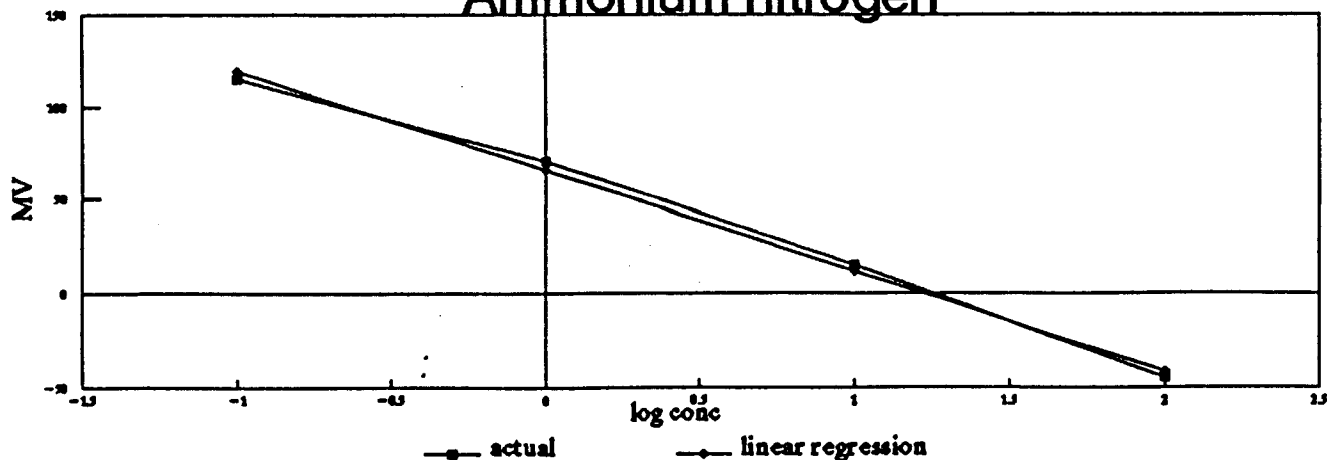
Duplicate recovery

IL	Sample concentration	Duplicate concentration	% recovery of duplicate
MS-1	451.0302	470.8659	95.78741
MS-2	7.559702	4.915739	65.02556

Spike recovery

ID	Conc. spike	Volume sample	Conc. sample	Volume Standard	Conc. standard	Volume total	% recovery of spike
MS-1, before	132.2803	100	45.10302	10	1000	110	100.4054
MS-1, after	128.7079	50	45.10302	5	1000	55	94.27569

Ammonium nitrogen



008281

SPECTROPHOTOMETRIC ANALYSIS DATA CALCULATION

ANALYSIS: AWD 9301

TECH: JMM

DATE: 12/17/93

543 nm

FILE: AWDNIT2.wk1

100 ppm

STANDARD CURVE CALCULATION

(Enter data in a12..a16 and c12..c16, then DRG to calculate.)

STANDARD

CONCENTRATION	ABSORBANCE	LR
0	0	-0.00142
0.5	0.031	0.028488
1	0.05	0.058393
1.5	0.093	0.088299
2	0.115	0.118205
2.5	0.152	0.148111
3.5	0.207	0.207922

Regression Output:

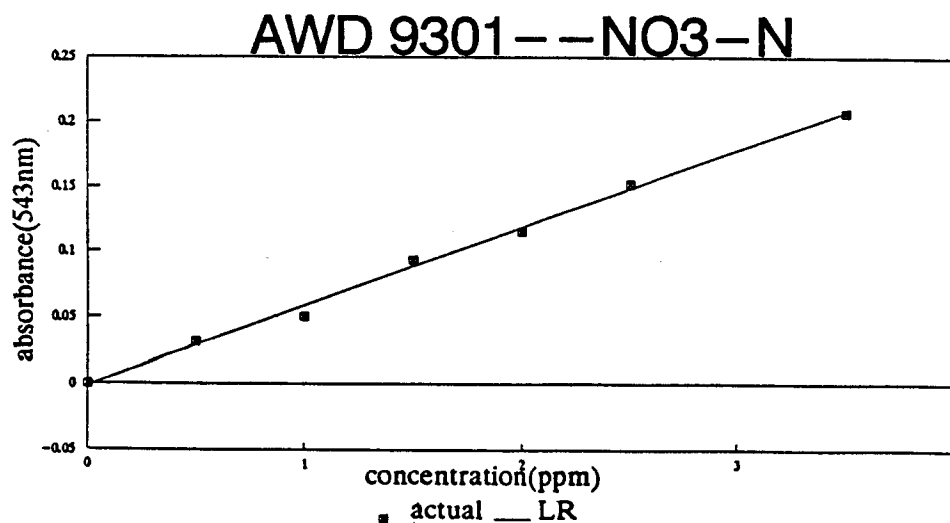
Constant	-0.00142
Std Err of Y Est	0.005042
R Squared	0.995939
No. of Observations	7
Degrees of Freedom	5
X Coefficient(s)	0.059811
Std Err of Coef.	0.001708

SAMPLES ID	<enter> ABSORBANCE	APPARENT CONCENTRATION	DILUTION FACTOR	REPORTED CONCENTRATION
MS1	0.019	0.34	10	3.009456
MS2	0.018	0.32	10	2.842264
MS2 Dup.	0.025	0.44	10	4.012608
Spike	0.149	2.51	10	24.74442
Blank	0.001	0.04	1	0.040428

QUALITY CONTROL

conc. spike	volume sample	conc. sample	volume standard	conc. standard	volume total	% recovery of spike
2.514869	40	0.324654	1	100	41	90.12348

Sample concentration	Duplicate concentration	% recovery of duplicate
2.84	4.01	141.18



SPECTROPHOTOMETRIC ANALYSIS DATA CALCULATION

ANALYSIS: PO4-P

TECH: JMM

DATE: 12/22/83 625 nm

File: AWDPHOS3.wk1

008282

STANDARD CURVE CALCULATION

(Enter data in a12..a16 and c12..c16, then DRG to calculate.)

STANDARD

CONCENTRATION

ABSORBANCE

LR

0	0	0.012845
0.1	0.044	0.078882
0.2	0.188	0.14492
0.4	0.288	0.276994
0.8	0.557	0.541142
1	0.651	0.673216

Regression Output:

Constant	0.012845
Std Err of Y Est	0.032031
R Squared	0.988492
No. of Observations	6
Degrees of Freedom	4
X Coefficient(s)	0.660371
Std Err of Coef.	0.035626

SAMPLES
ID<enter>
ABSORBANCEAPPARENT
CONCENTRATIONDILUTION
FACTORREPORTED
CONCENTRATION

MS1	0.081	0.10	100	10.32066
MS2	0.202	0.29	100	28.64369
MS1 Dup.	0.073	0.09	100	9.109217
Spike, ms1 (1 mL 50 ppm added to 25 mL, before extraction)	0.171	0.24	100	23.94936
Spike, ms1 (0.5 mL 50 ppm added to 10 mL, after extraction)	0.248	0.36	100	35.60947
Blank	-0.023	-0.05	10	-0.54281

QUALITY CONTROL

conc. spike	volume sample	conc. sample	volume standard	conc. standard	volume total	% recovery of spike
2.394936	25	1.032066	1	50	26	72.93337
3.560947	10	1.032066	0.5	50	10.5	108.2771

Sample concentration	Duplicate concentration	% recovery of duplicate
10.32	9.11	88.26

AWD 9301 -- PO4-P

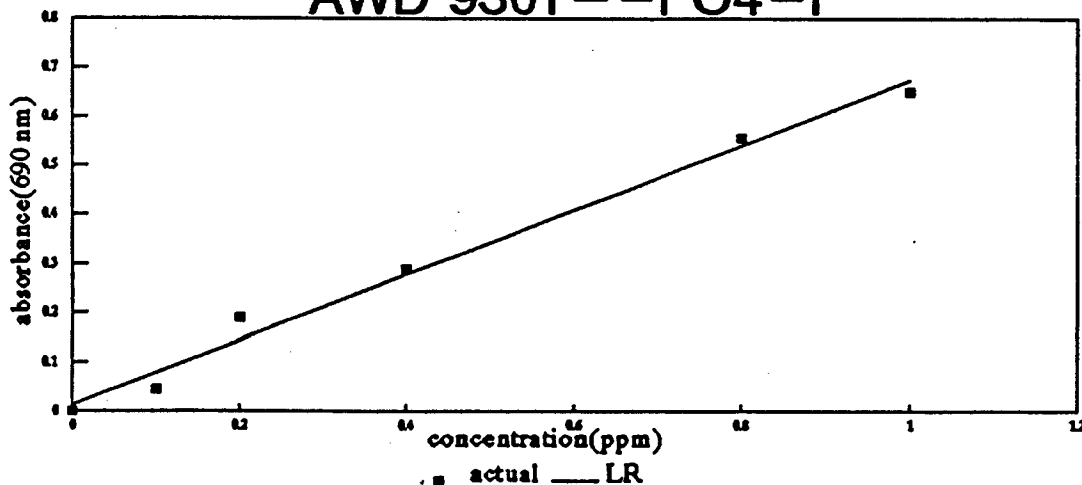


PLATE COUNT

DATE: 12/15/93
 PROJECT: AWD 9301
 TECH: JMM

METHODOLOGY: Total plate count

ID	PLATE COUNT	AVERAGE COUNT	DILUTION	CFU (per gram) (wet wt)	Dry/wet	CFU (per gram) (dry wt)
MS-1	157 161	156.333	2.00E-03	7.82E+05	0.8345	9.4E+05
MS-1 Duplicate	116 131	122.333	2.00E-03	6.12E+05	0.8345	7.3E+05
MS-2	43 34	38.3333	2.00E-05	1.92E+07	0.7982	2.4E+07
MS-2	327 300	315	2.00E-04	1.58E+07	0.7982	2.0E+07
Blank	0	0	0.00E+00	0.00E+00		

008283

FIELD MOISTURE CAPACITY
 SAMPLE SOURCE: AWD9301
 DATE 11/17/93
 TECH JMM

FIELD MOISTURE CAPACITY

#	Tare	Tare + wet solids	Net wet	Tare + dry solids	Net dry	Field Moisture Capacity (% dry wt)	Average (% dry wt)
MS2	38.9345	43.2397	4.3052	42.6995	3.7650	14.35	14.25
MS2(dup)	36.3151	40.6399	4.3248	40.1039	3.7888	14.15	
MS-1	36.4079	41.6897	5.2818	40.1399	3.7320	41.53	41.78
MS-1(Dup)	36.2568	40.6327	4.3759	39.3376	3.0808	42.04	

008284

Test ID:

008285
12/15/93

UNITS-

pH

Electrode Used

Temp. (Room)

meter S/N

Calibration

Slope

Int.

Cor. Cef.

tech:

date:

QC:

date: _____

12/15/93

sf ID

Electrochemical Analysis

AWP 8301

Test Sheet

UNITS

For the (T)ty

microphone

[illegible]

Electrode Used

Temp. (Room)

meter S/N

Calibration

[illegible]Slope

1260

Int.

Cor. Cef.

tech:

date:

QC:

date:

008287

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY #35711

SEND DATA TO:

NAME: Mr. John Forsyph
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyph
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 891-2170

PO #

=====

LABEL DESCRIPTION: PROJECT # AWD 9301
TASK NUMBER: AWD9301

SAMPLED BY: JOHN FORSYPH
LOCATION: TEST PIT 3A-1
DATE: 02/22/94
TIME: 3:25 PM

YES

GRAB SAMPLES ?
COMPOSITE SAMPLES ?
ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

YES

=====

RECEIVED BY LAB:	DATE: 22-FEB-94	TIME: 4:05 PM	ANALYST: R. SMOLENAK
ANALYSIS STARTED:	DATE: 23-FEB-94	TIME: 6:04 PM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 24-FEB-94	TIME: 11:03 AM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
TEST PIT	VOLATILE SCAN	SEE ATTACHED DATA		SW-8260	35711
3A-1 AWD					
SOIL SAMPLE					

008288

MANAGER:

Stephanie OlsonDATE: Feb 24, 1994LOW3A-1

SW-846 METHOD 8260*	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<1000	ug/Kg	1000
vinyl chloride	<1000	ug/Kg	1000
bromomethane	<1000	ug/Kg	1000
chloroethane	<1000	ug/Kg	1000
trichlorofluoromethane	<100	ug/Kg	100
1,1-dichloroethene	<100	ug/Kg	100
methylene chloride	2700	ug/Kg	100
trans-1,2-dichloroethene	<100	ug/Kg	100
1,1-dichloroethane	<100	ug/Kg	100
chloroform	<100	ug/Kg	100
1,2-dichloroethane	<100	ug/Kg	100
1,1,1-trichloroethane	<100	ug/Kg	100
carbon tetrachloride	<100	ug/Kg	100
benzene	<100	ug/Kg	100
trichloroethene	100	ug/Kg	100
1,2-dichloropropane	<100	ug/Kg	100
bromodichloromethane	<100	ug/Kg	100
cis-1,3-dichloropropene	<100	ug/Kg	100
trans-1,3-dichloropropene	<100	ug/Kg	100
1,1,2-trichloroethane	<100	ug/Kg	100
dibromochloromethane	<100	ug/Kg	100
bromoform	<100	ug/Kg	100
toluene	<100	ug/Kg	100
tetrachloroethene	<100	ug/Kg	100
chlorobenzene	<100	ug/Kg	100
ethylbenzene	300	ug/Kg	100
m/p-xylene	<100	ug/Kg	100
o-xylene	<100	ug/Kg	100
1,1,2,2-tetrachloroethane	<100	ug/Kg	100
1,3-dichlorobenzene	<100	ug/Kg	100
1,4-dichlorobenzene	<100	ug/Kg	100
1,2-dichlorobenzene	<100	ug/Kg	100

* Sample was prepared by SW-846 method 5030.

The analysis for GC/MS volatiles was performed by

MRD

on 2/23/94

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY #35712

SEND DATA TO:

NAME: Mr. John Forsyph
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9893
FAX: (610) 891-2170

BILL TO:

NAME: Mr. John Forsyph
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PO #

=====

LABEL DESCRIPTION: PROJECT # AWD 9301
TASK NUMBER: AWD9301

SAMPLED BY: JOHN FORSYPH
LOCATION: TEST PIT 3A-2
DATE: 02/22/94
TIME: 3:25 PM

YES

GRAB SAMPLES ?
COMPOSITE SAMPLES ?
ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

YES

=====

RECEIVED BY LAB:	DATE: 22-FEB-94	TIME: 4:05 PM	ANALYST: R. SMOLENAK
ANALYSIS STARTED:	DATE: 23-FEB-94	TIME: 6:04 PM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 24-FEB-94	TIME: 11:03 AM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
TEST PIT 3A-2 AWD SOIL SAMPLE	VOLATILE SCAN	SEE ATTACHED DATA		SW-8260	35712

BENCHMARK ANALYTICS ANALYSIS REPORT
1776 Main Street, Hellertown, PA 18055-1021

008290

SAMPLE : #35712 BIOSCIENCE

SW-846 METHOD 8260*	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<1000	ug/Kg	1000
vinyl chloride	<1000	ug/Kg	1000
bromomethane	<1000	ug/Kg	1000
chloroethane	<1000	ug/Kg	1000
trichlorofluoromethane	<100	ug/Kg	100
1,1-dichloroethene	<100	ug/Kg	100
methylene chloride	2500	ug/Kg	100
trans-1,2-dichloroethene	<100	ug/Kg	100
1,1-dichloroethane	<100	ug/Kg	100
chloroform	<100	ug/Kg	100
1,2-dichloroethane	<100	ug/Kg	100
1,1,1-trichloroethane	<100	ug/Kg	100
carbon tetrachloride	<100	ug/Kg	100
benzene	<100	ug/Kg	100
trichloroethene	100	ug/Kg	100
1,2-dichloropropane	<100	ug/Kg	100
bromodichloromethane	<100	ug/Kg	100
cis-1,3-dichloropropene	<100	ug/Kg	100
trans-1,3-dichloropropene	<100	ug/Kg	100
1,1,2-trichloroethane	<100	ug/Kg	100
dibromochloromethane	<100	ug/Kg	100
bromoform	<100	ug/Kg	100
toluene	<100	ug/Kg	100
tetrachloroethene	<100	ug/Kg	100
chlorobenzene	<100	ug/Kg	100
ethylbenzene	300	ug/Kg	100
m/p-xylene	<100	ug/Kg	100
o-xylene	<100	ug/Kg	100
1,1,2,2-tetrachloroethane	<100	ug/Kg	100
1,3-dichlorobenzene	<100	ug/Kg	100
1,4-dichlorobenzene	<100	ug/Kg	100
1,2-dichlorobenzene	<100	ug/Kg	100

* Sample was prepared by SW-846 method 5030.

The analysis for GC/MS volatiles was performed by

MRD

on

2/23/94

008291

FEB 24 '94 05:12PM BENCHMARK ANALYTICS

P.1-3

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

INVENTORY #35713

PHONE (610) 974-8100
FAX (610) 974-8104

SEND DATA TO:

NAME: Mr. John Forsyph
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyph
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION: PROJECT # AWD 9301
TASK NUMBER: AWD9301

SAMPLED BY: JOHN FORSYPH
LOCATION: TEST PIT 3A-3
DATE: 02/22/94
TIME: 3:30 PM

YES GRAB SAMPLES ?
____ COMPOSITE SAMPLES ?
____ ROUTINE DISTRIBUTION
YES CHAIN OF CUSTODY ?

=====

RECEIVED BY LAB:	DATE: 22-FEB-94	TIME: 4:05 PM	ANALYST: R. SMOLENAK
ANALYSIS STARTED:	DATE: 23-FEB-94	TIME: 6:04 PM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 24-FEB-94	TIME: 11:03 AM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
TEST PIT	VOLATILE SCAN	SEE ATTACHED DATA		SW-8260	35713
3A-3 AWD					
SOIL SAMPLE					

FEB 24 1994

BENCHMARK ANALYTICS ANALYSIS REPORT
1776 Main Street, Hellertown, PA 18055-1021

SAMPLE : #35713 BIOSCIENCE

SW-846 METHOD 8260*	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<1000	ug/Kg	1000
vinyl chloride	<1000	ug/Kg	1000
bromomethane	<1000	ug/Kg	1000
chloroethane	<1000	ug/Kg	1000
trichlorofluoromethane	<100	ug/Kg	100
1,1-dichloroethene	<100	ug/Kg	100
methylene chloride	1500	ug/Kg	100
trans-1,2-dichloroethene	<100	ug/Kg	100
1,1-dichloroethane	<100	ug/Kg	100
chloroform	<100	ug/Kg	100
1,2-dichloroethane	<100	ug/Kg	100
1,1,1-trichloroethane	<100	ug/Kg	100
carbon tetrachloride	<100	ug/Kg	100
benzene	<100	ug/Kg	100
trichloroethene	200	ug/Kg	100
1,2-dichloropropane	<100	ug/Kg	100
bromodichloromethane	<100	ug/Kg	100
cis-1,3-dichloropropene	<100	ug/Kg	100
trans-1,3-dichloropropene	<100	ug/Kg	100
1,1,2-trichloroethane	<100	ug/Kg	100
dibromochloromethane	<100	ug/Kg	100
bromoform	<100	ug/Kg	100
toluene	<100	ug/Kg	100
tetrachloroethene	<100	ug/Kg	100
chlorobenzene	<100	ug/Kg	100
ethylbenzene	400	ug/Kg	100
m/p-xylene	<100	ug/Kg	100
o-xylene	<100	ug/Kg	100
1,1,2,2-tetrachloroethane	<100	ug/Kg	100
1,3-dichlorobenzene	<100	ug/Kg	100
1,4-dichlorobenzene	<100	ug/Kg	100
1,2-dichlorobenzene	<100	ug/Kg	100

* Sample was prepared by SW-846 method 5030.

The analysis for GC/MS volatiles was performed by

MRD

on

2/23/94

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY #35708

SEND DATA TO:

NAME: Mr. John Forsyph
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyph
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION: PROJECT # AWD 9301
TASK NUMBER: AWD9301

SAMPLED BY: JOHN FORSYPH
LOCATION: TEST PIT 1A-1
DATE: 02/22/94
TIME: 3:15 PM

YES

GRAB SAMPLES ?
COMPOSITE SAMPLES ?
ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

YES

=====

RECEIVED BY LAB:	DATE: 22-FEB-94	TIME: 4:05 PM	ANALYST: R. SMOLENAK
ANALYSIS STARTED:	DATE: 23-FEB-94	TIME: 6:04 PM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 24-FEB-94	TIME: 11:03 AM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
TEST PIT	VOLATILE SCAN	SEE ATTACHED DATA		SW-8260	35708
1A-1 AWD					
SOIL SAMPLE					

MANAGER:

Stephanie Olyen

DATE: Feb 24, 1994

BENCHMARK ANALYTICS ANALYSIS REPORT
1776 Main Street, Hellertown, PA 18055-1021

SAMPLE : #35708 BIOSCIENCE

SW-846 METHOD 8260*	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<1000	ug/Kg	1000
vinyl chloride	<1000	ug/Kg	1000
bromomethane	<1000	ug/Kg	1000
chloroethane	<1000	ug/Kg	1000
trichlorofluoromethane	<100	ug/Kg	100
1,1-dichloroethene	<100	ug/Kg	100
methylene chloride	2000	ug/Kg	100
trans-1,2-dichloroethene	<100	ug/Kg	100
1,1-dichloroethane	<100	ug/Kg	100
chloroform	<100	ug/Kg	100
1,2-dichloroethane	<100	ug/Kg	100
1,1,1-trichloroethane	<100	ug/Kg	100
carbon tetrachloride	<100	ug/Kg	100
benzene	<100	ug/Kg	100
trichloroethene	1000	ug/Kg	100
1,2-dichloropropane	<100	ug/Kg	100
bromodichloromethane	<100	ug/Kg	100
cis-1,3-dichloropropene	<100	ug/Kg	100
trans-1,3-dichloropropene	<100	ug/Kg	100
1,1,2-trichloroethane	<100	ug/Kg	100
dibromochloromethane	<100	ug/Kg	100
bromoform	<100	ug/Kg	100
toluene	<100	ug/Kg	100
tetrachloroethene	<100	ug/Kg	100
chlorobenzene	<100	ug/Kg	100
ethylbenzene	<100	ug/Kg	100
m/p-xylene	<100	ug/Kg	100
o-xylene	<100	ug/Kg	100
1,1,2,2-tetrachloroethane	<100	ug/Kg	100
1,3-dichlorobenzene	<100	ug/Kg	100
1,4-dichlorobenzene	<100	ug/Kg	100
1,2-dichlorobenzene	<100	ug/Kg	100

* Sample was prepared by SW-846 method 5030.

The analysis for GC/MS volatiles was performed by

MRD

on

2/23/94

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY #35709

SEND DATA TO:

NAME: Mr. John Forsyph
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

BILL TO:

NAME: Mr. John Forsyph
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PO #

=====

LABEL DESCRIPTION: PROJECT # AWD 9301
TASK NUMBER: AWD9301

SAMPLED BY: JOHN FORSYPH
LOCATION: TEST PIT 1A-2
DATE: 02/22/94
TIME: 3:15 PM

YES

GRAB SAMPLES ?
COMPOSITE SAMPLES ?
ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

YES

=====

RECEIVED BY LAB:	DATE: 22-FEB-94	TIME: 4:05 PM	ANALYST: R. SMOLENAK
ANALYSIS STARTED:	DATE: 23-FEB-94	TIME: 6:04 PM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 24-FEB-94	TIME: 11:03 AM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
TEST PIT	VOLATILE SCAN	SEE ATTACHED DATA		SW-8260	35709
1A-2 AWD					
SOIL SAMPLE					

MANAGER:

Stephanie Olsen

DATE:

Feb 24, 1994

BENCHMARK ANALYTICS ANALYSIS REPORT
1776 Main Street, Hellertown, PA 18055-1021

SAMPLE : #35709 BIOSCIENCE **1A-2**

SW-846 METHOD 8260*	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<1000	ug/Kg	1000
vinyl chloride	<1000	ug/Kg	1000
bromomethane	<1000	ug/Kg	1000
chloroethane	<1000	ug/Kg	1000
trichlorofluoromethane	<100	ug/Kg	100
1,1-dichloroethene	<100	ug/Kg	100
methylene chloride	2400	ug/Kg	100
trans-1,2-dichloroethene	<100	ug/Kg	100
1,1-dichloroethane	<100	ug/Kg	100
chloroform	<100	ug/Kg	100
1,2-dichloroethane	<100	ug/Kg	100
1,1,1-trichloroethane	<100	ug/Kg	100
carbon tetrachloride	<100	ug/Kg	100
benzene	<100	ug/Kg	100
trichloroethene	860	ug/Kg	100
1,2-dichloropropane	<100	ug/Kg	100
bromodichloromethane	<100	ug/Kg	100
cis-1,3-dichloropropene	<100	ug/Kg	100
trans-1,3-dichloropropene	<100	ug/Kg	100
1,1,2-trichloroethane	<100	ug/Kg	100
dibromochloromethane	<100	ug/Kg	100
bromoform	<100	ug/Kg	100
toluene	100	ug/Kg	100
tetrachloroethene	<100	ug/Kg	100
chlorobenzene	<100	ug/Kg	100
ethylbenzene	<100	ug/Kg	100
m/p-xylene	<100	ug/Kg	100
o-xylene	<100	ug/Kg	100
1,1,2,2-tetrachloroethane	<100	ug/Kg	100
1,3-dichlorobenzene	<100	ug/Kg	100
1,4-dichlorobenzene	<100	ug/Kg	100
1,2-dichlorobenzene	<100	ug/Kg	100

* Sample was prepared by SW-846 method 5030.
 The analysis for GC/MS volatiles was performed by

MRD on 2/23/94

008297

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY #35710

SEND DATA TO:

NAME: Mr. John Forsyph
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

BILL TO:
NAME: Mr. John Forsyph
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PO #

=====

LABEL DESCRIPTION: PROJECT # AWD 9301
TASK NUMBER: AWD9301

SAMPLED BY: JOHN FORSYPH
LOCATION: TEST PIT 1A-3
DATE: 02/22/94
TIME: 3:20 PM

YES

GRAB SAMPLES ?
COMPOSITE SAMPLES ?
ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

YES

=====

RECEIVED BY LAB:	DATE: 22-FEB-94	TIME: 4:05 PM	ANALYST: R. SMOLENAK
ANALYSIS STARTED:	DATE: 23-FEB-94	TIME: 6:04 PM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 24-FEB-94	TIME: 11:03 AM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
TEST PIT 1A-3 AWD SOIL SAMPLE	VOLATILE SCAN	SEE ATTACHED DATA		SW-8260	35710

=====

MANAGER:

Stephen Ohta

DATE:

Feb 24, 1994

BENCHMARK ANALYTICS ANALYSIS REPORT
1776 Main Street, Hellertown, PA 18055-1021

SAMPLE : #35710 BIOSCIENCE

SW-846 METHOD 8260*	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<1000	ug/Kg	1000
vinyl chloride	<1000	ug/Kg	1000
bromomethane	<1000	ug/Kg	1000
chloroethane	<1000	ug/Kg	1000
trichlorofluoromethane	<100	ug/Kg	100
1,1-dichloroethene	<100	ug/Kg	100
methylene chloride	1600	ug/Kg	100
trans-1,2-dichloroethene	<100	ug/Kg	100
1,1-dichloroethane	<100	ug/Kg	100
chloroform	<100	ug/Kg	100
1,2-dichloroethane	<100	ug/Kg	100
1,1,1-trichloroethane	<100	ug/Kg	100
carbon tetrachloride	<100	ug/Kg	100
benzene	<100	ug/Kg	100
trichloroethene	1700	ug/Kg	100
1,2-dichloropropane	<100	ug/Kg	100
bromodichloromethane	<100	ug/Kg	100
cis-1,3-dichloropropene	<100	ug/Kg	100
trans-1,3-dichloropropene	<100	ug/Kg	100
1,1,2-trichloroethane	<100	ug/Kg	100
dibromochloromethane	<100	ug/Kg	100
bromoform	<100	ug/Kg	100
toluene	200	ug/Kg	100
tetrachloroethene	<100	ug/Kg	100
chlorobenzene	<100	ug/Kg	100
ethylbenzene	<100	ug/Kg	100
m/p-xylene	<100	ug/Kg	100
o-xylene	<100	ug/Kg	100
1,1,2,2-tetrachloroethane	<100	ug/Kg	100
1,3-dichlorobenzene	<100	ug/Kg	100
1,4-dichlorobenzene	<100	ug/Kg	100
1,2-dichlorobenzene	<100	ug/Kg	100

* Sample was prepared by SW-846 method 5030.

The analysis for GC/MS volatiles was performed by MRD on 2/23/94

008299

BIOPILE SIMULATION

008300

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

INVENTORY # 36903

PHONE (610) 974-8100
FAX (610) 974-8104

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

LABEL DESCRIPTION: PROJECT # AWD
PROJECT #: AWD9301

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/24/94
TIME: 12:00 PM

GRAB SAMPLES ?
COMPOSITE SAMPLES ?
ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

RECEIVED BY LAB: DATE: 25-MAR-94 TIME: 4:10 PM ANALYST: J. ALTEMOSE
ANALYSIS STARTED: DATE: 30-MAR-94 TIME: 8:00 AM ANALYST: MD
ANALYSIS COMPLETED: DATE: 05-APR-94 TIME: 10:13 AM ANALYST: MD

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
CO324 BP-1	VOLATILE SCAN	SEE ATTACHED DATA		SW-8010/8020	36903

MANAGER:

Stephen O'Brien

DATE:

April 6, 1994

008301

BENCHMARK ANALYTICS ANALYSIS REPORT

1776 Main Street, Hellertown, PA 18055-1021

SAMPLE : #36903 BIO-SCIENCE 1:40

SW METHOD 8260*	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<400	ug/Kg	400
vinyl chloride	<400	ug/Kg	400
bromomethane	<400	ug/Kg	400
chloroethane	<400	ug/Kg	400
trichlorofluoromethane	30	ug/Kg	J 40
1,1-dichloroethene	<40	ug/Kg	40
methylene chloride	<40	ug/Kg	B 40
trans-1,2-dichloroethene	<40	ug/Kg	40
1,1-dichloroethane	<40	ug/Kg	40
chloroform	<40	ug/Kg	40
1,2-dichloroethane	<40	ug/Kg	40
1,1,1-trichloroethane	<40	ug/Kg	40
carbon tetrachloride	<40	ug/Kg	40
benzene	<40	ug/Kg	40
trichloroethene	30	ug/Kg	J 40
1,2-dichloropropane	<40	ug/Kg	40
bromodichloromethane	<40	ug/Kg	40
cis-1,3-dichloropropene	<40	ug/Kg	40
trans-1,3-dichloropropene	<40	ug/Kg	40
1,1,2-trichloroethane	<40	ug/Kg	40
dibromochloromethane	<40	ug/Kg	40
bromoform	<40	ug/Kg	40
toluene	<40	ug/Kg	40
tetrachloroethene	<40	ug/Kg	40
chlorobenzene	<40	ug/Kg	40
ethylbenzene	30	ug/Kg	J 40
m/p-xylene	20	ug/Kg	J 40
o-xylene	<40	ug/Kg	40
1,1,2,2-tetrachloroethane	<40	ug/Kg	40
1,3-dichlorobenzene	<40	ug/Kg	40
1,4-dichlorobenzene	<40	ug/Kg	40
1,2-dichlorobenzene	<40	ug/Kg	40

J = Indicates an estimated value. Result is less than the sample quantitation limit and greater than the method detection limit.

B = Compound found in the blank. See soil blank report.

* Sample was prepared by SW-846 method 5030.

The analysis for GC/MS volatiles was performed by MRD on 04/04/94

008302

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

INVENTORY # 36904

PHONE (610) 974-8100
FAX (610) 974-8104

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION: PROJECT # AWD
PROJECT #: AWD9301

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/24/94
TIME: 12:00 PM

GRAB SAMPLES ?

COMPOSITE SAMPLES ?

ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

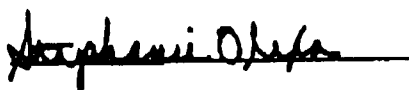
=====

RECEIVED BY LAB:	DATE:	25-MAR-94	TIME:	4:10 PM	ANALYST:	J. ALTEMOSE
ANALYSIS STARTED:	DATE:	30-MAR-94	TIME:	8:00 AM	ANALYST:	MD
ANALYSIS COMPLETED:	DATE:	05-APR-94	TIME:	10:13 AM	ANALYST:	MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
CO324 BP-2	VOLATILE SCAN	SEE ATTACHED DATA		SW-8010/8020	36904

MANAGER:



DATE:

April 6, 1994

BENCHMARK ANALYTICS ANALYSIS REPORT
1776 Main Street, Hellertown, PA 18055-1021

SAMPLE : #36904 BIO-SCIENCE 1:40

SW METHOD 8260*	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<400	ug/Kg	400
vinyl chloride	<400	ug/Kg	400
bromomethane	<400	ug/Kg	400
chloroethane	<400	ug/Kg	400
trichlorofluoromethane	<40	ug/Kg	40
1,1-dichloroethene	<40	ug/Kg	40
methylene chloride	50	ug/Kg	40
trans-1,2-dichloroethene	<40	ug/Kg	40
1,1-dichloroethane	<40	ug/Kg	40
chloroform	<40	ug/Kg	40
1,2-dichloroethane	<40	ug/Kg	40
1,1,1-trichloroethane	<40	ug/Kg	40
carbon tetrachloride	<40	ug/Kg	40
benzene	<40	ug/Kg	40
trichloroethene	80	ug/Kg	40
1,2-dichloropropane	<40	ug/Kg	40
bromodichloromethane	<40	ug/Kg	40
cis-1,3-dichloropropene	<40	ug/Kg	40
trans-1,3-dichloropropene	<40	ug/Kg	40
1,1,2-trichloroethane	<40	ug/Kg	40
dibromochloromethane	<40	ug/Kg	40
bromoform	<40	ug/Kg	40
toluene	<40	ug/Kg	40
tetrachloroethene	<40	ug/Kg	40
chlorobenzene	<40	ug/Kg	40
ethylbenzene	<40	ug/Kg	40
m/p-xylene	<40	ug/Kg	40
o-xylene	<40	ug/Kg	40
1,1,2,2-tetrachloroethane	<40	ug/Kg	40
1,3-dichlorobenzene	<40	ug/Kg	40
1,4-dichlorobenzene	<40	ug/Kg	40
1,2-dichlorobenzene	<40	ug/Kg	40

B = Compound found in the blank. See soil blank report.

* Sample was prepared by SW-846 method 5030.

The analysis for GC/MS volatiles was performed by

MRD on 04/04/94

008304

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY # 36905

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION: PROJECT # AWD
PROJECT #: AWD9301

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/24/94
TIME: 12:00 PM

GRAB SAMPLES ?
COMPOSITE SAMPLES ?
ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

YES

=====

RECEIVED BY LAB:	DATE: 25-MAR-94	TIME: 4:10 PM	ANALYST: J. ALTEMOSE
ANALYSIS STARTED:	DATE: 30-MAR-94	TIME: 8:00 AM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 05-APR-94	TIME: 10:13 AM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
CO324 BP-3	VOLATILE SCAN	SEE ATTACHED DATA		SW-8010/8020	36905

=====

MANAGER:

Stephenie Olsen

DATE:

April 6, 1994

008305

BENCHMARK ANALYTICS ANALYSIS REPORT

1776 Main Street, Hellertown, PA 18055-1021

SAMPLE : #36905 BIO-SCIENCE 1:40

SW METHOD 8260*	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<400	ug/Kg	400
vinyl chloride	<400	ug/Kg	400
bromomethane	<400	ug/Kg	400
chloroethane	<400	ug/Kg	400
trichlorofluoromethane	<40	ug/Kg	40
1,1-dichloroethene	<40	ug/Kg	40
methylene chloride	50	ug/Kg	40
trans-1,2-dichloroethene	<40	ug/Kg	40
1,1-dichloroethane	<40	ug/Kg	40
chloroform	<40	ug/Kg	40
1,2-dichloroethane	<40	ug/Kg	40
1,1,1-trichloroethane	<40	ug/Kg	40
carbon tetrachloride	<40	ug/Kg	40
benzene	<40	ug/Kg	40
trichloroethene	60	ug/Kg	40
1,2-dichloropropane	<40	ug/Kg	40
bromodichloromethane	<40	ug/Kg	40
cis-1,3-dichloropropene	<40	ug/Kg	40
trans-1,3-dichloropropene	<40	ug/Kg	40
1,1,2-trichloroethane	<40	ug/Kg	40
dibromochloromethane	<40	ug/Kg	40
bromoform	<40	ug/Kg	40
toluene	<40	ug/Kg	40
tetrachloroethene	<40	ug/Kg	40
chlorobenzene	<40	ug/Kg	40
ethylbenzene	40	ug/Kg	40
m/p-xylene	<40	ug/Kg	40
o-xylene	<40	ug/Kg	40
1,1,2,2-tetrachloroethane	<40	ug/Kg	40
1,3-dichlorobenzene	<40	ug/Kg	40
1,4-dichlorobenzene	<40	ug/Kg	40
1,2-dichlorobenzene	<40	ug/Kg	40

J = Indicates an estimated value. Result is less than the sample quantitation limit and greater than the method detection limit.

B = Compound found in the blank. See soil blank report.

* Sample was prepared by SW-846 method 5030.

The analysis for GC/MS volatiles was performed by

MRD

on

04/04/94

008306

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

INVENTORY # 36906

PHONE (610) 974-8100
FAX (610) 974-8104

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION: PROJECT # AWD
PROJECT #: AWD9301

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/24/94
TIME: 12:00 PM

GRAB SAMPLES ?

COMPOSITE SAMPLES ?

ROUTINE DISTRIBUTION

CHAIN OF CUSTODY ?

=====

RECEIVED BY LAB:	DATE: 25-MAR-94	TIME: 4:10 PM	ANALYST: J. ALTEMOSE
ANALYSIS STARTED:	DATE: 30-MAR-94	TIME: 8:00 AM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 05-APR-94	TIME: 10:13 AM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
CO324	VOLATILE SCAN	SEE ATTACHED DATA		SW-8010/8020	36906
BP-4					

MANAGER:

*Stephenie Oly*DATE: *April 6, 1994*

008307

BENCHMARK ANALYTICS ANALYSIS REPORT **1776 Main Street, Hellertown, PA 18055-1021**

SAMPLE : #36906 BIO-SCIENCE 1:40

SW METHOD 8260*	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<400	ug/Kg	400
vinyl chloride	<400	ug/Kg	400
bromomethane	<400	ug/Kg	400
chloroethane	<400	ug/Kg	400
trichlorofluoromethane	<40	ug/Kg	40
1,1-dichloroethene	<40	ug/Kg	40
methylene chloride	80	ug/Kg	40
trans-1,2-dichloroethene	<40	ug/Kg	40
1,1-dichloroethane	<40	ug/Kg	40
chloroform	<40	ug/Kg	40
1,2-dichloroethane	<40	ug/Kg	40
1,1,1-trichloroethane	<40	ug/Kg	40
carbon tetrachloride	<40	ug/Kg	40
benzene	<40	ug/Kg	40
trichloroethene	<40	ug/Kg	40
1,2-dichloropropane	<40	ug/Kg	40
bromodichloromethane	<40	ug/Kg	40
cis-1,3-dichloropropene	<40	ug/Kg	40
trans-1,3-dichloropropene	<40	ug/Kg	40
1,1,2-trichloroethane	<40	ug/Kg	40
dibromochloromethane	<40	ug/Kg	40
bromoform	<40	ug/Kg	40
toluene	<40	ug/Kg	40
tetrachloroethene	<40	ug/Kg	40
chlorobenzene	<40	ug/Kg	40
ethylbenzene	<40	ug/Kg	40
m/p-xylene	<40	ug/Kg	40
o-xylene	<40	ug/Kg	40
1,1,1,2-tetrachloroethane	<40	ug/Kg	40
1,3-dichlorobenzene	<40	ug/Kg	40
1,4-dichlorobenzene	<40	ug/Kg	40
1,2-dichlorobenzene	<40	ug/Kg	40

B

B = Compound found in the blank. See soil blank report.

* Sample was prepared by SW-846 method 5030.

The analysis for GC/MS volatiles was performed by MRD on 04/04/94

008308

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY # 36907

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION: PROJECT # AWD
PROJECT #: AWD9301

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/24/94
TIME: 12:00 PM

YES

GRAB SAMPLES ?
COMPOSITE SAMPLES ?
ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

=====

RECEIVED BY LAB:	DATE: 25-MAR-94	TIME: 4:10 PM	ANALYST: J. ALTEMOSE
ANALYSIS STARTED:	DATE: 30-MAR-94	TIME: 8:00 AM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 05-APR-94	TIME: 10:13 AM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
CO324	VOLATILE SCAN	SEE ATTACHED DATA		SW-8010/8020	36907
BP-5					

MANAGER:

Stephanie O'Hara

DATE:

April 6, 1994

008309

BENCHMARK ANALYTICS ANALYSIS REPORT

1776 Main Street, Hellertown, PA 18055-1021

SAMPLE : #36907 BIO-SCIENCE 1:40

SW METHOD 8260*	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<400	ug/Kg	400
vinyl chloride	<400	ug/Kg	400
bromomethane	<400	ug/Kg	400
chloroethane	<400	ug/Kg	400
trichlorofluoromethane	30	ug/Kg	J 40
1,1-dichloroethene	<40	ug/Kg	40
methylene chloride	60	ug/Kg	B 40
trans-1,2-dichloroethene	<40	ug/Kg	40
1,1-dichloroethane	<40	ug/Kg	40
chloroform	<40	ug/Kg	40
1,2-dichloroethane	<40	ug/Kg	40
1,1,1-trichloroethane	<40	ug/Kg	40
carbon tetrachloride	<40	ug/Kg	40
benzene	<40	ug/Kg	40
trichloroethene	20	ug/Kg	J 40
1,2-dichloropropane	<40	ug/Kg	40
bromodichloromethane	<40	ug/Kg	40
cis-1,3-dichloropropene	<40	ug/Kg	40
trans-1,3-dichloropropene	<40	ug/Kg	40
1,1,2-trichloroethane	<40	ug/Kg	40
dibromochloromethane	<40	ug/Kg	40
bromoform	<40	ug/Kg	40
toluene	<40	ug/Kg	40
tetrachloroethene	<40	ug/Kg	40
chlorobenzene	<40	ug/Kg	40
ethylbenzene	<40	ug/Kg	40
m/p-xylene	<40	ug/Kg	40
o-xylene	<40	ug/Kg	40
1,1,2,2-tetrachloroethane	<40	ug/Kg	40
1,3-dichlorobenzene	<40	ug/Kg	40
1,4-dichlorobenzene	<40	ug/Kg	40
1,2-dichlorobenzene	<40	ug/Kg	40

J = Indicates an estimated value. Result is less than the sample quantitation limit and greater than the method detection limit.

B = Compound found in the blank. See soil blank report.

* Sample was prepared by SW-846 method 5030.

The analysis for GC/MS volatiles was performed by MRD on 04/04/94

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

008310

INVENTORY # 36908

PHONE (610) 974-8100
FAX (610) 974-8104

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION: PROJECT # AWD
PROJECT #: AWD9301

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/24/94
TIME: 12:00 PM

=====

GRAB SAMPLES ?
COMPOSITE SAMPLES ?
ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

YES

=====

RECEIVED BY LAB: DATE: 25-MAR-94
ANALYSIS STARTED: DATE: 30-MAR-94
ANALYSIS COMPLETED: DATE: 05-APR-94

=====

TIME: 4:10 PM
TIME: 8:00 AM
TIME: 10:13 AM

=====

ANALYST: J. ALTEMOSE
ANALYST: MD
ANALYST: MD

=====

SAMPLE TEST
CO324
BP-6

VOLATILE SCAN

=====

RESULT UNITS METHOD REFERENCE #
SEE ATTACHED DATA SW-8010/8020 36908

MANAGER:

*Stephanie O. Hyslop*DATE: *April 6, 1994*

008311

BENCHMARK ANALYTICS ANALYSIS REPORT

1776 Main Street, Hellertown, PA 18055-1021

SAMPLE : #36908 BIO-SCIENCE 1:40

SW METHOD 8260*	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<400	ug/Kg	400
vinyl chloride	<400	ug/Kg	400
bromomethane	<400	ug/Kg	400
chloroethane	<400	ug/Kg	400
trichlorofluoromethane	<40	ug/Kg	40
1,1-dichloroethene	<40	ug/Kg	40
methylene chloride	200	ug/Kg	40
trans-1,2-dichloroethene	<40	ug/Kg	40
1,1-dichloroethane	<40	ug/Kg	40
chloroform	<40	ug/Kg	40
1,2-dichloroethane	<40	ug/Kg	40
1,1,1-trichloroethane	<40	ug/Kg	40
carbon tetrachloride	<40	ug/Kg	40
benzene	<40	ug/Kg	40
trichloroethene	70	ug/Kg	40
1,2-dichloropropane	<40	ug/Kg	40
bromodichloromethane	<40	ug/Kg	40
cis-1,3-dichloropropene	<40	ug/Kg	40
trans-1,3-dichloropropene	<40	ug/Kg	40
1,1,2-trichloroethane	<40	ug/Kg	40
dibromochloromethane	<40	ug/Kg	40
bromoform	<40	ug/Kg	40
toluene	<40	ug/Kg	40
tetrachloroethene	<40	ug/Kg	40
chlorobenzene	<40	ug/Kg	40
ethylbenzene	<40	ug/Kg	40
m/p-xylene	<40	ug/Kg	40
o-xylene	<40	ug/Kg	40
1,1,2,2-tetrachloroethane	<40	ug/Kg	40
1,3-dichlorobenzene	<40	ug/Kg	40
1,4-dichlorobenzene	<40	ug/Kg	40
1,2-dichlorobenzene	<40	ug/Kg	40

B = Compound found in the blank. See soil blank report.

* Sample was prepared by SW-846 method 5030.

The analysis for GC/MS volatiles was performed by

MRD

on

04/04/94

008312

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY # 36909

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 891-2170

PO #

=====

LABEL DESCRIPTION: PROJECT # AWD
PROJECT #: AWD9301

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/24/94
TIME: 12:00 PM

GRAB SAMPLES ?
COMPOSITE SAMPLES ?
ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

YES

=====

RECEIVED BY LAB:	DATE: 25-MAR-94	TIME: 4:10 PM	ANALYST: J. ALTEMOSE
ANALYSIS STARTED:	DATE: 30-MAR-94	TIME: 8:00 AM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 05-APR-94	TIME: 10:13 AM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
CO324 BP-7	VOLATILE SCAN	SEE ATTACHED DATA		SW-8010/8020	36909

=====

MANAGER:

Stephanie O'Leary

DATE:

April 6, 1994

BENCHMARK ANALYTICS ANALYSIS REPORT
1776 Main Street, Hellertown, PA 18055-1021

SAMPLE : #36909 BIO-SCIENCE 1:40

SW METHOD 8260*	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<400	ug/Kg	400
vinyl chloride	<400	ug/Kg	400
bromomethane	<400	ug/Kg	400
chloroethane	<400	ug/Kg	400
trichlorofluoromethane	<40	ug/Kg	40
1,1-dichloroethene	<40	ug/Kg	40
methylene chloride	30	ug/Kg	40
trans-1,2-dichloroethene	<40	ug/Kg	40
1,1-dichloroethane	<40	ug/Kg	40
chloroform	<40	ug/Kg	40
1,2-dichloroethane	<40	ug/Kg	40
1,1,1-trichloroethane	<40	ug/Kg	40
carbon tetrachloride	<40	ug/Kg	40
benzene	<40	ug/Kg	40
trichloroethene	20	ug/Kg	40
1,2-dichloropropane	<40	ug/Kg	40
bromodichloromethane	<40	ug/Kg	40
cis-1,3-dichloropropene	<40	ug/Kg	40
trans-1,3-dichloropropene	<40	ug/Kg	40
1,1,2-trichloroethane	<40	ug/Kg	40
dibromochloromethane	<40	ug/Kg	40
bromoform	<40	ug/Kg	40
toluene	<40	ug/Kg	40
tetrachloroethene	<40	ug/Kg	40
chlorobenzene	<40	ug/Kg	40
ethylbenzene	<40	ug/Kg	40
m/p-xylene	<40	ug/Kg	40
o-xylene	<40	ug/Kg	40
1,1,2,2-tetrachloroethane	<40	ug/Kg	40
1,3-dichlorobenzene	<40	ug/Kg	40
1,4-dichlorobenzene	<40	ug/Kg	40
1,2-dichlorobenzene	<40	ug/Kg	40

J = Indicates an estimated value. Result is less than the sample quantitation limit and greater than the method detection limit.

B = Compound found in the blank. See soil blank report.

* Sample was prepared by SW-846 method 5030.

The analysis for GC/MS volatiles was performed by MRD on 04/04/94

008314

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

INVENTORY # 36910

PHONE (610) 974-8100
FAX (610) 974-8104

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION: PROJECT # AWD
PROJECT #: AWD9301

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/24/94
TIME: 12:00 PM

GRAB SAMPLES ?

COMPOSITE SAMPLES ?

ROUTINE DISTRIBUTION

CHAIN OF CUSTODY ?

YES

=====

RECEIVED BY LAB:	DATE: 25-MAR-94	TIME: 4:10 PM	ANALYST: J. ALTEMOSE
ANALYSIS STARTED:	DATE: 30-MAR-94	TIME: 8:00 AM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 05-APR-94	TIME: 10:13 AM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
CO324	VOLATILE SCAN	SEE ATTACHED DATA		SW-8010/8020	36910
BP-8					

=====

MANAGER:

Stephen Oly

DATE:

April 6, 1994

BENCHMARK ANALYTICS ANALYSIS REPORT **1776 Main Street, Hellertown, PA 18055-1021**

008315

SAMPLE : #36910 BIO-SCIENCE 1:40

SW METHOD 8260*	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<400	ug/Kg	400
vinyl chloride	<400	ug/Kg	400
bromomethane	<400	ug/Kg	400
chloroethane	<400	ug/Kg	400
trichlorofluoromethane	<40	ug/Kg	40
1,1-dichloroethene	<40	ug/Kg	40
methylene chloride	30	ug/Kg	40
trans-1,2-dichloroethene	<40	ug/Kg	40
1,1-dichloroethane	<40	ug/Kg	40
chloroform	<40	ug/Kg	40
1,2-dichloroethane	<40	ug/Kg	40
1,1,1-trichloroethane	<40	ug/Kg	40
carbon tetrachloride	<40	ug/Kg	40
benzene	<40	ug/Kg	40
trichloroethene	70	ug/Kg	40
1,2-dichloropropane	<40	ug/Kg	40
bromodichloromethane	<40	ug/Kg	40
cis-1,3-dichloropropene	<40	ug/Kg	40
trans-1,3-dichloropropene	<40	ug/Kg	40
1,1,2-trichloroethane	<40	ug/Kg	40
dibromochloromethane	<40	ug/Kg	40
bromoform	<40	ug/Kg	40
toluene	<40	ug/Kg	40
tetrachloroethene	<40	ug/Kg	40
chlorobenzene	<40	ug/Kg	40
ethylbenzene	<40	ug/Kg	40
m/p-xylene	<40	ug/Kg	40
o-xylene	<40	ug/Kg	40
1,1,2,2-tetrachloroethane	<40	ug/Kg	40
1,3-dichlorobenzene	<40	ug/Kg	40
1,4-dichlorobenzene	<40	ug/Kg	40
1,2-dichlorobenzene	<40	ug/Kg	40

B J

J = Indicates an estimated value. Result is less than the sample quantitation limit and greater than the method detection limit.

B = Compound found in the blank. See soil blank report.

* Sample was prepared by SW-846 method 5030.

The analysis for GC/MS volatiles was performed by

MRD

on

04/04/94

008316

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY # 36911

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION: PROJECT # AWD
PROJECT #: AWD9301

SAMPLED BY: MAGARET TSAO

LOCATION: SEE BELOW

DATE: 03/24/94

TIME: 12:00 PM

☐ GRAB SAMPLES ?☐ COMPOSITE SAMPLES ?☐ ROUTINE DISTRIBUTION☒ YES☐ CHAIN OF CUSTODY ?

=====

RECEIVED BY LAB:	DATE: 25-MAR-94	TIME: 4:10 PM	ANALYST: J. ALTEMOSE
ANALYSIS STARTED:	DATE: 30-MAR-94	TIME: 8:00 AM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 06-APR-94	TIME: 10:13 AM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
CO324	VOLATILE SCAN	SEE ATTACHED DATA		SW-8010/8020	36911
BP-9					

=====

MANAGER:

Stephanie O'Neil

DATE:

April 6, 1994

BENCHMARK ANALYTICS ANALYSIS REPORT **1776 Main Street, Hellertown, PA 18055-1021**

SAMPLE : #36911 BIO-SCIENCE 1:40

SW METHOD 8260*	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<400	ug/Kg	400
vinyl chloride	<400	ug/Kg	400
bromomethane	<400	ug/Kg	400
chloroethane	<400	ug/Kg	400
trichlorofluoromethane	<40	ug/Kg	40
1,1-dichloroethene	<40	ug/Kg	40
methylene chloride	80	ug/Kg	40
trans-1,2-dichloroethene	<40	ug/Kg	40
1,1-dichloroethane	<40	ug/Kg	40
chloroform	<40	ug/Kg	40
1,2-dichloroethane	<40	ug/Kg	40
1,1,1-trichloroethane	<40	ug/Kg	40
carbon tetrachloride	<40	ug/Kg	40
benzene	<40	ug/Kg	40
trichloroethene	40	ug/Kg	40
1,2-dichloropropane	<40	ug/Kg	40
bromodichloromethane	<40	ug/Kg	40
cis-1,3-dichloropropene	<40	ug/Kg	40
trans-1,3-dichloropropene	<40	ug/Kg	40
1,1,2-trichloroethane	<40	ug/Kg	40
dibromochloromethane	<40	ug/Kg	40
bromoform	<40	ug/Kg	40
toluene	<40	ug/Kg	40
tetrachloroethene	<40	ug/Kg	40
chlorobenzene	<40	ug/Kg	40
ethylbenzene	<40	ug/Kg	40
m/p-xylene	<40	ug/Kg	40
o-xylene	<40	ug/Kg	40
1,1,2,2-tetrachloroethane	<40	ug/Kg	40
1,3-dichlorobenzene	<40	ug/Kg	40
1,4-dichlorobenzene	<40	ug/Kg	40
1,2-dichlorobenzene	<40	ug/Kg	40

B

B = Compound found in the blank. See soil blank report.

* Sample was prepared by SW-846 method 5030.

The analysis for GC/MS volatiles was performed by

MRD

on

04/04/94

008318

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY #36732-36738

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

LABEL DESCRIPTION: PROJECT NAME: AWD
PROJECT #: AWD 9301

SAMPLED BY: MARGARET TSAO
LOCATION: SEE BELOW
DATE: 03/21/94
TIME: N/A

GRAB SAMPLES ?
COMPOSITE SAMPLES ?
ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

RECEIVED BY LAB: DATE: 22-MAR-94 TIME: 12:45 PM ANALYST: J. ALTEMOSE
ANALYSIS STARTED: DATE: 28-MAR-94 TIME: 5:56 PM ANALYST: DM,MD
ANALYSIS COMPLETED: DATE: 29-MAR-94 TIME: 10:28 AM ANALYST: DM,MD

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
BP-1	METHYLENE CHLORIDE	0.03	MG	NIOSH 1005	36732
	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1002	36732
BP-2	METHYLENE CHLORIDE *	0.51	MG	NIOSH 1005	36733
	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1002	36733
BP-3	METHYLENE CHLORIDE *	0.42	MG	NIOSH 1005	36734
	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1002	36734
BP-4	METHYLENE CHLORIDE	0.02	MG	NIOSH 1005	36735
	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1002	36735
BP-5	METHYLENE CHLORIDE	<0.01	MG	NIOSH 1005	36736
	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1002	36736
BP-6	METHYLENE CHLORIDE *	0.29	MG	NIOSH 1005	36737
	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1002	36737
BP-7	METHYLENE CHLORIDE *	0.10	MG	NIOSH 1005	36738
	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1002	36738

ANALYTE CONCENTRATION IN BACK SORBENT SECTION GREATER THAN 10% OF FRONT SORBENT
SECTION INDICATING BREAK THROUGH AND POSSIBLE SAMPLE LOSS.

MANAGER:

Stephenie OlsenDATE: March 30, 1994

008319

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

INVENTORY #36739-36740

PHONE (610) 974-8100
FAX (610) 974-8104

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION: PROJECT NAME: AWD
PROJECT #: AWD 9301

SAMPLED BY: MARGARET TSAO
LOCATION: SEE BELOW
DATE: 03/21/94
TIME: N/A

GRAB SAMPLES ?
COMPOSITE SAMPLES ?
ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

=====

RECEIVED BY LAB:	DATE:	22-MAR-94	TIME:	12:45 PM	ANALYST:	J. ALTEMOSE
ANALYSIS STARTED:	DATE:	28-MAR-94	TIME:	5:56 PM	ANALYST:	DM,MD
ANALYSIS COMPLETED:	DATE:	29-MAR-94	TIME:	10:28 AM	ANALYST:	DM,MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
BP-8	METHYLENE CHLORIDE *	0.61	MG	NIOSH 1005	36739
	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1022	36739
BP-9	METHYLENE CHLORIDE	0.27	MG	NIOSH 1005	36740
	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1022	36740

* ANALYTE CONCENTRATION IN BACK SORBENT SECTION GREATER THAN 10 % OF FRONT SORBENT SECTION INDICATING BREAK THROUGH AND POSSIBLE SAMPLE LOSS.

MANAGER:

Stephen O'Leary

DATE:

March 30, 1994

008320

BIOREACTOR MONITORING DATA

Date	Room Temperature (degrees C)	Propane Flow (bubbles/min)	Humidifier Liquid Level (ml)
3/18/94	24.0	NA	NA
3/19/94	24.0	NA	NA
3/20/94	25.0	72	NA
3/21/94	23.0	NA	300
3/22/94	23.0	NA	400.0
3/23/94	25.5	80	350.0
3/24/94	24.5	NA	NA
3/25/94	24.0	62	350.0
3/26/94	21.8	78	335.0
3/27/94	24.0	62	325.0
3/28/94	21.6	62	300.0
3/29/94	22.7	62	375.0
3/30/94	22.6	46-60	350.0
3/31/94	27.6	86	300.0
4/1/94	21.1	66	300-350
4/2/94	22.8	88	325.0
4/4/94	25.7	84	350.0
4/5/94	24.2	88	325.0
4/6/94	23.5	88	300.0
4/7/94	23.7	88	350.0
4/8/94	23.7	88	325.0
4/9/94	25.7	70	300.0
4/10/94	25.6	68	250-350
4/11/94	23.4	88	325.0
4/18/94	NA	NA	NA
4/20/94	NA	NA	NA
4/21/94	24.7	92	350.0
4/22/94	22.5	92	350.0
4/25/94	25.8	78	350.0
4/26/94	24.4	76	325.0
4/27/94	25.0	76	300.0
4/28/94	24.7	76	350.0
4/29/94	25.0	72	350.0

BIOSLURRY SIMULATION

008322

U 031 8BS-1 to 9
3/18/94 4:30 pm
3/20/94 5:10 pm

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY #36723-36729

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

LABEL DESCRIPTION: PROJECT NAME: AWD
PROJECT #: AWD 9301

SAMPLED BY: MARGARET TSAO
LOCATION: SEE BELOW
DATE: 03/21/94
TIME: N/A

GRAB SAMPLES ?
COMPOSITE SAMPLES ?
ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

RECEIVED BY LAB: DATE: 22-MAR-94 TIME: 12:45 PM ANALYST: J. ALTEMOSE
ANALYSIS STARTED: DATE: 28-MAR-94 TIME: 5:56 PM ANALYST: DM, MD
ANALYSIS COMPLETED: DATE: 29-MAR-94 TIME: 10:28 AM ANALYST: DM, MD

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
BS-1	METHYLENE CHLORIDE	<0.01	MG	NIOSH 1005	36723
	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1022	36723
BS-2	METHYLENE CHLORIDE	0.03	MG	NIOSH 1005	36724
	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1022	36724
BS-3	METHYLENE CHLORIDE	<0.01	MG	NIOSH 1005	36725
	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1022	36725
BS-4	METHYLENE CHLORIDE	0.06	MG	NIOSH 1005	36726
	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1022	36726
BS-5	METHYLENE CHLORIDE	<0.01	MG	NIOSH 1005	36727
	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1022	36727
BS-6	METHYLENE CHLORIDE	<0.01	MG	NIOSH 1005	36728
	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1022	36728
BS-7	METHYLENE CHLORIDE	<0.01	MG	NIOSH 1005	36729
	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1022	36729

MANAGER:

Stephene Oly

DATE: March 30, 1994

008323

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY #36730-36731

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9696
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION: PROJECT NAME: AWD
PROJECT #: AWD 9301

SAMPLED BY: MARGARET TSAO
LOCATION: SEE BELOW
DATE: 03/21/94
TIME: N/A

GRAB SAMPLES ?
COMPOSITE SAMPLES ?
ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

=====

RECEIVED BY LAB:	DATE:	22-MAR-94	TIME:	12:45 PM	ANALYST:	J. ALTEMOSE
ANALYSIS STARTED:	DATE:	28-MAR-94	TIME:	5:56 PM	ANALYST:	DM,MD
ANALYSIS COMPLETED:	DATE:	29-MAR-94	TIME:	10:28 AM	ANALYST:	DM,MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
BS-8	METHYLENE CHLORIDE	<0.01	MG	NIOSH 1005	36730
	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1022	36730
BS-9	METHYLENE CHLORIDE	<0.01	MG	NIOSH 1005	36731
	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1022	36731

MANAGER:

Stephanie O'HaraDATE: March 30, 1994

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

008324

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY #36870-36876

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

LABEL DESCRIPTION: PROJECT NAME: AWD TASK #: AWD
PROJECT #: AWD 9301

SAMPLED BY: MARGARET TSAO
LOCATION: SEE BELOW
DATE: 03/22/94
TIME: 4:00 PM

GRAB SAMPLES ?
COMPOSITE SAMPLES ?
ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

RECEIVED BY LAB: DATE: 25-MAR-94 TIME: 8:31 AM ANALYST: R. SMOLENAK
ANALYSIS STARTED: DATE: 29-MAR-94 TIME: 3:02 PM ANALYST: DM
ANALYSIS COMPLETED: DATE: 29-MAR-94 TIME: 10:31 PM ANALYST: DM

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
I-21	METHYLENE CHLORIDE	0.03	MG	NIOSH 1005	36870
BL-1	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1022	36870
I-0321	METHYLENE CHLORIDE	<0.01	MG	NIOSH 1005	36871
BS-2	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1022	36871
I-0321	METHYLENE CHLORIDE **	0.44	MG	NIOSH 1005	36872
BS-3	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1022	36872
I-0321	METHYLENE CHLORIDE	0.05	MG	NIOSH 1005	36873
S-4	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1022	36873
V-0321	METHYLENE CHLORIDE	<0.01	MG	NIOSH 1005	36874
S-5	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1022	36874
V-0321	METHYLENE CHLORIDE	0.04	MG	NIOSH 1005	36875
S-6	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1022	36875
V-0321	METHYLENE CHLORIDE	<0.01	MG	NIOSH 1005	36876
RS-7	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1022	36876

SAMPLES WERE UNCAPPED

** ANALYTE CONCENTRATION IN BACK SORBENT SECTION GREATER THAN 10 % FRONT SORBENT
SECTION INDICATING BREAK THROUGH AND POSSIBLE SAMPLE LOSS.

MANAGER: Stephanie Olsza

DATE: March 31, 1994

008325

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

INVENTORY #36877-36879

PHONE (610) 974-8100
FAX (610) 974-8104

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION: PROJECT NAME: AWD TASK #: AWD
PROJECT #: AWD 9301

SAMPLED BY: MARGARET TSAO
LOCATION: SEE BELOW
DATE: 03/22/94
TIME: 4:00 PM

GRAB SAMPLES ?
COMPOSITE SAMPLES ?
ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

=====

RECEIVED BY LAB:	DATE: 25-MAR-94	TIME: 8:31 AM	ANALYST: R. SMOLENAK
ANALYSIS STARTED:	DATE: 29-MAR-94	TIME: 3:02 PM	ANALYST: DM
ANALYSIS COMPLETED:	DATE: 29-MAR-94	TIME: 10:31 PM	ANALYST: DM

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
V-0321	METHYLENE CHLORIDE **	0.29	MG	NIOSH 1005	36877
BS-8	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1022	36877
V-0321	METHYLENE CHLORIDE	0.10	MG	NIOSH 1005	36878
BS-9	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1022	36878
V-0321	METHYLENE CHLORIDE	0.10	MG	NIOSH 1005	36879
BS-10	TRICHLOROETHYLENE	<0.01	MG	NIOSH 1022	36879

* SAMPLES WERE UNCAPPED

** ANALYTE CONCENTRATION IN BACK SORBENT SECTION GREATER THAN 10 % OF FRONT SORBENT SECTION INDICATING BREAK THROUGH AND POSSIBLE SAMPLE LOSS.

MANAGER:

*Stephen O. Lyle*DATE: *March 31, 1994*

008326

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

INVENTORY # 36741

PHONE (610) 974-8100
FAX (610) 974-8104

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION:	PROJECT # AWD	TASK #: AWD
	PROJECT #: AWD9301	

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/21/94
TIME: 3:30 PM

GRAB SAMPLES ?
COMPOSITE SAMPLES ?
ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

=====

RECEIVED BY LAB:	DATE: 22-MAR-94	TIME: 12:45 PM	ANALYST: J. ALTEMOSE
ANALYSIS STARTED:	DATE: 27-MAR-94	TIME: 6:00 PM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 29-MAR-94	TIME: 6:30 AM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
BS-1	VOLATILE SCAN	SEE ATTACHED DATA		SW-8010/8020	36741

MANAGER:

Stephenie OlsenDATE: March 30, 1994

008327

BENCHMARK ANALYTICS ANALYSIS REPORT
1776 Main Street, Hellertown, PA 18055-1021

SAMPLE : #36741 BIO-SCIENCE

METHOD 8010/8020	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<10	ug/L	10
vinyl chloride	<10	ug/L	10
bromomethane	<10	ug/L	10
chloroethane	<10	ug/L	10
trichlorofluoromethane	<1	ug/L	1
1,1-dichloroethene	<1	ug/L	1
methylene chloride	1	ug/L	1
trans-1,2-dichloroethene	<1	ug/L	1
1,1-dichloroethane	<1	ug/L	1
chloroform	<1	ug/L	1
1,2-dichloroethane	2	ug/L	1
1,1,1-trichloroethane	<1	ug/L	1
carbon tetrachloride	<1	ug/L	1
benzene	2	ug/L	1
trichloroethene	<1	ug/L	1
1,2-dichloropropane	<1	ug/L	1
bromodichloromethane	<1	ug/L	1
cis-1,3-dichloropropene	<1	ug/L	1
trans-1,3-dichloropropene	<1	ug/L	1
1,1,2-trichloroethane	<1	ug/L	1
dibromochloromethane	<1	ug/L	1
bromoform	<1	ug/L	1
toluene	29	ug/L	1
tetrachloroethene	<1	ug/L	1
chlorobenzene	37	ug/L	1
ethylbenzene	<1	ug/L	1
m/p-xylene	<1	ug/L	1
o-xylene	<1	ug/L	1
1,1,2,2-tetrachloroethane	15	ug/L	1
1,3-dichlorobenzene	<1	ug/L	1
1,4-dichlorobenzene	2	ug/L	1
1,2-dichlorobenzene	<1	ug/L	1

The analysis for ELCD/PID volatiles was performed by MRD on 03/28/94

008328

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY # 36742

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

BILL TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PO #

=====

LABEL DESCRIPTION:	PROJECT # AWD	TASK #: AWD
	PROJECT #: AWD9301	

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/21/94
TIME: 3:30 PM

GRAB SAMPLES ?

COMPOSITE SAMPLES ?

ROUTINE DISTRIBUTION

CHAIN OF CUSTODY ?

=====

RECEIVED BY LAB:	DATE: 22-MAR-94	TIME: 12:45 PM	ANALYST: J. ALTEMOSE
ANALYSIS STARTED:	DATE: 27-MAR-94	TIME: 6:00 PM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 29-MAR-94	TIME: 6:30 AM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
BS-2	VOLATILE SCAN	SEE ATTACHED DATA		SW-8010/8020	36742

MANAGER:

Stephen O. J...DATE: March 30, 1994

BENCHMARK ANALYTICS ANALYSIS REPORT
1776 Main Street, Hellertown, PA 18055-1021

SAMPLE : #36742 BIO-SCIENCE

METHOD 8010/8020	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<10	ug/L	10
vinyl chloride	<10	ug/L	10
bromomethane	<10	ug/L	10
chloroethane	<10	ug/L	10
trichlorofluoromethane	<1	ug/L	1
1,1-dichloroethene	<1	ug/L	1
methylene chloride	<1	ug/L	1
trans-1,2-dichloroethene	<1	ug/L	1
1,1-dichloroethane	<1	ug/L	1
chloroform	<1	ug/L	1
1,2-dichloroethane	37	ug/L	1
1,1,1-trichloroethane	<1	ug/L	1
carbon tetrachloride	<1	ug/L	1
benzene	3	ug/L	1
trichloroethene	<1	ug/L	1
1,2-dichloropropane	<1	ug/L	1
bromodichloromethane	<1	ug/L	1
cis-1,3-dichloropropene	<1	ug/L	1
trans-1,3-dichloropropene	<1	ug/L	1
1,1,2-trichloroethane	<1	ug/L	1
dibromochloromethane	<1	ug/L	1
bromoform	<1	ug/L	1
toluene	35	ug/L	1
tetrachloroethene	<1	ug/L	1
chlorobenzene	42	ug/L	1
ethylbenzene	<1	ug/L	1
m/p-xylene	<1	ug/L	1
o-xylene	<1	ug/L	1
1,1,2,2-tetrachloroethane	18	ug/L	1
1,3-dichlorobenzene	<1	ug/L	1
1,4-dichlorobenzene	8	ug/L	1
1,2-dichlorobenzene	<1	ug/L	1

The analysis for ELCD/PID volatiles was performed by **MRD** on **03/28/94**

008330

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY # 36743

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION:	PROJECT # AWD	TASK #: AWD
	PROJECT #: AWD9301	

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/21/94
TIME: 3:30 PM

GRAB SAMPLES ?

COMPOSITE SAMPLES ?

ROUTINE DISTRIBUTION

CHAIN OF CUSTODY ?

=====

RECEIVED BY LAB:	DATE: 22-MAR-94	TIME: 12:45 PM	ANALYST: J. ALTEMOSE
ANALYSIS STARTED:	DATE: 27-MAR-94	TIME: 6:00 PM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 29-MAR-94	TIME: 6:30 AM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
BS-3	VOLATILE SCAN	SEE ATTACHED DATA		SW-8010/8020	36743

MANAGER:

Stephene O. LysaDATE: March 30, 1994

BENCHMARK ANALYTICS ANALYSIS REPORT
1776 Main Street, Hellertown, PA 18055-1021

SAMPLE : #36743 BIO-SCIENCE

METHOD 8010/8020	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<10	ug/L	10
vinyl chloride	<10	ug/L	10
bromomethane	<10	ug/L	10
chloroethane	<10	ug/L	10
trichlorofluoromethane	<1	ug/L	1
1,1-dichloroethene	<1	ug/L	1
methylene chloride	1	ug/L	1
trans-1,2-dichloroethene	<1	ug/L	1
1,1-dichloroethane	<1	ug/L	1
chloroform	<1	ug/L	1
1,2-dichloroethane	39	ug/L	1
1,1,1-trichloroethane	<1	ug/L	1
carbon tetrachloride	<1	ug/L	1
benzene	3	ug/L	1
trichloroethene	<1	ug/L	1
1,2-dichloropropane	<1	ug/L	1
bromodichloromethane	<1	ug/L	1
cis-1,3-dichloropropene	<1	ug/L	1
trans-1,3-dichloropropene	<1	ug/L	1
1,1,2-trichloroethane	<1	ug/L	1
dibromochloromethane	<1	ug/L	1
bromoform	<1	ug/L	1
toluene	44	ug/L	1
tetrachloroethene	<1	ug/L	1
chlorobenzene	48	ug/L	1
ethylbenzene	<1	ug/L	1
m/p-xylene	<1	ug/L	1
o-xylene	<1	ug/L	1
1,1,2,2-tetrachloroethane	21	ug/L	1
1,3-dichlorobenzene	<1	ug/L	1
1,4-dichlorobenzene	16	ug/L	1
1,2-dichlorobenzene	<1	ug/L	1

The analysis for ELCD/PID volatiles was performed by MRD on 03/28/94

008332

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY # 36744

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION:	PROJECT # AWD	TASK #: AWD
	PROJECT #: AWD9301	

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/21/94
TIME: 3:30 PM

GRAB SAMPLES ?

COMPOSITE SAMPLES ?

ROUTINE DISTRIBUTION
YES
CHAIN OF CUSTODY ?

=====

RECEIVED BY LAB:	DATE:	22-MAR-94	TIME:	12:45 PM	ANALYST:	J. ALTEMOSE
ANALYSIS STARTED:	DATE:	27-MAR-94	TIME:	6:00 PM	ANALYST:	MD
ANALYSIS COMPLETED:	DATE:	29-MAR-94	TIME:	6:30 AM	ANALYST:	MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
BS-4	VOLATILE SCAN	SEE ATTACHED DATA		SW-8010/8020	36744

MANAGER:

Stephen O'NeilDATE: March 30, 1994

BENCHMARK ANALYTICS ANALYSIS REPORT
1776 Main Street, Hellertown, PA 18055-1021

SAMPLE : #36744 BIO-SCIENCE 1:10*

METHOD 8010/8020	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<100	ug/L	100
vinyl chloride	<100	ug/L	100
bromomethane	<100	ug/L	100
chloroethane	<100	ug/L	100
trichlorofluoromethane	<10	ug/L	10
1,1-dichloroethene	<10	ug/L	10
methylene chloride	20	ug/L	10
trans-1,2-dichloroethene	<10	ug/L	10
1,1-dichloroethane	<10	ug/L	10
chloroform	<10	ug/L	10
1,2-dichloroethane	<10	ug/L	10
1,1,1-trichloroethane	<10	ug/L	10
carbon tetrachloride	<10	ug/L	10
benzene	<10	ug/L	10
trichloroethene	<10	ug/L	10
1,2-dichloropropane	<10	ug/L	10
bromodichloromethane	<10	ug/L	10
cis-1,3-dichloropropene	<10	ug/L	10
trans-1,3-dichloropropene	<10	ug/L	10
1,1,2-trichloroethane	<10	ug/L	10
dibromochloromethane	<10	ug/L	10
bromoform	<10	ug/L	10
toluene	<10	ug/L	10
tetrachloroethene	<10	ug/L	10
chlorobenzene	<10	ug/L	10
ethylbenzene	<10	ug/L	10
m/p-xylene	<10	ug/L	10
o-xylene	<10	ug/L	10
1,1,2,2-tetrachloroethane	<10	ug/L	10
1,3-dichlorobenzene	<10	ug/L	10
1,4-dichlorobenzene	120	ug/L	10
1,2-dichlorobenzene	<10	ug/L	10

* Limit of detection increased due to matrix interference and spike recovery data.

The analysis for ELCD/PID volatiles was performed by MRD on 03/28/94

008334

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY # 36745

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION:	PROJECT # AWD	TASK #: AWD
	PROJECT #: AWD9301	

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/21/94
TIME: 3:30 PM

GRAB SAMPLES ?

COMPOSITE SAMPLES ?

ROUTINE DISTRIBUTION

CHAIN OF CUSTODY ?

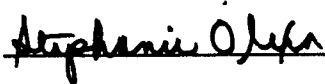
=====

RECEIVED BY LAB:	DATE: 22-MAR-94	TIME: 12:45 PM	ANALYST: J. ALTEMOSE
ANALYSIS STARTED:	DATE: 27-MAR-94	TIME: 6:00 PM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 29-MAR-94	TIME: 6:30 AM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
BS-5	VOLATILE SCAN	SEE ATTACHED DATA		SW-8010/8020	36745

MANAGER:



DATE: March 30, 1994

BENCHMARK ANALYTICS ANALYSIS REPORT
1776 Main Street, Hellertown, PA 18055-1021

SAMPLE : #36745 BIO-SCIENCE 1:10*

METHOD 8010/8020	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<100	ug/L	100
vinyl chloride	<100	ug/L	100
bromomethane	<100	ug/L	100
chloroethane	<100	ug/L	100
trichlorofluoromethane	<10	ug/L	10
1,1-dichloroethene	<10	ug/L	10
methylene chloride	<10	ug/L	10
trans-1,2-dichloroethene	<10	ug/L	10
1,1-dichloroethane	<10	ug/L	10
chloroform	<10	ug/L	10
1,2-dichloroethane	<10	ug/L	10
1,1,1-trichloroethane	<10	ug/L	10
carbon tetrachloride	<10	ug/L	10
benzene	<10	ug/L	10
trichloroethene	<10	ug/L	10
1,2-dichloropropane	<10	ug/L	10
bromodichloromethane	<10	ug/L	10
cis-1,3-dichloropropene	<10	ug/L	10
trans-1,3-dichloropropene	<10	ug/L	10
1,1,2-trichloroethane	<10	ug/L	10
dibromochloromethane	<10	ug/L	10
bromoform	<10	ug/L	10
toluene	<10	ug/L	10
tetrachloroethene	<10	ug/L	10
chlorobenzene	<10	ug/L	10
ethylbenzene	<10	ug/L	10
m/p-xylene	<10	ug/L	10
o-xylene	<10	ug/L	10
1,1,2,2-tetrachloroethane	<10	ug/L	10
1,3-dichlorobenzene	<10	ug/L	10
1,4-dichlorobenzene	20	ug/L	10
1,2-dichlorobenzene	<10	ug/L	10

* Limit of detection increased due to matrix interference and spike recovery data.

The analysis for ELCD/PID volatiles was performed by MRD on 03/28/94

008336

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

INVENTORY # 36746

PHONE (610) 974-8100
FAX (610) 974-8104

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION:	PROJECT # AWD	TASK #: AWD
	PROJECT #: AWD9301	

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/21/94
TIME: 3:30 PM

GRAB SAMPLES ?

COMPOSITE SAMPLES ?

ROUTINE DISTRIBUTION

CHAIN OF CUSTODY ?

=====

RECEIVED BY LAB:	DATE:	22-MAR-94	TIME:	12:45 PM	ANALYST:	J. ALTEMOSE
ANALYSIS STARTED:	DATE:	27-MAR-94	TIME:	6:00 PM	ANALYST:	MD
ANALYSIS COMPLETED:	DATE:	29-MAR-94	TIME:	6:30 AM	ANALYST:	MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
BS-6	VOLATILE SCAN	SEE ATTACHED DATA		SW-8010/8020	36746

MANAGER:

Stephanie O. LyleDATE: March 30, 1994

008337

BENCHMARK ANALYTICS ANALYSIS REPORT
1776 Main Street, Hellertown, PA 18055-1021

SAMPLE : #36746 BIO-SCIENCE 1:10*

METHOD 8010/8020	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<100	ug/L	100
vinyl chloride	<100	ug/L	100
bromomethane	<100	ug/L	100
chloroethane	<100	ug/L	100
trichlorofluoromethane	<10	ug/L	10
1,1-dichloroethene	<10	ug/L	10
methylene chloride	<10	ug/L	10
trans-1,2-dichloroethene	<10	ug/L	10
1,1-dichloroethane	<10	ug/L	10
chloroform	<10	ug/L	10
1,2-dichloroethane	<10	ug/L	10
1,1,1-trichloroethane	<10	ug/L	10
carbon tetrachloride	<10	ug/L	10
benzene	<10	ug/L	10
trichloroethene	<10	ug/L	10
1,2-dichloropropane	<10	ug/L	10
bromodichloromethane	<10	ug/L	10
cis-1,3-dichloropropene	<10	ug/L	10
trans-1,3-dichloropropene	<10	ug/L	10
1,1,2-trichloroethane	<10	ug/L	10
dibromochloromethane	<10	ug/L	10
bromoform	<10	ug/L	10
toluene	<10	ug/L	10
tetrachloroethene	<10	ug/L	10
chlorobenzene	<10	ug/L	10
ethylbenzene	<10	ug/L	10
m/p-xylene	<10	ug/L	10
o-xylene	<10	ug/L	10
1,1,2,2-tetrachloroethane	<10	ug/L	10
1,3-dichlorobenzene	<10	ug/L	10
1,4-dichlorobenzene	10	ug/L	10
1,2-dichlorobenzene	<10	ug/L	10

* Limit of detection increased due to matrix interference and spike recovery data.

The analysis for ELCD/PID volatiles was performed by MRD on 03/28/94

008338

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY # 36747

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

BILL TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PO #

=====

LABEL DESCRIPTION:	PROJECT # AWD	TASK #: AWD
	PROJECT #: AWD9301	

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/21/94
TIME: 3:30 PM

GRAB SAMPLES ?

COMPOSITE SAMPLES ?

ROUTINE DISTRIBUTION

CHAIN OF CUSTODY ?

=====

RECEIVED BY LAB:	DATE: 22-MAR-94	TIME: 12:45 PM	ANALYST: J. ALTEMOSE
ANALYSIS STARTED:	DATE: 27-MAR-94	TIME: 6:00 PM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 29-MAR-94	TIME: 6:30 AM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
BS-7	VOLATILE SCAN	SEE ATTACHED DATA		SW-8010/8020	36747

MANAGER:

Stephanie O'LearyDATE: March 30, 1994

BENCHMARK ANALYTICS ANALYSIS REPORT
1776 Main Street, Hellertown, PA 18055-1021

SAMPLE : #36747 BIO-SCIENCE 1:10*

METHOD 8010/8020	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<100	ug/L	100
vinyl chloride	<100	ug/L	100
bromomethane	<100	ug/L	100
chloroethane	<100	ug/L	100
trichlorofluoromethane	<10	ug/L	10
1,1-dichloroethene	<10	ug/L	10
methylene chloride	<10	ug/L	10
trans-1,2-dichloroethene	<10	ug/L	10
1,1-dichloroethane	<10	ug/L	10
chloroform	<10	ug/L	10
1,2-dichloroethane	<10	ug/L	10
1,1,1-trichloroethane	<10	ug/L	10
carbon tetrachloride	<10	ug/L	10
benzene	<10	ug/L	10
trichloroethene	<10	ug/L	10
1,2-dichloropropane	<10	ug/L	10
bromodichloromethane	<10	ug/L	10
cis-1,3-dichloropropene	<10	ug/L	10
trans-1,3-dichloropropene	<10	ug/L	10
1,1,2-trichloroethane	<10	ug/L	10
dibromochloromethane	<10	ug/L	10
bromoform	<10	ug/L	10
toluene	<10	ug/L	10
tetrachloroethene	<10	ug/L	10
chlorobenzene	<10	ug/L	10
ethylbenzene	<10	ug/L	10
m/p-xylene	<10	ug/L	10
o-xylene	<10	ug/L	10
1,1,2,2-tetrachloroethane	<10	ug/L	10
1,3-dichlorobenzene	<10	ug/L	10
1,4-dichlorobenzene	<10	ug/L	10
1,2-dichlorobenzene	<10	ug/L	10

* Limit of detection increased due to matrix interference and spike recovery data.

The analysis for ELCD/PID volatiles was performed by MRD on 03/28/94

008340

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY # 36748

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PO #

=====

LABEL DESCRIPTION:	PROJECT # AWD	TASK #: AWD
	PROJECT #: AWD9301	

=====

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/21/94
TIME: 3:30 PM

GRAB SAMPLES ?

COMPOSITE SAMPLES ?

ROUTINE DISTRIBUTION
YES
CHAIN OF CUSTODY ?

=====

RECEIVED BY LAB:	DATE: 22-MAR-94	TIME: 12:45 PM	ANALYST: J. ALTEMOSE
ANALYSIS STARTED:	DATE: 27-MAR-94	TIME: 6:00 PM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 29-MAR-94	TIME: 6:30 AM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
BS-8	VOLATILE SCAN	SEE ATTACHED DATA		SW-8010/8020	36748

MANAGER:

Stephanie O'LearyDATE: March 30, 1994

BENCHMARK ANALYTICS ANALYSIS REPORT
1776 Main Street, Hellertown, PA 18055-1021

SAMPLE : #36748 BIO-SCIENCE 1:10*

METHOD 8010/8020	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<100	ug/L	100
vinyl chloride	<100	ug/L	100
bromomethane	<100	ug/L	100
chloroethane	<100	ug/L	100
trichlorofluoromethane	<10	ug/L	10
1,1-dichloroethene	<10	ug/L	10
methylene chloride	<10	ug/L	10
trans-1,2-dichloroethene	<10	ug/L	10
1,1-dichloroethane	<10	ug/L	10
chloroform	<10	ug/L	10
1,2-dichloroethane	<10	ug/L	10
1,1,1-trichloroethane	<10	ug/L	10
carbon tetrachloride	<10	ug/L	10
benzene	<10	ug/L	10
trichloroethene	<10	ug/L	10
1,2-dichloropropane	<10	ug/L	10
bromodichloromethane	<10	ug/L	10
cis-1,3-dichloropropene	<10	ug/L	10
trans-1,3-dichloropropene	<10	ug/L	10
1,1,2-trichloroethane	<10	ug/L	10
dibromochloromethane	<10	ug/L	10
bromoform	<10	ug/L	10
toluene	20	ug/L	10
tetrachloroethene	<10	ug/L	10
chlorobenzene	<10	ug/L	10
ethylbenzene	<10	ug/L	10
m/p-xylene	<10	ug/L	10
o-xylene	<10	ug/L	10
1,1,2,2-tetrachloroethane	<10	ug/L	10
1,3-dichlorobenzene	<10	ug/L	10
1,4-dichlorobenzene	<10	ug/L	10
1,2-dichlorobenzene	<10	ug/L	10

* Limit of detection increased due to matrix interference and spike recovery data.

The analysis for ELCD/PID volatiles was performed by MRD on 03/28/94

008342

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY # 36749

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION:	PROJECT # AWD	TASK #: AWD
	PROJECT #: AWD9301	

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/21/94
TIME: 3:30 PM

GRAB SAMPLES ?

COMPOSITE SAMPLES ?

ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

YES

=====

RECEIVED BY LAB:	DATE: 22-MAR-94	TIME: 12:45 PM	ANALYST: J. ALTEMOSE
ANALYSIS STARTED:	DATE: 27-MAR-94	TIME: 6:00 PM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 29-MAR-94	TIME: 6:30 AM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
BS-9	VOLATILE SCAN	SEE ATTACHED DATA		SW-8010/8020	36749

MANAGER:

Stephanie O'LearyDATE: march 30, 1994

BENCHMARK ANALYTICS ANALYSIS REPORT
1776 Main Street, Hellertown, PA 18055-1021

008343

SAMPLE : #36749 BIO-SCIENCE 1:10*

METHOD 8010/8020	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<100	ug/L	100
vinyl chloride	<100	ug/L	100
bromomethane	<100	ug/L	100
chloroethane	<100	ug/L	100
trichlorofluoromethane	<10	ug/L	10
1,1-dichloroethene	<10	ug/L	10
methylene chloride	<10	ug/L	10
trans-1,2-dichloroethene	<10	ug/L	10
1,1-dichloroethane	<10	ug/L	10
chloroform	<10	ug/L	10
1,2-dichloroethane	<10	ug/L	10
1,1,1-trichloroethane	<10	ug/L	10
carbon tetrachloride	<10	ug/L	10
benzene	<10	ug/L	10
trichloroethene	<10	ug/L	10
1,2-dichloropropane	<10	ug/L	10
bromodichloromethane	<10	ug/L	10
cis-1,3-dichloropropene	<10	ug/L	10
trans-1,3-dichloropropene	<10	ug/L	10
1,1,2-trichloroethane	<10	ug/L	10
dibromochloromethane	<10	ug/L	10
bromoform	<10	ug/L	10
toluene	50	ug/L	10
tetrachloroethene	<10	ug/L	10
chlorobenzene	<10	ug/L	10
ethylbenzene	<10	ug/L	10
m/p-xylene	<10	ug/L	10
o-xylene	<10	ug/L	10
1,1,2,2-tetrachloroethane	<10	ug/L	10
1,3-dichlorobenzene	<10	ug/L	10
1,4-dichlorobenzene	<10	ug/L	10
1,2-dichlorobenzene	<10	ug/L	10

* Limit of detection increased due to matrix interference and spike recovery data.

The analysis for ELCD/PID volatiles was performed by MRD on 03/28/94

008344

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY # 36750

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION:	PROJECT # AWD	TASK #: AWD
	PROJECT #: AWD9301	

=====

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/21/94
TIME: 3:30 PM

GRAB SAMPLES ?

COMPOSITE SAMPLES ?

ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

YES

=====

RECEIVED BY LAB:	DATE: 22-MAR-94	TIME: 12:45 PM	ANALYST: J. ALTEMOSE
ANALYSIS STARTED:	DATE: 27-MAR-94	TIME: 6:00 PM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 29-MAR-94	TIME: 6:30 AM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
BS-10	VOLATILE SCAN	SEE ATTACHED DATA		SW-8010/8020	36750

MANAGER:

Stephanie OdejaDATE: March 30, 1994

BENCHMARK ANALYTICS ANALYSIS REPORT
1776 Main Street, Hellertown, PA 18055-1021

008345

SAMPLE : #36750 BIO-SCIENCE

METHOD 8010/8020	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<10	ug/L	10
vinyl chloride	<10	ug/L	10
bromomethane	<10	ug/L	10
chloroethane	<10	ug/L	10
trichlorofluoromethane	<1	ug/L	1
1,1-dichloroethene	<1	ug/L	1
methylene chloride	2	ug/L	1
trans-1,2-dichloroethene	<1	ug/L	1
1,1-dichloroethane	<1	ug/L	1
chloroform	<1	ug/L	1
1,2-dichloroethane	<1	ug/L	1
1,1,1-trichloroethane	<1	ug/L	1
carbon tetrachloride	<1	ug/L	1
benzene	<1	ug/L	1
trichloroethene	<1	ug/L	1
1,2-dichloropropane	<1	ug/L	1
bromodichloromethane	<1	ug/L	1
cis-1,3-dichloropropene	<1	ug/L	1
trans-1,3-dichloropropene	<1	ug/L	1
1,1,2-trichloroethane	<1	ug/L	1
dibromochloromethane	<1	ug/L	1
bromoform	<1	ug/L	1
toluene	<1	ug/L	1
tetrachloroethene	<1	ug/L	1
chlorobenzene	<1	ug/L	1
ethylbenzene	<1	ug/L	1
m/p-xylene	<1	ug/L	1
o-xylene	<1	ug/L	1
1,1,2,2-tetrachloroethane	<1	ug/L	1
1,3-dichlorobenzene	<1	ug/L	1
1,4-dichlorobenzene	<1	ug/L	1
1,2-dichlorobenzene	<1	ug/L	1

The analysis for ELCD/PID volatiles was performed by MRD on 03/28/94

008346

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY # 36912

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION: PROJECT # AWD
PROJECT #: AWD9301

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/25/94
TIME: 10:30 AM

GRAB SAMPLES ?

COMPOSITE SAMPLES ?

ROUTINE DISTRIBUTION
YES CHAIN OF CUSTODY ?

=====

RECEIVED BY LAB:	DATE: 25-MAR-94	TIME: 4:10 PM	ANALYST: J. ALTEMOSF
ANALYSIS STARTED:	DATE: 30-MAR-94	TIME: 8:00 AM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 05-APR-94	TIME: 10:13 AM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
CO325	VOLATILE SCAN *	SEE ATTACHED DATA		SW-8010/8020	36912
BS-1					

=====

* LIMIT OF DETECTION INCREASED DUE TO MATRIX INTERFERENCE AND SPIKE RECOVERY DATA

MANAGER:

Stephenie O'Leary

DATE:

April 6, 1994

BENCHMARK ANALYTICS ANALYSIS REPORT
1776 Main Street, Hellertown, PA 18055-1021

SAMPLE : #36912 BIO-SCIENCE 1:2

SW METHOD 8260	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<20	ug/L	20
vinyl chloride	<20	ug/L	20
bromomethane	<20	ug/L	20
chloroethane	<20	ug/L	20
trichlorofluoromethane	<2	ug/L	2
1,1-dichloroethene	<2	ug/L	2
methylene chloride	4	ug/L	2
trans-1,2-dichloroethene	<2	ug/L	2
1,1-dichloroethane	<2	ug/L	2
chloroform	<2	ug/L	2
1,2-dichloroethane	<2	ug/L	2
1,1,1-trichloroethane	<2	ug/L	2
carbon tetrachloride	<2	ug/L	2
benzene	<2	ug/L	2
trichloroethene	<2	ug/L	2
1,2-dichloropropane	<2	ug/L	2
bromodichloromethane	<2	ug/L	2
cis-1,3-dichloropropene	<2	ug/L	2
trans-1,3-dichloropropene	<2	ug/L	2
1,1,2-trichloroethane	<2	ug/L	2
dibromochloromethane	<2	ug/L	2
bromoform	<2	ug/L	2
toluene	<2	ug/L	2
tetrachloroethene	<2	ug/L	2
chlorobenzene	<2	ug/L	2
ethylbenzene	<2	ug/L	2
m/p-xylene	<2	ug/L	2
o-xylene	<2	ug/L	2
1,1,2,2-tetrachloroethane	<2	ug/L	2
1,3-dichlorobenzene	<2	ug/L	2
1,4-dichlorobenzene	<2	ug/L	2
1,2-dichlorobenzene	<2	ug/L	2

B

B = Compound found in the blank. See water blank report.

The analysis for GC/MS volatiles was performed by MRD on 04/04/94

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

008348

INVENTORY # 36913

PHONE (610) 974-8100
FAX (610) 974-8104

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION: PROJECT # AWD
PROJECT #: AWD9301

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/25/94
TIME: 10:30 AM

GRAB SAMPLES ?
COMPOSITE SAMPLES ?
ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

=====

RECEIVED BY LAB:	DATE: 25-MAR-94	TIME: 4:10 PM	ANALYST: J. ALTEMOSE
ANALYSIS STARTED:	DATE: 30-MAR-94	TIME: 8:00 AM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 05-APR-94	TIME: 10:13 AM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
CO325	VOLATILE SCAN *	SEE ATTACHED DATA		SW-8010/8020	36913
BS-2					

* LIMIT OF DETECTION INCREASED DUE TO MATRIX INTERFERENCE AND SPIKE RECOVERY DATA.

MANAGER:

Stephanie O. Hays

DATE:

April 6, 1994

008349

BENCHMARK ANALYTICS ANALYSIS REPORT **1776 Main Street, Hellertown, PA 18055-1021**

SAMPLE : #36913 BIO-SCIENCE 1:2

SW METHOD 8260	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<20	ug/L	20
vinyl chloride	<20	ug/L	20
bromomethane	<20	ug/L	20
chloroethane	<20	ug/L	20
trichlorofluoromethane	<2	ug/L	2
1,1-dichloroethene	<2	ug/L	2
methylene chloride	5	ug/L	2
trans-1,2-dichloroethene	<2	ug/L	2
1,1-dichloroethane	<2	ug/L	2
chloroform	<2	ug/L	2
1,2-dichloroethane	<2	ug/L	2
1,1,1-trichloroethane	<2	ug/L	2
carbon tetrachloride	<2	ug/L	2
benzene	<2	ug/L	2
trichloroethene	<2	ug/L	2
1,2-dichloropropane	<2	ug/L	2
bromodichloromethane	<2	ug/L	2
cis-1,3-dichloropropene	<2	ug/L	2
trans-1,3-dichloropropene	<2	ug/L	2
1,1,2-trichloroethane	<2	ug/L	2
dibromochloromethane	<2	ug/L	2
bromoform	<2	ug/L	2
toluene	<2	ug/L	2
tetrachloroethene	<2	ug/L	2
chlorobenzene	<2	ug/L	2
ethylbenzene	<2	ug/L	2
m/p-xylene	<2	ug/L	2
o-xylene	<2	ug/L	2
1,1,2,2-tetrachloroethane	<2	ug/L	2
1,3-dichlorobenzene	<2	ug/L	2
1,4-dichlorobenzene	<2	ug/L	2
1,2-dichlorobenzene	<2	ug/L	2

B

B = Compound found in the blank. See water blank report.

The analysis for GC/MS volatiles was performed by MRD on 04/04/94

008350

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY # 36914

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PO #

=====

LABEL DESCRIPTION: PROJECT # AWD
PROJECT #: AWD9301

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/25/94
TIME: 10:30 AM

GRAB SAMPLES ?

COMPOSITE SAMPLES ?

ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?
YES

=====

RECEIVED BY LAB:	DATE: 25-MAR-94	TIME: 4:10 PM	ANALYST: J. ALTEMOSE
ANALYSIS STARTED:	DATE: 30-MAR-94	TIME: 8:00 AM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 05-APR-94	TIME: 8:07 PM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
CO325	VOLATILE SCAN *	SEE ATTACHED DATA		SW-8010/8020	36914
BS-3					

=====

* LIMIT OF DETECTION INCREASED DUE TO MATRIX INTERFERENCE AND SPIKE RECOVERY DATA

MANAGER:

Stephanie O. Lupa

DATE:

April 6, 1994

008351

BENCHMARK ANALYTICS ANALYSIS REPORT **1776 Main Street, Hellertown, PA 18055-1021**

SAMPLE : #36914 BIO-SCIENCE 1:2

SW METHOD 8260	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<20	ug/L	20
vinyl chloride	<20	ug/L	20
bromomethane	<20	ug/L	20
chloroethane	<20	ug/L	20
trichlorofluoromethane	<2	ug/L	2
1,1-dichloroethene	<2	ug/L	2
methylene chloride	4	ug/L	2
trans-1,2-dichloroethene	<2	ug/L	2
1,1-dichloroethane	<2	ug/L	2
chloroform	<2	ug/L	2
1,2-dichloroethane	<2	ug/L	2
1,1,1-trichloroethane	<2	ug/L	2
carbon tetrachloride	<2	ug/L	2
benzene	<2	ug/L	2
trichloroethene	<2	ug/L	2
1,2-dichloropropane	<2	ug/L	2
bromodichloromethane	<2	ug/L	2
cis-1,3-dichloropropene	<2	ug/L	2
trans-1,3-dichloropropene	<2	ug/L	2
1,1,2-trichloroethane	<2	ug/L	2
dibromochloromethane	<2	ug/L	2
bromoform	<2	ug/L	2
toluene	<2	ug/L	2
tetrachloroethene	<2	ug/L	2
chlorobenzene	<2	ug/L	2
ethylbenzene	<2	ug/L	2
m/p-xylene	<2	ug/L	2
o-xylene	<2	ug/L	2
1,1,2,2-tetrachloroethane	<2	ug/L	2
1,3-dichlorobenzene	<2	ug/L	2
1,4-dichlorobenzene	<2	ug/L	2
1,2-dichlorobenzene	<2	ug/L	2

B

B = Compound found in the blank. See water blank report.

The analysis for GC/MS volatiles was performed by

MRD

on

04/05/94

008352

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY # 36915

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION: PROJECT # AWD
PROJECT #: AWD9301

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/25/94
TIME: 10:30 AM

GRAB SAMPLES ?

COMPOSITE SAMPLES ?

ROUTINE DISTRIBUTION
YES
CHAIN OF CUSTODY ?

=====

RECEIVED BY LAB:	DATE: 25-MAR-94	TIME: 4:10 PM	ANALYST: J. ALTEMOSE
ANALYSIS STARTED:	DATE: 30-MAR-94	TIME: 8:00 AM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 05-APR-94	TIME: 8:07 PM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
CO325	VOLATILE SCAN *	SEE ATTACHED DATA		SW-8010/8020	36915
BS-4					

=====

LIMIT OF DETECTION INCREASED DUE TO MATRIX INTERFERENCE AND SPIKE RECOVERY DATA

MANAGER:

Stephen J. O'Leary

DATE:

April 6, 1995

BENCHMARK ANALYTICS ANALYSIS REPORT
1776 Main Street, Hellertown, PA 18055-1021

SAMPLE : #36915 BIO-SCIENCE 1:100

SW METHOD 8260	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<1000	ug/L	1000
vinyl chloride	<1000	ug/L	1000
bromomethane	<1000	ug/L	1000
chloroethane	<1000	ug/L	1000
trichlorofluoromethane	<100	ug/L	100
1,1-dichloroethene	<100	ug/L	100
methylene chloride	100	ug/L	100
trans-1,2-dichloroethene	<100	ug/L	100
1,1-dichloroethane	<100	ug/L	100
chloroform	<100	ug/L	100
1,2-dichloroethane	<100	ug/L	100
1,1,1-trichloroethane	<100	ug/L	100
carbon tetrachloride	<100	ug/L	100
benzene	<100	ug/L	100
trichloroethene	<100	ug/L	100
1,2-dichloropropane	<100	ug/L	100
bromodichloromethane	<100	ug/L	100
cis-1,3-dichloropropene	<100	ug/L	100
trans-1,3-dichloropropene	<100	ug/L	100
1,1,2-trichloroethane	<100	ug/L	100
dibromochloromethane	<100	ug/L	100
bromoform	<100	ug/L	100
toluene	<100	ug/L	100
tetrachloroethene	<100	ug/L	100
chlorobenzene	<100	ug/L	100
ethylbenzene	<100	ug/L	100
m/p-xylene	<100	ug/L	100
o-xylene	<100	ug/L	100
1,1,2,2-tetrachloroethane	<100	ug/L	100
1,3-dichlorobenzene	<100	ug/L	100
1,4-dichlorobenzene	<100	ug/L	100
1,2-dichlorobenzene	<100	ug/L	100

B

B = Compound found in the blank. See water blank report.

The analysis for GC/MS volatiles was performed by MRD on 04/05/94

008354

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

INVENTORY # 36916

PHONE (610) 974-8100
FAX (610) 974-8104

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION: PROJECT # AWD
PROJECT #: AWD9301

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/25/94
TIME: 10:30 AM

GRAB SAMPLES ?
COMPOSITE SAMPLES ?
ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

=====

RECEIVED BY LAB:	DATE: 25-MAR-94	TIME: 4:10 PM	ANALYST: J. ALTEMOSE
ANALYSIS STARTED:	DATE: 30-MAR-94	TIME: 8:00 AM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 05-APR-94	TIME: 8:07 PM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
CO325	VOLATILE SCAN *	SEE ATTACHED DATA		SW-8010/8020	36916
BS-5					

* LIMIT OF DETECTION INCREASED DUE TO MATRIX INTERFERENCE AND SPIKE RECOVERY DATA.

MANAGER:

Stephanie O'Leary

DATE:

April 6, 1994

BENCHMARK ANALYTICS ANALYSIS REPORT
1776 Main Street, Hellertown, PA 18055-1021

SAMPLE : #36916 BIO-SCIENCE 1:100

SW METHOD 8260	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<1000	ug/L	1000
vinyl chloride	<1000	ug/L	1000
bromomethane	<1000	ug/L	1000
chloroethane	<1000	ug/L	1000
trichlorofluoromethane	<100	ug/L	100
1,1-dichloroethene	<100	ug/L	100
methylene chloride	1100	ug/L	100
trans-1,2-dichloroethene	<100	ug/L	100
1,1-dichloroethane	<100	ug/L	100
chloroform	<100	ug/L	100
1,2-dichloroethane	<100	ug/L	100
1,1,1-trichloroethane	<100	ug/L	100
carbon tetrachloride	<100	ug/L	100
benzene	<100	ug/L	100
trichloroethene	<100	ug/L	100
1,2-dichloropropane	<100	ug/L	100
bromodichloromethane	<100	ug/L	100
cis-1,3-dichloropropene	<100	ug/L	100
trans-1,3-dichloropropene	<100	ug/L	100
1,1,2-trichloroethane	<100	ug/L	100
dibromochloromethane	<100	ug/L	100
bromoform	<100	ug/L	100
toluene	<100	ug/L	100
tetrachloroethene	<100	ug/L	100
chlorobenzene	<100	ug/L	100
ethylbenzene	<100	ug/L	100
m/p-xylene	<100	ug/L	100
o-xylene	<100	ug/L	100
1,1,2,2-tetrachloroethane	<100	ug/L	100
1,3-dichlorobenzene	<100	ug/L	100
1,4-dichlorobenzene	<100	ug/L	100
1,2-dichlorobenzene	<100	ug/L	100

B = Compound found in the blank. See water blank report.

The analysis for GC/MS volatiles was performed by MRD on 04/05/94

008356

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY # 36917

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION: PROJECT # AWD
PROJECT #: AWD9301

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/25/94
TIME: 10:30 AM

GRAB SAMPLES ?

COMPOSITE SAMPLES ?

ROUTINE DISTRIBUTION
YES CHAIN OF CUSTODY ?

=====

RECEIVED BY LAB:	DATE: 25-MAR-94	TIME: 4:10 PM	ANALYST: J. ALTEMOSE
ANALYSIS STARTED:	DATE: 30-MAR-94	TIME: 8:00 AM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 05-APR-94	TIME: 8:07 PM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
CO325	VOLATILE SCAN *	SEE ATTACHED DATA		SW-8010/8020	36917
BS-6					

=====

* LIMIT OF DETECTION INCREASED DUE TO MATRIX INTERFERENCE AND SPIKE RECOVERY DATA

MANAGER:

*Stephanie O. Hys*DATE: *April 6, 1994*

BENCHMARK ANALYTICS ANALYSIS REPORT
1776 Main Street, Hellertown, PA 18055-1021

SAMPLE : #36917 BIO-SCIENCE 1:100

SW METHOD 8260	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<1000	ug/L	1000
vinyl chloride	<1000	ug/L	1000
bromomethane	<1000	ug/L	1000
chloroethane	<1000	ug/L	1000
trichlorofluoromethane	<100	ug/L	100
1,1-dichloroethene	<100	ug/L	100
methylene chloride	1000	ug/L	100
trans-1,2-dichloroethene	<100	ug/L	100
1,1-dichloroethane	<100	ug/L	100
chloroform	<100	ug/L	100
1,2-dichloroethane	<100	ug/L	100
1,1,1-trichloroethane	<100	ug/L	100
carbon tetrachloride	<100	ug/L	100
benzene	<100	ug/L	100
trichloroethene	<100	ug/L	100
1,2-dichloropropane	<100	ug/L	100
bromodichloromethane	<100	ug/L	100
cis-1,3-dichloropropene	<100	ug/L	100
trans-1,3-dichloropropene	<100	ug/L	100
1,1,2-trichloroethane	<100	ug/L	100
dibromochloromethane	<100	ug/L	100
bromoform	<100	ug/L	100
toluene	<100	ug/L	100
tetrachloroethene	<100	ug/L	100
chlorobenzene	<100	ug/L	100
ethylbenzene	<100	ug/L	100
m/p-xylene	<100	ug/L	100
o-xylene	<100	ug/L	100
1,1,2,2-tetrachloroethane	<100	ug/L	100
1,3-dichlorobenzene	<100	ug/L	100
1,4-dichlorobenzene	<100	ug/L	100
1,2-dichlorobenzene	<100	ug/L	100

B = Compound found in the blank. See water blank report.

The analysis for GC/MS volatiles was performed by MRD on 04/05/94

008358

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

INVENTORY # 36918

PHONE (610) 974-8100
FAX (610) 974-8104

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION: PROJECT # AWD
PROJECT #: AWD9301

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/25/94
TIME: 10:30 AM

=====

GRAB SAMPLES ?
COMPOSITE SAMPLES ?
ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

YES

=====

RECEIVED BY LAB:	DATE: 25-MAR-94	TIME: 4:10 PM	ANALYST: J. ALTEMOSE
ANALYSIS STARTED:	DATE: 30-MAR-94	TIME: 8:00 AM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 05-APR-94	TIME: 8:07 PM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
CO325	VOLATILE SCAN *	SEE ATTACHED DATA		SW-8010/8020	36918
BS-7					

=====

* LIMIT OF DETECTION INCREASED DUE TO MATRIX INTERFERENCE AND SPIKE RECOVERY DATA.

MANAGER:

Stephanie Oly

DATE:

April 6, 1994

BENCHMARK ANALYTICS ANALYSIS REPORT **1776 Main Street, Hellertown, PA 18055-1021**

008359

SAMPLE : #36918 BIO-SCIENCE 1:100

SW METHOD 8260 COMPOUND	RESULTS AS RECEIVED		LIMIT OF QUANTITATION
chloromethane	<1000	ug/L	1000
vinyl chloride	<1000	ug/L	1000
bromomethane	<1000	ug/L	1000
chloroethane	<1000	ug/L	1000
trichlorofluoromethane	<100	ug/L	100
1,1-dichloroethene	<100	ug/L	100
methylene chloride	400	ug/L	100
trans-1,2-dichloroethene	<100	ug/L	100
1,1-dichloroethane	<100	ug/L	100
chloroform	<100	ug/L	100
1,2-dichloroethane	<100	ug/L	100
1,1,1-trichloroethane	<100	ug/L	100
carbon tetrachloride	<100	ug/L	100
benzene	<100	ug/L	100
trichloroethene	<100	ug/L	100
1,2-dichloropropane	<100	ug/L	100
bromodichloromethane	<100	ug/L	100
cis-1,3-dichloropropene	<100	ug/L	100
trans-1,3-dichloropropene	<100	ug/L	100
1,1,2-trichloroethane	<100	ug/L	100
dibromochloromethane	<100	ug/L	100
bromoform	<100	ug/L	100
toluene	<100	ug/L	100
tetrachloroethene	<100	ug/L	100
chlorobenzene	<100	ug/L	100
ethylbenzene	<100	ug/L	100
m/p-xylene	<100	ug/L	100
o-xylene	<100	ug/L	100
1,1,2,2-tetrachloroethane	<100	ug/L	100
1,3-dichlorobenzene	<100	ug/L	100
1,4-dichlorobenzene	<100	ug/L	100
1,2-dichlorobenzene	<100	ug/L	100

B

B = Compound found in the blank. See water blank report.

The analysis for GC/MS volatiles was performed by MRD on 04/05/94

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

008360

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY # 36919

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

PO #

=====

LABEL DESCRIPTION: PROJECT # AWD
PROJECT #: AWD9301

=====

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/25/94
TIME: 10:30 AM

GRAB SAMPLES ?

COMPOSITE SAMPLES ?

ROUTINE DISTRIBUTION
YES
CHAIN OF CUSTODY ?

=====

RECEIVED BY LAB:	DATE:	25-MAR-94	TIME:	4:10 PM	ANALYST:	J. ALTEMOSE
ANALYSIS STARTED:	DATE:	30-MAR-94	TIME:	8:00 AM	ANALYST:	MD
ANALYSIS COMPLETED:	DATE:	05-APR-94	TIME:	8:07 PM	ANALYST:	MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
CO325	VOLATILE SCAN *	SEE ATTACHED DATA		SW-8010/8020	36919
BS-8					

=====

LIMIT OF DETECTION INCREASED DUE TO MATRIX INTERFERENCE AND SPIKE RECOVERY DATA.

MANAGER:

Stephanie O'Leary

DATE:

April 6, 1994

BENCHMARK ANALYTICS ANALYSIS REPORT
1776 Main Street, Hellertown, PA 18055-1021

008361

SAMPLE : #36919 BIO-SCIENCE 1:2

SW METHOD 8260	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<20	ug/L	20
vinyl chloride	<20	ug/L	20
bromomethane	<20	ug/L	20
chloroethane	<20	ug/L	20
trichlorofluoromethane	<2	ug/L	2
1,1-dichloroethene	<2	ug/L	2
methylene chloride	5	ug/L	2
trans-1,2-dichloroethene	<2	ug/L	2
1,1-dichloroethane	<2	ug/L	2
chloroform	<2	ug/L	2
1,2-dichloroethane	<2	ug/L	2
1,1,1-trichloroethane	<2	ug/L	2
carbon tetrachloride	<2	ug/L	2
benzene	<2	ug/L	2
trichloroethene	<2	ug/L	2
1,2-dichloropropane	<2	ug/L	2
bromodichloromethane	<2	ug/L	2
cis-1,3-dichloropropene	<2	ug/L	2
trans-1,3-dichloropropene	<2	ug/L	2
1,1,2-trichloroethane	<2	ug/L	2
dibromochloromethane	<2	ug/L	2
bromoform	<2	ug/L	2
toluene	<2	ug/L	2
tetrachloroethene	<2	ug/L	2
chlorobenzene	<2	ug/L	2
ethylbenzene	<2	ug/L	2
m/p-xylene	<2	ug/L	2
o-xylene	<2	ug/L	2
1,1,2,2-tetrachloroethane	<2	ug/L	2
1,3-dichlorobenzene	<2	ug/L	2
1,4-dichlorobenzene	<2	ug/L	2
1,2-dichlorobenzene	<2	ug/L	2

B

B = Compound found in the blank. See water blank report.

The analysis for GC/MS volatiles was performed by MRD on 04/05/94

008362

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY # 36920

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017
PHONE: (610) 974-9693
FAX: (610) 691-2170

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017
PO #

LABEL DESCRIPTION: PROJECT # AWD
PROJECT #: AWD9301

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/25/94
TIME: 10:30 AM

GRAB SAMPLES ?
COMPOSITE SAMPLES ?
ROUTINE DISTRIBUTION
CHAIN OF CUSTODY ?

RECEIVED BY LAB: DATE: 25-MAR-94 TIME: 4:10 PM ANALYST: J. ALTEMOSE
ANALYSIS STARTED: DATE: 30-MAR-94 TIME: 8:00 AM ANALYST: MD
ANALYSIS COMPLETED: DATE: 05-APR-94 TIME: 8:07 PM ANALYST: MD

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
CO325	VOLATILE SCAN *	SEE ATTACHED DATA		SW-8010/8020	36920
BS-9					

* LIMIT OF DETECTION INCREASED DUE TO MATRIX INTERFERENCE AND SPIKE RECOVERY DATA.

MANAGER: Stephanie Adams

DATE: April 6, 1994

BENCHMARK ANALYTICS ANALYSIS REPORT
1776 Main Street, Hellertown, PA 18055-1021

008363

SAMPLE : #36920 BIO-SCIENCE 1:2

SW METHOD 8260 COMPOUND	RESULTS AS RECEIVED		LIMIT OF QUANTITATION
chloromethane	<20	ug/L	20
vinyl chloride	<20	ug/L	20
bromomethane	<20	ug/L	20
chloroethane	<20	ug/L	20
trichlorofluoromethane	<2	ug/L	2
1,1-dichloroethene	<2	ug/L	2
methylene chloride	4	ug/L	2
trans-1,2-dichloroethene	<2	ug/L	2
1,1-dichloroethane	<2	ug/L	2
chloroform	<2	ug/L	2
1,2-dichloroethane	<2	ug/L	2
1,1,1-trichloroethane	<2	ug/L	2
carbon tetrachloride	<2	ug/L	2
benzene	<2	ug/L	2
trichloroethene	<2	ug/L	2
1,2-dichloropropane	<2	ug/L	2
bromodichloromethane	<2	ug/L	2
cis-1,3-dichloropropene	<2	ug/L	2
trans-1,3-dichloropropene	<2	ug/L	2
1,1,2-trichloroethane	<2	ug/L	2
dibromochloromethane	<2	ug/L	2
bromoform	<2	ug/L	2
toluene	<2	ug/L	2
tetrachloroethene	<2	ug/L	2
chlorobenzene	<2	ug/L	2
ethylbenzene	<2	ug/L	2
m/p-xylene	<2	ug/L	2
o-xylene	<2	ug/L	2
1,1,2,2-tetrachloroethane	<2	ug/L	2
1,3-dichlorobenzene	<2	ug/L	2
1,4-dichlorobenzene	<2	ug/L	2
1,2-dichlorobenzene	<2	ug/L	2

B

B = Compound found in the blank. See water blank report.

The analysis for GC/MS volatiles was performed by MRD on 04/05/94

008364

BENCHMARK ANALYTICS
1776 MAIN STREET
HELLERTOWN, PA. 18055

PHONE (610) 974-8100
FAX (610) 974-8104

INVENTORY # 36921

SEND DATA TO:

NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PHONE: (610) 974-9693
FAX: (610) 691-2170

BILL TO:
NAME: Mr. John Forsyth
COMPANY: Bioscience Inc.
ADDRESS: 1550 Valley Center Parkway Suite 140
Bethlehem PA 18017

PO #

=====

LABEL DESCRIPTION: PROJECT # AWD
PROJECT #: AWD9301

SAMPLED BY: MAGARET TSAO
LOCATION: SEE BELOW
DATE: 03/25/94
TIME: 10:30 AM

____ GRAB SAMPLES ?
____ COMPOSITE SAMPLES ?
____ ROUTINE DISTRIBUTION
____ CHAIN OF CUSTODY ?
YES

=====

RECEIVED BY LAB:	DATE: 25-MAR-94	TIME: 4:10 PM	ANALYST: J. ALTEMOSE
ANALYSIS STARTED:	DATE: 30-MAR-94	TIME: 8:00 AM	ANALYST: MD
ANALYSIS COMPLETED:	DATE: 05-APR-94	TIME: 10:13 AM	ANALYST: MD

=====

SAMPLE	TEST	RESULT	UNITS	METHOD	REFERENCE #
CO325	VOLATILE SCAN	SEE ATTACHED DATA		SW-8010/8020	36921
BS-10					

=====

MANAGER:

*Stephen O. Hyslop*DATE: *April 6, 1994*

008365

BENCHMARK ANALYTICS ANALYSIS REPORT **1776 Main Street, Hellertown, PA 18055-1021**

SAMPLE : #36921 BIO-SCIENCE

SW METHOD 8260	RESULTS		LIMIT OF
COMPOUND	AS RECEIVED		QUANTITATION
chloromethane	<10	ug/L	10
vinyl chloride	<10	ug/L	10
bromomethane	<10	ug/L	10
chloroethane	<10	ug/L	10
trichlorofluoromethane	<1	ug/L	1
1,1-dichloroethene	<1	ug/L	1
methylene chloride	2	ug/L	1
trans-1,2-dichloroethene	<1	ug/L	1
1,1-dichloroethane	<1	ug/L	1
chloroform	<1	ug/L	1
1,2-dichloroethane	<1	ug/L	1
1,1,1-trichloroethane	<1	ug/L	1
carbon tetrachloride	<1	ug/L	1
benzene	<1	ug/L	1
trichloroethene	<1	ug/L	1
1,2-dichloropropane	<1	ug/L	1
bromodichloromethane	<1	ug/L	1
cis-1,3-dichloropropene	<1	ug/L	1
trans-1,3-dichloropropene	<1	ug/L	1
1,1,2-trichloroethane	<1	ug/L	1
dibromochloromethane	<1	ug/L	1
bromoform	<1	ug/L	1
toluene	<1	ug/L	1
tetrachloroethene	<1	ug/L	1
chlorobenzene	<1	ug/L	1
ethylbenzene	<1	ug/L	1
m/p-xylene	<1	ug/L	1
o-xylene	<1	ug/L	1
1,1,2,2-tetrachloroethane	<1	ug/L	1
1,3-dichlorobenzene	<1	ug/L	1
1,4-dichlorobenzene	<1	ug/L	1
1,2-dichlorobenzene	<1	ug/L	1

B = Compound found in the blank. See water blank report.

The analysis for GC/MS volatiles was performed by **MRD** on **04/04/94**

BIOREACTOR MONITORING DATA

008366

Date	Room Temperature (degrees C)	Propane Flow (bubbles/min)	Humidifier Liquid Level (ml)
3/18/94	24.0	NA	NA
3/19/94	24.0	NA	NA
3/20/94	25.0	72	NA
3/21/94	23.0	NA	300
3/22/94	23.0	NA	400.0
3/23/94	25.5	80	350.0
3/24/94	24.5	NA	NA
3/25/94	24.0	62	350.0
3/26/94	21.8	78	335.0
3/27/94	24.0	62	325.0
3/28/94	21.6	62	300.0
3/29/94	22.7	62	375.0
3/30/94	22.6	46-60	350.0
3/31/94	27.6	86	300.0
4/1/94	21.1	66	300-350
4/2/94	22.8	88	325.0
4/4/94	25.7	84	350.0
4/5/94	24.2	88	325.0
4/6/94	23.5	88	300.0
4/7/94	23.7	88	350.0
4/8/94	23.7	88	325.0
4/9/94	25.7	70	300.0
4/10/94	25.6	68	250-350
4/11/94	23.4	88	325.0
4/18/94	NA	NA	NA
4/20/94	NA	NA	NA
4/21/94	24.7	92	350.0
4/22/94	22.5	92	350.0
4/25/94	25.8	78	350.0
4/26/94	24.4	76	325.0
4/27/94	25.0	76	300.0
4/28/94	24.7	76	350.0
4/29/94	25.0	72	350.0

John Hall, *Chairman*
Pam Reed, *Commissioner*
Peggy Garner, *Commissioner*
Anthony Grigsby, *Executive Director*



Handwritten signature
008367
RECEIVED
EPA REGION VI
1994 JUL 13 AM 1:3,
BRANCH

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

July 11, 1994

Mr. David Tolbert, Project Manager
Longhorn Army Ammunition Plant
Attn: SMCLO-EN
Marshall, Texas 75671-1059

Re: Natural Resource Trustee Responsibilities

Dear Mr. Tolbert:

In accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) §107(f)(2)(B), the Governor of Texas has designated the Texas Natural Resource Conservation Commission (TNRCC), Texas Parks and Wildlife Department (TPWD) and the General Land Office (GLO) as natural resource trustees. As natural resource trustee for air, groundwater, drinking water supplies, and surface water, TNRCC is authorized to recover damages pursuant to CERCLA §107(a)(4)(C) when there is injury to, destruction of, or threat to natural resources as a result of a release of a hazardous substance. The general measure of natural resource damages is the cost of restoration, plus loss of use costs, and the trustees' assessment costs.

The Damage Assessment and Restoration Program (DARP), within the Pollution Cleanup Division has been designated to fulfill TNRCC's trustee responsibilities on behalf of the public. Although natural resource trustee notification by the Department of the Army has not been provided to TNRCC, DARP is prepared to begin to fulfill TNRCC's trustee responsibilities at the Longhorn Army Ammunition Plant (LHAAP) site. DARP staff have conducted a preliminary natural resource survey (PNRS) in accordance with §300.615(c)(1) of the National Oil and Hazardous Substance Pollution Contingency Plan (NCP). This PNRS of areas affected by releases from the LHAAP indicate TNRCC trust resources are, or potentially may be injured.

In order to accomplish trustee responsibilities in a cost-effective manner, TNRCC DARP seeks to restore injured trust natural resources by cooperating with remedial project managers (RPM) in coordinating planning, investigations and assessments, consistent with §300.615(c)(2) of the NCP. Early involvement in the removal and remedial process allows natural resource trustees to identify trust resource interests and provide assistance to the RPM in developing removal and/or remedial actions that restore natural resources, or at a minimum reduce natural resource injury. These proactive

Mr. David Tolbert
Page 2

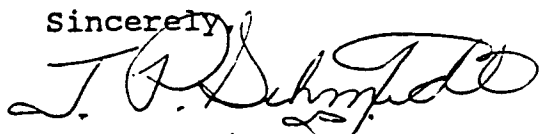
measures may eliminate or substantially reduce any future claim for natural resource damages. Generally, the more comprehensive the remediation, the less likely there will be any civil action for natural resource damages.

To begin to accomplish TNRCC's trustee goal of natural resource restoration, TNRCC DARP staff are prepared to apply their scientific, technical and trust resource management expertise to evaluating the level and effects of contaminants on trust resources at or near LHAAP. This will allow TNRCC's trust resource interests to be defined, and to identify information and data necessary to evaluate potential environmental injury associated with contamination at the site. Then DARP staff can begin to develop strategies necessary to reduce trust resource injuries at LHAAP.

Ms. Ginny King has been designated to represent TNRCC's trustee interests at LHAAP and coordinate with other natural resource trustee agencies as required by §300.615(a) of the NCP. Ms. King can be reached at (512) 239-2152 should you have any questions regarding TNRCC DARP staff's required involvement in future planning and investigations at LHAAP.

TNRCC DARP staff look forward to working cooperatively with the Department of the Army staff in restoring and protecting natural resources at or near the LHAAP. Thank you in advance for your cooperation in this matter.

Sincerely,



J.P. Schmidt, Manager
Trustee Delegate
Damage Assessment & Restoration Program
Emergency Response & Assessment Section
Pollution Cleanup Division

JPS/GK/gk

cc: ✓ Glenn Sekavec, DOI, Regional Envir. Officer,
Albuquerque
Diane Hyatt, GLO, NRDA Director, Austin
Don Pitts, TPWD NRDA Coordinator, Austin
Lisa Marie Price, EPA Region VI Project Manager, Dallas
Michael Moore, TNRCC Superfund Project Manager, Austin
Allan Posnick, TNRCC FFRP, Austin
Lt. Colonel Lawrence Sowa, Commanding Officer, LHAAP

REPLY TO
ATTENTION OFDEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
MARSHALL TEXAS 75670-1059

JUL 12 PM 2:41

SUPERFUND BRANCH

008369



11 July 1994

SMCLO-EN

Ms. Lisa Price
Superfund Enforcement
U.S. Environmental Protection Agency
1445 Ross Avenue
Dallas, Texas 75202

Dear Ms. Price:

Enclosed are two copies of the Draft Final Phase II Work Plan of 125 Waste Process Sumps and 20 Waste Rack Sumps of Longhorn Army Ammunition Plant in Karnack, Texas.

Please review and send your comments back to us by 10 August 1994.

If there are any questions, please contact Mr. David Tolbert at (903) 679-2728.

Sincerely,

Lawrence J. Sowa
Lieutenant Colonel, U.S. Army
Commanding Officer

Encls



008370

JUL 05 1994

CERTIFIED MAIL: RETURN RECEIPT REQUESTED

David Tolbert, Project Manager
Longhorn Army Ammunition Plant
Attn: SMCLO-EN
Marshall, Texas 75671-1059

Re: Draft Final Initial Screening of Alternatives for
Longhorn Army Ammunition Plant

Dear David:

Pursuant to the Federal Facility Agreement for the Longhorn Army Ammunition Plant, EPA is submitting comments on the Draft Final Initial Screening of Alternatives for Longhorn Army Ammunition Plant. EPA's comments are included as an enclosure to this letter.

If you have any questions about EPA's comments or any other matter, please contact me at (214) 655-6744.

Sincerely,

Lisa Marie Price
Remedial Project Manager
Superfund Texas Enforcement

Enclosure

cc: Lieutenant Colonel Lawrence J. Sowa
Commanding Officer, U.S. Army
Longhorn Army Ammunition Plant
Marshall, Texas 75671-1059

Tulsa District Corps of Engineers
P.O. Box 61
Attn: Mr. Ross Nguyen
CESWT-PP-E
Tulsa, OK 74121-0061

Mike Moore, Superfund
Texas Natural Resource Conservation Commission
P.O. Box 13087
Capital Station
1700 N. Congress Avenue
Austin, TX 78711-3087

EPA Comments
Draft Initial Screening of Alternatives
7/6/94

General Comments:

- #1 In light of the fact that this project is possibly a couple, if not several, years from issuing a Feasibility Study for any of the sites requiring possible remediation (with the exception of the sites requiring interim remedial action), EPA requests that the Initial Screening of Alternatives not be resubmitted for regulatory approval until such time as it is necessary for the purpose of scoping and determining completeness of information for the Feasibility Study. Therefore, the timing of the resubmission of the Initial Screening of Alternatives could be delayed until after complete characterization of the extent and nature of contamination when the issue of technologies for bench-scale testing are being investigated.
- #2 EPA requests that the Vendor Information System for Innovative Treatment Technologies (VISITT) be accessed in order to broaden the scope of the identification of technologies that may appropriate, effective, and implementable at the Longhorn Army Ammunition Plant facility.
- #3 Of course, the document will require revision once additional information is generated for sites currently addressed in this draft and also as additional sites with similar or different contaminants are identified.
- #4 EPA is reserving its right to make final comments on the ARARs during the Remedial Investigation/Feasibility Study.

JUL 13 1994

CERTIFIED MAIL: RETURN RECEIPT REQUESTED

P104195161

David Tolbert, Project Manager
Longhorn Army Ammunition Plant
Attn: SMCLO-EN
Marshall, Texas 75671-1059

Re: Landfill Caps Remedial Design Investigations
Draft Final Work Plan dated June 1994

Dear David:

Pursuant to the Federal Facility Agreement for the Longhorn Army Ammunition, EPA is submitting comments on the Landfill Caps Remedial Design Investigations Draft Final Work Plan, dated June 1994.

EPA's comments are as follows:

Comment #1 Section 2.2, page 1: EPA would like to see the grid of the areas for each of the landfills that is to be soil gas surveyed. Additional figures should be included to show the grid areas.

Comment #2 Section 2.2, page 4: EPA strenuously objects to the soil gas sampling collection method! EPA requests that a Tedlar bag sample collection method be used. When collecting grab gas samples for analysis, a Tedlar bag collection system allows for the collection of a representative gas sample. The Tedlar bag collection system consists of:

- * a Tedlar bag complete with necessary fittings
- * a box in which a vacuum is created
- * a sampling pump to create the necessary vacuum
- * an appropriate Teflon and Tygon tubing

The tedlar bag is placed into the vacuum box and the fitting is inserted into Teflon tubing. The Teflon tubing is the path through which the gaseous media will travel. The pump is attached to the Tygon tubing, which is part of the vacuum fitting on the vacuum box. The pump evacuates the air in the vacuum box, creating a pressure differential causing the sample to be drawn into the bag. The sample introduced

into the Tedlar bag never passes through the pump. The flow rate for the pump must be defined prior to sampling (usually 3 liters/minute) for bag sampling). The Tedlar bag, upon collection of the sample, should be stored in either a clean cooler or a trash bag to prevent photodegradation. It is imperative that sample analysis be conducted within 48 hours, as after that time compounds may escape or become altered. Will an onsite lab be available? If not, how quickly can the samples be transported to a lab? If you want more information regarding this sample collection method, EPA can provide assistance.

- Comment #3 Section 3.0: EPA is reserving its comments on the actual cap design, however, EPA suggests that the Checklist for Landfill Cover Design developed by the Corps of Engineers Omaha District dated May 1993 be used and that Corps of Engineer Waterways Experiment Station HELP Model be used to determine the appropriateness of the caps' conceptual model.
- Comment #4 Section 4.0: EPA is reserving comment on the schedule for the construction of the landfill caps.
- Comment #5 Site Safety and Health Plan (SSHP) Tables 6.1-1 and 6.2-1: More current information is available for these sites and should be included.
- Comment #6 SSHP Section 11.0, 12.0, and 13.0: Given the potential for releases, Level C protection should be available in the field if field conditions warrant increasing the level of protection for the onsite personnel. Given the type of contaminants that could potentially be encountered, a PID and/or Dreagar Pump are inadequate and inappropriate for ambient air monitoring and for determining action levels for personal protection. A CGI in conjunction with a OVA or FID should be used.

If you have any questions about EPA's comments or any other matter, please contact me at (214) 655-6744. After August 1, 1994, my new phone number is (214) 665-6744.

Sincerely,

Lisa Marie Price
Remedial Project Manager
Superfund Texas Enforcement

cc: Lieutenant Colonel Lawrence J. Sowa
Commanding Officer, U.S. Army

008374

Longhorn Army Ammunition Plant
Marshall, Texas 75671-1059

Tulsa District Corps of Engineers
P.O. Box 61
Attn: Mr. Ross Nguyen
CESWT-PP-E
Tulsa, OK 74121-0061

Mike Moore, Superfund
Texas Natural Resource Conservation Commission
P.O. Box 13087
Capital Station
1700 N. Congress Avenue
Austin, TX 78711-3087

REPLY TO
ATTENTION OFDEPARTMENT OF THE ARMY
LONGHORN/LOUISIANA ARMY AMMUNITION PLANTS
MARSHALL, TEXAS 75671-1059

008375



July 27, 1994

Engineering Division

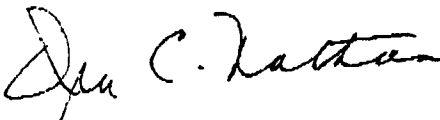
Ms. Lisa Price
Superfund Enforcement
U. S. Environmental Protection Agency
1445 Ross Avenue
Dallas, Texas 75202

Dear Ms. Price:

Request extension of submittal dates for the "Draft Proposed Plan for the Interim Remedial Action" and the "RI/FS Report for Sites 13 & 14" to August 1st and 2nd, respectively. Extension is requested due to illness and hospitalization of Technical Manager.

If you have any questions, please contact Mr. David Tolbert at 903-679-2728.

Sincerely,

for 
Lawrence J. Sowa
Lieutenant Colonel, U. S. Army
Commanding Officer

JUL 13 1994

CERTIFIED MAIL: RETURN RECEIPT REQUESTED

JUL 13 1994

David Tolbert, Project Manager
Longhorn Army Ammunition Plant
Attn: SMCLO-EN
Marshall, Texas 75671-1059

P104195160 JUL 1 1994

Re: Monitoring Well MW-15 at UEP/Burning Ground No. 3
Longhorn Army Ammunition Plant

Dear David:

As we discussed during the June 22, 1994, monthly Project Coordinators meeting, EPA is concerned regarding the planned abandonment of monitoring well MW-15 at UEP/Burning Ground No.3, as outlined in the May 1994 draft Existing Monitoring Well Condition Survey. As was stated in EPA's June 7, 1994, letter, EPA requests that MW-15 be replaced using state-of-art materials and techniques for the installation and construction of monitoring wells in DNAPL- contaminated environments. However, during the June 1994, monthly Project Coordinators meeting, the Army expressed hesitancy in replacing MW-15 for various reasons, the least of which not being the potential for cross-contamination during the installation of the replacement monitoring well.

EPA understands that the Army is concerned that monitoring well MW-15 may be acting as a conduit for vertical migration of DNAPL. EPA, however, has not told the basis for the concern. Regardless, during the course of the Remedial Investigation (RI) for the facility and specifically at the UEP/Burning Ground No. 3, a thorough and complete evaluation and characterization of the groundwater contamination, including the DNAPL, must be conducted. Therefore, proper procedures must be developed for the drilling, installation, development, and sampling of wells in suspected or known DNAPL-contaminated environments. EPA requests to review these procedures once developed. Additionally, because of the relatively shallow groundwater contamination (less than 50 feet below ground surface) non-intrusive geophysical techniques (eg. terrain conductivity) maybe useful in determining appropriate areas to investigate with the direct push technology (eg. CPT).

Regarding the abandonment of monitoring well MW-15, EPA requests the well (casing, etc.) be pulled and that the construction of the well be surveyed, if possible, to determine the conduit pathway. The removal of the well should be done such that the hole is backfilled as the well casing is being pulled. Furthermore, EPA suggests that some research into an appropriate grout material be conducted. It has been suggested that a clay

bentonite with an organic polymer be used to grout the well hole. Research has shown that cement bentonite would be inappropriate given the types and concentrations of organic contaminants at the UEP/Burning Ground No.3 area. Mr. John Cullinane of the Jackson, Mississippi Corps of Engineers office may be able to assist you in determining a compatible grout.

If you have any questions about EPA's comments or any other matter, please contact me at (214) 655-6744. After August 1, 1994, my new phone number is (214) 665-6744.

Sincerely,

Lisa Marie Price
Remedial Project Manager
Superfund Texas Enforcement

cc: Lieutenant Colonel Lawrence J. Sowa
Commanding Officer, U.S. Army
Longhorn Army Ammunition Plant
Marshall, Texas 75671-1059

Tulsa District Corps of Engineers
P.O. Box 61
Attn: Mr. Ross Nguyen
CESWT-PP-E
Tulsa, OK 74121-0061

Mike Moore, Superfund
Texas Natural Resource Conservation Commission
P.O. Box 13087
Capital Station
1700 N. Congress Avenue
Austin, TX 78711-3087



DEPARTMENT OF THE ARMY

LONGHORN ARMY AMMUNITION PLANT
MARSHALL, TEXAS 75671-1059

008378

REPLY TO
ATTENTION OF

July 29, 1994

Engineering Division

Ms. Lisa Price
Superfund Enforcement
U.S. Environmental Protection Agency
1445 Ross Avenue
Dallas, Texas 75202

Dear Ms. Price:

Enclosed are two copies of the Preliminary Draft
Proposed Plan for Burning Ground 3, for Longhorn Army
Ammunition Plant, in Karnack, Texas.

Please review and send your comments back to us by
30 August 1994. If possible, please send comments by
23 August 1994 so that responses to comments can be
prepared prior to the 30 August 1994 Resolution
Meeting.

If there are any questions, please contact
Mr. David Tolbert at 903-679-2728.

Sincerely,

Encls

Lawrence J. Sowa
Lieutenant Colonel, U.S. Army
Commanding Officer



008379

JUL 29 1994

CERTIFIED MAIL: RETURN RECEIPT REQUESTED

David Tolbert, Project Manager
Longhorn Army Ammunition Plant
Attn: SMCLO-EN
Marshall, Texas 75671-1059

Re: Draft Work Plan Addendum
Soil and Groundwater Background Concentration Study
Longhorn Army Ammunition Plant

Dear David:

Pursuant to the Federal Facility Agreement for the Longhorn Army Ammunition Plant, EPA is submitting comments on the Draft Work Plan Addendum Soil and Groundwater Background Concentration Study for Longhorn Army Ammunition Plant and conditionally approving the work plan. The conditions for final approval are that all of EPA's comments are addressed and the appropriate changes made to the document. EPA's comments are included as an enclosure to this letter. Upon receipt of the revised Work Plan Addendum Soil and Groundwater Background Concentration Study Longhorn Army Ammunition Plant by EPA, the document will be considered final and approved.

If you have any questions about EPA's comments or any other matter, please contact me at my new phone number (214) 665-6744.

Sincerely,

Lisa Marie Price
Remedial Project Manager
Superfund Texas Enforcement

Enclosure

cc: Lieutenant Colonel Lawrence J. Sowa
Commanding Officer, U.S. Army
Longhorn Army Ammunition Plant
Marshall, Texas 75671-1059

008380

Tulsa District Corps of Engineers
P.O. Box 61
Attn: Mr. Ross Nguyen
CESWT-PP-E
Tulsa, OK 74121-0061

Mike Moore, Superfund
Texas Natural Resource Conservation Commission
P.O. Box 13087
Capital Station
1700 N. Congress Avenue
Austin, TX 78711-3087

Draft Work Plan Addendum
Soil and Groundwater Background Concentration Study
Longhorn Army Ammunition Plant
EPA's Comments 7/29/94

- Comment #1 Refer to Section 5.3 of the *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A) EPA/540/1-89/002* regarding the use of Sample Quantitation Limits (SQL). EPA requests that SQLs be used since SQLs are the most appropriate limits to consider when evaluating non-detected chemicals (Section 5.3.4).
- Comment #2 When the background information is presented, a table should be provided which shows frequency of detection and range of detections per inorganic analyte for all background samples taken across the facility. As per Comment #2, SQLs should be used rather than non-detects. In addition, the mean concentration (calculate geometric and then transform mean back) or the 95% Upper Confidence Limit (UCL) concentration (based upon arithmetic averages) should be given (as opposed to the 90 percent noted on page 3 of the work plan) and shown on this table. Refer to *Guidance for Data Useability in Risk Assessment EPA/540/G-90/008* for more information on use and presentation of information.
- Comment #3 Section 1.0, page 1: Change the following sentence to read: "The ultimate goal of these investigations is to provide data which can be used to determine the impact of LHAAP activities upon the environment. *The results will be used in the sumps investigations as well as other site investigations.*"
- Comment #4 Section 2.1, page 2: There is nothing uniform about the Wilcox Formation and the distribution of interbedded sands, silts and clays underlying the site. The term "uniform" implies homogeneity.
- Comment #5 Page 3, 1st paragraph: Refer to Section 4.4 of the *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A) EPA/540/1-89/002* regarding background sampling. The error rate identified in the work plan is 25 percent, however, the *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A) EPA/540/1-89/002* states that the α should be 0.05 with β being 0.15.

008382

JUL 29 1994

CERTIFIED MAIL: RETURN RECEIPT REQUESTED

David Tolbert, Project Manager
Longhorn Army Ammunition Plant
Attn: SMCLO-EN
Marshall, Texas 75671-1059

Re: Draft Work Plan Addendum
Remedial Investigation
Sites 11, 1/1A, XX, 27 for
Longhorn Army Ammunition Plant

Dear David:

Pursuant to the Federal Facility Agreement for the Longhorn Army Ammunition Plant, EPA is submitting comments on the Draft Work Plan Addendum Remedial Investigation Sites 11, 1/1A, XX, 27 for Longhorn Army Ammunition Plant and conditionally approving the work plan. The conditions for final approval are that all of EPA's comments are addressed and the appropriate changes made to the document. EPA's comments are included as an enclosure to this letter. Upon receipt of the revised Work Plan Addendum Remedial Investigation Sites 11, 1/1A, XX, 27 for Longhorn Army Ammunition Plant by EPA, the document will be considered final and approved.

If you have any questions about EPA's comments or any other matter, please contact me at my new phone number (214) 665-6744.

Sincerely,

Lisa Marie Price
Remedial Project Manager
Superfund Texas Enforcement

Enclosure

cc: Lieutenant Colonel Lawrence J. Sowa
Commanding Officer, U.S. Army
Longhorn Army Ammunition Plant
Marshall, Texas 75671-1059

008383

Tulsa District Corps of Engineers
P.O. Box 61
Attn: Mr. Ross Nguyen
CESWT-PP-E
Tulsa, OK 74121-0061

Mike Moore, Superfund
Texas Natural Resource Conservation Commission
P.O. Box 13087
Capital Station
1700 N. Congress Avenue
Austin, TX 78711-3087

**Draft Work Plan Addendum
Remedial Investigation
Sites 11, 1/1A, XX, 27 for
Longhorn Army Ammunition Plant
EPA's comments 7/29/94**

008384

- Comment #1 Section 3, page 4 of 24: The last sentence of the first paragraph should be completed.
- Comment #2 Section 4, page 7 of 11: I don't think the text truly reflects the agreement that EPA, TNRCC and the Army reached regarding the phase 2 RI investigation for site XX. According to EPA's records, the order of events is as follows: 1) conduct soil gas survey; 2) if no concentrations of acetone are detected during the soil gas survey, a 10-foot soil boring will be drilled near SB-19 with soil samples collected and analyzed; OR 3) if concentrations of acetone are detected during the soil gas survey, a monitoring well will be installed at the location of the highest concentration with soil and groundwater samples collected and analyzed. If EPA's recollection is correct, please clarify the text. If EPA's recollection is incorrect, please notify EPA.