NM2 - 3

GENERAL CORRESPONDENCE YEAR(S):

2004 - 1992

1912

NEW MEXICO ENERGY, MINERALS and
NATURAL RESOURCES DEPARTMENT

BILL RICHARDSON
Governor
Joanna Prukop
Cabinet Secretary

Mark E. Fesmire, P.E.
Director
Oil Conservation Division

September 20, 2004

Mr. Buddy Shaw
BP America Production Co.
200 Amoco Court
Farmington, NM 87401

Dear Mr. Shaw:

Since the New Mexico Oil Conservation Division (NMOCD) promulgated Rule 50 covering pits and below-grade tanks, there has arisen a need, in certain circumstances, for operators to transport their drill cuttings off-site and dispose of them.

NMOCD Rule 711, as it pertains to landfarms, does not specifically address the issue of exempt oilfield wastes that may be contaminated with salts. Your landfarm application and permit were written with only hydrocarbon-contaminated soils in mind. Salt-contaminated wastes cause the following problems:

1. Lessening the effectiveness of the biodegradation capacity of your landfarm
2. Rapid leachability causing adverse effects on groundwater

If you want to accept salt-contaminated cuttings or any other salt-contaminated wastes, your 711 permit must be modified to ensure that your acceptance of those wastes will not adversely affect public health or the environment.

Please check one of the following:

☐ I have accepted or intend to accept salt-contaminated wastes in my landfarm. An OCD form C-137, applying for a modification to my 711 permit is attached. Included, as an attachment, is a demonstration that the accepted salt-contaminated soils will not adversely affect groundwater in the foreseeable future. (Closure requirements will also require modification to ensure the protection of groundwater. Should your acceptance of salt-contaminated wastes prove detrimental to groundwater, future liability for such damage rests with the landfarm operator).

☐ I do not intend to accept salt-contaminated wastes in my landfarm. Should this condition change, I will submit an OCD Form C-137 for a modification to my 711 permit at that time.

New Mexico Oil Conservation Division
Attn: Ed Martin
1220 S. St. Francis
Santa Fe, NM 87505

This letter must be returned to the above address no later than October 31, 2004. An extension of time may be granted if you contact this office no later than that date.

If you have any questions, contact Ed Martin (505) 476-3492 or emartin@state.nm.us

____________________________ ________________________
Signed Date

Kieling, Martyne

From: Kieling, Martyne
Sent: Thursday, January 30, 2003 9:50 AM
To: 'benkobd@bp.com'
Cc: Anderson, Roger; 'jlovato@nm.blm.gov'; Foust, Denny
Subject: SulfaTreat Disposal

Brittany,

This is in response to your question to Roger Anderson of the OCD.

Thank you for the information and the web site link it was very informative. The BP Crouch Mesa Landfarm Facility can receive this waste (SulfaTreat) into the it Composting facility. If BP wishes to manage this waste on site at each individual well site, best management practices (BMP's) must be installed. This would include a landfarm/compost style set up including adequate berming to prevent run-off or run-on, management of the waste in 6 inch lifts or less or in compost piles similar to those constructed at Crouch Mesa. If you plan on managing the waste at each individual well site we would request that you submit a list of those sites with their legal description so that we may track individual well site cleanup activities.

Please be advised that if you combine waste from more than one well site at a single well location you are developing a centralized surface waste management facility and would need to be permitted as such under Rule 711.

Please call me at 505-476-3488 or e-mail me if you have any questions.

Sincerely
Martyne Kieling

Roger C. Anderson
Roger C. Anderson
Environmental Bureau Chief
Oil Conservation Division

-----Original Message-----
From: Benko, Brittany D [mailto:BenkoBD@bp.com]
Sent: Thursday, January 30, 2003 7:39 AM
To: 'RCANDERSON@state.nm.us'; 'jlovato@nm.blm.gov'
Subject: SulfaTreat Disposal
Importance: High

Roger and Jim,
We are in the process of removing/replacing spent SulfaTreat (pyrite) from vessels on 30 of our well locations. The vessels are between the separator and the meter run and the SulfaTreat inside the vessels is used to remove the sulfur from the gas. Spent SulfaTreat is non-hazardous and an E & P Exempt Waste. Each wellsite vessel contains approximately 2600 pounds of spent SulfaTreat (pyrite). I have included more information below as well as a website link that describes the waste in more detail.

Why is SULFATREAT® Environmentally Safe? SULFATREAT® begins as a safe and stable compound, and when it reacts with H2S, it forms another safe and stable compound called "pyrite" also known as "fools gold". Reacted SULFATREAT® has passed every stringent environmental test and EPA regulation including: California's Title 22 Metals Analysis; Calwet Extraction Test; Fish and Shrimp Biossay Tests for Toxicity; and the EPA's newest procedure - the TCLP (Toxicity Characteristic Leaching Procedure) which became effective September 2, 1990. Reacted SULFATREAT® was tested by a major California

Kieling, Martyne

From:	Anderson, Roger
Sent:	Thursday, January 30, 2003 8:00 AM
To:	Kieling, Martyne
Subject:	FW: SulfaTreat Disposal
Importance:	High

Roger C. Anderson
Roger C. Anderson
Environmental Bureau Chief
Oil Conservation Division

-----Original Message-----
From: Benko, Brittany D [mailto:BenkoBD@bp.com]
Sent: Thursday, January 30, 2003 7:39 AM
To: 'RCANDERSON@state.nm.us'; 'jlovato@nm.blm.gov'
Subject: SulfaTreat Disposal
Importance: High

Roger and Jim,

We are in the process of removing/replacing spent SulfaTreat (pyrite) from vessels on 30 of our well locations. The vessels are between the separator and the meter run and the SulfaTreat inside the vessels is used to remove the sulfur from the gas. Spent SulfaTreat is non-hazardous and an E & P Exempt Waste. Each wellsite vessel contains approximately 2600 pounds of spent SulfaTreat (pyrite). I have included more information below as well as a website link that describes the waste in more detail.

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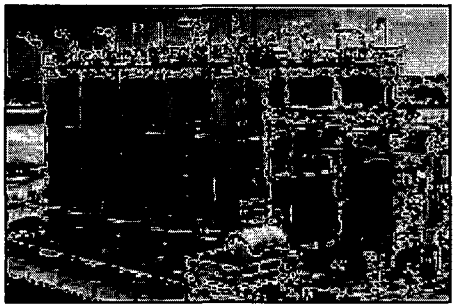
http://www.axsia.com/Content.asp?t=ProductPage&ProductID=19

We are requesting the ability to remediate the spent SulfaTreat on site as well as the ability to take it to our Crouch Mesa landfarm if that becomes necessary. (Most sites are federal). Thanks for you consideration!

Brittany D Benko
Field Environmental Coordinator
SJPU HSE, Farmington, NM
Office (505) 326-9235
Cell (505) 486-4424
benkobd@bp.com

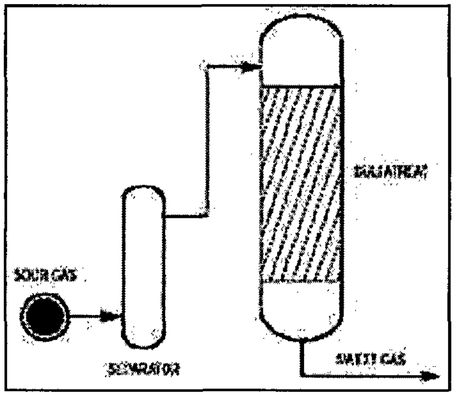
SULFATREAT® H_2S Scavenger

Makes Gas Conditioning Easier and More Predictable



What is SULFATREAT®?

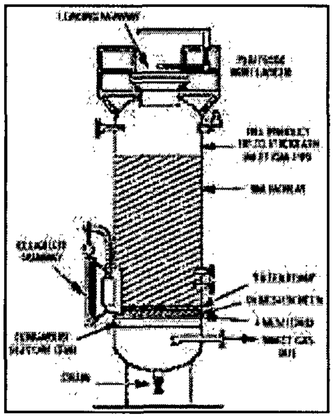
SULFATREAT® is a batch process for removal of hydrogen sulfide gas (H_2S) from natural gas. SulfaTreat is different from other processes in that it is a dry material. No free liquids whatsoever are used with the SULFATREAT® process. This unique dry characteristic makes processing gas much easier and more predictable than with other products on the market, including iron sponge and the many liquid processes.



How is SULFATREAT® Used?

The process must be situated immediately after a gas/liquid separator and before the dehydration process. The preferable gas temperature is between 50°F and 120°F, and is water saturated. The process is not pressure sensitive and is not affected by the presence of any other constituent in the gas stream. The process is completely selective to H_2S, and no undesirable offgases are produced by the SULFATREAT® process.

A vertical pressure vessel, hollow on the inside except for a support tray near the bottom head seam, with loading and cleanout manways is all that is necessary for the SULFATREAT® process. In situations where a customer's vessel is not suitable, inexpensive modifications can easily be made.



Why is SULFATREAT® Environmentally Safe?

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How Does SULFATREAT® Differ from Iron Sponge?

SULFATREAT® is black, granular, about the size of pea gravel and is uniform in shape and size. Iron sponge looks like red iron oxide impregnated on wood chips, and is uneven in shape and size. Chemically, SULFATREAT® has a different molecular structure than iron sponge. This unique molecular structure allows SULFATREAT® to remove approximately 2 to 3 times more sulfur than iron sponge, and thus SULFATREAT® lasts 2 to 3 times longer between changeouts. SULFATREAT®'s molecular structure also makes it nonpyrophoric, whereas reacted iron sponge is extremely pyrophoric when exposed to air. The uniform shape and size of the SULFATREAT® material will not allow gas to channel (i.e. rat hole) through the bed, as commonly occurs with iron sponge.

Other differences with iron sponge are that SULFATREAT® can be changed out in a fraction of the time that it takes wood chips to be changed out, and with less effort. SULFATREAT®'s gradual breakthrough of H_2S near the end of a batch allows for better planning and budgeting of changeouts, without shutting down because of offspec gas. Iron sponge's break-throughs are sudden and dramatic.

SULFATREAT®	**Iron Sponge**
Nonpyrophoric	Nonpyrophoric
Long bed life	Shorter bed life
Safe to handle, and environmentally safe after reaction	Dangerous to personnel and listed as a generic hazardous chemical on SARA Title III

Why are Injection Chemicals Undesirable?

Because flow conditions vary greatly, operators must inject enough chemical to cover peak production periods and spikes in H_2S levels. This requires over-injection and wastes money. The effectiveness of the injection method depends on good dispersion of the chemicals into the gas and sufficient contact time, both of which are difficult to control. Most injection chemicals are hazardous and toxic, and are regulated under SARA Title III. Reports from the field indicate that chemical injection tends to result solidification causing blockages in pipes and equipment. SULFATREAT® has none of these problems.

SULFATREAT®	**Injection Chemicals**
No downstream carry over	Chemicals can solidify in pipeline and equipment
Non-hazardous/non-toxic	Hazardous/toxic
Constant efficiency over designed range of operating conditions	Inefficient if operating conditions fluctuate or if chemical dispersion is inadequate
Lower cost	Higher cost due to inefficiencies and over injection requirement

Dry (SULFATREAT®)	**Liquid**
Cannot foam	Foaming is common
Not affected by fluctuations in flowrate and pressure	Product carry over and reduced efficiency are caused by changes

Why is a Dry Process Better than a Liquid?

A dry process, such as SULFATREAT®, has few operating problems than a liquid process and thus, is more predictable and reliable. Foaming is a major problem with liquids. Foaming occurs when hydrocarbons condense in the liquid or as a result of variations in flowrate and pressure. Foaming causes carry over of the liquid which can affect downstream processes. To prevent foaming, defoaming agents are used which can be hazardous and in some cases cancer causing. Product concentrations and liquid levels need to be checked continuously. Proper gas dispersion is a problem with liquid processes and is also dependent on flow rates and pressures which are rarely constant.

SULFATREAT®, by comparison, remains fixed and steady in the tower regardless of fluctuation in operating conditions. SulfaTreat's uniform shape and porosity naturally disperses the gas evenly across the bed, and SULFATREAT® can tolerate wide variations in flow rates and pressures.

Site Map

NEW MEXICO ENERGY, MINERALS and
NATURAL RESOURCES DEPARTMENT

GARY E. JOHNSON
Governor
Betty Rivera
Cabinet Secretary

Lori Wrotenbery
Director
Oil Conservation Division

November 12, 2002

Ms. Brittany Benko
BP America Production Company
200 Amoco Court
Farmington, New Mexico 87401

RE: **BP America Production Company's Request for Approval to Remediate**
GCU 134 Earthen Pit
Unit M, Section 17, T 29 N, R 12 W, NMPM, San Juan County, NM
Crouch Mesa Centralized Surface Waste Management Facility
Permit NM-02-0003.

Dear Ms. Benko:

The New Mexico Oil Conservation Division (OCD) has received Blagg Engineering Inc.'s letter on behalf of BP-American Production Company dated October 29, 2002. The request to remediate drum contents at the Crouch Mesa facility along with analytical data has been reviewed and is hereby approved.

Please be advised that our approval does not relieve BP-Amoco of liability should your operation result in pollution of surface water, ground water, or the environment. In addition, OCD approval does not relieve BP-American Production Company of responsibility for compliance with other federal, state or local laws and/or regulations.

Sincerely,

Martyne J. Kieling
Environmental Geologist

cc: OCD Aztec District Office
Jeff Blagg, Blagg Engineering, Inc.

BLAGG ENGINEERING, INC.
P.O. Box 87, Bloomfield, New Mexico 87413
Phone: (505)632-1199 Fax: (505)632-3903

October 29, 2002

Ms. Martyne Kieling
New Mexico Oil Conservation Division
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

Re: BP-America Production Company
Request for Approval to Remediate Drum Contents
Various Well Locations

Dear Ms. Kieling:

On behalf of BP America Production Company (BP), Blagg Engineering, Inc. (BEI) seeks NMOCD approval to remediate the contents of approximately 61 gallons of oilfield waste fluids accumulated by BP and stored in 7 drums at various locations. BP requests approval to stabilize the fluids with soil and then transport the solid material to the NMOCD permitted BP Crouch Mesa Waste Management facility for remediation. Empty drums will be cleaned and either re-used or transported to a permitted solid waste landfill.

BEI inspected the drums and made a contents identification based on labels and/or drum type. Those drum contents that could not be positively identified and were sampled for characterization of reactivity, corrosivity, and ignitability (RCI), eight (8) RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, cadmium and chromium) and TCLP Volatiles. Samples were submitted to Envirotech, Inc. Laboratories in Farmington, New Mexico for testing.

The contents of two drums could be positively identified based on drum type and labeling. One drum contained lube oil contaminated with water (due to broken sight glass allowing rain water to seep into the drum) and the other drum contained used ethylene glycol. Material Safety Data Sheets (MSDS) were inspected for these content types and were found to be non-hazardous.

Included in Table 1 on the following page are the results of the drum inspection and laboratory testing:

Barrel #1 RCI, metals

Table 1
BP America Production Company
Drum Sampling Identification Results

Drum Location	Drum Size & Type	Fill Volume	Comments
Heath, WD B 1A	55 gallon steel	15± gallons	Clear, non viscous liquid. Passed RCI, 8 RCRA metals and TCLP Volatiles
Giomi GC C1	55 gallon steel	2± gallons	New lube oil in drum with broken site glass. Possibly mixed with rain water.
Nye GC B 1E	42 gallon steel	1± gallon	Used ethylene glycol.
Florance 121	55 gallon steel	5± gallons	Unknown contents, appears to be used engine oil. Passed RCI, 8 RCRA metals and TCLP Volatiles.
Cahn Evap. Pond	55 gallon steel	10+/- gallons	Thick viscous liquid. Passed RCI, 8 RCRA metals and TCLP Volatiles.
Graig 3E (Durango)	55 gallon steel	10+/- gallons	Pure, clear yellow colored viscous liquid. Passed RCI, 8 RCRA metals and TCLP Volatiles.
Carnes GU 32-6-11 #1 (Durango)	55 gallon pvc	18+/- gallons	Pure, clear orange viscous liquid. Passed RCI, 8 RCRA metals and TCLP Volatiles

Laboratory test reports for drums sampled are attached. Based on drum sampling test results and MSDS information, BEI does not believe that remediation of the drum contents at the Crouch Mesa landfarm will present any conflicts with the facility permit.

Questions or comments concerning this transmittal may be directed to myself at (505)632-1199 or to Brittany Benko with BP at (505)326-9235.

Respectfully submitted:
Blagg Engineering, Inc.

Jeffrey C. Blagg, P.E.
President

Attachments: Lab Reports
MSDS Sheets

cc: B. Benko - BP San Juan Op.
D. Mustard - BP Durango
D. Foust - NMOCD Aztec

10244

CHAIN OF CUSTODY RECORD

Client / Project Name: BLAGG/BP

Project Location: DURANGO OP. CTR.

Sampler: J. C. Blagg

Client No. 94034-010

Sample No./ Identification	Sample Date	Sample Time	Lab Number	Sample Matrix	No. of Containers	RCI	8 RCRA Metals	TCLP VOL.				Remarks
DRUM GRAIG 3E	9/19/02	0815	23837	LIQUID	3	X	X	X				
DRUM CARNES GU 32-6-11 #1	11	0930	23839	11	3	X	X	X				

ANALYSIS / PARAMETERS

	Date	Time		Date	Time
Relinquished by: (Signature) J. C. Blagg	9/19/02	1500	Received by: (Signature) Christine M Walters	9/19/02	15:00
Relinquished by: (Signature)			Received by: (Signature)		
Relinquished by: (Signature)			Received by: (Signature)		

ENVIROTECH INC.

5796 U.S. Highway 64
Farmington, New Mexico 87401
(505) 632-0615

Sample Receipt

	Y	N	N/A
Received Intact	✓		
Cool - Ice/Blue Ice	✓		

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

SUSPECTED HAZARDOUS WASTE ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Graig Drum 3E	Date Reported:	09-20-02
Lab ID#:	23837	Date Sampled:	09-19-02
Sample Matrix:	Liquid	Date Received:	09-19-02
Preservative:	Cool	Date Analyzed:	09-20-02
Condition:	Cool and Intact	Chain of Custody:	10244

Parameter	Result	
IGNITABILITY:	**Negative**	
CORROSIVITY:	**Negative**	**pH = 7.90**
REACTIVITY:	**Negative**	

RCRA Hazardous Waste Criteria

Parameter	Hazardous Waste Criterion
IGNITABILITY:	Characteristic of Ignitability as defined by 40 CFR, Subpart C, Sec. 261.21. *(i.e. Sample ignition upon direct contact with flame or flash point < 60° C.)*
CORROSIVITY:	Characteristic of Corrosivity as defined by 40 CFR, Subpart C, Sec. 261.22. *(i.e. pH less than or equal to 2.0 or pH greater than or equal to 12.5)*
REACTIVITY:	Characteristic of Reactivity as defined by 40 CFR, Subpart C, Sec. 261.23. *(i.e. Violent reaction with water, strong base, strong acid, or the generation of Sulfide or Cyanide gases at STP with pH between 2.0 and 12.5)*

Reference: 40 CFR part 261 Subpart C sections 261.21 - 261.23, July 1, 1992.

Comments: **Durango OP Center.**

Christine M Walters
Analyst

Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

SUSPECTED HAZARDOUS WASTE ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Carnes GU Drum 32-6-11 #1	Date Reported:	09-20-02
Lab ID#:	23838	Date Sampled:	09-19-02
Sample Matrix:	Liquid	Date Received:	09-19-02
Preservative:	Cool	Date Analyzed:	09-20-02
Condition:	Cool and Intact	Chain of Custody:	10244

Parameter	**Result**	
IGNITABILITY:	**Negative**	
CORROSIVITY:	**Negative**	**pH = 8.18**
REACTIVITY:	**Negative**	

RCRA Hazardous Waste Criteria

Parameter	Hazardous Waste Criterion
IGNITABILITY:	Characteristic of Ignitability as defined by 40 CFR, Subpart C, Sec. 261.21. *(i.e. Sample ignition upon direct contact with flame or flash point < 60° C.)*
CORROSIVITY:	Characteristic of Corrosivity as defined by 40 CFR, Subpart C, Sec. 261.22. *(i.e. pH less than or equal to 2.0 or pH greater than or equal to 12.5)*
REACTIVITY:	Characteristic of Reactivity as defined by 40 CFR, Subpart C, Sec. 261.23. *(i.e. Violent reaction with water, strong base, strong acid, or the generation of Sulfide or Cyanide gases at STP with pH between 2.0 and 12.5)*

Reference: 40 CFR part 261 Subpart C sections 261.21 - 261.23, July 1, 1992.

Comments: **Durango OP Center.**

Christine m Walters
Analyst

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Graig Drum 3E	Date Reported:	09-23-02
Laboratory Number:	23837	Date Sampled:	09-19-02
Chain of Custody:	10244	Date Received:	09-19-02
Sample Matrix:	Liquid	Date Analyzed:	09-23-02
Preservative:	Cool	Date Digested:	09-20-02
Condition:	Cool & Intact	Analysis Needed:	RCRA Metals

Parameter	Concentration (mg/L)	Det. Limit (mg/L)	Regulatory Level (mg/L)
Arsenic	0.022	0.001	5.0
Barium	0.052	0.001	100
Cadmium	0.106	0.001	1.0
Chromium	0.003	0.001	5.0
Lead	0.002	0.001	5.0
Mercury	ND	0.001	0.2
Selenium	0.006	0.001	1.0
Silver	ND	0.001	5.0

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectroscopy, SW-846, USEPA, December 1996.

Note: Regulatory Limits based on 40 CFR part 261 subpart C section 261.24, August 24, 1998.

Comments: **Durango OP. Ctr.**

Analyst

Christine M Walters
Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Carnes GU Drum 32-6-11 #1	Date Reported:	09-23-02
Laboratory Number:	23838	Date Sampled:	09-19-02
Chain of Custody:	10244	Date Received:	09-19-02
Sample Matrix:	Liquid	Date Analyzed:	09-23-02
Preservative:	Cool	Date Digested:	09-20-02
Condition:	Cool & Intact	Analysis Needed:	RCRA Metals

Parameter	Concentration (mg/L)	Det. Limit (mg/L)	Regulatory Level (mg/L)
Arsenic	0.031	0.001	5.0
Barium	0.037	0.001	100
Cadmium	0.182	0.001	1.0
Chromium	0.001	0.001	5.0
Lead	0.001	0.001	5.0
Mercury	ND	0.001	0.2
Selenium	0.003	0.001	1.0
Silver	ND	0.001	5.0

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectroscopy, SW-846, USEPA, December 1996.

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Comments: **Durango OP. Ctr.**

Analyst

Christine m Walters
Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS
Quality Control / Quality Assurance Report

Client:	QA/QC	Project #:	N/A
Sample ID:	09-23-TM QA/QC	Date Reported:	09-23-02
Laboratory Number:	23837	Date Sampled:	N/A
Sample Matrix:	Liquid	Date Received:	N/A
Analysis Requested:	Total RCRA Metals	Date Analyzed:	09-23-02
Condition:	N/A	Date Digested:	09-20-02

Blank & Duplicate Conc. (mg/L)	Instrument Blank (mg/L)	Method Blank	Detection Limit	Sample	Duplicate	% Diff.	Acceptance Range
Arsenic	ND	ND	0.001	0.022	0.022	0.0%	0% - 30%
Barium	ND	ND	0.001	0.052	0.051	1.9%	0% - 30%
Cadmium	ND	ND	0.001	0.106	0.104	1.9%	0% - 30%
Chromium	ND	ND	0.001	0.003	0.003	0.0%	0% - 30%
Lead	ND	ND	0.001	0.002	0.002	0.0%	0% - 30%
Mercury	ND	ND	0.001	ND	ND	0.0%	0% - 30%
Selenium	ND	ND	0.001	0.006	0.006	0.0%	0% - 30%
Silver	ND	ND	0.001	ND	ND	0.0%	0% - 30%

Spike Conc. (mg/Kg)	Spike Added	Sample	Spiked Sample	Percent Recovery	Acceptance Range
Arsenic	0.500	0.022	0.520	99.6%	80% - 120%
Barium	0.500	0.052	0.550	99.6%	80% - 120%
Cadmium	0.500	0.106	0.604	99.7%	80% - 120%
Chromium	0.500	0.003	0.502	99.8%	80% - 120%
Lead	0.500	0.002	0.501	99.8%	80% - 120%
Mercury	0.050	ND	0.049	98.0%	80% - 120%
Selenium	0.500	0.006	0.505	99.8%	80% - 120%
Silver	0.500	ND	0.499	99.8%	80% - 120%

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Comments: **QA/QC for samples 23837 - 23838.**

Analyst

Christine M Walters
Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020
AROMATIC / HALOGENATED VOLATILE ORGANICS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Graig Drum 3E	Date Reported:	09-23-02
Laboratory Number:	23837	Date Sampled:	09-19-02
Chain of Custody:	10244	Date Received:	09-19-02
Sample Matrix:	Liquid	Date Extracted:	N/A
Preservative:	Cool	Date Analyzed:	09-23-02
Condition:	Cool & Intact	Analysis Requested:	TCLP

Parameter	Concentration (mg/L)	Detection Limit (mg/L)	Regulatory Limits (mg/L)
Vinyl Chloride	ND	0.0001	0.2
1,1-Dichloroethene	ND	0.0001	0.7
2-Butanone (MEK)	0.0228	0.0001	200
Chloroform	ND	0.0001	6.0
Carbon Tetrachloride	ND	0.0001	0.5
Benzene	0.0090	0.0001	0.5
1,2-Dichloroethane	ND	0.0001	0.5
Trichloroethene	ND	0.0003	0.5
Tetrachloroethene	ND	0.0005	0.7
Chlorobenzene	ND	0.0003	100
1,4-Dichlorobenzene	ND	0.0002	7.5

ND - Parameter not detected at the stated detection limit.

QA/QC Acceptance Criteria

Parameter	Percent Recovery
Fluorobenzene	100%
1,4-difluorobenzene	100%
4-bromochlorobenzene	100%

References:
Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Note: Regulatory Limits based on 40 CFR part 261 Subpart C section 261.24, July 1, 1992.

Comments: **Durango OP. Ctr.**

Analyst

Christine M Walters
Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020
AROMATIC / HALOGENATED VOLATILE ORGANICS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Carnes GU Drum 32-6-11 #1	Date Reported:	09-23-02
Laboratory Number:	23838	Date Sampled:	09-19-02
Chain of Custody:	10244	Date Received:	09-19-02
Sample Matrix:	Liquid	Date Extracted:	N/A
Preservative:	Cool	Date Analyzed:	09-23-02
Condition:	Cool & Intact	Analysis Requested:	TCLP

Parameter	Concentration (mg/L)	Detection Limit (mg/L)	Regulatory Limits (mg/L)
Vinyl Chloride	ND	0.0001	0.2
1,1-Dichloroethene	ND	0.0001	0.7
2-Butanone (MEK)	0.0269	0.0001	200
Chloroform	ND	0.0001	6.0
Carbon Tetrachloride	ND	0.0001	0.5
Benzene	ND	0.0001	0.5
1,2-Dichloroethane	ND	0.0001	0.5
Trichloroethene	ND	0.0003	0.5
Tetrachloroethene	ND	0.0005	0.7
Chlorobenzene	ND	0.0003	100
1,4-Dichlorobenzene	ND	0.0002	7.5

ND - Parameter not detected at the stated detection limit.

QA/QC Acceptance Criteria

Parameter	Percent Recovery
Fluorobenzene	100%
1,4-difluorobenzene	100%
4-bromochlorobenzene	100%

References:
Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Note: Regulatory Limits based on 40 CFR part 261 Subpart C section 261.24, July 1, 1992.

Comments: **Durango OP. Ctr.**

Analyst

Christine M. Walters
Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

QUALITY ASSURANCE / QUALITY CONTROL

DOCUMENTATION

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ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020
AROMATIC / HALOGENATED VOLATILE ORGANICS
Quality Assurance Report

Client:	QA/QC	Project #:	N/A
Sample ID:	Laboratory Blank	Date Reported:	09-23-02
Laboratory Number:	09-23-TCV	Date Sampled:	N/A
Sample Matrix:	Water	Date Received:	N/A
Preservative:	N/A	Date Analyzed:	09-23-02
Condition:	N/A	Analysis Requested:	TCLP

Parameter	Concentration (mg/L)	Detection Limit (mg/L)	Regulatory Limits (mg/L)
Vinyl Chloride	ND	0.0001	0.2
1,1-Dichloroethene	ND	0.0001	0.7
2-Butanone (MEK)	ND	0.0001	200
Chloroform	ND	0.0001	6.0
Carbon Tetrachloride	ND	0.0001	0.5
Benzene	ND	0.0001	0.5
1,2-Dichloroethane	ND	0.0001	0.5
Trichloroethene	ND	0.0003	0.5
Tetrachloroethene	ND	0.0005	0.7
Chlorobenzene	ND	0.0003	100
1,4-Dichlorobenzene	ND	0.0002	7.5

ND - Parameter not detected at the stated detection limit.

QA/QC Acceptance Criteria

Parameter	Percent Recovery
Fluorobenzene	100%
1,4-difluorobenzene	100%
4-bromochlorobenzene	100%

References:
Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Note: Regulatory Limits based on 40 CFR part 261 Subpart C section 261.24, July 1, 1992.

Comments: **QA/QC for samples 23776, 23837 - 23838.**

Analyst

Christine M Walters
Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020
AROMATIC / HALOGENATED VOLATILE ORGANICS
Quality Assurance Report

Client:	QA/QC	Project #:	N/A
Sample ID:	Method Blank	Date Reported:	09-23-02
Laboratory Number:	0909-TCV	Date Sampled:	N/A
Sample Matrix:	TCLP Extract	Date Received:	N/A
Preservative:	N/A	Date Analyzed:	09-23-02
Condition:	N/A	Date Extracted:	09-09-02
		Analysis Requested:	TCLP

Parameter	Concentration (mg/L)	Detection Limit (mg/L)	Regulatory Limits (mg/L)
Vinyl Chloride	ND	0.0001	0.2
1,1-Dichloroethene	ND	0.0001	0.7
2-Butanone (MEK)	ND	0.0001	200
Chloroform	ND	0.0001	6.0
Carbon Tetrachloride	ND	0.0001	0.5
Benzene	ND	0.0001	0.5
1,2-Dichloroethane	ND	0.0001	0.5
Trichloroethene	ND	0.0003	0.5
Tetrachloroethene	ND	0.0005	0.7
Chlorobenzene	ND	0.0003	100
1,4-Dichlorobenzene	ND	0.0002	7.5

ND - Parameter not detected at the stated detection limit.

QA/QC Acceptance Criteria

Parameter	Percent Recovery
Fluorobenzene	99%
1,4-difluorobenzene	98%
4-bromochlorobenzene	98%

References:
Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Note: Regulatory Limits based on 40 CFR part 261 Subpart C section 261.24, July 1, 1992.

Comments: **QA/QC for samples 23776, 23837 - 23838.**

Analyst

Christine M. Walters
Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020
AROMATIC / HALOGENATED VOLATILE ORGANICS
QUALITY ASSURANCE REPORT

Client:	QA/QC	Project #:	N/A
Sample ID:	Matrix Duplicate	Date Reported:	09-23-02
Laboratory Number:	23776	Date Sampled:	N/A
Sample Matrix:	TCLP Extract	Date Received:	N/A
Analysis Requested:	TCLP	Date Analyzed:	09-23-02
Condition:	N/A	Date Extracted:	09-09-02

Parameter	Sample Result (mg/L)	Duplicate Sample Result (mg/L)	Detection Limits (mg/L)	Percent Difference
Vinyl Chloride	ND	ND	0.0001	0.0%
1,1-Dichloroethene	ND	ND	0.0001	0.0%
2-Butanone (MEK)	0.0018	0.0018	0.0001	0.0%
Chloroform	ND	ND	0.0001	0.0%
Carbon Tetrachloride	ND	ND	0.0001	0.0%
Benzene	0.0022	0.0022	0.0001	0.0%
1,2-Dichloroethane	ND	ND	0.0001	0.0%
Trichloroethene	ND	ND	0.0003	0.0%
Tetrachloroethene	ND	ND	0.0005	0.0%
Chlorobenzene	ND	ND	0.0003	0.0%
1,4-Dichlorobenzene	ND	ND	0.0002	0.0%

ND - Parameter not detected at the stated detection limit.

References:
Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Comments: **QA/QC for samples 23776, 23837 - 23838.**

Analyst

Christine m Walters
Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020
AROMATIC / HALOGENATED VOLATILE ORGANICS QUALITY ASSURANCE REPORT

Client:	QA/QC	Project #:	N/A
Sample ID:	Matrix Spike	Date Reported:	09-23-02
Laboratory Number:	23776	Date Sampled:	N/A
Sample Matrix:	TCLP Extract	Date Received:	N/A
Analysis Requested:	TCLP	Date Analyzed:	09-23-02
Condition:	N/A	Date Extracted:	09-09-02

Parameter	Sample Result (mg/L)	Spike Added (mg/L)	Spiked Sample Result (mg/L)	Det. Limit (mg/L)	Percent Recovery	SW-846 % Rec. Accept. Range
Vinyl Chloride	ND	0.050	0.0495	0.0001	99%	28-163
1,1-Dichloroethene	ND	0.050	0.0494	0.0001	99%	43-143
2-Butanone (MEK)	0.0018	0.050	0.0513	0.0001	99%	47-132
Chloroform	ND	0.050	0.0500	0.0001	100%	49-133
Carbon Tetrachloride	ND	0.050	0.0490	0.0001	98%	43-143
Benzene	0.0022	0.050	0.0517	0.0001	99%	39-150
1,2-Dichloroethane	ND	0.050	0.0490	0.0001	98%	51-147
Trichloroethene	ND	0.050	0.0495	0.0003	99%	35-146
Tetrachloroethene	ND	0.050	0.0495	0.0005	99%	26-162
Chlorobenzene	ND	0.050	0.0495	0.0003	99%	38-150
1,4-Dichlorobenzene	ND	0.050	0.0495	0.0002	99%	42-143

ND - Parameter not detected at the stated detection limit.

References:
Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Comments: **QA/QC for samples 23776, 23837 - 23838.**

Analyst

Review

CHAIN OF CUSTODY RECORD

09305

Client / Project Name: BLAGG / BP

Project Location: CAHN POND

Sampler: J-C. Blagg

Client No.: 94034-010

Sample No./ Identification	Sample Date	Sample Time	Lab Number	Sample Matrix	No. of Containers	RCI	8 RCRA Metals					Remarks
					ANALYSIS / PARAMETERS							
BARREL #1	7/6/01	1030	20230	LIQUID	1	X	X					ONLY Run Metals if Pass RCI

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
J-C. Blagg	7/9/01	0850		7-9-01	0850
Relinquished by: (Signature)			Received by: (Signature)		
Relinquished by: (Signature)			Received by: (Signature)		

ENVIROTECH INC.

5796 U.S. Highway 64
Farmington, New Mexico 87401
(505) 632-0615

Sample Receipt	Y	N	N/A
Received Intact	✓		
Cool - Ice/Blue Ice	✓		

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

SUSPECTED HAZARDOUS WASTE ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Barrel #1	Date Reported:	07-09-01
Lab ID#:	20230	Date Sampled:	07-06-01
Sample Matrix:	Liquid	Date Received:	07-09-01
Preservative:	Cool	Date Analyzed:	07-09-01
Condition:	Cool and Intact	Chain of Custody:	9305

Parameter	Result	
IGNITABILITY:	Negative	
CORROSIVITY:	Negative	pH = 7.62
REACTIVITY:	Negative	

RCRA Hazardous Waste Criteria

Parameter	Hazardous Waste Criterion
IGNITABILITY:	Characteristic of Ignitability as defined by 40 CFR, Subpart C, Sec. 261.21. *(i.e. Sample ignition upon direct contact with flame or flash point < 60° C.)*
CORROSIVITY:	Characteristic of Corrosivity as defined by 40 CFR, Subpart C, Sec. 261.22. *(i.e. pH less than or equal to 2.0 or pH greater than or equal to 12.5)*
REACTIVITY:	Characteristic of Reactivity as defined by 40 CFR, Subpart C, Sec. 261.23. *(i.e. Violent reaction with water, strong base, strong acid, or the generation of Sulfide or Cyanide gases at STP with pH between 2.0 and 12.5)*

Reference: 40 CFR part 261 Subpart C sections 261.21 - 261.23, July 1, 1992.

Comments: Cahn Pond.

Analyst

Christine M Walters
Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Barrel #1	Date Reported:	07-09-01
Laboratory Number:	20230	Date Sampled:	07-06-01
Chain of Custody:	9305	Date Received:	07-09-01
Sample Matrix:	Liquid	Date Analyzed:	07-09-01
Preservative:	Cool	Date Digested:	07-09-01
Condition:	Cool & Intact	Analysis Needed:	RCRA Metals

Parameter	Concentration (mg/L)	Det. Limit (mg/L)	Regulatory Level (mg/L)
Arsenic	ND	0.001	5.0
Barium	ND	0.001	100
Cadmium	ND	0.001	1.0
Chromium	ND	0.001	5.0
Lead	ND	0.001	5.0
Mercury	ND	0.001	0.2
Selenium	ND	0.001	1.0
Silver	ND	0.001	5.0

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Note: Regulatory Limits based on 40 CFR part 261 subpart C section 261.24, August 24, 1998.

Comments: **Cahn Pond.**

Analyst

Christine M Walters

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS
Quality Control / Quality Assurance Report

Client:	QA/QC	Project #:	N/A
Sample ID:	07-09-TM QA/QC	Date Reported:	07-09-01
Laboratory Number:	20230	Date Sampled:	N/A
Sample Matrix:	Liquid	Date Received:	N/A
Analysis Requested:	Total RCRA Metals	Date Analyzed:	07-09-01
Condition:	N/A	Date Digested:	07-09-01

Blank & Duplicate Conc. (mg/L)	Instrument Blank (mg/L)	Detection Limit	Sample (mg/L)	Duplicate (mg/L)	% Diff	Acceptance Range
Arsenic	ND	0.001	ND	ND	0.0%	0% - 30%
Barium	ND	0.001	ND	ND	0.0%	0% - 30%
Cadmium	ND	0.001	ND	ND	0.0%	0% - 30%
Chromium	ND	0.001	ND	ND	0.0%	0% - 30%
Lead	ND	0.001	ND	ND	0.0%	0% - 30%
Mercury	ND	0.001	ND	ND	0.0%	0% - 30%
Selenium	ND	0.001	ND	ND	0.0%	0% - 30%
Silver	ND	0.001	ND	ND	0.0%	0% - 30%

Spike Conc. (mg/L)	Spike Added	Sample (mg/L)	Spiked Sample	Percent Recovery	Acceptance Range
Arsenic	0.500	ND	0.498	99.6%	80% - 120%
Barium	0.500	ND	0.501	100.2%	80% - 120%
Cadmium	0.500	ND	0.499	99.8%	80% - 120%
Chromium	0.500	ND	0.498	99.6%	80% - 120%
Lead	0.500	ND	0.500	100.0%	80% - 120%
Mercury	0.050	ND	0.049	98.0%	80% - 120%
Selenium	0.500	ND	0.497	99.4%	80% - 120%
Silver	0.500	ND	0.499	99.8%	80% - 120%

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Comments: **QA/QC for sample 20230.**

Analyst

Christine M Walters
Review

CHAIN OF CUSTODY RECORD

10319

Client / Project Name BLAGG/BP			Project Location DRUM SAMPLING		ANALYSIS / PARAMETERS								
Sampler: J. C. Blagg			Client No. 94034-010		No. of Containers	TCLP VOL.	8 RCRA METALS	RCI				Remarks	
Sample No./ Identification	Sample Date	Sample Time	Lab Number	Sample Matrix									
W.D.HEATH B 1A	10/3/2	1040	23966	LIQUID	3	X	X	X					
FLORANCE 121	"	1420	23967	"	3	X	X	X					
CAHN	10/4/2	1158	23968	LIQUID	1	X							

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
J. C. Blagg	10/4/02	1326		10-4-02	1326
Relinquished by: (Signature)			Received by: (Signature)		
Relinquished by: (Signature)			Received by: (Signature)		

ENVIROTECH INC.

5796 U.S. Highway 64
Farmington, New Mexico 87401
(505) 632-0615

Sample Receipt	Y	N	N/A
Received Intact	✓		
Cool - Ice/Blue Ice	✓		

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020
AROMATIC / HALOGENATED
VOLATILE ORGANICS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	W. D. Heath B 1A	Date Reported:	10-09-02
Laboratory Number:	23966	Date Sampled:	10-03-02
Chain of Custody:	10319	Date Received:	10-04-02
Sample Matrix:	Liquid	Date Extracted:	N/A
Preservative:	Cool	Date Analyzed:	10-09-02
Condition:	Cool & Intact	Analysis Requested:	TCLP

Parameter	Concentration (mg/L)	Detection Limit (mg/L)	Regulatory Limits (mg/L)
Vinyl Chloride	ND	0.0001	0.2
1,1-Dichloroethene	ND	0.0001	0.7
2-Butanone (MEK)	0.0056	0.0001	200
Chloroform	ND	0.0001	6.0
Carbon Tetrachloride	ND	0.0001	0.5
Benzene	0.0021	0.0001	0.5
1,2-Dichloroethane	ND	0.0001	0.5
Trichloroethene	ND	0.0003	0.5
Tetrachloroethene	ND	0.0005	0.7
Chlorobenzene	ND	0.0003	100
1,4-Dichlorobenzene	ND	0.0002	7.5

ND - Parameter not detected at the stated detection limit.

QA/QC Acceptance Criteria

Parameter	Percent Recovery
Fluorobenzene	100%
1,4-difluorobenzene	100%
4-bromochlorobenzene	100%

References:

Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Note: Regulatory Limits based on 40 CFR part 261 Subpart C section 261.24, July 1, 1992.

Comments: **Drum Sampling.**

Analyst

Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020
AROMATIC / HALOGENATED
VOLATILE ORGANICS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Florance 121	Date Reported:	10-09-02
Laboratory Number:	23967	Date Sampled:	10-03-02
Chain of Custody:	10319	Date Received:	10-04-02
Sample Matrix:	Liquid	Date Extracted:	N/A
Preservative:	Cool	Date Analyzed:	10-09-02
Condition:	Cool & Intact	Analysis Requested:	TCLP

Parameter	Concentration (mg/L)	Detection Limit (mg/L)	Regulatory Limits (mg/L)
Vinyl Chloride	ND	0.0001	0.2
1,1-Dichloroethene	ND	0.0001	0.7
2-Butanone (MEK)	0.0145	0.0001	200
Chloroform	ND	0.0001	6.0
Carbon Tetrachloride	ND	0.0001	0.5
Benzene	0.0013	0.0001	0.5
1,2-Dichloroethane	ND	0.0001	0.5
Trichloroethene	ND	0.0003	0.5
Tetrachloroethene	ND	0.0005	0.7
Chlorobenzene	ND	0.0003	100
1,4-Dichlorobenzene	ND	0.0002	7.5

ND - Parameter not detected at the stated detection limit.

QA/QC Acceptance Criteria

Parameter	Percent Recovery
Fluorobenzene	100%
1,4-difluorobenzene	100%
4-bromochlorobenzene	100%

References:

Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Note: Regulatory Limits based on 40 CFR part 261 Subpart C section 261.24, July 1, 1992.

Comments: **Drum Sampling.**

Analyst

Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

[illegible]A METHODS 8010/8020
AROMATIC / HALOGENATED VOLATILE ORGANICS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Cahn	Date Reported:	10-09-02
Laboratory Number:	23968	Date Sampled:	10-04-02
Chain of Custody:	10319	Date Received:	10-04-02
Sample Matrix:	Liquid	Date Extracted:	N/A
Preservative:	Cool	Date Analyzed:	10-09-02
Condition:	Cool & Intact	Analysis Requested:	TCLP

Parameter	Concentration (mg/L)	Detection Limit (mg/L)	Regulatory Limits (mg/L)
Vinyl Chloride	ND	0.0001	0.2
1,1-Dichloroethene	ND	0.0001	0.7
2-Butanone (MEK)	0.0043	0.0001	200
Chloroform	ND	0.0001	6.0
Carbon Tetrachloride	ND	0.0001	0.5
Benzene	0.0313	0.0001	0.5
1,2-Dichloroethane	ND	0.0001	0.5
Trichloroethene	ND	0.0003	0.5
Tetrachloroethene	ND	0.0005	0.7
Chlorobenzene	ND	0.0003	100
1,4-Dichlorobenzene	ND	0.0002	7.5

ND - Parameter not detected at the stated detection limit.

QA/QC Acceptance Criteria

Parameter	Percent Recovery
Fluorobenzene	100%
1,4-difluorobenzene	100%
4-bromochlorobenzene	100%

References:

Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Note: Regulatory Limits based on 40 CFR part 261 Subpart C section 261.24, July 1, 1992.

Comments: **Drum Sampling.**

Analyst

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

QUALITY ASSURANCE / QUALITY CONTROL

DOCUMENTATION

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020
AROMATIC / HALOGENATED VOLATILE ORGANICS
Quality Assurance Report

Client:	QA/QC	Project #:	N/A
Sample ID:	Laboratory Blank	Date Reported:	10-09-02
Laboratory Number:	10-09-TCV	Date Sampled:	N/A
Sample Matrix:	Water	Date Received:	N/A
Preservative:	N/A	Date Analyzed:	10-09-02
Condition:	N/A	Analysis Requested:	TCLP

Parameter	Concentration (mg/L)	Detection Limit (mg/L)	Regulatory Limits (mg/L)
Vinyl Chloride	ND	0.0001	0.2
1,1-Dichloroethene	ND	0.0001	0.7
2-Butanone (MEK)	ND	0.0001	200
Chloroform	ND	0.0001	6.0
Carbon Tetrachloride	ND	0.0001	0.5
Benzene	ND	0.0001	0.5
1,2-Dichloroethane	ND	0.0001	0.5
Trichloroethene	ND	0.0003	0.5
Tetrachloroethene	ND	0.0005	0.7
Chlorobenzene	ND	0.0003	100
1,4-Dichlorobenzene	ND	0.0002	7.5

ND - Parameter not detected at the stated detection limit.

QA/QC Acceptance Criteria

Parameter	Percent Recovery
Fluorobenzene	100%
1,4-difluorobenzene	100%
4-bromochlorobenzene	100%

References:
Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Note: Regulatory Limits based on 40 CFR part 261 Subpart C section 261.24, July 1, 1992.

Comments: **QA/QC for samples 23966 - 23968.**

Analyst

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020
AROMATIC / HALOGENATED VOLATILE ORGANICS
QUALITY ASSURANCE REPORT

Client:	QA/QC	Project #:	N/A
Sample ID:	Matrix Duplicate	Date Reported:	10-09-02
Laboratory Number:	23966	Date Sampled:	N/A
Sample Matrix:	Liquid	Date Received:	N/A
Analysis Requested:	TCLP	Date Analyzed:	10-09-02
Condition:	N/A	Date Extracted:	N/A

Parameter	Sample Result (mg/L)	Duplicate Sample Result (mg/L)	Detection Limits (mg/L)	Percent Difference
Vinyl Chloride	ND	ND	0.0001	0.0%
1,1-Dichloroethene	ND	ND	0.0001	0.0%
2-Butanone (MEK)	0.0056	0.0057	0.0001	1.6%
Chloroform	ND	ND	0.0001	0.0%
Carbon Tetrachloride	ND	ND	0.0001	0.0%
Benzene	0.0021	0.0020	0.0001	3.0%
1,2-Dichloroethane	ND	ND	0.0001	0.0%
Trichloroethene	ND	ND	0.0003	0.0%
Tetrachloroethene	ND	ND	0.0005	0.0%
Chlorobenzene	ND	ND	0.0003	0.0%
1,4-Dichlorobenzene	ND	ND	0.0002	0.0%

ND - Parameter not detected at the stated detection limit.

References:	Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
	Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
	Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
	Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Comments: **QA/QC for samples 23966 - 23968.**

Analyst

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020 AROMATIC / HALOGENATED VOLATILE ORGANICS QUALITY ASSURANCE REPORT

Client:	QA/QC	Project #:	N/A
Sample ID:	Matrix Spike	Date Reported:	10-09-02
Laboratory Number:	23966	Date Sampled:	N/A
Sample Matrix:	Liquid	Date Received:	N/A
Analysis Requested:	TCLP	Date Analyzed:	10-09-02
Condition:	N/A	Date Extracted:	N/A

Parameter	Sample Result (mg/L)	Spike Added (mg/L)	Spiked Sample Result (mg/L)	Det. Limit (mg/L)	Percent Recovery	SW-846 % Rec. Accept. Range
Vinyl Chloride	ND	0.050	0.0495	0.0001	99.0%	28-163
1,1-Dichloroethene	ND	0.050	0.0494	0.0001	98.8%	43-143
2-Butanone (MEK)	0.0056	0.050	0.0554	0.0001	99.6%	47-132
Chloroform	ND	0.050	0.0500	0.0001	99.9%	49-133
Carbon Tetrachloride	ND	0.050	0.0490	0.0001	98.0%	43-143
Benzene	0.0021	0.050	0.0519	0.0001	99.6%	39-150
1,2-Dichloroethane	ND	0.050	0.0490	0.0001	98.0%	51-147
Trichloroethene	ND	0.050	0.0495	0.0003	99.0%	35-146
Tetrachloroethene	ND	0.050	0.0495	0.0005	99.0%	26-162
Chlorobenzene	ND	0.050	0.0495	0.0003	99.0%	38-150
1,4-Dichlorobenzene	ND	0.050	0.0495	0.0002	99.0%	42-143

ND - Parameter not detected at the stated detection limit.

References:
Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Comments: QA/QC for samples 23966 - 23968.

Analyst

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS
Quality Control / Quality Assurance Report

Client:	QA/QC	Project #:	N/A
Sample ID:	10-07-TM QA/QC	Date Reported:	10-07-02
Laboratory Number:	23966	Date Sampled:	N/A
Sample Matrix:	Liquid	Date Received:	N/A
Analysis Requested:	Total RCRA Metals	Date Analyzed:	10-07-02
Condition:	N/A	Date Digested:	10-07-02

Blank & Duplicate Conc. (mg/L)	Instrument Blank (mg/L)	Method Blank	Detection Limit	Sample	Duplicate	% Diff.	Acceptance Range
Arsenic	ND	ND	0.001	ND	ND	0.0%	0% - 30%
Barium	ND	ND	0.001	0.016	0.016	0.0%	0% - 30%
Cadmium	ND	ND	0.001	0.001	0.001	0.0%	0% - 30%
Chromium	ND	ND	0.001	0.003	0.003	0.0%	0% - 30%
Lead	ND	ND	0.001	0.002	0.002	0.0%	0% - 30%
Mercury	ND	ND	0.001	ND	ND	0.0%	0% - 30%
Selenium	ND	ND	0.001	ND	ND	0.0%	0% - 30%
Silver	ND	ND	0.001	ND	ND	0.0%	0% - 30%

Spike Conc. (mg/L)	Spike Added	Sample	Spiked Sample	Percent Recovery	Acceptance Range
Arsenic	0.500	ND	0.499	99.8%	80% - 120%
Barium	0.500	0.016	0.515	99.8%	80% - 120%
Cadmium	0.500	0.001	0.500	99.8%	80% - 120%
Chromium	0.500	0.003	0.502	99.8%	80% - 120%
Lead	0.500	0.002	0.501	99.8%	80% - 120%
Mercury	0.050	ND	0.049	98.0%	80% - 120%
Selenium	0.500	ND	0.498	99.6%	80% - 120%
Silver	0.500	ND	0.498	99.6%	80% - 120%

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Comments: **QA/QC for samples 23966 - 23967.**

Analyst

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	W. D. Heath B 1A	Date Reported:	10-07-02
Laboratory Number:	23966	Date Sampled:	10-03-02
Chain of Custody:	10319	Date Received:	10-04-02
Sample Matrix:	Liquid	Date Analyzed:	10-07-02
Preservative:	Cool	Date Digested:	10-07-02
Condition:	Cool & Intact	Analysis Needed:	RCRA Metals

Parameter	Concentration (mg/L)	Det. Limit (mg/L)	Regulatory Level (mg/L)
Arsenic	ND	0.001	5.0
Barium	0.016	0.001	100
Cadmium	0.001	0.001	1.0
Chromium	0.003	0.001	5.0
Lead	0.002	0.001	5.0
Mercury	ND	0.001	0.2
Selenium	ND	0.001	1.0
Silver	ND	0.001	5.0

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Note: Regulatory Limits based on 40 CFR part 261 subpart C section 261.24, August 24, 1998.

Comments: **Drum Sampling.**

Analyst

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Florance 121	Date Reported:	10-07-02
Laboratory Number:	23967	Date Sampled:	10-03-02
Chain of Custody:	10319	Date Received:	10-04-02
Sample Matrix:	Liquid	Date Analyzed:	10-07-02
Preservative:	Cool	Date Digested:	10-07-02
Condition:	Cool & Intact	Analysis Needed:	RCRA Metals

Parameter	Concentration (mg/L)	Det. Limit (mg/L)	Regulatory Level (mg/L)
Arsenic	ND	0.001	5.0
Barium	0.002	0.001	100
Cadmium	0.001	0.001	1.0
Chromium	0.001	0.001	5.0
Lead	0.001	0.001	5.0
Mercury	ND	0.001	0.2
Selenium	ND	0.001	1.0
Silver	ND	0.001	5.0

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Note: Regulatory Limits based on 40 CFR part 261 subpart C section 261.24, August 24, 1998.

Comments: **Drum Sampling.**

Analyst

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

SUSPECTED HAZARDOUS WASTE ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	W. D. Heath B 1A	Date Reported:	10-07-02
Lab ID#:	23966	Date Sampled:	10-03-02
Sample Matrix:	Liquid	Date Received:	10-04-02
Preservative:	Cool	Date Analyzed:	10-07-02
Condition:	Cool and Intact	Chain of Custody:	10319

Parameter	**Result**	
IGNITABILITY:	**Negative**	
CORROSIVITY:	**Negative**	**pH = 4.46**
REACTIVITY:	**Negative**	

RCRA Hazardous Waste Criteria

Parameter	Hazardous Waste Criterion
IGNITABILITY:	Characteristic of Ignitability as defined by 40 CFR, Subpart C, Sec. 261.21. *(i.e. Sample ignition upon direct contact with flame or flash point < 60° C.)*
CORROSIVITY:	Characteristic of Corrosivity as defined by 40 CFR, Subpart C, Sec. 261.22. *(i.e. pH less than or equal to 2.0 or pH greater than or equal to 12.5)*
REACTIVITY:	Characteristic of Reactivity as defined by 40 CFR, Subpart C, Sec. 261.23. *(i.e. Violent reaction with water, strong base, strong acid, or the generation of Sulfide or Cyanide gases at STP with pH between 2.0 and 12.5)*

Reference: 40 CFR part 261 Subpart C sections 261.21 - 261.23, July 1, 1992.

Comments: **Drum Sampling.**

Analyst

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

SUSPECTED HAZARDOUS WASTE ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Florance 121	Date Reported:	10-07-02
Lab ID#:	23967	Date Sampled:	10-03-02
Sample Matrix:	Liquid	Date Received:	10-04-02
Preservative:	Cool	Date Analyzed:	10-07-02
Condition:	Cool and Intact	Chain of Custody:	10319

Parameter	Result	
IGNITABILITY:	**Negative**	
CORROSIVITY:	**Negative**	**pH = 8.54**
REACTIVITY:	**Negative**	

RCRA Hazardous Waste Criteria

Parameter	Hazardous Waste Criterion
IGNITABILITY:	Characteristic of Ignitability as defined by 40 CFR, Subpart C, Sec. 261.21. *(i.e. Sample ignition upon direct contact with flame or flash point < 60° C.)*
CORROSIVITY:	Characteristic of Corrosivity as defined by 40 CFR, Subpart C, Sec. 261.22. *(i.e. pH less than or equal to 2.0 or pH greater than or equal to 12.5)*
REACTIVITY:	Characteristic of Reactivity as defined by 40 CFR, Subpart C, Sec. 261.23. *(i.e. Violent reaction with water, strong base, strong acid, or the generation of Sulfide or Cyanide gases at STP with pH between 2.0 and 12.5)*

Reference: 40 CFR part 261 Subpart C sections 261.21 - 261.23, July 1, 1992.

Comments: **Drum Sampling.**

Analyst

Review

CONOCO

MATERIAL SAFETY DATA SHEET

I. MATERIAL IDENTIFICATION

Name: Conoco Fleet Motor Oil SAE 10W, 10W LP, 10W-30, 15W-40, 20-20W, 30, 40, 50/ Fleet Supreme 10W-30, 15W-40
Conoco Product Code: 6210/6211/6220/6230/6240/6250/6260/6261/6271
Synonyms: Lubricating Oil, Motor Oil
Chemical Family: Petroleum Hydrocarbon
Manufacturer: Conoco Inc.
Address: P.O. Box 1267, Ponca City, OK 74603

CAS Registry No.: Mixture
Transportation Emergency No.: (800) 424-9300 (Chemtrec)
Product Information No.: (405) 767-6000

II. HAZARDOUS INGREDIENTS HAZARD DATA

HAZARDOUS INGREDIENTS	HAZARD DATA
Hazard Determination:	
Health Effect Properties: None.	Not applicable.
Physical Effect Properties:	
Product/Mixture: None.	Not applicable.

III. PHYSICAL DATA

Appearance and Odor: Dark brown liquid; mild petroleum hydrocarbon odor.

Boiling Range (°F)	650-1200	Specific Gravity (H_2O=1)	0.88
Vapor Pressure (mmHg)	Nil	% Volatile (by volume)	Nil
Vapor Density (Air=1)	Not Applicable	Evaporation Rate (Ether=1)	Nil
Solubility in Water	Insoluble		

IV. REACTIVITY DATA

Stable: X *Unstable:*

Hazardous Decomposition Products: Normal combustion forms carbon dioxide; incomplete combustion may produce carbon monoxide.

Conditions To Avoid: Strong oxidizing materials, heat, flame.

Hazardous Polymerization: Will not occur.

V. FIRE AND EXPLOSION HAZARD DATA

Flash Point (Method used): 340° F (PMCC) Autoignition Temperature: 650° F

Handle and store in accordance with NFPA procedure for Class III B Combustible Liquids.

Extinguishing Media: Use water spray, dry chemical, foam, or carbon dioxide.

Special Fire Fighting Procedures: Water or foam may cause frothing. Use water to keep fire-exposed containers cool. Water spray may be used to flush spills away from exposures.

V. FIRE AND EXPLOSION HAZARD DATA (continued)

Unusual Fire and Explosion Hazards: Products of combustion may contain carbon monoxide, carbon dioxide, and other toxic materials. Do not enter enclosed or confined space without proper protective equipment including respiratory protection.

National Fire Protection Association (NFPA) Classification HAZARD RATING

Health 0 Fire 1 Reactivity 0

Least - 0 Slight - 1 Moderate - 2
High - 3 Extreme - 4

VI. TRANSPORTATION AND STORAGE DOT HAZARD CLASS: Not Applicable

Precautions To Be Taken In Handling And Storing: Product is Class III B Combustible Liquid per NFPA Code No. 30-1984. Store and handle accordingly.

Shipping Paper Description: Not D.O.T. Regulated.

Placard: Not D.O.T. Regulated.

D.O.T. Label: Not Regulated.

OSHA Label (Recommended): CAUTION: Prolonged or repeated skin contact with used motor oil may be harmful. Wash thoroughly with soap and water after use.

VII. HEALTH HAZARD INFORMATION

PEL Not Established TLV Not Established

Ceiling Value Not Established AEL Not Established

Primary Route of Entry: Skin.

Signs and Symptoms of Exposure/Medical Conditions Aggravated By Exposure:

No adverse health effect has been identified specifically for this product. Health effect information from animal and human studies has been included on related materials, even though health experts may disagree as to the significance of this data.

Mouse skin painting studies have shown that highly solvent-refined petroleum distillates having a boiling point below 700° F, and which are similar to ingredients in this product, have not caused skin tumors. The product may cause irritation to eyes, lungs, or skin after prolonged or repeated exposure.

Laboratory studies have shown that mice developed skin cancer following repeated skin application of, and continuous exposure to, used motor oil. In these studies, the used motor oil was not removed between applications. Health hazards to used motor oil can be minimized by avoiding prolonged skin contact.

Listed as Carcinogen or Potential Carcinogen by: NTP No IARC No OSHA No

VIII. EMERGENCY AND FIRST AID PROCEDURES

Eyes: Immediately wash with fresh water for at least 15 minutes and get medical attention.

Skin: Remove contaminated clothing as soon as possible. Wash exposed skin thoroughly with soap and water. If irritation persists, consult a physician.

Launder contaminated clothing before reuse. Extremely contaminated leather shoes should be discarded.

If exposed to hot oil, immediately cool with cold water. Do not attempt to remove oil but continue to cool exposed areas with cold packs and seek medical attention.

Inhalation: If overexposure occurs, remove individual to fresh air. If breathing stops, administer artificial respiration.

Ingestion: If this material is swallowed, do not induce vomiting. If vomiting begins, lower victim's head in an effort to prevent vomitus from entering lungs. Immediately consult a physician. Do not attempt to give liquid to an unconscious person.

Note to Physicians: Gastric lavage by qualified medical personnel may be considered, depending on quantity of material ingested.

IX. SPILL, LEAK AND DISPOSAL PROCEDURES

RCRA HAZARDOUS WASTE: Yes _____ No __X__

In Case Of Spill Or Leak: Contain spill immediately in smallest area possible. Recover as much of the product itself as possible by such methods as vacuuming, followed by soaking up residual fluids by use of absorbent materials. Remove contaminated items including solids and place in proper container for disposal. Avoid washing, draining or directing material to storm or sanitary sewers.

Waste Disposal Method: Recycle as much of the recoverable product as possible. Dispose of nonrecyclable material by such methods as controlled incineration, complying with federal, state and local regulations.

X. PRECAUTIONARY MEASURES

Respiratory Protection: None required except under unusual circumstances such as described in Section V.

Ventilation: Normal shop ventilation.

Protective Gloves: None required.

Eye Protection: None required.

Other Protective Equipment: None required.

The above data is based on tests and experience which Conoco believes reliable and are supplied for informational purposes only. CONOCO DISCLAIMS ANY LIABILITY FOR DAMAGE OR INJURY WHICH RESULTS FROM THE USE OF THE ABOVE DATA AND NOTHING CONTAINED THEREIN SHALL CONSTITUTE A GUARANTEE, WARRANTY (INCLUDING WARRANTY OF MERCHANTABILITY) OR REPRESENTATION (INCLUDING FREEDOM FROM PATENT LIABILITY) BY CONOCO WITH RESPECT TO THE DATA, THE PRODUCT DESCRIBED, OR THEIR USE FOR ANY SPECIFIC PURPOSE, EVEN IF THAT PURPOSE IS KNOWN TO CONOCO.

2-62-7820-01

MATERIAL SAFETY DATA SHEET

Ashland Chemical Company
DIVISION OF ASHLAND OIL, INC.
P. O. BOX 2219, COLUMBUS, OHIO 43216 • (614) 889-3333

24-HOUR EMERGENCY TELEPHONE (606) 324-1133

THIS MSDS COMPLIES WITH 29 CFR 1910.1200 (THE HAZARD COMMUNICATION STANDARD)

PRODUCT NAME: ANTIFREEZE PERMANENT DRUMS

AMOCO PRODUCTION COMPANY
PETROLEUM CENTER BLDG
501 AIRPORT DRIVE
FARMINGTON NM 87401

ATTN: PLANT MGR./SAFETY DIR.

05 50 009 0368460-
DATA SHEET NO: 0032289-001
LATEST REVISION DATE: 03/86-86063
PRODUCT: 7021100
INVOICE: 204323
INVOICE DATE: 08/19/86
TO: AMOCO PRODUCTIONS COMPANY
802 DRAKE AVE
FARMINGTON NM 87401

SECTION I-PRODUCT IDENTIFICATION

GENERAL OR GENERIC ID: GLYCOL

DOT HAZARD CLASSIFICATION: NOT APPLICABLE

SECTION II-COMPONENTS

INGREDIENT	% (BY WT)	PEL	TLV	NOTE
ETHYLENE GLYCOL CAS #: 107-21-1	>95		50 PPM - CEILING	(1)

(1): PEL NOT ESTABLISHED FOR THIS MATERIAL

SECTION III-PHYSICAL DATA

PROPERTY	REFINEMENT	MEASUREMENT
BOILING POINT	FOR PRODUCT	388.00 DEG F (197.77 DEG C) @ 760.00 MMHG
VAPOR PRESSURE	FOR PRODUCT	0.05 MMHG @ 68.00 DEG F (20.00 DEG C)
SPECIFIC VAPOR DENSITY	AIR = 1	2.1
SPECIFIC GRAVITY		1.130 @ 68.00 DEG F (20.00 DEG C)
PERCENT VOLATILES		30-60%
EVAPORATION RATE		SLOWER THAN ETHER

SECTION IV-FIRE AND EXPLOSION INFORMATION

FLASH POINT 232.0 DEG F
(111.1 DEG C)

EXPLOSIVE LIMIT (PRODUCT) LOWER - 3.2%

EXTINGUISHING MEDIA: ALCOHOL FOAM OR CARBON DIOXIDE OR DRY CHEMICAL

HAZARDOUS DECOMPOSITION PRODUCTS: MAY FORM TOXIC MATERIALS:, CARBON DIOXIDE AND CARBON MONOXIDE, VARIOUS HYDROCARBONS, ETC.

FIREFIGHTING PROCEDURES: WEAR SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE WHEN FIGHTING FIRES.

SPECIAL FIRE & EXPLOSION HAZARDS: VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL ALONG THE GROUND OR BE MOVED BY VENTILATION AND IGNITED BY HEAT, PILOT LIGHTS, OTHER FLAMES AND IGNITION SOURCES AT LOCATIONS DISTANT FROM MATERIAL HANDLING POINT.

NEVER USE WELDING OR CUTTING TORCH ON OR NEAR DRUM (EVEN EMPTY) BECAUSE PRODUCT (EVEN JUST RESIDUE) CAN IGNITE EXPLOSIVELY.
NFPA CODES: HEALTH- 1 FLAMMABILITY- 1 REACTIVITY- 0

SECTION V-HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE 50 PPM - CEILING

SEE SECTION II

EFFECTS OF ACUTE OVEREXPOSURE: FOR PRODUCT

EYES - CAN CAUSE MODERATE IRRITATION, REDNESS, TEARING.
SKIN - CAN CAUSE SLIGHT IRRITATION.
BREATHING - EXCESSIVE INHALATION OF VAPORS CAN CAUSE NASAL AND RESPIRATORY IRRITATION, DIZZINESS, WEAKNESS, FATIGUE, NAUSEA, HEADACHE, POSSIBLE UNCONSCIOUSNESS, AND EVEN ASPHYXIATION.
SWALLOWING - CAN CAUSE GASTROINTESTINAL IRRITATION, NAUSEA, VOMITING, AND DIARRHEA.
EYES - CAN CAUSE IRRITATION.
BREATHING - EXCESSIVE INHALATION OF VAPORS CAN CAUSE NASAL AND RESPIRATORY IRRITATION.

CONTINUED ON PAGE: 2

SECTION V-HEALTH HAZARD DATA (CONTINUED)

FIRST AID:

IF ON SKIN: THOROUGHLY WASH EXPOSED AREA WITH SOAP AND WATER. REMOVE CONTAMINATED CLOTHING. LAUNDER CONTAMINATED CLOTHING BEFORE RE-USE.

IF IN EYES: FLUSH WITH LARGE AMOUNTS OF WATER, LIFTING UPPER AND LOWER LIDS OCCASIONALLY, GET MEDICAL ATTENTION.

IF SWALLOWED: IMMEDIATELY DRINK TWO GLASSES OF WATER AND INDUCE VOMITING BY EITHER GIVING IPECAC SYRUP OR BY PLACING FINGER AT BACK OF THROAT. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. GET MEDICAL ATTENTION IMMEDIATELY.

IF BREATHED: IF AFFECTED, REMOVE INDIVIDUAL TO FRESH AIR. IF BREATHING IS DIFFICULT, ADMINISTER OXYGEN. IF BREATHING HAS STOPPED GIVE ARTIFICIAL RESPIRATION. KEEP PERSON WARM, QUIET AND GET MEDICAL ATTENTION.

PRIMARY ROUTE(S) OF ENTRY:

INHALATION

EFFECTS OF CHRONIC OVEREXPOSURE: FOR PRODUCT

OVEREXPOSURE TO THIS MATERIAL (OR ITS COMPONENTS) HAS APPARENTLY BEEN FOUND TO CAUSE THE FOLLOWING EFFECTS IN LABORATORY ANIMALS:, KIDNEY DAMAGE

OVEREXPOSURE TO THIS MATERIAL (OR ITS COMPONENTS) HAS BEEN SUGGESTED AS A CAUSE OF THE FOLLOWING EFFECTS IN HUMANS:, LIVER ABNORMALITIES, KIDNEY DAMAGE, CENTRAL NERVOUS SYSTEM DAMAGE

SECTION VI-REACTIVITY DATA

HAZARDOUS POLYMERIZATION: CANNOT OCCUR

STABILITY: STABLE

INCOMPATIBILITY: AVOID CONTACT WITH:, STRONG OXIDIZING AGENTS.

SECTION VII-SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:

SMALL SPILL: ABSORB LIQUID ON PAPER, VERMICULITE, FLOOR ABSORBENT, OR OTHER ABSORBENT MATERIAL AND TRANSFER TO HOOD.

LARGE SPILL: ELIMINATE ALL IGNITION SOURCES (FLARES, FLAMES INCLUDING PILOT LIGHTS, ELECTRICAL SPARKS). PERSONS NOT WEARING PROTECTIVE EQUIPMENT SHOULD BE EXCLUDED FROM AREA OF SPILL UNTIL CLEAN-UP HAS BEEN COMPLETED. STOP SPILL AT SOURCE, DIKE AREA OF SPILL TO PREVENT SPREADING, PUMP LIQUID TO SALVAGE TANK. REMAINING LIQUID MAY BE TAKEN UP ON SAND, CLAY, EARTH, FLOOR ABSORBENT, OR OTHER ABSORBENT MATERIAL AND SHOVELED INTO CONTAINERS.

WASTE DISPOSAL METHOD:

SMALL SPILL: ALLOW VOLATILE PORTION TO EVAPORATE IN HOOD. ALLOW SUFFICIENT TIME FOR VAPORS TO COMPLETELY CLEAR HOOD DUCT WORK. DISPOSE OF REMAINING MATERIAL IN ACCORDANCE WITH APPLICABLE REGULATIONS.

LARGE SPILL: DESTROY BY LIQUID INCINERATION.
CONTAMINATED ABSORBENT MAY BE DEPOSITED IN A LANDFILL IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL REGULATIONS.

SECTION VIII-PROTECTIVE EQUIPMENT TO BE USED

RESPIRATORY PROTECTION: IF TLV OF THE PRODUCT OR ANY COMPONENT IS EXCEEDED, A NIOSH/MSHA JOINTLY APPROVED AIR SUPPLIED RESPIRATOR IS ADVISED IN ABSENCE OF PROPER ENVIRONMENTAL CONTROL. OSHA REGULATIONS ALSO PERMIT OTHER NIOSH/MSHA RESPIRATORS UNDER SPECIFIED CONDITIONS. (SEE YOUR SAFETY EQUIPMENT SUPPLIER). ENGINEERING OR ADMINISTRATIVE CONTROLS SHOULD BE IMPLEMENTED TO REDUCE EXPOSURE.

IF NEEDED USE A NIOSH/MSHA JOINTLY APPROVED DUST RESPIRATOR.(ASK YOUR SAFETY EQUIPMENT SUPPLIER)

VENTILATION: PROVIDE SUFFICIENT MECHANICAL (GENERAL AND/OR LOCAL EXHAUST) VENTILATION TO MAINTAIN EXPOSURE BELOW TLV(S).

PROTECTIVE GLOVES: WEAR RESISTANT GLOVES SUCH AS:, NEOPRENE, NITRILE RUBBER, POLYVINYL CHLORIDE

EYE PROTECTION: CHEMICAL SPLASH GOGGLES IN COMPLIANCE WITH OSHA REGULATIONS ARE ADVISED; HOWEVER, OSHA REGULATIONS ALSO PERMIT OTHER TYPE SAFETY GLASSES. (CONSULT YOUR SAFETY EQUIPMENT SUPPLIER)

OTHER PROTECTIVE EQUIPMENT: NORMAL WORK CLOTHING COVERING ARMS AND LEGS.

SECTION IX-SPECIAL PRECAUTIONS OR OTHER COMMENTS

CONTAINERS OF THIS MATERIAL MAY BE HAZARDOUS WHEN EMPTIED. SINCE EMPTIED CONTAINERS RETAIN PRODUCT RESIDUES (VAPOR, LIQUID, AND/OR SOLID), ALL HAZARD PRECAUTIONS

CONTINUED ON PAGE: 3

SECTION IX-SPECIAL PRECAUTIONS OR OTHER COMMENTS (CONTINUED)

GIVEN IN THE DATA SHEET MUST BE OBSERVED.

Kieling, Martyne

From:	Kieling, Martyne
Sent:	Tuesday, September 24, 2002 11:58 AM
To:	'Colin_Wasteneys@URSCorp.com'
Cc:	Foust, Denny; Anderson, Roger
Subject:	RE: Rule 711 Variance - BP Soil Composting Facility, Crouch Mesa New Mexico

Dear Mr. Wasteneys:

Regarding your request for clarification the New Mexico Oil Conservation Division (NMOCD) has reviewed the NMOCD Order No. R-11660 dated September 20, 2001. The NMOCD agrees that the Division Order approval for the wastes generated from the Red Mesa Pump Station-Utah, and the Tonalea Pump Station and the Cameron Pump Station - Arizona would include the former Line 90 crude oil pipeline that joins these pump stations. The crude oil contaminated soil at the pump stations is the same crude oil that would have contaminated the soil along the former Line 90 crude oil pipeline.

The NMOCD approves of the contaminated soil from the former Line 90 crude oil pipeline going to the BP America Production Company Crouch Mesa Landfarm Permit NM-02-003.

Please let me know if I can be of any further assistance.

Sincerely,

Martyne Kieling
Environmental Geologist
New Mexico Oil Conservation Division.
1220 South St. Francis Dr.
Santa Fe, New Mexico 87505

-----Original Message-----
From: Colin_Wasteneys@URSCorp.com [mailto:Colin_Wasteneys@URSCorp.com]
Sent: Tuesday, September 24, 2002 11:24 AM
To: mkieling@state.nm.us
Subject: Rule 711 Variance - BP Soil Composting Facility, Crouch Mesa New Mexico

Ms. Martyne Kieling
New Mexico Oil Conservation Division (NMOCD)
1220 South St. Francis Dr.
Santa Fe, New Mexico 87505

Dear Ms. Kieling,

As a follow up to our telephone conversation this afternoon regarding NMOCD Order No. R-11660:

BP Amoco Production operates the Crouch Mesa Soil Composting Facility (San Juan County, New Mexico) under NMOCD permit No. NM-02-003. In September 2001, BP Amoco Production was granted a permit modification and exception to certain provisions of OCD Rule 711 pertaining to treatment of petroleum contaminated from non-New Mexico locations. The Order (Case No. 12707, Order No. R-11660 - entered on September 20, 2001) allows for the treatment of non-hazardous petroleum contaminated soil from three Line 90 pipeline pump stations located outside of New Mexico. The three pump stations are: Red Mesa Pump Station, Utah; Tonalea Pump Station, Arizona; and Cameron Pump Station, Arizona.

In a telephone conversation with Roger Anderson of NMOCD on June 24, 2002, Mr. Anderson confirmed that treatment of non-hazardous petroleum contaminated soil associated with the pipeline in between the out-of-state pump stations would also be allowed at the BP Crouch Mesa facility under the conditions of the variance.

We would like to obtain written documentation of the NMOCD understanding that the Rule 711 variance would include all petroleum contaminated soil associated with the Line 90 pipeline and pump stations in Utah and Arizona.

In order to confirm this understanding, could you please reply to this e-mail message stating your concurrence with this understanding?

If you have any questions, please feel free to call me

Thank you,

Colin Wasteneys, R.G.
Senior Geologist
URS Corporation
282 Delaware Avenue
Buffalo, NY 14202-1805
tel. (716) 505-1010 ext. 1164
fax. (716) 505-1013

1912

NEW MEXICO ENERGY, MINERALS and
NATURAL RESOURCES DEPARTMENT

GARY E. JOHNSON
Governor
Betty Rivera
Cabinet Secretary

Lori Wrotenbery
Director
Oil Conservation Division

August 14, 2002

Ms. Brittany Benko
BP America Production Company
200 Amoco Court
Farmington, New Mexico 87401

RE: Request for Approval to Remediate Drum Contents
Key Energy Crouch Mesa Yard, San Juan County, NM
Crouch Mesa Centralized Surface Waste Management Facility
Permit NM-02-0003.

Dear Ms. Benko:

The New Mexico Oil Conservation Division (OCD) has received Blagg Engineering Inc.'s letter on behalf of BP America Production Company dated July 24, 2002. The request to remediate drum contents at the Crouch Mesa facility along with analytical data has been reviewed. Drum contents from drums numbered 2 through 23 are hereby approved for solidification and remediation at the Crouch Mesa Facility.

Please be advised that our approval does not relieve BP America Production Company of liability should your operation result in pollution of surface water, ground water, or the environment. In addition, OCD approval does not relieve BP America Production Company of responsibility for compliance with other federal, state or local laws and/or regulations.

If you have any questions please contact me at (505) 476-3488.

Sincerely,

Martyne J. Kieling
Environmental Geologist

cc: OCD Aztec District Office
Jeff Blagg, Blagg Engineering, Inc.

Oil Conservation Division * 1220 South St. Francis Drive * Santa Fe, New Mexico 87505
Phone: (505) 476-3440 * Fax (505) 476-3462 * http://www.emnrd.state.nm.us

BLAGG ENGINEERING, INC.
P.O. Box 87, Bloomfield, New Mexico 87413
Phone: (505)632-1199 Fax: (505)632-3903

July 24, 2002

RECEIVED
JUL 29 2002
Environmental Bureau
Oil Conservation Division

Ms.. Martyne Kieling
New Mexico Oil Conservation Division
1220 St. Francis Drive
Santa Fe, New Mexico 87504

Re: BP-America Production Company
Request for Approval to Remediate Drum Contents
Key Energy Crouch Mesa Storage Yard, San Juan County, NM

Dear Ms. Kieling:

On behalf of BP America Production Company (BP), Blagg Engineering, Inc. (BEI) seeks NMOCD approval to remediate the contents of approximately 119 gallons of oilfield waste fluids accumulated by BP and stored in 22 drums at the Key Energy Crouch Mesa Yard, San Juan County, New Mexico. BP requests approval to stabilize the fluids with soil and then transport the solid material to the NMOCD permitted BP Crouch Mesa Waste Management facility for remediation. Empty drums will be cleaned and either re-used or transported to a permitted solid waste landfill.

BEI inspected the drums and made a contents identification based on labels and/or drum type. Certain drum contents could not be positively identified and were sampled for characterization of reactivity, corrosivity, and ignitability (RCI), eight (8) RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, cadmium and chromium) and TCLP Volatiles. Samples were submitted to Envirotech, Inc. Laboratories in Farmington, New Mexico for testing.

The contents of many drums could be positively identified based on drum type and labeling. These drums contained lube oil contaminated with water (due to leaking bungs allowing rain water to seep into the drum) or used ethylene glycol. Material Safety Data Sheets (MSDS) were inspected for these content types and were found to be non-hazardous.

Included in Table 1 on the following page are the results of the drum inspection and laboratory testing:

Table 1

BP America Production Company
Key Energy Crouch Mesa Storage Yard: Drum Sampling Identification Results

Drum ID	Drum Size & Type	Fill Volume	Comments
2	55 gallon steel	2" (3± gallons)	Very dark brown liquid. Passed RCI, 8 RCRA metals and TCLP Volatiles
3	55 gallon steel	1± pint	de minimus volume, lube oil mixed with water
4	55 gallon steel	3"(5± gallons)	Dark brown liquid. Passed RCI, 8 RCRA metals and TCLP Volatiles
5	40 gallon steel	1" (2± gallons)	Used ethylene glycol
6	55 gallon steel	3" (5+/- gallons)	Used ethylene glycol
7	55 gallon steel	3" (5 +/- gallons)	New lube oil mixed with water
8	55 gallon steel	4" (6+/- gallons)	Clear Liquid. Passed RCI, 8RCRA metals and TCLP Volatiles
9	55 gallon steel	2" (3+/- gallons)	Rust colored liquid. Passed RCI, 8 RCRA metals and TCLP Volatiles
10	55 gallon steel	2" (3+/- gallons)	Lube oil mixed with water
11	40 gallon steel	10"(14± gallons)	Lube oil mixed with water
12	40 gallon steel	5" (7 +/- gallons)	Used ethylene glycol
13	55 gallon steel	10" (16+/-gallons)	Clear Liquid. Passed RCI, 8 RCRA metals and TCLP Volatiles
14	55 gallon steel	1" (2 +/- gallons)	Used ethylene glycol
15	40 gallon steel	8" (13 +/- gallons)	Lube oil mixed with water
16	30 gallon steel	1" (1 +/- gallon)	Lube oil mixed with water
17	30 gallon steel	1" (1 +/- gallon)	Lube oil mixed with water
18	55 gallon pvc on rack	5" (8 +/- gallons)	Drum and contents identical to No. 19, except dried out due to cracked lid.
19	55 gallon pvc on rack	5" (8+/- gallons)	Very dark brown, viscous liquid. Passed RCI, 8 RCRA metals and TCLP Volatiles
20	55 gallon steel	1" (1+/- gallon)	Used ethylene glycol
21	55 gallon steel	5"(8± gallons)	Used ethylene glycol
22	5 gallon plastic	4± gallons	Lube oil mixed with water
23	5 gallon plastic	4± gallons	Lube oil mixed with water

Laboratory test reports for drums identified as No. 2, 4, 8, 9, 13 and 19 (and 18, identical to No. 19) are attached. Included with these test reports are test results for drums identified as No. 1 and No. 24. These two drums failed RCI ignitability and BP is not requesting NMOCD approval to remediate the contents at the Crouch Mesa facility. Alternative permitted disposal for these two drums will be pursued.

Based on drum sampling test results and MSDS information, BEI does not believe that remediation of the drum contents at the Crouch Mesa landfarm will present any conflicts with the facility permit.

Questions or comments concerning this transmittal may be directed to myself at (505)632-1199 or to Brittany Benko with BP at (505)326-9235.

Respectfully submitted:
Blagg Engineering, Inc.

Jeffrey C. Blagg

Jeffrey C. Blagg, P.E.
President

Attachments: Lab Reports
MSDS Sheets

cc: B. Benko - BP San Juan Op.
D. Foust - NMOCD Aztec

jcb\bp.key.drums.wpd

CHAIN OF CUSTODY RECORD

10076

Client / Project Name BLAGG/BP	Project Location KEY CROUCH MESA
Sampler: J-C-Blagg	Client No. 94034-010

ANALYSIS / PARAMETERS

Sample No./ Identification	Sample Date	Sample Time	Lab Number	Sample Matrix	No. of Containers	TCLP VOL.						Remarks
DRUM #2	7/18/02	0930	23314	LIQUID	1	X						
DRUM #4	"	0938	23315	"	1	X						
DRUM #8	"	0943	23316	"	1	X						
DRUM #9	"	0946	23317	"	1	X						
DRUM #13	"	0952	23318	"	1	X						
DRUM #19	"	1000	23319	"	1	X						

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
J-C-Blagg	7/18/02	1024		7-18-02	102
Relinquished by: (Signature)			Received by: (Signature)		
Relinquished by: (Signature)			Received by: (Signature)		

ENVIROTECH INC.

5796 U.S. Highway 64
Farmington, New Mexico 87401
(505) 632-0615

Sample Receipt	Y	N	N/A
Received Intact	✓		
Cool - Ice/Blue Ice	✓		

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020
AROMATIC / HALOGENATED VOLATILE ORGANICS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #2	Date Reported:	07-20-02
Laboratory Number:	23314	Date Sampled:	07-18-02
Chain of Custody:	10076	Date Received:	07-18-02
Sample Matrix:	Liquid	Date Extracted:	N/A
Preservative:	Cool	Date Analyzed:	07-20-02
Condition:	Cool & Intact	Analysis Requested:	TCLP

Parameter	Concentration (mg/L)	Detection Limit (mg/L)	Regulatory Limits (mg/L)
Vinyl Chloride	ND	0.0001	0.2
1,1-Dichloroethene	ND	0.0001	0.7
2-Butanone (MEK)	0.323	0.0001	200
Chloroform	ND	0.0001	6.0
Carbon Tetrachloride	ND	0.0001	0.5
Benzene	0.0099	0.0001	0.5
1,2-Dichloroethane	ND	0.0001	0.5
Trichloroethene	ND	0.0003	0.5
Tetrachloroethene	ND	0.0005	0.7
Chlorobenzene	ND	0.0003	100
1,4-Dichlorobenzene	ND	0.0002	7.5

ND - Parameter not detected at the stated detection limit.

QA/QC Acceptance Criteria	Parameter	Percent Recovery
	Fluorobenzene	100%
	1,4-difluorobenzene	100%
	4-bromochlorobenzene	100%

References:

Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Note: Regulatory Limits based on 40 CFR part 261 Subpart C section 261.24, July 1, 1992.

Comments: **Key Crouch Mesa.**

Analyst

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020
AROMATIC / HALOGENATED VOLATILE ORGANICS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #4	Date Reported:	07-20-02
Laboratory Number:	23315	Date Sampled:	07-18-02
Chain of Custody:	10076	Date Received:	07-18-02
Sample Matrix:	Liquid	Date Extracted:	N/A
Preservative:	Cool	Date Analyzed:	07-20-02
Condition:	Cool & Intact	Analysis Requested:	TCLP

Parameter	Concentration (mg/L)	Detection Limit (mg/L)	Regulatory Limits (mg/L)
Vinyl Chloride	ND	0.0001	0.2
1,1-Dichloroethene	ND	0.0001	0.7
2-Butanone (MEK)	ND	0.0001	200
Chloroform	ND	0.0001	6.0
Carbon Tetrachloride	ND	0.0001	0.5
Benzene	ND	0.0001	0.5
1,2-Dichloroethane	ND	0.0001	0.5
Trichloroethene	ND	0.0003	0.5
Tetrachloroethene	ND	0.0005	0.7
Chlorobenzene	ND	0.0003	100
1,4-Dichlorobenzene	ND	0.0002	7.5

ND - Parameter not detected at the stated detection limit.

QA/QC Acceptance Criteria	Parameter	Percent Recovery
	Fluorobenzene	100%
	1,4-difluorobenzene	100%
	4-bromochlorobenzene	100%

References:
Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Note: Regulatory Limits based on 40 CFR part 261 Subpart C section 261.24, July 1, 1992.

Comments: **Key Crouch Mesa.**

Analyst

Review

EPA METHODS 8010/8020
AROMATIC / HALOGENATED VOLATILE ORGANICS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #8	Date Reported:	07-20-02
Laboratory Number:	23316	Date Sampled:	07-18-02
Chain of Custody:	10076	Date Received:	07-18-02
Sample Matrix:	Liquid	Date Extracted:	N/A
Preservative:	Cool	Date Analyzed:	07-20-02
Condition:	Cool & Intact	Analysis Requested:	TCLP

Parameter	Concentration (mg/L)	Detection Limit (mg/L)	Regulatory Limits (mg/L)
Vinyl Chloride	ND	0.0001	0.2
1,1-Dichloroethene	ND	0.0001	0.7
2-Butanone (MEK)	ND	0.0001	200
Chloroform	ND	0.0001	6.0
Carbon Tetrachloride	ND	0.0001	0.5
Benzene	ND	0.0001	0.5
1,2-Dichloroethane	ND	0.0001	0.5
Trichloroethene	ND	0.0003	0.5
Tetrachloroethene	ND	0.0005	0.7
Chlorobenzene	ND	0.0003	100
1,4-Dichlorobenzene	ND	0.0002	7.5

ND - Parameter not detected at the stated detection limit.

QA/QC Acceptance Criteria	Parameter	Percent Recovery
	Fluorobenzene	100%
	1,4-difluorobenzene	100%
	4-bromochlorobenzene	100%

References:
Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Note: Regulatory Limits based on 40 CFR part 261 Subpart C section 261.24, July 1, 1992.

Comments: **Key Crouch Mesa.**

Analyst

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020
AROMATIC / HALOGENATED VOLATILE ORGANICS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #9	Date Reported:	07-20-02
Laboratory Number:	23317	Date Sampled:	07-18-02
Chain of Custody:	10076	Date Received:	07-18-02
Sample Matrix:	Liquid	Date Extracted:	N/A
Preservative:	Cool	Date Analyzed:	07-20-02
Condition:	Cool & Intact	Analysis Requested:	TCLP

Parameter	Concentration (mg/L)	Detection Limit (mg/L)	Regulatory Limits (mg/L)
Vinyl Chloride	ND	0.0001	0.2
1,1-Dichloroethene	ND	0.0001	0.7
2-Butanone (MEK)	ND	0.0001	200
Chloroform	ND	0.0001	6.0
Carbon Tetrachloride	ND	0.0001	0.5
Benzene	ND	0.0001	0.5
1,2-Dichloroethane	ND	0.0001	0.5
Trichloroethene	ND	0.0003	0.5
Tetrachloroethene	ND	0.0005	0.7
Chlorobenzene	ND	0.0003	100
1,4-Dichlorobenzene	ND	0.0002	7.5

ND - Parameter not detected at the stated detection limit.

QA/QC Acceptance Criteria	Parameter	Percent Recovery
	Fluorobenzene	100%
	1,4-difluorobenzene	100%
	4-bromochlorobenzene	100%

References: Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Note: Regulatory Limits based on 40 CFR part 261 Subpart C section 261.24, July 1, 1992.

Comments: **Key Crouch Mesa.**

Analyst

Review

EPA METHODS 8010/8020
AROMATIC / HALOGENATED VOLATILE ORGANICS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #13	Date Reported:	07-20-02
Laboratory Number:	23318	Date Sampled:	07-18-02
Chain of Custody:	10076	Date Received:	07-18-02
Sample Matrix:	Liquid	Date Extracted:	N/A
Preservative:	Cool	Date Analyzed:	07-20-02
Condition:	Cool & Intact	Analysis Requested:	TCLP

Parameter	Concentration (mg/L)	Detection Limit (mg/L)	Regulatory Limits (mg/L)
Vinyl Chloride	ND	0.0001	0.2
1,1-Dichloroethene	ND	0.0001	0.7
2-Butanone (MEK)	ND	0.0001	200
Chloroform	ND	0.0001	6.0
Carbon Tetrachloride	ND	0.0001	0.5
Benzene	ND	0.0001	0.5
1,2-Dichloroethane	ND	0.0001	0.5
Trichloroethene	ND	0.0003	0.5
Tetrachloroethene	ND	0.0005	0.7
Chlorobenzene	ND	0.0003	100
1,4-Dichlorobenzene	ND	0.0002	7.5

ND - Parameter not detected at the stated detection limit.

QA/QC Acceptance Criteria	Parameter	Percent Recovery
	Fluorobenzene	100%
	1,4-difluorobenzene	100%
	4-bromochlorobenzene	100%

References: Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Note: Regulatory Limits based on 40 CFR part 261 Subpart C section 261.24, July 1, 1992.

Comments: **Key Crouch Mesa.**

Analyst

Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020 AROMATIC / HALOGENATED VOLATILE ORGANICS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #19	Date Reported:	07-20-02
Laboratory Number:	23319	Date Sampled:	07-18-02
Chain of Custody:	10076	Date Received:	07-18-02
Sample Matrix:	Liquid	Date Extracted:	N/A
Preservative:	Cool	Date Analyzed:	07-20-02
Condition:	Cool & Intact	Analysis Requested:	TCLP

Parameter	Concentration (mg/L)	Detection Limit (mg/L)	Regulatory Limits (mg/L)
Vinyl Chloride	ND	0.0001	0.2
1,1-Dichloroethene	ND	0.0001	0.7
2-Butanone (MEK)	0.0136	0.0001	200
Chloroform	ND	0.0001	6.0
Carbon Tetrachloride	ND	0.0001	0.5
Benzene	0.0043	0.0001	0.5
1,2-Dichloroethane	ND	0.0001	0.5
Trichloroethene	ND	0.0003	0.5
Tetrachloroethene	ND	0.0005	0.7
Chlorobenzene	ND	0.0003	100
1,4-Dichlorobenzene	ND	0.0002	7.5

ND - Parameter not detected at the stated detection limit.

QA/QC Acceptance Criteria	Parameter	Percent Recovery
	Fluorobenzene	100%
	1,4-difluorobenzene	100%
	4-bromochlorobenzene	100%

References:

Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Note: Regulatory Limits based on 40 CFR part 261 Subpart C section 261.24, July 1, 1992.

Comments: **Key Crouch Mesa.**

Analyst

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

QUALITY ASSURANCE / QUALITY CONTROL

DOCUMENTATION

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020 AROMATIC / HALOGENATED VOLATILE ORGANICS Quality Assurance Report

Client:	QA/QC	Project #:	N/A
Sample ID:	Laboratory Blank	Date Reported:	07-20-02
Laboratory Number:	07-20-TCV	Date Sampled:	N/A
Sample Matrix:	Water	Date Received:	N/A
Preservative:	N/A	Date Analyzed:	07-20-02
Condition:	N/A	Analysis Requested:	TCLP

Parameter	Concentration (mg/L)	Detection Limit (mg/L)	Regulatory Limits (mg/L)
Vinyl Chloride	ND	0.0001	0.2
1,1-Dichloroethene	ND	0.0001	0.7
2-Butanone (MEK)	ND	0.0001	200
Chloroform	ND	0.0001	6.0
Carbon Tetrachloride	ND	0.0001	0.5
Benzene	ND	0.0001	0.5
1,2-Dichloroethane	ND	0.0001	0.5
Trichloroethene	ND	0.0003	0.5
Tetrachloroethene	ND	0.0005	0.7
Chlorobenzene	ND	0.0003	100
1,4-Dichlorobenzene	ND	0.0002	7.5

ND - Parameter not detected at the stated detection limit.

QA/QC Acceptance Criteria	Parameter	Percent Recovery
	Fluorobenzene	100%
	1,4-difluorobenzene	100%
	4-bromochlorobenzene	100%

References:
Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Note: Regulatory Limits based on 40 CFR part 261 Subpart C section 261.24, July 1, 1992.

Comments: **QA/QC for samples 23305, 23314 - 23319.**

Analyst

Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020
AROMATIC / HALOGENATED VOLATILE ORGANICS
Quality Assurance Report

Client:	QA/QC	Project #:	N/A
Sample ID:	Method Blank	Date Reported:	07-20-02
Laboratory Number:	07-16-TCV	Date Sampled:	N/A
Sample Matrix:	TCLP Extract	Date Received:	N/A
Preservative:	N/A	Date Analyzed:	07-20-02
Condition:	N/A	Date Extracted:	07-16-02
		Analysis Requested:	TCLP

Parameter	Concentration (mg/L)	Detection Limit (mg/L)	Regulatory Limits (mg/L)
Vinyl Chloride	ND	0.0001	0.2
1,1-Dichloroethene	ND	0.0001	0.7
2-Butanone (MEK)	ND	0.0001	200
Chloroform	ND	0.0001	6.0
Carbon Tetrachloride	ND	0.0001	0.5
Benzene	ND	0.0001	0.5
1,2-Dichloroethane	ND	0.0001	0.5
Trichloroethene	ND	0.0003	0.5
Tetrachloroethene	ND	0.0005	0.7
Chlorobenzene	ND	0.0003	100
1,4-Dichlorobenzene	ND	0.0002	7.5

ND - Parameter not detected at the stated detection limit.

QA/QC Acceptance Criteria	Parameter	Percent Recovery
	Fluorobenzene	99%
	1,4-difluorobenzene	98%
	4-bromochlorobenzene	98%

References:

Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Note: Regulatory Limits based on 40 CFR part 261 Subpart C section 261.24, July 1, 1992.

Comments: **QA/QC for samples 23305, 23314 - 23319.**

Analyst

Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020
AROMATIC / HALOGENATED VOLATILE ORGANICS
QUALITY ASSURANCE REPORT

Client:	QA/QC	Project #:	N/A
Sample ID:	Matrix Duplicate	Date Reported:	07-20-02
Laboratory Number:	23305	Date Sampled:	N/A
Sample Matrix:	TCLP Extract	Date Received:	N/A
Analysis Requested:	TCLP	Date Analyzed:	07-20-02
Condition:	N/A	Date Extracted:	07-16-02

Parameter	Sample Result (mg/L)	Duplicate Sample Result (mg/L)	Detection Limits (mg/L)	Percent Difference
Vinyl Chloride	ND	ND	0.0001	0.0%
1,1-Dichloroethene	ND	ND	0.0001	0.0%
2-Butanone (MEK)	0.108	0.108	0.0001	0.0%
Chloroform	ND	ND	0.0001	0.0%
Carbon Tetrachloride	ND	ND	0.0001	0.0%
Benzene	0.0074	0.0074	0.0001	0.0%
1,2-Dichloroethane	ND	ND	0.0001	0.0%
Trichloroethene	ND	ND	0.0003	0.0%
Tetrachloroethene	ND	ND	0.0005	0.0%
Chlorobenzene	ND	ND	0.0003	0.0%
1,4-Dichlorobenzene	ND	ND	0.0002	0.0%

ND - Parameter not detected at the stated detection limit.

References:
Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Comments: **QA/QC for samples 23305, 23314 - 23319.**

Analyst

Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020
AROMATIC / HALOGENATED VOLATILE ORGANICS QUALITY ASSURANCE REPORT

Client:	QA/QC	Project #:	N/A
Sample ID:	Matrix Spike	Date Reported:	07-20-02
Laboratory Number:	23305	Date Sampled:	N/A
Sample Matrix:	TCLP Extract	Date Received:	N/A
Analysis Requested:	TCLP	Date Analyzed:	07-20-02
Condition:	N/A	Date Extracted:	07-16-02

Parameter	Sample Result (mg/L)	Spike Added (mg/L)	Spiked Sample Result (mg/L)	Det. Limit (mg/L)	Percent Recovery	SW-846 % Rec. Accept. Range
Vinyl Chloride	ND	0.050	0.0495	0.0001	99%	28-163
1,1-Dichloroethene	ND	0.050	0.0494	0.0001	99%	43-143
2-Butanone (MEK)	0.108	0.050	0.157	0.0001	99%	47-132
Chloroform	ND	0.050	0.0500	0.0001	100%	49-133
Carbon Tetrachloride	ND	0.050	0.0490	0.0001	98%	43-143
Benzene	0.0074	0.050	0.0569	0.0001	99%	39-150
1,2-Dichloroethane	ND	0.050	0.0490	0.0001	98%	51-147
Trichloroethene	ND	0.050	0.0495	0.0003	99%	35-146
Tetrachloroethene	ND	0.050	0.0495	0.0005	99%	26-162
Chlorobenzene	ND	0.050	0.0495	0.0003	99%	38-150
1,4-Dichlorobenzene	ND	0.050	0.0495	0.0002	99%	42-143

ND - Parameter not detected at the stated detection limit.

References:
Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Comments: **QA/QC for samples 23305, 23314 - 23319.**

Analyst

Review

10022

CHAIN OF CUSTODY RECORD

Client / Project Name: BLAGG/BP

Project Location: KEY CRUNCH MESA YARD

Sampler: J-C-Blagg

Client No. 94034-010

ANALYSIS / PARAMETERS

Sample No./ Identification	Sample Date	Sample Time	Lab Number	Sample Matrix	No. of Containers	8 RCRA METALS	RCI					Remarks
DRUM #1	6/20/02	1025	23113	LIQUID	1	X	X					
DRUM #2	"	1021	23114	"	1	X	X					
DRUM #4	"	1018	23115	"	1	X	X					
DRUM #8	"	1012	23116	"	1	X	X					
DRUM #9	"	1007	23117	"	1	X	X					
DRUM #13	"	1003	23118	"	1	X	X					
DRUM #19	"	0955	23119	"	1	X	X					
DRUM #24	"	0930	23120	"	1	X	X					

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
J-C-Blagg	6/20/02	1045		6·20·02	104
Relinquished by: (Signature)			Received by: (Signature)		
Relinquished by: (Signature)			Received by: (Signature)		

ENVIROTECH INC.

5796 U.S. Highway 64
Farmington, New Mexico 87401
(505) 632-0615

Sample Receipt

	Y	N	N/A
Received Intact	✓		
Cool - Ice/Blue Ice	✓		

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #1	Date Reported:	06-21-02
Laboratory Number:	23113	Date Sampled:	06-20-02
Chain of Custody:	10022	Date Received:	06-20-02
Sample Matrix:	Liquid	Date Analyzed:	06-21-02
Preservative:	Cool	Date Digested:	06-21-02
Condition:	Cool & Intact	Analysis Needed:	RCRA Metals

Parameter	Concentration (mg/L)	Det. Limit (mg/L)	Regulatory Level (mg/L)
Arsenic	**0.007**	**0.001**	**5.0**
Barium	**0.276**	**0.001**	**100**
Cadmium	**0.002**	**0.001**	**1.0**
Chromium	**0.381**	**0.001**	**5.0**
Lead	**0.226**	**0.001**	**5.0**
Mercury	**ND**	**0.001**	**0.2**
Selenium	**0.002**	**0.001**	**1.0**
Silver	**ND**	**0.001**	**5.0**

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Note: Regulatory Limits based on 40 CFR part 261 subpart C section 261.24, August 24, 1998.

Comments: **Key Crouch Mesa Yard.**

Analyst

Christini M Walters
Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #2	Date Reported:	06-21-02
Laboratory Number:	23114	Date Sampled:	06-20-02
Chain of Custody:	10022	Date Received:	06-20-02
Sample Matrix:	Liquid	Date Analyzed:	06-21-02
Preservative:	Cool	Date Digested:	06-21-02
Condition:	Cool & Intact	Analysis Needed:	RCRA Metals

Parameter	Concentration (mg/L)	Det. Limit (mg/L)	Regulatory Level (mg/L)
Arsenic	ND	0.001	5.0
Barium	0.004	0.001	100
Cadmium	ND	0.001	1.0
Chromium	ND	0.001	5.0
Lead	ND	0.001	5.0
Mercury	ND	0.001	0.2
Selenium	ND	0.001	1.0
Silver	ND	0.001	5.0

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Note: Regulatory Limits based on 40 CFR part 261 subpart C section 261.24, August 24, 1998.

Comments: **Key Crouch Mesa Yard.**

Analyst

Christini M Walters
Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #4	Date Reported:	06-21-02
Laboratory Number:	23115	Date Sampled:	06-20-02
Chain of Custody:	10022	Date Received:	06-20-02
Sample Matrix:	Liquid	Date Analyzed:	06-21-02
Preservative:	Cool	Date Digested:	06-21-02
Condition:	Cool & Intact	Analysis Needed:	RCRA Metals

Parameter	Concentration (mg/L)	Det. Limit (mg/L)	Regulatory Level (mg/L)
Arsenic	ND	0.001	5.0
Barium	0.061	0.001	100
Cadmium	ND	0.001	1.0
Chromium	ND	0.001	5.0
Lead	ND	0.001	5.0
Mercury	ND	0.001	0.2
Selenium	ND	0.001	1.0
Silver	ND	0.001	5.0

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Note: Regulatory Limits based on 40 CFR part 261 subpart C section 261.24, August 24, 1998.

Comments: **Key Crouch Mesa Yard.**

Analyst

Christini M Walters
Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #8	Date Reported:	06-21-02
Laboratory Number:	23116	Date Sampled:	06-20-02
Chain of Custody:	10022	Date Received:	06-20-02
Sample Matrix:	Liquid	Date Analyzed:	06-21-02
Preservative:	Cool	Date Digested:	06-21-02
Condition:	Cool & Intact	Analysis Needed:	RCRA Metals

Parameter	Concentration (mg/L)	Det. Limit (mg/L)	Regulatory Level (mg/L)
Arsenic	**ND**	**0.001**	**5.0**
Barium	**0.022**	**0.001**	**100**
Cadmium	**ND**	**0.001**	**1.0**
Chromium	**ND**	**0.001**	**5.0**
Lead	**ND**	**0.001**	**5.0**
Mercury	**ND**	**0.001**	**0.2**
Selenium	**ND**	**0.001**	**1.0**
Silver	**ND**	**0.001**	**5.0**

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Note: Regulatory Limits based on 40 CFR part 261 subpart C section 261.24, August 24, 1998.

Comments: **Key Crouch Mesa Yard.**

Analyst

Christine M Walters

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #9	Date Reported:	06-21-02
Laboratory Number:	23117	Date Sampled:	06-20-02
Chain of Custody:	10022	Date Received:	06-20-02
Sample Matrix:	Liquid	Date Analyzed:	06-21-02
Preservative:	Cool	Date Digested:	06-21-02
Condition:	Cool & Intact	Analysis Needed:	RCRA Metals

Parameter	Concentration (mg/L)	Det. Limit (mg/L)	Regulatory Level (mg/L)
Arsenic	ND	0.001	5.0
Barium	0.009	0.001	100
Cadmium	ND	0.001	1.0
Chromium	ND	0.001	5.0
Lead	ND	0.001	5.0
Mercury	ND	0.001	0.2
Selenium	ND	0.001	1.0
Silver	ND	0.001	5.0

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Note: Regulatory Limits based on 40 CFR part 261 subpart C section 261.24, August 24, 1998.

Comments: **Key Crouch Mesa Yard.**

Analyst

Christini M Walters
Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #13	Date Reported:	06-21-02
Laboratory Number:	23118	Date Sampled:	06-20-02
Chain of Custody:	10022	Date Received:	06-20-02
Sample Matrix:	Liquid	Date Analyzed:	06-21-02
Preservative:	Cool	Date Digested:	06-21-02
Condition:	Cool & Intact	Analysis Needed:	RCRA Metals

Parameter	Concentration (mg/L)	Det. Limit (mg/L)	Regulatory Level (mg/L)
Arsenic	**ND**	**0.001**	**5.0**
Barium	**0.030**	**0.001**	**100**
Cadmium	**ND**	**0.001**	**1.0**
Chromium	**ND**	**0.001**	**5.0**
Lead	**ND**	**0.001**	**5.0**
Mercury	**ND**	**0.001**	**0.2**
Selenium	**ND**	**0.001**	**1.0**
Silver	**ND**	**0.001**	**5.0**

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Note: Regulatory Limits based on 40 CFR part 261 subpart C section 261.24, August 24, 1998.

Comments: **Key Crouch Mesa Yard.**

Analyst

Christini M Walters

Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #19	Date Reported:	06-21-02
Laboratory Number:	23119	Date Sampled:	06-20-02
Chain of Custody:	10022	Date Received:	06-20-02
Sample Matrix:	Liquid	Date Analyzed:	06-21-02
Preservative:	Cool	Date Digested:	06-21-02
Condition:	Cool & Intact	Analysis Needed:	RCRA Metals

Parameter	Concentration (mg/L)	Det. Limit (mg/L)	Regulatory Level (mg/L)
Arsenic	0.018	0.001	5.0
Barium	0.481	0.001	100
Cadmium	0.008	0.001	1.0
Chromium	0.187	0.001	5.0
Lead	0.193	0.001	5.0
Mercury	ND	0.001	0.2
Selenium	0.010	0.001	1.0
Silver	ND	0.001	5.0

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Note: Regulatory Limits based on 40 CFR part 261 subpart C section 261.24, August 24, 1998.

Comments: **Key Crouch Mesa Yard.**

Analyst

Christine M Walters

Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #24	Date Reported:	06-21-02
Laboratory Number:	23120	Date Sampled:	06-20-02
Chain of Custody:	10022	Date Received:	06-20-02
Sample Matrix:	Liquid	Date Analyzed:	06-21-02
Preservative:	Cool	Date Digested:	06-21-02
Condition:	Cool & Intact	Analysis Needed:	RCRA Metals

Parameter	Concentration (mg/L)	Det. Limit (mg/L)	Regulatory Level (mg/L)
Arsenic	**0.004**	**0.001**	**5.0**
Barium	**0.174**	**0.001**	**100**
Cadmium	**0.005**	**0.001**	**1.0**
Chromium	**0.062**	**0.001**	**5.0**
Lead	**0.086**	**0.001**	**5.0**
Mercury	**ND**	**0.001**	**0.2**
Selenium	**0.003**	**0.001**	**1.0**
Silver	**ND**	**0.001**	**5.0**

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Note: Regulatory Limits based on 40 CFR part 261 subpart C section 261.24, August 24, 1998.

Comments: **Key Crouch Mesa Yard.**

Analyst

Christine M Walters

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS
Quality Control / Quality Assurance Report

Client:	QA/QC	Project #:	N/A
Sample ID:	06-21-TM QA/QC	Date Reported:	06-21-02
Laboratory Number:	23113	Date Sampled:	N/A
Sample Matrix:	Liquid	Date Received:	N/A
Analysis Requested:	Total RCRA Metals	Date Analyzed:	06-21-02
Condition:	N/A	Date Digested:	06-21-02

Blank & Duplicate Conc. (mg/L)	Instrument Blank (mg/L)	Method Blank	Detection Limit	Sample	Duplicate	% Diff.	Acceptance Range
Arsenic	**ND**	**ND**	**0.001**	**0.007**	**0.007**	**0.0%**	**0% - 30%**
Barium	**ND**	**ND**	**0.001**	**0.276**	**0.276**	**0.0%**	**0% - 30%**
Cadmium	**ND**	**ND**	**0.001**	**0.002**	**0.002**	**0.0%**	**0% - 30%**
Chromium	**ND**	**ND**	**0.001**	**0.381**	**0.378**	**0.8%**	**0% - 30%**
Lead	**ND**	**ND**	**0.001**	**0.23**	**0.22**	**0.9%**	**0% - 30%**
Mercury	**ND**	**ND**	**0.001**	**ND**	**ND**	**0.0%**	**0% - 30%**
Selenium	**ND**	**ND**	**0.001**	**0.002**	**0.002**	**0.0%**	**0% - 30%**
Silver	**ND**	**ND**	**0.001**	**ND**	**ND**	**0.0%**	**0% - 30%**

Spike Conc. (mg/L)	Spike Added	Sample	Spiked Sample	Percent Recovery	Acceptance Range
Arsenic	**0.500**	**0.007**	**0.506**	**99.8%**	**80% - 120%**
Barium	**0.500**	**0.276**	**0.774**	**99.7%**	**80% - 120%**
Cadmium	**0.500**	**0.002**	**0.501**	**99.8%**	**80% - 120%**
Chromium	**0.500**	**0.381**	**0.880**	**99.9%**	**80% - 120%**
Lead	**0.500**	**0.226**	**0.720**	**99.2%**	**80% - 120%**
Mercury	**0.050**	**ND**	**0.049**	**98.0%**	**80% - 120%**
Selenium	**0.500**	**0.002**	**0.501**	**99.8%**	**80% - 120%**
Silver	**0.500**	**ND**	**0.499**	**99.8%**	**80% - 120%**

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Comments: **QA/QC for samples 23113 - 23120.**

Analyst

Christine M Walters
Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

SUSPECTED HAZARDOUS WASTE ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #1	Date Reported:	06-21-02
Lab ID#:	23113	Date Sampled:	06-20-02
Sample Matrix:	Liquid	Date Received:	06-20-02
Preservative:	Cool	Date Analyzed:	06-20-02
Condition:	Cool and Intact	Chain of Custody:	10022

Parameter	Result	
IGNITABILITY:	**Positive**	**Flash Point < 60° C**
CORROSIVITY:	**Negative**	**pH = 6.22**
REACTIVITY:	**Negative**	

RCRA Hazardous Waste Criteria

Parameter	Hazardous Waste Criterion
IGNITABILITY:	Characteristic of Ignitability as defined by 40 CFR, Subpart C, Sec. 261.21. *(i.e. Sample ignition upon direct contact with flame or flash point < 60° C.)*
CORROSIVITY:	Characteristic of Corrosivity as defined by 40 CFR, Subpart C, Sec. 261.22. *(i.e. pH less than or equal to 2.0 or pH greater than or equal to 12.5)*
REACTIVITY:	Characteristic of Reactivity as defined by 40 CFR, Subpart C, Sec. 261.23. *(i.e. Violent reaction with water, strong base, strong acid, or the generation of Sulfide or Cyanide gases at STP with pH between 2.0 and 12.5)*

Reference: 40 CFR part 261 Subpart C sections 261.21 - 261.23, July 1, 1992.

Comments: **Key Crouch Mesa Yard.**

Christine M Walters
Analyst

Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

SUSPECTED HAZARDOUS WASTE ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #2	Date Reported:	06-21-02
Lab ID#:	23114	Date Sampled:	06-20-02
Sample Matrix:	Liquid	Date Received:	06-20-02
Preservative:	Cool	Date Analyzed:	06-20-02
Condition:	Cool and Intact	Chain of Custody:	10022

Parameter	Result	
IGNITABILITY:	**Negative**	
CORROSIVITY:	**Negative**	**pH = 5.72**
REACTIVITY:	**Negative**	

RCRA Hazardous Waste Criteria

Parameter	Hazardous Waste Criterion
IGNITABILITY:	Characteristic of Ignitability as defined by 40 CFR, Subpart C, Sec. 261.21. *(i.e. Sample ignition upon direct contact with flame or flash point < 60° C.)*
CORROSIVITY:	Characteristic of Corrosivity as defined by 40 CFR, Subpart C, Sec. 261.22. *(i.e. pH less than or equal to 2.0 or pH greater than or equal to 12.5)*
REACTIVITY:	Characteristic of Reactivity as defined by 40 CFR, Subpart C, Sec. 261.23. *(i.e. Violent reaction with water, strong base, strong acid, or the generation of Sulfide or Cyanide gases at STP with pH between 2.0 and 12.5)*

Reference: 40 CFR part 261 Subpart C sections 261.21 - 261.23, July 1, 1992.

Comments: **Key Crouch Mesa Yard.**

Christine M Walters

Analyst

Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

SUSPECTED HAZARDOUS WASTE ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #4	Date Reported:	06-21-02
Lab ID#:	23115	Date Sampled:	06-20-02
Sample Matrix:	Liquid	Date Received:	06-20-02
Preservative:	Cool	Date Analyzed:	06-20-02
Condition:	Cool and Intact	Chain of Custody:	10022

Parameter	Result	
IGNITABILITY:	**Negative**	
CORROSIVITY:	**Negative**	**pH = 5.09**
REACTIVITY:	**Negative**	

RCRA Hazardous Waste Criteria

Parameter	Hazardous Waste Criterion
IGNITABILITY:	Characteristic of Ignitability as defined by 40 CFR, Subpart C, Sec. 261.21. *(i.e. Sample ignition upon direct contact with flame or flash point < 60° C.)*
CORROSIVITY:	Characteristic of Corrosivity as defined by 40 CFR, Subpart C, Sec. 261.22. *(i.e. pH less than or equal to 2.0 or pH greater than or equal to 12.5)*
REACTIVITY:	Characteristic of Reactivity as defined by 40 CFR, Subpart C, Sec. 261.23. *(i.e. Violent reaction with water, strong base, strong acid, or the generation of Sulfide or Cyanide gases at STP with pH between 2.0 and 12.5)*

Reference: 40 CFR part 261 Subpart C sections 261.21 - 261.23, July 1, 1992.

Comments: **Key Crouch Mesa Yard.**

Christine M Walters
Analyst

Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

SUSPECTED HAZARDOUS WASTE ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #8	Date Reported:	06-21-02
Lab ID#:	23116	Date Sampled:	06-20-02
Sample Matrix:	Liquid	Date Received:	06-20-02
Preservative:	Cool	Date Analyzed:	06-20-02
Condition:	Cool and Intact	Chain of Custody:	10022

Parameter	Result	
IGNITABILITY:	**Negative**	
CORROSIVITY:	**Negative**	**pH = 5.74**
REACTIVITY:	**Negative**	

RCRA Hazardous Waste Criteria

Parameter	Hazardous Waste Criterion
IGNITABILITY:	Characteristic of Ignitability as defined by 40 CFR, Subpart C, Sec. 261.21. *(i.e. Sample ignition upon direct contact with flame or flash point < 60° C.)*
CORROSIVITY:	Characteristic of Corrosivity as defined by 40 CFR, Subpart C, Sec. 261.22. *(i.e. pH less than or equal to 2.0 or pH greater than or equal to 12.5)*
REACTIVITY:	Characteristic of Reactivity as defined by 40 CFR, Subpart C, Sec. 261.23. *(i.e. Violent reaction with water, strong base, strong acid, or the generation of Sulfide or Cyanide gases at STP with pH between 2.0 and 12.5)*

Reference: 40 CFR part 261 Subpart C sections 261.21 - 261.23, July 1, 1992.

Comments: **Key Crouch Mesa Yard.**

Christine M Walters

Analyst

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

SUSPECTED HAZARDOUS WASTE ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #9	Date Reported:	06-21-02
Lab ID#:	23117	Date Sampled:	06-20-02
Sample Matrix:	Liquid	Date Received:	06-20-02
Preservative:	Cool	Date Analyzed:	06-20-02
Condition:	Cool and Intact	Chain of Custody:	10022

Parameter	Result	
IGNITABILITY:	**Negative**	
CORROSIVITY:	**Negative**	**pH = 5.13**
REACTIVITY:	**Negative**	

RCRA Hazardous Waste Criteria

Parameter	Hazardous Waste Criterion
IGNITABILITY:	Characteristic of Ignitability as defined by 40 CFR, Subpart C, Sec. 261.21. *(i.e. Sample ignition upon direct contact with flame or flash point < 60° C.)*
CORROSIVITY:	Characteristic of Corrosivity as defined by 40 CFR, Subpart C, Sec. 261.22. *(i.e. pH less than or equal to 2.0 or pH greater than or equal to 12.5)*
REACTIVITY:	Characteristic of Reactivity as defined by 40 CFR, Subpart C, Sec. 261.23. *(i.e. Violent reaction with water, strong base, strong acid, or the generation of Sulfide or Cyanide gases at STP with pH between 2.0 and 12.5)*

Reference: 40 CFR part 261 Subpart C sections 261.21 - 261.23, July 1, 1992.

Comments: **Key Crouch Mesa Yard.**

Christine M Walters
Analyst

Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

SUSPECTED HAZARDOUS WASTE ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #13	Date Reported:	06-21-02
Lab ID#:	23118	Date Sampled:	06-20-02
Sample Matrix:	Liquid	Date Received:	06-20-02
Preservative:	Cool	Date Analyzed:	06-20-02
Condition:	Cool and Intact	Chain of Custody:	10022

Parameter	Result	
IGNITABILITY:	**Negative**	
CORROSIVITY:	**Negative**	**pH = 6.37**
REACTIVITY:	**Negative**	

RCRA Hazardous Waste Criteria

Parameter	Hazardous Waste Criterion
IGNITABILITY:	Characteristic of Ignitability as defined by 40 CFR, Subpart C, Sec. 261.21. *(i.e. Sample ignition upon direct contact with flame or flash point < 60° C.)*
CORROSIVITY:	Characteristic of Corrosivity as defined by 40 CFR, Subpart C, Sec. 261.22. *(i.e. pH less than or equal to 2.0 or pH greater than or equal to 12.5)*
REACTIVITY:	Characteristic of Reactivity as defined by 40 CFR, Subpart C, Sec. 261.23. *(i.e. Violent reaction with water, strong base, strong acid, or the generation of Sulfide or Cyanide gases at STP with pH between 2.0 and 12.5)*

Reference: 40 CFR part 261 Subpart C sections 261.21 - 261.23, July 1, 1992.

Comments: **Key Crouch Mesa Yard.**

Christine M Walters

Analyst

Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

SUSPECTED HAZARDOUS WASTE ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #19	Date Reported:	06-21-02
Lab ID#:	23119	Date Sampled:	06-20-02
Sample Matrix:	Liquid	Date Received:	06-20-02
Preservative:	Cool	Date Analyzed:	06-20-02
Condition:	Cool and Intact	Chain of Custody:	10022

Parameter	Result	
IGNITABILITY:	**Negative**	
CORROSIVITY:	**Negative**	**pH = 6.13**
REACTIVITY:	**Negative**	

RCRA Hazardous Waste Criteria

Parameter	Hazardous Waste Criterion
IGNITABILITY:	Characteristic of Ignitability as defined by 40 CFR, Subpart C, Sec. 261.21. *(i.e. Sample ignition upon direct contact with flame or flash point < 60° C.)*
CORROSIVITY:	Characteristic of Corrosivity as defined by 40 CFR, Subpart C, Sec. 261.22. *(i.e. pH less than or equal to 2.0 or pH greater than or equal to 12.5)*
REACTIVITY:	Characteristic of Reactivity as defined by 40 CFR, Subpart C, Sec. 261.23. *(i.e. Violent reaction with water, strong base, strong acid, or the generation of Sulfide or Cyanide gases at STP with pH between 2.0 and 12.5)*

Reference: 40 CFR part 261 Subpart C sections 261.21 - 261.23, July 1, 1992.

Comments: **Key Crouch Mesa Yard.**

Christine M Walters

Analyst

Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

SUSPECTED HAZARDOUS WASTE ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #24	Date Reported:	06-21-02
Lab ID#:	23120	Date Sampled:	06-20-02
Sample Matrix:	Liquid	Date Received:	06-20-02
Preservative:	Cool	Date Analyzed:	06-20-02
Condition:	Cool and Intact	Chain of Custody:	10022

Parameter	**Result**	
IGNITABILITY:	**Positive**	**Flash Point < 60° C**
CORROSIVITY:	**Negative**	**pH = 5.97**
REACTIVITY:	**Negative**	

RCRA Hazardous Waste Criteria

Parameter	Hazardous Waste Criterion
IGNITABILITY:	Characteristic of Ignitability as defined by 40 CFR, Subpart C, Sec. 261.21. *(i.e. Sample ignition upon direct contact with flame or flash point < 60° C.)*
CORROSIVITY:	Characteristic of Corrosivity as defined by 40 CFR, Subpart C, Sec. 261.22. *(i.e. pH less than or equal to 2.0 or pH greater than or equal to 12.5)*
REACTIVITY:	Characteristic of Reactivity as defined by 40 CFR, Subpart C, Sec. 261.23. *(i.e. Violent reaction with water, strong base, strong acid, or the generation of Sulfide or Cyanide gases at STP with pH between 2.0 and 12.5)*

Reference: 40 CFR part 261 Subpart C sections 261.21 - 261.23, July 1, 1992.

Comments: **Key Crouch Mesa Yard.**

Christine M Walters
Analyst

Review

CONOCO MATERIAL SAFETY DATA SHEET

I. MATERIAL IDENTIFICATION

Name: Conoco Fleet Motor Oil SAE 10W, 10W LP,
10W-30, 15W-40, 20-20W, 30, 40, 50/
Fleet Supreme 10W-30, 15W-40
Conoco Product Code: 6210/6211/6220/6230/6240/6250/
6260/6261/6271
Synonyms: Lubricating Oil, Motor Oil
Chemical Family: Petroleum Hydrocarbon
Manufacturer: Conoco Inc.
Address: P.O. Box 1267, Ponca City, OK 74603

CAS Registry No.: Mixture
Transportation Emergency No.:
(800) 424-9300 (Chemtrec)
Product Information No.:
(405) 767-6000

II. HAZARDOUS INGREDIENTS HAZARD DATA

Hazard Determination:

Health Effect Properties: None.	Not applicable.
Physical Effect Properties: Product/Mixture: None.	Not applicable.

III. PHYSICAL DATA

Appearance and Odor: Dark brown liquid; mild petroleum hydrocarbon odor.

Boiling Range (°F)	650-1200	Specific Gravity (H_2O=1)	0.88
Vapor Pressure (mmHg)	Nil	% Volatile (by volume)	Nil
Vapor Density (Air=1)	Not Applicable	Evaporation Rate (Ether=1)	Nil
Solubility in Water	Insoluble		

IV. REACTIVITY DATA Stable: X Unstable:

Hazardous Decomposition Products: Normal combustion forms carbon dioxide; incomplete combustion may produce carbon monoxide.

Conditions To Avoid: Strong oxidizing materials, heat, flame.

Hazardous Polymerization: Will not occur.

V. FIRE AND EXPLOSION HAZARD DATA

Flash Point (Method used): 340° F (PMCC) Autoignition Temperature: 650° F

Handle and store in accordance with NFPA procedure for Class III B Combustible Liquids.

Extinguishing Media: Use water spray, dry chemical, foam, or carbon dioxide.

Special Fire Fighting Procedures: Water or foam may cause frothing. Use water to keep fire-exposed containers cool. Water spray may be used to flush spills away from exposures.

V. FIRE AND EXPLOSION HAZARD DATA (continued)

Unusual Fire and Explosion Hazards: Products of combustion may contain carbon monoxide, carbon dioxide, and other toxic materials. Do not enter enclosed or confined space without proper protective equipment including respiratory protection.

National Fire Protection Association (NFPA) Classification   HAZARD RATING
Health 0   Fire 1   Reactivity 0   Least - 0   Slight - 1   Moderate - 2
High - 3   Extreme - 4

VI. TRANSPORTATION AND STORAGE   DOT HAZARD CLASS: Not Applicable

Precautions To Be Taken In Handling And Storing: Product is Class III B Combustible Liquid per NFPA Code No. 30-1984. Store and handle accordingly.

Shipping Paper Description: Not D.O.T. Regulated.

Placard: Not D.O.T. Regulated.

D.O.T. Label: Not Regulated.

OSHA Label (Recommended): CAUTION: Prolonged or repeated skin contact with used motor oil may be harmful. Wash thoroughly with soap and water after use.

VII. HEALTH HAZARD INFORMATION

PEL Not Established   TLV Not Established

Ceiling Value Not Established   AEL Not Established

Primary Route of Entry: Skin.

Signs and Symptoms of Exposure/Medical Conditions Aggravated By Exposure:
No adverse health effect has been identified specifically for this product. Health effect information from animal and human studies has been included on related materials, even though health experts may disagree as to the significance of this data.

Mouse skin painting studies have shown that highly solvent-refined petroleum distillates having a boiling point below 700° F, and which are similar to ingredients in this product, have not caused skin tumors. The product may cause irritation to eyes, lungs, or skin after prolonged or repeated exposure.

Laboratory studies have shown that mice developed skin cancer following repeated skin application of, and continuous exposure to, used motor oil. In these studies, the used motor oil was not removed between applications. Health hazards to used motor oil can be minimized by avoiding prolonged skin contact.

Listed as Carcinogen or Potential Carcinogen by: NTP No   IARC No   OSHA No

VIII. EMERGENCY AND FIRST AID PROCEDURES

Eyes: Immediately wash with fresh water for at least 15 minutes and get medical attention.

Skin: Remove contaminated clothing as soon as possible. Wash exposed skin thoroughly with soap and water. If irritation persists, consult a physician.

Launder contaminated clothing before reuse. Extremely contaminated leather shoes should be discarded.

If exposed to hot oil, immediately cool with cold water. Do not attempt to remove oil but continue to cool exposed areas with cold packs and seek medical attention.

Inhalation: If overexposure occurs, remove individual to fresh air. If breathing stops, administer artificial respiration.

Ingestion: If this material is swallowed, do not induce vomiting. If vomiting begins, lower victim's head in an effort to prevent vomitus from entering lungs. Immediately consult a physician. Do not attempt to give liquid to an unconscious person.

Note to Physicians: Gastric lavage by qualified medical personnel may be considered, depending on quantity of material ingested.

IX. SPILL, LEAK AND DISPOSAL PROCEDURES

RCRA HAZARDOUS WASTE: Yes _____ No __X__

In Case Of Spill Or Leak: Contain spill immediately in smallest area possible. Recover as much of the product itself as possible by such methods as vacuuming, followed by soaking up residual fluids by use of absorbent materials. Remove contaminated items including solids and place in proper container for disposal. Avoid washing, draining or directing material to storm or sanitary sewers.

Waste Disposal Method: Recycle as much of the recoverable product as possible. Dispose of nonrecyclable material by such methods as controlled incineration, complying with federal, state and local regulations.

X. PRECAUTIONARY MEASURES

Respiratory Protection: None required except under unusual circumstances such as described in Section V.

Ventilation: Normal shop ventilation.

Protective Gloves: None required.

Eye Protection: None required.

Other Protective Equipment: None required.

The above data is based on tests and experience which Conoco believes reliable and are supplied for informational purposes only. CONOCO DISCLAIMS ANY LIABILITY FOR DAMAGE OR INJURY WHICH RESULTS FROM THE USE OF THE ABOVE DATA AND NOTHING CONTAINED THEREIN SHALL CONSTITUTE A GUARANTEE, WARRANTY (INCLUDING WARRANTY OF MERCHANTABILITY) OR REPRESENTATION (INCLUDING FREEDOM FROM PATENT LIABILITY) BY CONOCO WITH RESPECT TO THE DATA, THE PRODUCT DESCRIBED, OR THEIR USE FOR ANY SPECIFIC PURPOSE, EVEN IF THAT PURPOSE IS KNOWN TO CONOCO.

2-62-7820-01

MATERIAL SAFETY DATA SHEET

Ashland Chemical Company
DIVISION OF ASHLAND OIL, INC.
P. O. BOX 2219, COLUMBUS, OHIO 43216 • (614) 889-3333
24-HOUR EMERGENCY TELEPHONE (606) 324-1133

THIS MSDS COMPLIES WITH 29 CFR 1910.1200 (THE HAZARD COMMUNICATION STANDARD)

PRODUCT NAME: ANTIFREEZE PERMANENT DRUMS

AMOCO PRODUCTION COMPANY
PETROLEUM CENTER BLDG
501 AIRPORT DRIVE
FARMINGTON NM 87401

ATTN: PLANT MGR./SAFETY DIR.

05 50 009 0368460-
DATA SHEET NO: 0032289-001
LATEST REVISION DATE: 03/86-86063
PRODUCT: 7021100
INVOICE: 204323
INVOICE DATE: 08/19/86
TO: AMOCO PRODUCTIONS COMPANY
802 DRAKE AVE
FARMINGTON NM 87401

SECTION I-PRODUCT IDENTIFICATION

GENERAL OR GENERIC ID: GLYCOL

DOT HAZARD CLASSIFICATION: NOT APPLICABLE

SECTION II-COMPONENTS

INGREDIENT	% (BY WT)	PEL	TLV	NOTE
ETHYLENE GLYCOL CAS #: 107-21-1	>95		50 PPM - CEILING	(1)

(1): PEL NOT ESTABLISHED FOR THIS MATERIAL

SECTION III-PHYSICAL DATA

PROPERTY	REFINEMENT	MEASUREMENT
BOILING POINT	FOR PRODUCT	388.00 DEG F (197.77 DEG C) @ 760.00 MMHG
VAPOR PRESSURE	FOR PRODUCT	0.05 MMHG @ 68.00 DEG F (20.00 DEG C)
SPECIFIC VAPOR DENSITY	AIR = 1	2.1
SPECIFIC GRAVITY		1.130 @ 68.00 DEG F (20.00 DEG C)
PERCENT VOLATILES		30-60%
EVAPORATION RATE		SLOWER THAN ETHER

SECTION IV-FIRE AND EXPLOSION INFORMATION

FLASH POINT 232.0 DEG F
(111.1 DEG C)

EXPLOSIVE LIMIT (PRODUCT) LOWER - 3.2%

EXTINGUISHING MEDIA: ALCOHOL FOAM OR CARBON DIOXIDE OR DRY CHEMICAL

HAZARDOUS DECOMPOSITION PRODUCTS: MAY FORM TOXIC MATERIALS:, CARBON DIOXIDE AND CARBON MONOXIDE, VARIOUS HYDROCARBONS, ETC.

FIREFIGHTING PROCEDURES: WEAR SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE WHEN FIGHTING FIRES.

SPECIAL FIRE & EXPLOSION HAZARDS: VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL ALONG THE GROUND OR BE MOVED BY VENTILATION AND IGNITED BY HEAT, PILOT LIGHTS, OTHER FLAMES AND IGNITION SOURCES AT LOCATIONS DISTANT FROM MATERIAL HANDLING POINT.

NEVER USE WELDING OR CUTTING TORCH ON OR NEAR DRUM (EVEN EMPTY) BECAUSE PRODUCT (EVEN JUST RESIDUE) CAN IGNITE EXPLOSIVELY.
NFPA CODES: HEALTH- 1 FLAMMABILITY- 1 REACTIVITY- 0

SECTION V-HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE 50 PPM - CEILING

SEE SECTION II

EFFECTS OF ACUTE OVEREXPOSURE: FOR PRODUCT

EYES - CAN CAUSE MODERATE IRRITATION, REDNESS, TEARING.
SKIN - CAN CAUSE SLIGHT IRRITATION.
BREATHING - EXCESSIVE INHALATION OF VAPORS CAN CAUSE NASAL AND RESPIRATORY IRRITATION, DIZZINESS, WEAKNESS, FATIGUE, NAUSEA, HEADACHE, POSSIBLE UNCONSCIOUSNESS, AND EVEN ASPHYXIATION.
SWALLOWING - CAN CAUSE GASTROINTESTINAL IRRITATION, NAUSEA, VOMITING, AND DIARRHEA.
EYES - CAN CAUSE IRRITATION.
BREATHING - EXCESSIVE INHALATION OF VAPORS CAN CAUSE NASAL AND RESPIRATORY IRRITATION.

CONTINUED ON PAGE: 2

SECTION V-HEALTH HAZARD DATA (CONTINUED)

FIRST AID:

IF ON SKIN: THOROUGHLY WASH EXPOSED AREA WITH SOAP AND WATER. REMOVE CONTAMINATED CLOTHING. LAUNDER CONTAMINATED CLOTHING BEFORE RE-USE.

IF IN EYES: FLUSH WITH LARGE AMOUNTS OF WATER, LIFTING UPPER AND LOWER LIDS OCCASIONALLY, GET MEDICAL ATTENTION.

IF SWALLOWED: IMMEDIATELY DRINK TWO GLASSES OF WATER AND INDUCE VOMITING BY EITHER GIVING IPECAC SYRUP OR BY PLACING FINGER AT BACK OF THROAT. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. GET MEDICAL ATTENTION IMMEDIATELY.

IF BREATHED: IF AFFECTED, REMOVE INDIVIDUAL TO FRESH AIR. IF BREATHING IS DIFFICULT, ADMINISTER OXYGEN. IF BREATHING HAS STOPPED GIVE ARTIFICIAL RESPIRATION. KEEP PERSON WARM, QUIET AND GET MEDICAL ATTENTION.

PRIMARY ROUTE(S) OF ENTRY:

INHALATION

EFFECTS OF CHRONIC OVEREXPOSURE: FOR PRODUCT

OVEREXPOSURE TO THIS MATERIAL (OR ITS COMPONENTS) HAS APPARENTLY BEEN FOUND TO CAUSE THE FOLLOWING EFFECTS IN LABORATORY ANIMALS:, KIDNEY DAMAGE

OVEREXPOSURE TO THIS MATERIAL (OR ITS COMPONENTS) HAS BEEN SUGGESTED AS A CAUSE OF THE FOLLOWING EFFECTS IN HUMANS:, LIVER ABNORMALITIES, KIDNEY DAMAGE, CENTRAL NERVOUS SYSTEM DAMAGE

SECTION VI-REACTIVITY DATA

HAZARDOUS POLYMERIZATION: CANNOT OCCUR

STABILITY: STABLE

INCOMPATIBILITY: AVOID CONTACT WITH:, STRONG OXIDIZING AGENTS.

SECTION VII-SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:

SMALL SPILL: ABSORB LIQUID ON PAPER, VERMICULITE, FLOOR ABSORBENT, OR OTHER ABSORBENT MATERIAL AND TRANSFER TO HOOD.

LARGE SPILL: ELIMINATE ALL IGNITION SOURCES (FLARES, FLAMES INCLUDING PILOT LIGHTS, ELECTRICAL SPARKS). PERSONS NOT WEARING PROTECTIVE EQUIPMENT SHOULD BE EXCLUDED FROM AREA OF SPILL UNTIL CLEAN-UP HAS BEEN COMPLETED. STOP SPILL AT SOURCE, DIKE AREA OF SPILL TO PREVENT SPREADING, PUMP LIQUID TO SALVAGE TANK. REMAINING LIQUID MAY BE TAKEN UP ON SAND, CLAY, EARTH, FLOOR ABSORBENT, OR OTHER ABSORBENT MATERIAL AND SHOVELED INTO CONTAINERS.

WASTE DISPOSAL METHOD:

SMALL SPILL: ALLOW VOLATILE PORTION TO EVAPORATE IN HOOD. ALLOW SUFFICIENT TIME FOR VAPORS TO COMPLETELY CLEAR HOOD DUCT WORK. DISPOSE OF REMAINING MATERIAL IN ACCORDANCE WITH APPLICABLE REGULATIONS.

LARGE SPILL: DESTROY BY LIQUID INCINERATION.
CONTAMINATED ABSORBENT MAY BE DEPOSITED IN A LANDFILL IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL REGULATIONS.

SECTION VIII-PROTECTIVE EQUIPMENT TO BE USED

RESPIRATORY PROTECTION: IF TLV OF THE PRODUCT OR ANY COMPONENT IS EXCEEDED, A NIOSH/MSHA JOINTLY APPROVED AIR SUPPLIED RESPIRATOR IS ADVISED IN ABSENCE OF PROPER ENVIRONMENTAL CONTROL. OSHA REGULATIONS ALSO PERMIT OTHER NIOSH/MSHA RESPIRATORS UNDER SPECIFIED CONDITIONS. (SEE YOUR SAFETY EQUIPMENT SUPPLIER). ENGINEERING OR ADMINISTRATIVE CONTROLS SHOULD BE IMPLEMENTED TO REDUCE EXPOSURE.

IF NEEDED USE A NIOSH/MSHA JOINTLY APPROVED DUST RESPIRATOR.(ASK YOUR SAFETY EQUIPMENT SUPPLIER)

VENTILATION: PROVIDE SUFFICIENT MECHANICAL (GENERAL AND/OR LOCAL EXHAUST) VENTILATION TO MAINTAIN EXPOSURE BELOW TLV(S).

PROTECTIVE GLOVES: WEAR RESISTANT GLOVES SUCH AS:, NEOPRENE, NITRILE RUBBER, POLYVINYL CHLORIDE

EYE PROTECTION: CHEMICAL SPLASH GOGGLES IN COMPLIANCE WITH OSHA REGULATIONS ARE ADVISED; HOWEVER, OSHA REGULATIONS ALSO PERMIT OTHER TYPE SAFETY GLASSES. (CONSULT YOUR SAFETY EQUIPMENT SUPPLIER)

OTHER PROTECTIVE EQUIPMENT: NORMAL WORK CLOTHING COVERING ARMS AND LEGS.

SECTION IX-SPECIAL PRECAUTIONS OR OTHER COMMENTS

CONTAINERS OF THIS MATERIAL MAY BE HAZARDOUS WHEN EMPTIED.SINCE EMPTIED CONTAINERS RETAIN PRODUCT RESIDUES (VAPOR, LIQUID, AND/OR SOLID), ALL HAZARD PRECAUTIONS

CONTINUED ON PAGE: 3

SECTION IX-SPECIAL PRECAUTIONS OR OTHER COMMENTS (CONTINUED)

GIVEN IN THE DATA SHEET MUST BE OBSERVED.

THE INFORMATION ACCUMULATED HEREIN IS BELIEVED TO BE ACCURATE BUT IS NOT WARRANTED TO BE WHETHER ORIGINATING WITH THE COMPANY OR NOT. RECIPIENTS ARE ADVISED TO CONFIRM IN ADVANCE OF NEED THAT THE INFORMATION IS CURRENT, APPLICABLE, AND SUITABLE TO THEIR CIRCUMSTANCES.

NEW MEXICO ENERGY, MINERALS and
NATURAL RESOURCES DEPARTMENT

GARY E. JOHNSON
Governor
Betty Rivera
Cabinet Secretary

Lori Wrotenbery
Director
Oil Conservation Division

August 14, 2002

Ms. Brittany Benko
BP America Production Company
200 Amoco Court
Farmington, New Mexico 87401

RE: **BP America Production Company's Request for Approval to Remediate**
GCU 134 Earthen Pit
Unit M, Section 17, T 29 N, R 12 W, NMPM, San Juan County, NM
Crouch Mesa Centralized Surface Waste Management Facility
Permit NM-02-0003.

Dear Ms. Benko:

The New Mexico Oil Conservation Division (OCD) has received Blagg Engineering Inc.'s letter on behalf of BP America Production Company dated June 19, 2002 and July 16, 2002. The request to remediate GCU 134 earthen pit contents at the Crouch Mesa facility along with analytical data has been reviewed and is hereby approved.

Please be advised that our approval does not relieve BP America Production Company of liability should your operation result in pollution of surface water, ground water, or the environment. In addition, OCD approval does not relieve BP America Production Company of responsibility for compliance with other federal, state or local laws and/or regulations.

I am sorry for the delay in processing this request. If you have any questions please contact me at (505) 476-3488.

Sincerely,

Martyne J. Kieling
Environmental Geologist

cc: OCD Aztec District Office
Jeff Blagg, Blagg Engineering, Inc.

Kieling, Martyne

From: Jeffcblagg@aol.com

Sent: Wednesday, August 14, 2002 1:36 PM

To: mkieling@state.nm.us

Cc: BenkoBD@bp.com; dfoust@state.nm.us

Subject: BP GCU 134 Waste Disposal, (M) Sec. 17 - T29N - R12W, San Juan County, NM

Martyne:

Referencing our telephone conversation on August 5, 2002 and our correspondence dated July 16, 2002 with respect to waste found in an earthen pit at the BP GCU 134, this is to confirm your verbal approval to transport this waste to the BP Crouch Mesa Waste Management Facility for remediation. Presently there is work crew at the site and the waste is expected to be moved to the landfarm by August 23, 2002. On behalf of BP, we appreciate your attention to this matter.

Thanks,
Jeff

BLAGG ENGINEERING, INC.
P.O. Box 87, Bloomfield, New Mexico 87413
Phone: (505)632-1199 Fax: (505)632-3903

RECEIVED
JUL 22 2002
Environmental Bureau
Oil Conservation Division

July 16, 2002

Ms. Martyne Kieling
New Mexico Oil Conservation Division
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

Re: BP America Production Company - GCU 134 Earthen Pit
Request for Approval to Remediate Deposited Waste Material - Additional Test Results
(M) Sec. 17 - T29N - R12W, San Juan County, New Mexico

Dear Ms. Kieling:

Referencing our correspondence dated June 19, 2002 with respect to waste found at the subject well location, Blagg Engineering, Inc. (BEI) has conducted additional sampling and testing pursuant to your request. On July 1, 2002 a sample of waste was collected and submitted to Envirotech, Inc. Laboratories for determination of TCLP volatiles. Test results (attached) indicate that TCLP volatiles do not exceed regulatory standards and therefor the waste material is not classified as hazardous. Prior correspondence on this matter included test results indicating acceptable values for RCRA metals and ignitability, corrosivity and reactivity.

On behalf of BP America Production Company, BEI seeks NMOCD approval to stabilize the waste material with soil and then transport the solid material to the NMOCD permitted Crouch Mesa Landfarm facility for remediation. Based on the sample test results BEI does not believe that remediation of the material at the Crouch Mesa Landfarm will present any conflicts with the facility permit.

Questions or comments concerning this transmittal may be directed to myself at (505)632-1199 or to Brittany Benko of BP at (505)632-9235.

Respectfully submitted:
Blagg Engineering, Inc.

Jeffrey C. Blagg

Jeffrey C. Blagg, P.E.
President

Attachment: Lab Reports

cc: Brittany Benko - BP San Juan Op.
Denny Foust - NMOCD Aztec

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020
AROMATIC / HALOGENATED VOLATILE ORGANICS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Blow Pit Waste	Date Reported:	07-03-02
Laboratory Number:	23208	Date Sampled:	07-01-02
Chain of Custody:	10044	Date Received:	07-01-02
Sample Matrix:	TCLP Extract	Date Extracted:	07-02-02
Preservative:	Cool	Date Analyzed:	07-03-02
Condition:	Cool & Intact	Analysis Requested:	TCLP

Parameter	Concentration (mg/L)	Detection Limit (mg/L)	Regulatory Limits (mg/L)
Vinyl Chloride	**ND**	**0.0001**	**0.2**
1,1-Dichloroethene	**ND**	**0.0001**	**0.7**
2-Butanone (MEK)	**0.0150**	**0.0001**	**200**
Chloroform	**ND**	**0.0001**	**6.0**
Carbon Tetrachloride	**ND**	**0.0001**	**0.5**
Benzene	**0.189**	**0.0001**	**0.5**
1,2-Dichloroethane	**ND**	**0.0001**	**0.5**
Trichloroethene	**ND**	**0.0003**	**0.5**
Tetrachloroethene	**ND**	**0.0005**	**0.7**
Chlorobenzene	**ND**	**0.0003**	**100**
1,4-Dichlorobenzene	**ND**	**0.0002**	**7.5**

ND - Parameter not detected at the stated detection limit.

QA/QC Acceptance Criteria	Parameter	Percent Recovery
	Fluorobenzene	**100%**
	1,4-difluorobenzene	**100%**
	4-bromochlorobenzene	**100%**

References: Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Note: Regulatory Limits based on 40 CFR part 261 Subpart C section 261.24, July 1, 1992.

Comments: **GCU 134.**

Analyst

Christine M. Walters
Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

QUALITY ASSURANCE / QUALITY CONTROL

DOCUMENTATION

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020
AROMATIC / HALOGENATED VOLATILE ORGANICS
Quality Assurance Report

Client:	QA/QC	Project #:	N/A
Sample ID:	Laboratory Blank	Date Reported:	07-03-02
Laboratory Number:	07-03-TCV	Date Sampled:	N/A
Sample Matrix:	Water	Date Received:	N/A
Preservative:	N/A	Date Analyzed:	07-03-02
Condition:	N/A	Analysis Requested:	TCLP

Parameter	Concentration (mg/L)	Detection Limit (mg/L)	Regulatory Limits (mg/L)
Vinyl Chloride	**ND**	**0.0001**	**0.2**
1,1-Dichloroethene	**ND**	**0.0001**	**0.7**
2-Butanone (MEK)	**ND**	**0.0001**	**200**
Chloroform	**ND**	**0.0001**	**6.0**
Carbon Tetrachloride	**ND**	**0.0001**	**0.5**
Benzene	**ND**	**0.0001**	**0.5**
1,2-Dichloroethane	**ND**	**0.0001**	**0.5**
Trichloroethene	**ND**	**0.0003**	**0.5**
Tetrachloroethene	**ND**	**0.0005**	**0.7**
Chlorobenzene	**ND**	**0.0003**	**100**
1,4-Dichlorobenzene	**ND**	**0.0002**	**7.5**

ND - Parameter not detected at the stated detection limit.

QA/QC Acceptance Criteria	Parameter	Percent Recovery
	Fluorobenzene	**100%**
	1,4-difluorobenzene	**100%**
	4-bromochlorobenzene	**100%**

References:
Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Note: Regulatory Limits based on 40 CFR part 261 Subpart C section 261.24, July 1, 1992.

Comments: **QA/QC for sample 23208.**

Analyst

Christine M Walters
Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020 AROMATIC / HALOGENATED VOLATILE ORGANICS
Quality Assurance Report

Client:	QA/QC	Project #:	N/A
Sample ID:	Method Blank	Date Reported:	07-03-02
Laboratory Number:	07-02-TCV	Date Sampled:	N/A
Sample Matrix:	TCLP Extract	Date Received:	N/A
Preservative:	N/A	Date Analyzed:	07-03-02
Condition:	N/A	Date Extracted:	07-02-02
		Analysis Requested:	TCLP

Parameter	Concentration (mg/L)	Detection Limit (mg/L)	Regulatory Limits (mg/L)
Vinyl Chloride	**ND**	**0.0001**	**0.2**
1,1-Dichloroethene	**ND**	**0.0001**	**0.7**
2-Butanone (MEK)	**ND**	**0.0001**	**200**
Chloroform	**ND**	**0.0001**	**6.0**
Carbon Tetrachloride	**ND**	**0.0001**	**0.5**
Benzene	**ND**	**0.0001**	**0.5**
1,2-Dichloroethane	**ND**	**0.0001**	**0.5**
Trichloroethene	**ND**	**0.0003**	**0.5**
Tetrachloroethene	**ND**	**0.0005**	**0.7**
Chlorobenzene	**ND**	**0.0003**	**100**
1,4-Dichlorobenzene	**ND**	**0.0002**	**7.5**

ND - Parameter not detected at the stated detection limit.

QA/QC Acceptance Criteria	Parameter	Percent Recovery
	Fluorobenzene	**99%**
	1,4-difluorobenzene	**98%**
	4-bromochlorobenzene	**98%**

References: Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Note: Regulatory Limits based on 40 CFR part 261 Subpart C section 261.24, July 1, 1992.

Comments: **QA/QC for sample 23208.**

Analyst

Christine M Walters
Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020
AROMATIC / HALOGENATED VOLATILE ORGANICS
QUALITY ASSURANCE REPORT

Client:	QA/QC	Project #:	N/A
Sample ID:	Matrix Duplicate	Date Reported:	07-03-02
Laboratory Number:	23208	Date Sampled:	N/A
Sample Matrix:	TCLP Extract	Date Received:	N/A
Analysis Requested:	TCLP	Date Analyzed:	07-03-02
Condition:	N/A	Date Extracted:	07-02-02

Parameter	Sample Result (mg/L)	Duplicate Sample Result (mg/L)	Detection Limits (mg/L)	Percent Difference
Vinyl Chloride	ND	ND	0.0001	0.0%
1,1-Dichloroethene	ND	ND	0.0001	0.0%
2-Butanone (MEK)	0.0150	0.0150	0.0001	0.0%
Chloroform	ND	ND	0.0001	0.0%
Carbon Tetrachloride	ND	ND	0.0001	0.0%
Benzene	0.189	0.189	0.0001	0.0%
1,2-Dichloroethane	ND	ND	0.0001	0.0%
Trichloroethene	ND	ND	0.0003	0.0%
Tetrachloroethene	ND	ND	0.0005	0.0%
Chlorobenzene	ND	ND	0.0003	0.0%
1,4-Dichlorobenzene	ND	ND	0.0002	0.0%

ND - Parameter not detected at the stated detection limit.

References:
Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Comments: **QA/QC for sample 23208.**

Analyst

Christine M Walters
Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHODS 8010/8020
AROMATIC / HALOGENATED VOLATILE ORGANICS QUALITY ASSURANCE REPORT

Client:	QA/QC	Project #:	N/A
Sample ID:	Matrix Spike	Date Reported:	07-03-02
Laboratory Number:	23208	Date Sampled:	N/A
Sample Matrix:	TCLP Extract	Date Received:	N/A
Analysis Requested:	TCLP	Date Analyzed:	07-03-02
Condition:	N/A	Date Extracted:	07-02-02

Parameter	Sample Result (mg/L)	Spike Added (mg/L)	Spiked Sample Result (mg/L)	Det. Limit (mg/L)	Percent Recovery	SW-846 % Rec. Accept. Range
Vinyl Chloride	ND	0.050	0.0495	0.0001	99%	28-163
1,1-Dichloroethene	ND	0.050	0.0494	0.0001	99%	43-143
2-Butanone (MEK)	0.0150	0.050	0.0640	0.0001	98%	47-132
Chloroform	ND	0.050	0.0500	0.0001	100%	49-133
Carbon Tetrachloride	ND	0.050	0.0490	0.0001	98%	43-143
Benzene	0.189	0.050	0.239	0.0001	100%	39-150
1,2-Dichloroethane	ND	0.050	0.0490	0.0001	98%	51-147
Trichloroethene	ND	0.050	0.0495	0.0003	99%	35-146
Tetrachloroethene	ND	0.050	0.0495	0.0005	99%	26-162
Chlorobenzene	ND	0.050	0.0495	0.0003	99%	38-150
1,4-Dichlorobenzene	ND	0.050	0.0495	0.0002	99%	42-143

ND - Parameter not detected at the stated detection limit.

References:
Method 1311, Toxicity Characteristic Leaching Procedure, SW-846, USEPA, July 1992.
Method 5030, Purge-and-Trap, SW-846, USEPA, July 1992.
Method 8010, Halogenated Volatile Organic, SW-846, USEPA, Sept. 1994.
Method 8020, Aromatic Volatile Organics, SW-846, USEPA, Sept. 1994.

Comments: **QA/QC for sample 23208.**

Analyst

Christine M Walters
Review

CHAIN OF CUSTODY RECORD

10044

Client / Project Name BLAGG/BP	Project Location GCU 134
Sampler: J-C-Blagg	Client No. 94034-010

ANALYSIS / PARAMETERS

Sample No./ Identification	Sample Date	Sample Time	Lab Number	Sample Matrix	No. of Containers	TCLP VOL.						Remarks
BLOW PIT Waste	7/1/02	1355	23208	SOIL/SLUDGE	1	✓						

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
J-C-Blagg	7/1/02	1443		7-1-02	1443
Relinquished by: (Signature)			Received by: (Signature)		
Relinquished by: (Signature)			Received by: (Signature)		

ENVIROTECH INC.

5796 U.S. Highway 64
Farmington, New Mexico 87401
(505) 632-0615

Sample Receipt	Y	N	N/A
Received Intact	✓		
Cool - Ice/Blue Ice	✓		

BLAGG ENGINEERING, INC.
P.O. Box 87, Bloomfield, New Mexico 87413
Phone: (505)632-1199 Fax: (505)632-3903

RECEIVED
JUN 24 2002
Environmental Bureau
Oil Conservation Division

June 19, 2002

Ms. Martyne Kieling
New Mexico Oil Conservation Division
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

Re: BP America Production Company - GCU 134 Earthen Pit
Request for Approval to Remediate Deposited Waste Material
(M) Sec. 17 - T29N - R12W, San Juan County, New Mexico

Dear Ms. Kieling:

On behalf of BP America Production Company (BP), Blagg Engineering, Inc. (BEI) seeks NMOCD approval to remediate waste material deposited into a dry earthen pit at the GCU 134 well location. A viscous oil/lube mix of unknown origin was discovered to be disposed into an earthen pit at this well site on June 12, 2002. The total contents is estimated by BEI to be less than 55 gallons and has the appearance of used oil mixed with gear lube. This well is in an area of San Juan County that is presently experiencing new housing developments and the origin of the material may be from a local resident.

BEI inspected the waste material on June 13, 2002. A sample was collected and submitted to Envirotech, Inc. laboratories in Farmington, New Mexico for hazardous waste identification (ignitability, corrosivity and reactivity) and 8 RCRA metals analysis (arsenic, barium, cadmium, chromium, lead, mercury, cadmium and chromium). The sample passed the laboratory testing with negative results on hazardous characteristics and metals analysis indicated primarily non-detect, except for a trace amount of barium (see attached laboratory reports). Field visual and odor qualities did not indicate any hazardous materials contents such as volatility or hydrogen sulfide.

BP requests approval to stabilize the waste material with soil and then transport the solid material to the NMOCD permitted Crouch Mesa Landfarm facility for remediation. Based on the sample test results BEI does not believe that remediation of the material at the Crouch Mesa Landfarm will present any conflicts with the facility permit.

Questions or comments concerning this transmittal may be directed to myself at (505)632-1199 or to Brittany Benko of BP at (505)632-9235.

Respectfully submitted:
Blagg Engineering, Inc.

Jeffrey C. Blagg

Jeffrey C. Blagg, P.E.
President

Attachment: Lab Reports

cc: Brittany Benko - BP San Juan Op.
Denny Foust - NMOCD Aztec

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Prod. Pit Oil/Grease Sludge	Date Reported:	06-14-02
Laboratory Number:	23050	Date Sampled:	06-13-02
Chain of Custody:	9984	Date Received:	06-13-02
Sample Matrix:	Sludge	Date Analyzed:	06-14-02
Preservative:	Cool	Date Digested:	06-13-02
Condition:	Cool & Intact	Analysis Needed:	RCRA Metals

Parameter	Concentration (mg/Kg)	Det. Limit (mg/Kg)	Regulatory Level (mg/Kg)
Arsenic	**ND**	**0.001**	**5.0**
Barium	**0.002**	**0.001**	**100**
Cadmium	**ND**	**0.001**	**1.0**
Chromium	**ND**	**0.001**	**5.0**
Lead	**ND**	**0.001**	**5.0**
Mercury	**ND**	**0.001**	**0.2**
Selenium	**ND**	**0.001**	**1.0**
Silver	**ND**	**0.001**	**5.0**

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Note: Regulatory Limits based on 40 CFR part 261 subpart C section 261.24, August 24, 1998.

Comments: **GCU 134.**

Analyst

Christine M Walters
Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS
Quality Control / Quality Assurance Report

Client:	QA/QC	Project #:	N/A
Sample ID:	06-14-TM QA/QC	Date Reported:	06-14-02
Laboratory Number:	22919	Date Sampled:	N/A
Sample Matrix:	Soil	Date Received:	N/A
Analysis Requested:	Total RCRA Metals	Date Analyzed:	06-14-02
Condition:	N/A	Date Digested:	06-13-02

Blank & Duplicate Conc. (mg/Kg)	Instrument Blank (mg/L)	Method Blank	Detection Limit	Sample	Duplicate	% Diff.	Acceptance Range
Arsenic	**ND**	**ND**	**0.001**	**ND**	**ND**	**0.0%**	**0% - 30%**
Barium	**ND**	**ND**	**0.001**	**3.97**	**3.95**	**0.5%**	**0% - 30%**
Cadmium	**ND**	**ND**	**0.001**	**ND**	**ND**	**0.0%**	**0% - 30%**
Chromium	**ND**	**ND**	**0.001**	**0.670**	**0.672**	**0.3%**	**0% - 30%**
Lead	**ND**	**ND**	**0.001**	**0.217**	**0.216**	**0.5%**	**0% - 30%**
Mercury	**ND**	**ND**	**0.001**	**ND**	**ND**	**0.0%**	**0% - 30%**
Selenium	**ND**	**ND**	**0.001**	**ND**	**ND**	**0.0%**	**0% - 30%**
Silver	**ND**	**ND**	**0.001**	**ND**	**ND**	**0.0%**	**0% - 30%**

Spike Conc. (mg/Kg)	Spike Added	Sample	Spiked Sample	Percent Recovery	Acceptance Range
Arsenic	**0.500**	**ND**	**0.498**	**99.6%**	**80% - 120%**
Barium	**0.500**	**3.97**	**4.44**	**99.3%**	**80% - 120%**
Cadmium	**0.500**	**ND**	**0.499**	**99.8%**	**80% - 120%**
Chromium	**0.500**	**0.670**	**1.16**	**99.1%**	**80% - 120%**
Lead	**0.500**	**0.217**	**0.715**	**99.7%**	**80% - 120%**
Mercury	**0.050**	**ND**	**0.049**	**98.0%**	**80% - 120%**
Selenium	**0.500**	**ND**	**0.498**	**99.6%**	**80% - 120%**
Silver	**0.500**	**ND**	**0.499**	**99.8%**	**80% - 120%**

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Comments: **QA/QC for samples 22919, 23050.**

Analyst

Christine M Walters

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

SUSPECTED HAZARDOUS WASTE ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Prod. Pit Oil/Grease Sludge	Date Reported:	06-14-02
Lab ID#:	23050	Date Sampled:	06-13-02
Sample Matrix:	Sludge	Date Received:	06-13-02
Preservative:	Cool	Date Analyzed:	06-13-02
Condition:	Cool and Intact	Chain of Custody:	9984

Parameter	Result	
IGNITABILITY:	**Negative**	
CORROSIVITY:	**Negative**	**pH = 4.95**
REACTIVITY:	**Negative**	

RCRA Hazardous Waste Criteria

Parameter	Hazardous Waste Criterion
IGNITABILITY:	Characteristic of Ignitability as defined by 40 CFR, Subpart C, Sec. 261.21. *(i.e. Sample ignition upon direct contact with flame or flash point < 60° C.)*
CORROSIVITY:	Characteristic of Corrosivity as defined by 40 CFR, Subpart C, Sec. 261.22. *(i.e. pH less than or equal to 2.0 or pH greater than or equal to 12.5)*
REACTIVITY:	Characteristic of Reactivity as defined by 40 CFR, Subpart C, Sec. 261.23. *(i.e. Violent reaction with water, strong base, strong acid, or the generation of Sulfide or Cyanide gases at STP with pH between 2.0 and 12.5)*

Reference: 40 CFR part 261 Subpart C sections 261.21 - 261.23, July 1, 1992.

Comments: **GCU 134.**

Analyst

Christine M Walters
Review

CHAIN OF CUSTODY RECORD

09984

Client / Project Name BLAGG/BP	Project Location GCU 134	ANALYSIS / PARAMETERS
Sampler: J-C-Blagg	Client No. 94034-010	

Sample No./ Identification	Sample Date	Sample Time	Lab Number	Sample Matrix	No. of Containers	8 RCRA METALS	RCI					Remarks
PROD. PIT	6-13-2	1115	23050	SLUDGE	1	X	X					
OIL/GREASE SLUDGE												

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
J-C-Blagg	6/13/02	1323		6-13-02	1323
Relinquished by: (Signature)			Received by: (Signature)		
Relinquished by: (Signature)			Received by: (Signature)		

ENVIROTECH INC.

5796 U.S. Highway 64
Farmington, New Mexico 87401
(505) 632-0615

Sample Receipt	Y	N	N/A
Received Intact	✓		
Cool - Ice/Blue Ice	✓		

Kieling, Martyne

From: Phillips, Dorothy
Sent: Thursday, January 24, 2002 7:31 AM
To: EMNRD OCD - ARTESIA; EMNRD OCD - AZTEC; EMNRD OCD - HOBBS; EMNRD OCD - SANTA FE
Subject: Change of Name

We have two change of names that have just been completed

Amoco Production Company OGRID 778 is now BP America Production Company

Hallwood Production Company OGRID 9812 is now HEC Petroleum Inc.
Thanks

NEW MEXICO ENERGY, MINERALS and
NATURAL RESOURCES DEPARTMENT

GARY E. JOHNSON
Governor
Carol Leach
Acting Cabinet Secretary

Lori Wrotenbery
Director
Oil Conservation Division

January 23, 2002

Mr. Buddy Shaw
Amoco Production Company
200 Amoco Court
Farmington, New Mexico 87401

RE: **BP-Amoco Request for Approval to Remediate Drum Contents**
M& R Trucking (Vastar Resources) Storage Yard, Farmington, NM
Crouch Mesa Centralized Surface Waste Management Facility
Permit NM-02-0003.

Dear Mr. Shaw:

The New Mexico Oil Conservation Division (OCD) has received Blagg Engineering Inc.'s letter on behalf of BP-Amoco dated June 26, 2001. The request to remediate drum contents at the Crouch Mesa facility along with analytical data has been reviewed and is hereby approved. A verbal approval was given in July 2001, to Blagg Engineering Inc. by the OCD and is herein followed by a written approval.

Please be advised that our approval does not relieve BP-Amoco of liability should your operation result in pollution of surface water, ground water, or the environment. In addition, OCD approval does not relieve BP-Amoco of responsibility for compliance with other federal, state or local laws and/or regulations.

We are sorry for the delay in processing this request. If you have any questions please contact me at (505) 476-3488.

Sincerely,

Martyne J. Kieling
Environmental Geologist

cc: OCD Aztec District Office
Jeff Blagg, Blagg Engineering, Inc.

Oil Conservation Division * 1220 South St. Francis Drive * Santa Fe, New Mexico 87505
Phone: (505) 476-3440 * Fax (505) 476-3462 * http://www.emnrd.state.nm.us

NEW MEXICO ENERGY, MINERALS and NATURAL RESOURCES DEPARTMENT

GARY E. JOHNSON
Governor
Jennifer A. Salisbury
Cabinet Secretary

Lori Wrotenbery
Director
Oil Conservation Division

RECEIVED
DEC 18 2001
Environmental Bureau
Oil Conservation Division

Certified Receipt #7000 0520 0018 0518 0254

December 12, 2001

Buddy Shaw Amoco Production Company
Bp Amoco Group
200 Energy Court
Farmington, Nm 87401

RE: Vital Concepts /Evergreen Nursery Beneficial Use of Composted Soil

Dear Mr. Shaw:

I am in receipt of a letter from Vital Concepts dated September 21, 2001, proposing to use composted soil by Evergreen Nursery for horticultural purposes. The composted soil will be utilized at a site operated by Evergreen Nursery. The composted soil will be from Amoco Production's (Amoco) Crouch Mesa Facility, permitted under New Mexico Oil Conservation Division (OCD) Rule 711.The soil will not be remediated. You have concurred with this proposal in a letter dated December 4, 2001. The OCD has reviewed the proposal presented in the two letters.

The OCD approves a test period until June 1, 2002 with the following requirements. The total amount of composted soil utilized in the project is not to exceed 120 cubic yards. The address for the soil processing test site must be filed with OCD. Evergreen Nursery will acknowledge on the bill of lading that the soils from each load are from the Amoco Crouch Mesa Facility for treating oil field contaminated soils. A copy of each bill of lading will be available at the preparation site and a copy of each bill of lading will be filed with EPC Company, Managing Consultants for the Amoco Crouch Mesa Facility. The processing area will be bermed to prevent run off. Each composted soil batch will not exceed 40 cubic yards. Each batch will be tested, for TPH and TCLP metals (or total metals), by utilizing one composite sample from no less than five collection points before processing begins. These test results are to be available for inspection at the processing site. The potting mix will be used only on plants not for human consumption. The processing site will be open to inspection by OCD personnel during normal working hours. Discovery of any materials in excess of hazardous waste standards by Vital Concepts/Evergreen Nursery shall be cause for immediate verbal notification to the OCD Aztec office and the Amoco Farmington office.

This letter replaces my letter dated November 1, 2001, which was based on a different interpretation of the original proposal. This approval does not relieve Amoco of liability if contaminants are found to pose a threat to surface water, ground water, human health or the environment. OCD approval does not relieve Amoco of compliance with other federal, state, tribal or local laws and regulations.

To renew or extend this approval a report must be filed with OCD under an Amoco cover letter. The report must justify continuing utilization of the composted material for horticultural purposes and outline any necessary restrictions based on data collected during the current approval period.

If you have questions, please feel free to call me at 505-334-6178 ext. 15.

Yours truly,

Denny G. Foust

Denny G. Foust
Environmental Geologist
Deputy Oil & Gas Inspector
dfoust@state.nm.us

DGF/mk

XC: Jerry Finney, Vital Concepts, Bloomfield
Dan Alden, Evergreen Nursery, Aztec
Louis Froelick, EPC, Bloomfield
DGF File
Environmental File
EC: Martyne Kieling, OCD, Santa Fe
Roger Anderson, OCD, Santa Fe

RECEIVED

DEC 18 2001

Environmental Bureau
Oil Conservation Division

bp

Amoco Production Company
A Part of the BP Amoco Group
200 Energy Court
Farmington, NM 87401

Phone: (505) 326-9200

DEC 2001
RECEIVED
OIL CON. DIV
DIST. 3

December 4, 2001

NMOCD
1000 Rio Brazos Road
Aztec, NM 87410

Attention: Denny Foust

Soil Use for Evergreen Nursery

This letter will confirm our phone conversation concerning the above subject. BP Amoco requests your approval to use approximately 30 cubic yards of composted material from our Crouch Mesa Central Site to use for growth testing at Evergreen Nursery. Vital Concepts will be performing this test.

The contaminated soils will be taken to land owned by Dan Alden, Evergreen Nursery. Dan will sign a release for the soil acknowledging its origin. His land is located near the Flora Vista bridge. Dan would receive the soil and we would sample and analyze it for TPH and the eight metals. A sample will be tested on an HPLC at the University of Colorado Medical School to compare the treated soil hydrocarbon and protein with the as received soil by means of graph variances. This comparison would be made after a 30 day test period. The treated soil will be utilized as part of a potting mix to demonstrate plant growth. Results would be the basis for continuing the conversion of all the current contaminated material. Post appraisal of this project would determine future activity.

Thank you for your consideration!

Buddy

Buddy Shaw
Environmental Coordinator
(505) 326-9219

Martyne Kreling

RECEIVED

DEC 18 2001

Environmental Bureau
Oil Conservation Division

December 11, 2001

Danny Foutz
Aztec Oil Conservation Division (505) 334-6178 ext 15
1000 Rio Brazos Road
Aztec, New Mexico 87410

OPTIONAL FORM 99 (7-90)

FAX TRANSMITTAL

	# of pages ▶ 1
To Danny Foutz	From D Slim
Dept./Agency Aztec OCD	Phone # (520) 729-7326
Fax # (505) 334-6178	Fax # (520) 729-5066
NSN 7540-01-317-7368 5099-101	GENERAL SERVICES ADMINISTRATION

Mary Debouise
Grazing Manager (505) 827-5731
310 old Santa Fe trail
Santa Fe, New Mexico 87504

J.C. Well Service & R.J. Enterprises
John Cunningham (505) 327-9931
P.O. Box 51
Farmington, New Mexico 87499

Navajo Nation Dept. of Agriculture
Fritz Roanhorse (928) 871-6606
P.O. Box 4889
Window Rock, Arizona 86515

Dear Sirs/Madam:

This letter will serve as an official request from the lessees of the Navajo Nation Tribal Ranch Programs, Dean Leo Slim and Delbert Leo Slim, of Range Land located in Township 20 North, Range 12 West, Section 16, McKinley County, New Mexico.

This request includes the proposal of an earthen dam to be left intact by J.C. Well Service & R.J. Enterprises. We propose that upon the completion of the reclamation process and granted of clearance of the initial area that the physical structure to remain in place. This large water pond is vital to the ecology of the land and will serve to adequately sustain livestock in its present and future state.

Your cooperation in this matter would be greatly appreciated. If you have any questions regarding this matter please contact me at (520) 729-7326.

Sincerely,

Dean Slim & Delbert Slim, Grazing Land Lessee
IK3 Westbrook
P.O. Box 736
Fort Defiance, Arizona 86504
(520) 729-2334 - Home
(520) 729-7326 - Work

Certified Receipt #

November 1, 2001

Buddy Shaw Amoco Production Company
BP Amoco Group
200 Energy Court
Farmington, NM 87401

RE: Vital Concepts /Evergreen Nursery Beneficial Use of Remediated Soil

Dear Mr. Shaw:

I am in receipt of a letter from Vital Concepts dated September 21, 2001 proposing to use remediated soil from Amoco Production's (Amoco) Crouch Mesa Facility, permitted under New Mexico Oil Conservation Division (OCD) Rule 711, for horticultural purposes. You have concurred with this proposal in a letter dated October 22, 2001. The OCD has reviewed the proposal in the two letters.

The OCD approves a test period until May 1, 2002 with the following requirements. The total amount of remediated soil utilized in the project is not to exceed 120 cubic yards. The address for the soil processing test site must be filed with OCD. Evergreen Nursery will acknowledge on the bill of lading that the soils from each load are from the Amoco Crouch Mesa Facility for treating oil field contaminated soils. A copy of each bill of lading will be available at the preparation site and a copy of each bill of lading will be filed with EPC Company, Managing Consultants for the Amoco Crouch Mesa Facility. The processing area will be bermed to prevent run off. Each 40 cubic yard remediated soil batch will be tested for TPH and total metals by composite sampling from no less than five points before processing begins. These test results are to be available for inspection at the processing site. The potting mix will be used only on plants not for human consumption. The processing site will be open to inspection by OCD personnel during normal working hours. Discovery of any materials in excess of hazardous waste standards by Vital Concepts/Evergreen Nursery shall be cause for immediate verbal notification to the OCD Aztec office and the Amoco Farmington office.

If you have questions please feel free to call me at 505-334-6178 ext 15.

XC: Jerry Finney, Vital Concepts, Bloomfield
Dan Alden, Evergreen Nursery, Aztec
Louis Froelick, EPC, Bloomfield
DGF File
Environmental File
EC: Martyne Kieling, OCD, Santa Fe
Roger Anderson, OCD, Santa Fe

VITAL CONCEPTS
PO Box 2329
Farmington, NM 87401

OCT 2001
RECEIVED
OIL CON. DIV
DIST. 3

September 21,2001

Mr. Denny Foust
NMOCD
Aztec, NM

Dear Denny:

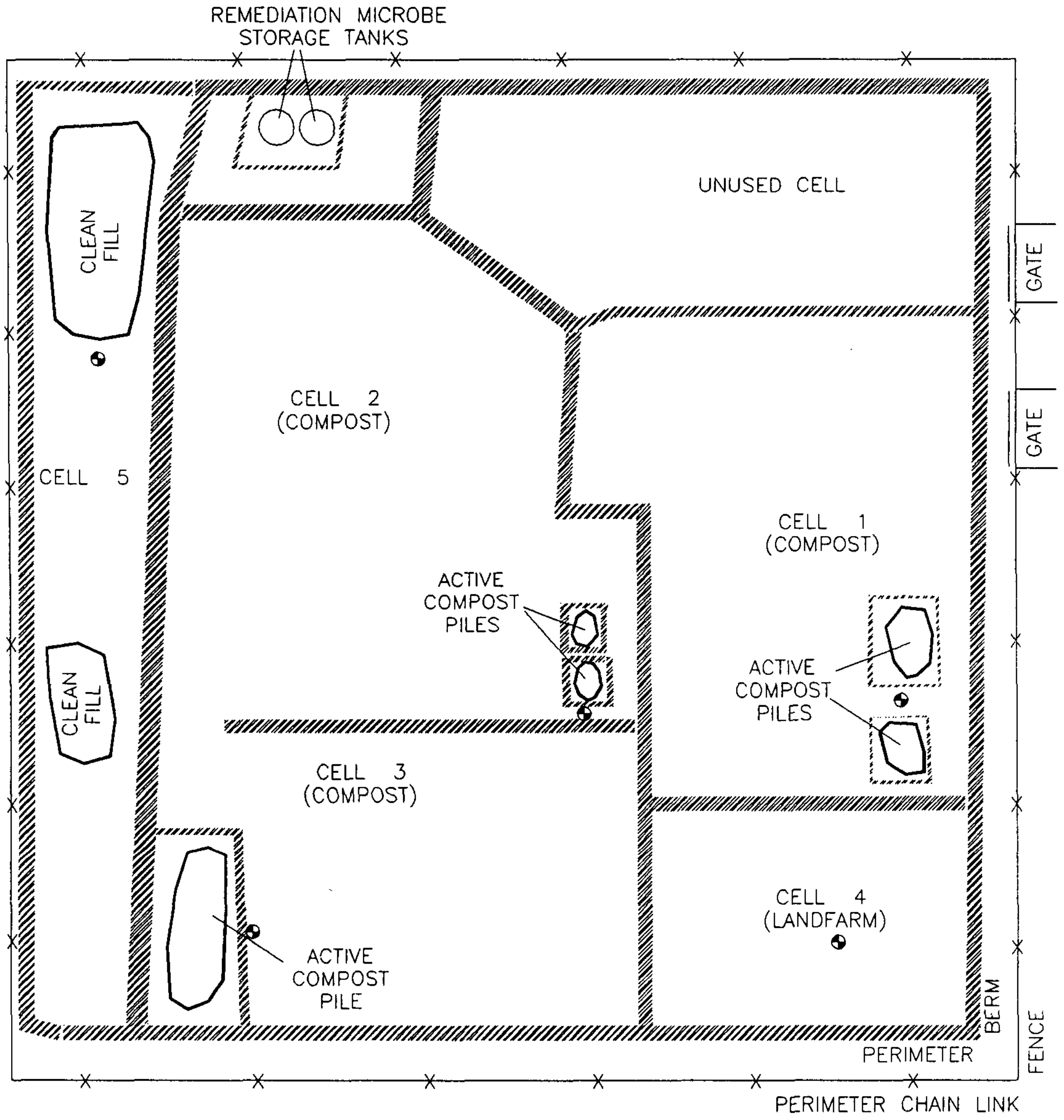
Vital concepts is proposing a small demonstration to prove remediation for beneficial reuse of oil contaminated soil. We are requesting your permission for our relocation of 25 to 30 cubic yards of the most contaminated topsoil from British Petroleum's EPC Couch Mesa site for our demonstration. We believe the soil will be of high horticultural value, after the hydrocarbon contaminants are converted to amino acids and proteins resulting from our treatment.

We plan to take the soils to land owned by Dan Alden, Evergreen Nursery. Dan will sign a release for the soil acknowledging its origin. The land is at CR near the Flora Vista Bridge. Dan would receive the soil and we would sample and analyze the soil for TPH and metals. The TPH tests will consist of 8015 Modified the graphs will be kept. Also a sample run on an HPLC will be done by University of Colorado Medical School to compare the treated soil hydrocarbon and protein results with the as-received hydrocarbons by means of graph variances. This comparison would be made after a 30-day test period. The treated soil would be utilized as part of a potting mix to demonstrate plant growth. This would be the basis for continuing the conversion of all of the current contaminated materials and future contaminated soils for BP and similar oil and gas companies.

We would hope to receive your approval and initiate this action in early to mid-October. Please call me with questions, or discussion as soon as you can; my number is 505 632-1558. In any event I will give you a call within the week to check on the progress of this request.

Sincerely yours
Vital Concepts

John Lacey for
Jerry Finney



LEGEND

N

—x——x— 6' TALL CHAIN LINK FENCE

▨ SOIL BERM

⊕ SAMPLE POINT 4/24/00

0 200 400 FEET

AMOCO PRODUCTION CO.
CROUCH MESA WASTE MGMT FAC
SW/4 SE/4 SEC 2 T29N R12W
SAN JUAN CO., NEW MEXICO

APRIL 2000

BLAGG ENGINEERING, INC.
CONSULTING ENGINEERING SERVICES

P.O. BOX 87
BLOOMFIELD, NEW MEXICO 87413

PHONE: (505) 632-1199

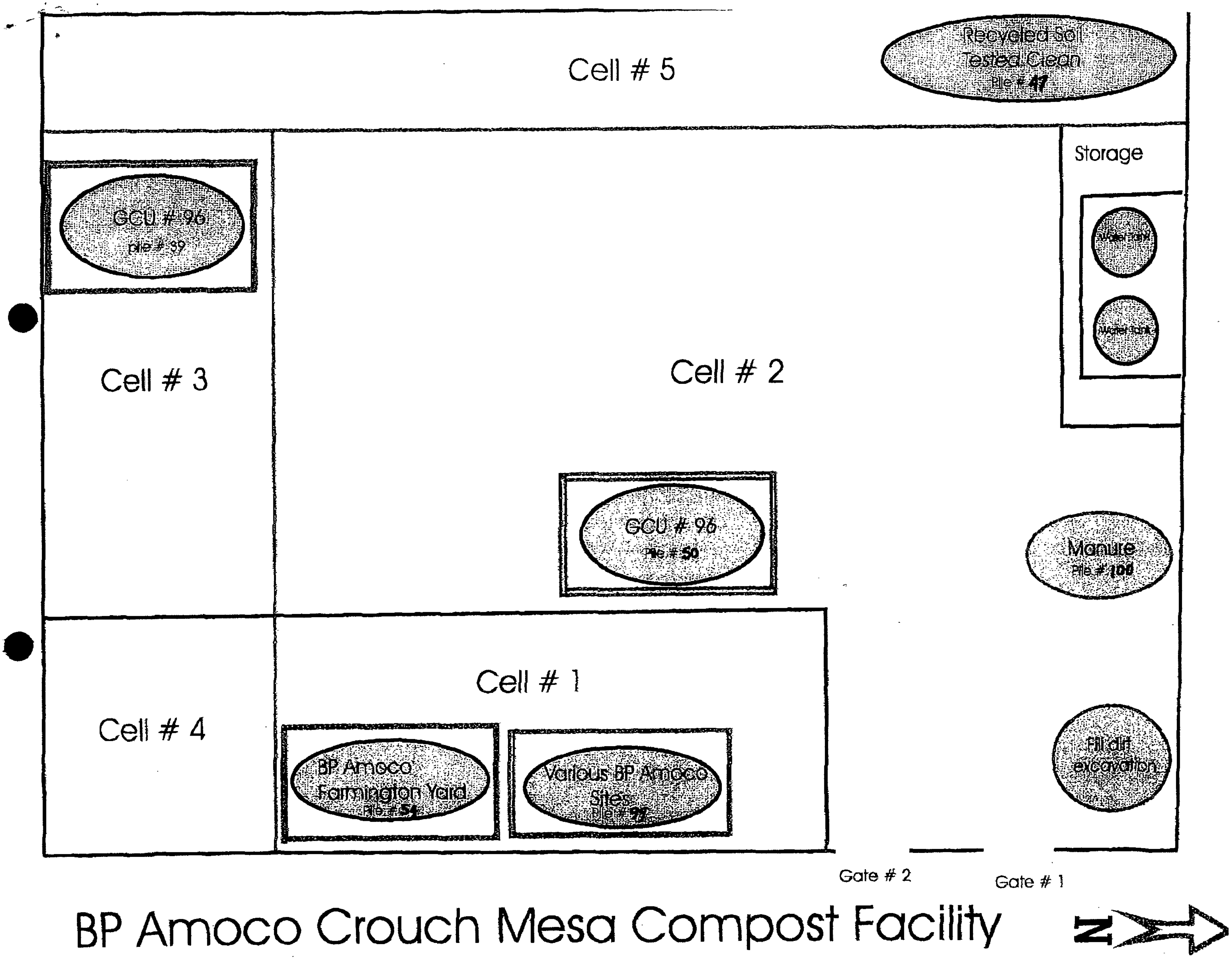
SITE SCHEMATIC

FIGURE 1	DRWN BY: JCB
CRMESA2	PROJ MGR: JCB

BP Amoco Crouch Mesa Compost Facility

10-Apr-00

Cell Number	Pile Number	Origin
1	99	Silt in Blow Back Tanks, Various Drilling BP Amoco Sites
1	54	BP Amoco Farmington Yard
2	50	Gallegos Canyon Unit # 96
3	39	Gallegos Canyon Unit # 96
2	100	Manure stockpile
5	47	Recycled Soil, Tested Clean
4	Empty	Cell 4 is currently empty



BP Amoco Crouch Mesa Compost Facility

AMOCO PRODUCTION COMPANY / CROUCH MESA COMPOST SITE

Date	load #	Point of origin	Material	Yards	Trucking company	Truck #	Pile #	Cell #	Checked in by
2-1-2000	1	Gallegos Canyon #96 Amoco MI		13	Paul & Sons.	V.13	50	2	
" "	2	Gallegos Canyon #96		13	" "	" "	50	2	" "
" "	3			13	" "	" "	50	2	" "
" "	4			12	" "	" "	50	2	" "
" "	5			13	" "	" "	50	2	" "
2-3-00	1			12	" "	V13	50	2	
	2			13	" "	"	50	2	
	3			13	" "	"	50	2	
	4			13	" "	U13	50	2	
	5			13	" "	V 13	50	2	
	6			13	" "	V15	50	2	
	7			13	" "	U 13	50	2	
	8			13	" "	U 13	50	2	
2-4-00	1			13	" "	U 13	50	2	S.A.
	2			13	"	#4	50	2	S.A.
	1			15	"	U 13	50	2	S.A.
	1			13	"	V 4	50	2	S.A.
	1			13	"	13	50	2	"
	1			13	"	4	50	2	"
	"			13	"	15	50	2	"
2-4-00	1	GAllegos Canyon		13	"	4	50	2	" C.M.
	2	#96		13	paul & Sons	13	50	2	C.M.
	3			13	paul & Sons	V4	50	2	C.M.
	4			13	paul & Sons	13	50	2	C.M.
	5			13	paul & Son's	4	50	2	C.M.
	6			13	paul & Sons	13	50	2	C.M.
	7			13	paul & Sons	4	50	2	C.M.
2-7-00	1	Gallegos Canyon #96		13	Paul & Sons.	4 T	50	2	LWF
	2			13		U13T	50	2	LWF
	3			20		A-7 BD	39	3	LWF
	4			13		4 T	50	2	LWF
	5			13		U-13T	50	2	LWF
	6			20		A-7 BD	39	3	LWF
	7			13		4	50	2	LWF
	8			13		U-13	50	2	LWF

450

AMOCO PRODUCTION COMPANY / CROUCH MESA COMPOST SITE

Date	load #	Point of origin	Material	Yards	Trucking company	Truck #	Pile #	Cell #	Checked in by
2-7-00	9	Gallegos Canyon #96		20	Poul & Sons.	A-7	39	3	
	10			13		U-13	50	2	
	11			20		A-7	39	3	
	12			13		U-13	50	2	
	13			20		A-7	39	3	
	14			13		U-13	50	2	
	15			13		U-13	50	2	
	16			20		A-7	39	3	
	17			13		U-13	50	2	
	18			20		A-7	39	3	
2-8-00		Gollegos Canyon #96			Poul & Sons				C.M
	1			20		A7	39	3	cm
	1			13		U13	50	2	cm
	2			20		A7	50	2	cm
	3			20		A7	39	3	cm
	2			13		U 13	50	2	cm
	4			20		A7	39	3	cm
	3			13		U13	50	2	cm
	5			20		A7	39	3	cm
	4			13		U13	50	2	cm
	6			20		A7	39	3	cm
	5			13		U 13	50	2	cm
	6			13		U 13	50	2	cm
	7			20		A7	39	3	cm
	8			13		U13	50	2	cm
	8			20		A7	39	3	cm
2-9-00	1	Gallegos Canyon #96		13	PAul & Sons	U 13	50	2	cm
2-9-00	1			13		U 4	50	2	C.m.
	1			20		A7	39	3	cm
	2			13		U 13	50	2	cm
	2			13		U 4	50	2	cm
	2			20		A 7	39	3	cm
	3			13		U 13	50	2	cm
	3			13		U 4	50	2	CM.
	3			20		A 7	39	3.	cm

AMOCO PRODUCTION COMPANY / CROUCH MESA COMPOST SITE

Date	load #	Point of origin	Material	Yards	Trucking company	Truck #	Pile #	Cell #	Checked in by
2-9-00	4	Gallegos canyon #96		13	paul & Sons	U13	50	2	Chris
	4			13		U4	50	2	Cm
	4			20		A7	39	3	Cm
	5			13		U4	50	2	
	5			20		A7	39	3	
	5			13		U13	50	2	
	6			13		U4	50	2	
	6			20		A7	39	3	
	6			13		U13	50	2	
	7			20		A7	39	3	
	7			13		U4	50	2	
	7			13		U13	50	2	
	8			20		A7	39	3	
	9			13		U4	50	2	
2-10-00	1	Gallegos canyon #96		13	paul & Sons	U13	50	2	Cm
	1			20		A7	39	3	
	2			13		U13	50	2	
	2			20		A7	39	3	
	3			13		U13	50	2	
	1			13		U4	50	2	
	3			20		A7	39	3	
	2			13		U4	50	2	
	4			13		U13	50	2	
	4			20		A7	39	3	
	3			13		U4	50	2	
	5			13		U13	50	2	
	5			20		A7	39	3	
	4			13		U4	50	2	
	5			13		U4	50	2	
	6			20		A7	39	3	
	6			13		U13	50	2	
	7			20		A7	39	3	C.m.
2-11-00	1	Gallegos canyon #96		13	PAul & Sons	V13	50	2	Clyde
	1			13		V4	50	2	Clyde
	1			20		A7	39	3	Clyde

(4)

AMOCO PRODUCTION COMPANY / CROUCH MESA COMPOST SITE

Date	load #	Point of origin	Material	Yards	Trucking company	Truck #	Pile #	Cell #	Checked in by
2/11/00	2	Gallegos Canyon #96		13	Paul + Sons	V 13	50	2	Clyde
	2			13		V 4	50	2	Clyde
	2			20		A 7	39	3	Clyde
	3			13		V 13	50	2	Clyde
	3			20		A7	39	3	Cm
	3			13		V4	50	2	Cm
	4			13		V 13	50	2	
	4			20		A7	39	3	
	4			13		V 4	50	2	
	5			13		V 13	50	2	
	5			13		V 4	50	2	
	6			13		V 13	50	2	Cm
2-14-00	1	Gallegos Canyon #96		13	Paul & Sons.	V 4	50	2	
	1			13	P	V13	50	2	
	2			13		V4	50	2	
	2			13		V13	50	2	
	3			13		V4	50	2	
	3			13		V13	50	2	
2-14-00	4	Gallegos Canyon #96		13	Paul & Sons	V 4	50	2	Cm
	4			13		V 13	50	2	
	1			20		A7	39	3	
	5			13		V4	50	2	
	5			13		V 13	50	2	
	1			13		V 5	39	3	
	2			20		A7	39	3	
	6			13		V 13	39	3	
	2			13		V 5	39	3	
	3			20		A7	39	3	
	6			13		V 4	39	3	
2/15/00	1	Gallegos Canyon #96		13	Paul + Sons	V 13	39	3	Clyde
	1			13		V 5	39	3	Clyde
	1			20		A 7	39	3	Clyde
	2			V13		V 13	39	3	Cm
	2			13		V 5	39	3	Cm
	[illegible]			[illegible]		A 7	39	[illegible]	[illegible]

AMOCO PRODUCTION COMPANY / CROUCH MESA COMPOST SITE

Date	load #	Point of origin	Material	Yards	Trucking company	Truck #	Pile #	Cell #	Checked in by
2-16-98	1	B P Amoco Farmington yd	Oily Rags	1	E. P. C.	N/A	54	1	S. A.
4-5-98	1			1	E. P. C.		54	1	T. E.
5-30-98	1			1	E. P. C.		54	1	M. G.
6-21-98	1			1	E. P. C.		54	1	S. A.
7-9-98	1			1	E. P. C.		54	1	S. A.
8-11-98	1			1	E. P. C.		54	1	M. G.
10-14-98	1			1	E. P. C.		54	1	M. G.
11 4 98	1			1	E. P. C.		54	1	M. G.
12 1 98	1			1	E. P. C.		54	1	S. A
1- -99	1			1	E. P. C.		54	1	S. A.
2-6-99	1			1	E. P. C.		54	1	S. A.
3-15-99	1			1	E. P. C.		54	1	S. A.
4-29-99	1			1	E. P. C.		54	1	S. A.
5-17-99	1			1	E. P. C.		54	1	S. A
6-2-99	1	/ /		1	E. P. C.		54	1	S. A.
7 12 99	1	/ /		1	E. P. C.		54	1	C. P.
12 15-99	1	/ /		1	E. P. C.		54	1	S. A.
5-20-00	1	/ /	Oily Rags	1	E. P. C		54	1	C. M.

AMOCO PRODUCTION COMPANY / CROUCH MESA COMPOST SITE

Date	load #	Point of origin	Material	Yards	Trucking company	Truck #	Pile #	Cell #	Checked in by
4-12-2005	1	AL Elliot A-4		13	555		99	1	Cm
4-12-2005	2	JAquez GC. B1B		13	555		99	1	cm

INDUSTRIAL ECOSYSTEMS INC

DBA ENVIRONMENTAL PROTECTION CO.

AMOCO PRODUCTION CO, CROUCH MESA COMPOST FACILITY

WEEKLY BIO-PILE TEMPERTURE RECORD

DATE MATERIAL RECIEVED February 15, 2000

ORIGIN OF MATERIAL BP Amoco Gallegos Canyon Unit # 96

MATERIAL STORED IN CELL NUMBER 2 & 3 PILE NUMBER 50 & 39

WEEK #	DATE	PILE TEMP.	DATE TURNED
Week # 1	2/15/00	44	Constructed
Week # 2	2/22/00	46	
Week # 3	2/28/00	50	
Week # 4	3/6/00	53	
Week # 5	3/13/00	60	
Week # 6	3/21/00	60	
Week # 7	3/29/00	59	
Week # 8	4/4/00	65	
Week # 9	4/11/00	67	Turned & Treated
Week 10	4/17/00	76	
Week 11	4/25/00	91	
Week 12	5/2/00	123	
Week 13	5/10/00	93	
Week 14	5/15/00	77	

WEEK #	DATE	PILE TEMP.	DATE TURNED

TESTED CLEAN AND STOCKPILED FOR CLEAN FILL ON ____________

INDUSTRIAL ECOSYSTEMS INC
DBA ENVIRONMENTAL PROTECTION CO.

AMOCO PRODUCTION CO, CROUCH MESA COMPOST FACILITY

WEEKLY BIO-PILE TEMPERTURE RECORD

DATE MATERIAL RECIEVED April 12, 2000

ORIGIN OF MATERIAL Various BP Amoco Sites

MATERIAL STORED IN CELL NUMBER 1 PILE NUMBER 99

WEEK #	DATE	PILE TEMP.	DATE TURNED
Week # 1	4/12/00	64	Constructed
Week # 2	4/18/00	71	
Week # 3	4/24/00	74	
Week # 4	5/2/00	79	
Week # 5	5/10/00	88	
Week # 6	5/15/00	85	

WEEK #	DATE	PILE TEMP.	DATE TURNED

TESTED CLEAN AND STOCKPILED FOR CLEAN FILL ON ____________

INDUSTRIAL ECOSYSTEMS INC
DBA ENVIRONMENTAL PROTECTION CO.

AMOCO PRODUCTION CO, CROUCH MESA COMPOST FACILITY

WEEKLY BIO-PILE TEMPERTURE RECORD

DATE MATERIAL RECIEVED March 20, 2000

ORIGIN OF MATERIAL BP Amoco Farmington Yard

MATERIAL STORED IN CELL NUMBER 1 PILE NUMBER 54

WEEK #	DATE	PILE TEMP.	DATE TURNED
Week 1	3/20/00	39	Constructed
Week 2	3/29/00	44	
Week 3	4/4/00	55	
Week 4	4/11/00	60	
Week 5	4/17/00	64	
Week 6	4/24/00	69	
Week 7	5/2/00	68	
Week 8	5/10/00	76	
Week 9	5/15/00	77	

WEEK #	DATE	PILE TEMP.	DATE TURNED

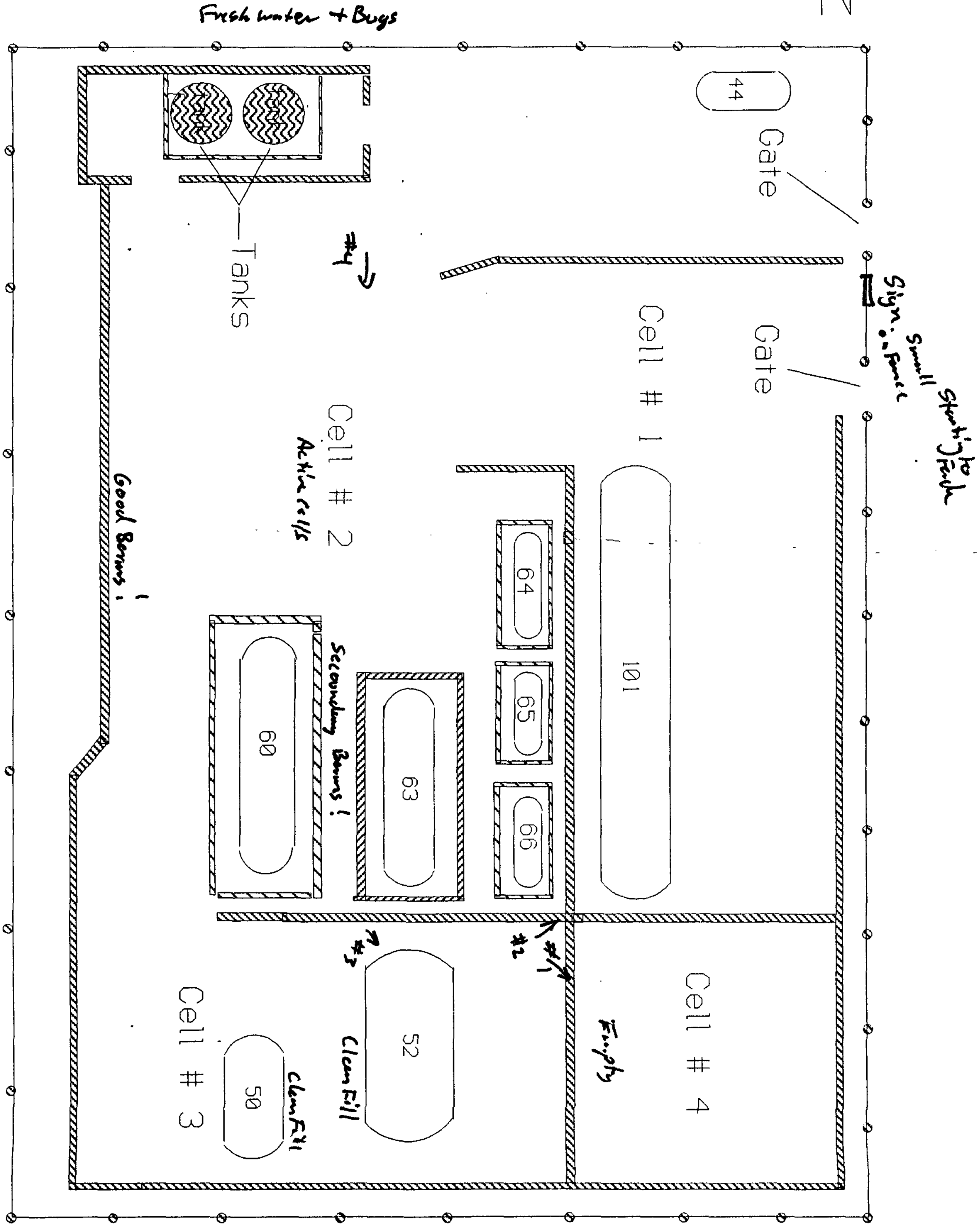
TESTED CLEAN AND STOCKPILED FOR CLEAN FILL ON

AMOCO CROUCH MESA SITE
APRIL 20, 1998

CELL NUMBER	PILE NUMBER	ORIGIN
1	101	CLEAN FILL (ROCK)
2	44	CLEAN (SANDSTONE)
2	60	WHITE GAS COM # 1
2	64	BARNES LS 8 A
2	65	EATON GAS COM B # 1
2	66	AMOCO YARD (DRUMS)
2	63	CORNELL B # 1
3	50	CLEAN FILL (ROCK)
3	52	CLEAN FILL (DIRT)

CELL # 4 IS CURRENTLY EMPTY

AMOCO CROUCH MESA SITE



JC BLAGG@compuserve.com

BLAGG ENGINEERING, INC.
P.O. Box 87, Bloomfield, New Mexico 87413
Phone: (505)632-1199 Fax: (505)632-3903

RECEIVED
JUN 28 2001
CONSERVATION DIV

June 26, 2001

Mr. Rodger Anderson
New Mexico Oil Conservation Division
1220 St. Francis Drive
Santa Fe, New Mexico 87504

Re: BP-Amoco Request for Approval to Remediate Drum Contents
M & R Trucking (Vastar Resources) Storage Yard, Farmington, NM

Dear Mr. Anderson:

On behalf of BP-Amoco, Blagg Engineering, Inc. (BEI) seeks NMOCD approval to remediate the contents of approximately 236 gallons of treatment fluids acquired by BP-Amoco following the recent merger with Vastar Resources. These fluids are contained in 32 drums stored at the M & R Trucking Storage Yard in Farmington, New Mexico. Most of the drums contain minor residual amounts of fluid (see Table 1, below) that were used for oilfield treatment applications. The drums were stored by Vastar at the M & R Trucking Yard for a number of years and labels are no longer legible. BP-Amoco requests approval to stabilize the fluids with soil and then transport the solid material to the NMOCD permitted Crouch Mesa Landfarm facility for remediation. Empty drums will be cleaned and either re-used or disposed at a permitted solid waste disposal landfill.

BEI inspected the drums between May 29 - June 4, 2001. A calibrated organic vapor meter photo-ionization detector (PID) was used to test the headspace in each drum. No drum tested a PID reading in excess of 1.3 parts per million, indicating an absence of volatile organics. BEI made a qualitative identification based on sample characteristics such as color, consistency, odor and viscosity. Drum contents with similar characteristics were cataloged, sampled and submitted to Envirotech, Inc. laboratories in Farmington, New Mexico for hazardous waste identification (ignitability, corrosivity and reactivity) and 8 RCRA metals analysis (arsenic, barium, cadmium, chromium, lead, mercury, cadmium and chromium). All of the drum samples passed the testing and were therefore not identified as hazardous. Field visual and odor qualities did not indicate any hazardous materials contents such as volatility or hydrogen sulfide. The results of the field and labortory testing are presented in Table 1 on the following page.

Table 1

BP-Amoco/Vastar Resources
M & R Trucking Storage Yard
Drum Sampling Identification Results

Drum ID	Drum Size & Type	Fill Volume	Comments
1	55 gallon steel	Full	Pure, clear viscous fluid. PID=0.0. Passed RCRA testing.
2	55 gallon steel	Full	Identical to #1. PID=0.0
3	55 gallon steel	4" (6+/- gallons)	Yellow, viscous fluid. PID=0.6. Passed RCRA testing.
4	55 gallon steel	1/4"	de minimus volume, identical to #3. PID=0.0
5	55 gallon steel	1/4"	de minimus volume, identical to #3. PID=0.0
6	55 gallon steel	2" (3 +/- gallons)	Brown, viscous fluid. PID=0.0. Passed RCRA testing.
7	55 gallon steel	5" (8 +/- gallons)	Foamy, lite brown non-viscous fluid. PID=0.0. Passed RCRA testing.
8	55 gallon steel	4" (6+/- gallons)	Identical to #7. PID=0.0
9	55 gallon steel	4" (6+/- gallons)	Identical to #7. PID=0.0
10	55 gallon steel	5" (8+/- gallons)	Identical to #7. PID=0.0
11	55 gallon steel	1/4"	de minimus volume, identical to #3. PID=0.0
12	55 gallon steel	2" (3 +/- gallons)	Identical to #7. PID=0.0
13	55 gallon steel	3" (5 +/- gallons)	Identical to #7. PID=0.0
14	55 gallon steel	2" (3 +/- gallons)	Identical to #7. PID=0.0
15	55 gallon steel	2" (3 +/- gallons)	Foamy, dark brown non-viscous fluid. PID=0.0. Passed RCRA testing.
16	55 gallon steel	3" (5 +/- gallons)	Foamy, red brown non-viscous fluid. PID=0.0. Passed RCRA testing.
17	55 gallon steel	6" (10 +/- gallons)	Identical to #7. PID=0.0
18	55 gallon steel	3" (5 +/- gallons)	Identical to #7. PID=0.0
19	55 gallon steel	5" (8+/- gallons)	Identical to #7. PID=0.0
20	55 gallon steel	2" (3 +/- gallons)	Identical to #7. PID=0.0
21	55 gallon steel	1/4"	de minimus volume, identical to #3. PID=0.0
22	55 gallon steel	2" (3 +/- gallons)	Clear/yellow very viscous fluid. PID=0.0. Passed RCRA testing.
23	55 gallon steel	1/4"	de minimus volume, identical to #22. PID=0.0

24	55 gallon steel	2" (3 +/- gallons)	Identical to #22. PID=0.0
25	55 gallon steel	6" (10 +/- gallons)	Identical to #7. PID=0.0
26	55 gallon steel	3" (5 +/- gallons)	Identical to #22. PID=0.0
27	55 gallon steel	5" (8+/- gallons)	Identical to #7. PID=0.0
28	55 gallon steel	2" (3 +/- gallons)	Identical to #7. PID=0.0
29	55 gallon steel	2" (3 +/- gallons)	Foamy, viscous yellow fluid. PID=1.3. Passed RCRA testing
30	55 gallon steel	1" (2 +/- gallons)	Identical to #22. PID=0.0
31	55 gallon steel	3" (5 +/- gallons)	Identical to #7. PID=0.0
32	55 gallon steel	1" (2 +/- gallons)	Identical to #7. PID=0.0

Based on the drum sampling and testing BEI does not believe that remediation of the drum contents at the Crouch Mesa landfarm will present any conflicts with the facility permit.

Questions or comments concerning this transmittal may be directed to myself at (505)632-1199 or to Buddy Shaw at BP-Amoco at (505)632-9219.

Respectfully submitted:
Blagg Engineering, Inc.

Jeffrey C. Blagg

Jeffrey C. Blagg, P.E.
President

Attachment: Lab Reports

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

SUSPECTED HAZARDOUS WASTE ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #1	Date Reported:	05-31-01
Lab ID#:	19922	Date Sampled:	05-29-01
Sample Matrix:	Liquid	Date Received:	05-29-01
Preservative:	Cool	Date Analyzed:	05-30-01
Condition:	Cool and Intact	Chain of Custody:	8675

Parameter	**Result**	
IGNITABILITY:	**Negative**	
CORROSIVITY:	**Negative**	**pH = 6.68**
REACTIVITY:	**Negative**	

RCRA Hazardous Waste Criteria

Parameter	Hazardous Waste Criterion
IGNITABILITY:	Characteristic of Ignitability as defined by 40 CFR, Subpart C, Sec. 261.21. *(i.e. Sample ignition upon direct contact with flame or flash point < 60° C.)*
CORROSIVITY:	Characteristic of Corrosivity as defined by 40 CFR, Subpart C, Sec. 261.22. *(i.e. pH less than or equal to 2.0 or pH greater than or equal to 12.5)*
REACTIVITY:	Characteristic of Reactivity as defined by 40 CFR, Subpart C, Sec. 261.23. *(i.e. Violent reaction with water, strong base, strong acid, or the generation of Sulfide or Cyanide gases at STP with pH between 2.0 and 12.5)*

Reference: 40 CFR part 261 Subpart C sections 261.21 - 261.23, July 1, 1992.

Comments: **M & R Trucking: Drums.**

Christine M Walters
Analyst

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

SUSPECTED HAZARDOUS WASTE ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #3	Date Reported:	05-31-01
Lab ID#:	19923	Date Sampled:	05-29-01
Sample Matrix:	Liquid	Date Received:	05-29-01
Preservative:	Cool	Date Analyzed:	05-30-01
Condition:	Cool and Intact	Chain of Custody:	8675

Parameter	Result	
IGNITABILITY:	**Negative**	
CORROSIVITY:	**Negative**	**pH = 4.85**
REACTIVITY:	**Negative**	

RCRA Hazardous Waste Criteria

Parameter	Hazardous Waste Criterion
IGNITABILITY:	Characteristic of Ignitability as defined by 40 CFR, Subpart C, Sec. 261.21. *(i.e. Sample ignition upon direct contact with flame or flash point < 60° C.)*
CORROSIVITY:	Characteristic of Corrosivity as defined by 40 CFR, Subpart C, Sec. 261.22. *(i.e. pH less than or equal to 2.0 or pH greater than or equal to 12.5)*
REACTIVITY:	Characteristic of Reactivity as defined by 40 CFR, Subpart C, Sec. 261.23. *(i.e. Violent reaction with water, strong base, strong acid, or the generation of Sulfide or Cyanide gases at STP with pH between 2.0 and 12.5)*

Reference: 40 CFR part 261 Subpart C sections 261.21 - 261.23, July 1, 1992.

Comments: **M & R Trucking: Drums.**

Christine M Walters
Analyst

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

SUSPECTED HAZARDOUS WASTE ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #6	Date Reported:	05-31-01
Lab ID#:	19924	Date Sampled:	05-29-01
Sample Matrix:	Liquid	Date Received:	05-29-01
Preservative:	Cool	Date Analyzed:	05-30-01
Condition:	Cool and Intact	Chain of Custody:	8675

Parameter	Result	
IGNITABILITY:	**Negative**	
CORROSIVITY:	**Negative**	**pH = 5.00**
REACTIVITY:	**Negative**	

RCRA Hazardous Waste Criteria

Parameter	Hazardous Waste Criterion
IGNITABILITY:	Characteristic of Ignitability as defined by 40 CFR, Subpart C, Sec. 261.21. *(i.e. Sample ignition upon direct contact with flame or flash point < 60° C.)*
CORROSIVITY:	Characteristic of Corrosivity as defined by 40 CFR, Subpart C, Sec. 261.22. *(i.e. pH less than or equal to 2.0 or pH greater than or equal to 12.5)*
REACTIVITY:	Characteristic of Reactivity as defined by 40 CFR, Subpart C, Sec. 261.23. *(i.e. Violent reaction with water, strong base, strong acid, or the generation of Sulfide or Cyanide gases at STP with pH between 2.0 and 12.5)*

Reference: 40 CFR part 261 Subpart C sections 261.21 - 261.23, July 1, 1992.

Comments: **M & R Trucking: Drums.**

Christina M Walters
Analyst

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

SUSPECTED HAZARDOUS WASTE ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #7	Date Reported:	05-31-01
Lab ID#:	19925	Date Sampled:	05-29-01
Sample Matrix:	Liquid	Date Received:	05-29-01
Preservative:	Cool	Date Analyzed:	05-30-01
Condition:	Cool and Intact	Chain of Custody:	8675

Parameter	Result	
IGNITABILITY:	**Negative**	
CORROSIVITY:	**Negative**	**pH = 7.51**
REACTIVITY:	**Negative**	

RCRA Hazardous Waste Criteria

Parameter	Hazardous Waste Criterion
IGNITABILITY:	Characteristic of Ignitability as defined by 40 CFR, Subpart C, Sec. 261.21. *(i.e. Sample ignition upon direct contact with flame or flash point < 60° C.)*
CORROSIVITY:	Characteristic of Corrosivity as defined by 40 CFR, Subpart C, Sec. 261.22. *(i.e. pH less than or equal to 2.0 or pH greater than or equal to 12.5)*
REACTIVITY:	Characteristic of Reactivity as defined by 40 CFR, Subpart C, Sec. 261.23. *(i.e. Violent reaction with water, strong base, strong acid, or the generation of Sulfide or Cyanide gases at STP with pH between 2.0 and 12.5)*

Reference: 40 CFR part 261 Subpart C sections 261.21 - 261.23, July 1, 1992.

Comments: **M & R Trucking: Drums.**

Christine M Walters
Analyst

Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

SUSPECTED HAZARDOUS WASTE ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #15	Date Reported:	05-31-01
Lab ID#:	19926	Date Sampled:	05-29-01
Sample Matrix:	Liquid	Date Received:	05-29-01
Preservative:	Cool	Date Analyzed:	05-30-01
Condition:	Cool and Intact	Chain of Custody:	8675

Parameter	Result	
IGNITABILITY:	**Negative**	
CORROSIVITY:	**Negative**	**pH = 5.12**
REACTIVITY:	**Negative**	

RCRA Hazardous Waste Criteria

Parameter	Hazardous Waste Criterion
IGNITABILITY:	Characteristic of Ignitability as defined by 40 CFR, Subpart C, Sec. 261.21. *(i.e. Sample ignition upon direct contact with flame or flash point < 60° C.)*
CORROSIVITY:	Characteristic of Corrosivity as defined by 40 CFR, Subpart C, Sec. 261.22. *(i.e. pH less than or equal to 2.0 or pH greater than or equal to 12.5)*
REACTIVITY:	Characteristic of Reactivity as defined by 40 CFR, Subpart C, Sec. 261.23. *(i.e. Violent reaction with water, strong base, strong acid, or the generation of Sulfide or Cyanide gases at STP with pH between 2.0 and 12.5)*

Reference: 40 CFR part 261 Subpart C sections 261.21 - 261.23, July 1, 1992.

Comments: **M & R Trucking: Drums.**

Christine m Walters
Analyst

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

SUSPECTED HAZARDOUS WASTE ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #16	Date Reported:	05-31-01
Lab ID#:	19927	Date Sampled:	05-29-01
Sample Matrix:	Liquid	Date Received:	05-29-01
Preservative:	Cool	Date Analyzed:	05-30-01
Condition:	Cool and Intact	Chain of Custody:	8675

Parameter	Result	
IGNITABILITY:	**Negative**	
CORROSIVITY:	**Negative**	**pH = 4.68**
REACTIVITY:	**Negative**	

RCRA Hazardous Waste Criteria

Parameter	Hazardous Waste Criterion
IGNITABILITY:	Characteristic of Ignitability as defined by 40 CFR, Subpart C, Sec. 261.21. *(i.e. Sample ignition upon direct contact with flame or flash point < 60° C.)*
CORROSIVITY:	Characteristic of Corrosivity as defined by 40 CFR, Subpart C, Sec. 261.22. *(i.e. pH less than or equal to 2.0 or pH greater than or equal to 12.5)*
REACTIVITY:	Characteristic of Reactivity as defined by 40 CFR, Subpart C, Sec. 261.23. *(i.e. Violent reaction with water, strong base, strong acid, or the generation of Sulfide or Cyanide gases at STP with pH between 2.0 and 12.5)*

Reference: 40 CFR part 261 Subpart C sections 261.21 - 261.23, July 1, 1992.

Comments: **M & R Trucking: Drums.**

Christine m Walters
Analyst

Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

SUSPECTED HAZARDOUS WASTE ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #22	Date Reported:	05-31-01
Lab ID#:	19928	Date Sampled:	05-29-01
Sample Matrix:	Liquid	Date Received:	05-29-01
Preservative:	Cool	Date Analyzed:	05-30-01
Condition:	Cool and Intact	Chain of Custody:	8675

Parameter	**Result**	
IGNITABILITY:	**Negative**	
CORROSIVITY:	**Negative**	**pH = 7.38**
REACTIVITY:	**Negative**	

RCRA Hazardous Waste Criteria

Parameter	Hazardous Waste Criterion
IGNITABILITY:	Characteristic of Ignitability as defined by 40 CFR, Subpart C, Sec. 261.21. *(i.e. Sample ignition upon direct contact with flame or flash point < 60° C.)*
CORROSIVITY:	Characteristic of Corrosivity as defined by 40 CFR, Subpart C, Sec. 261.22. *(i.e. pH less than or equal to 2.0 or pH greater than or equal to 12.5)*
REACTIVITY:	Characteristic of Reactivity as defined by 40 CFR, Subpart C, Sec. 261.23. *(i.e. Violent reaction with water, strong base, strong acid, or the generation of Sulfide or Cyanide gases at STP with pH between 2.0 and 12.5)*

Reference: 40 CFR part 261 Subpart C sections 261.21 - 261.23, July 1, 1992.

Comments: **M & R Trucking: Drums.**

Christine M Walters
Analyst

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

SUSPECTED HAZARDOUS WASTE ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #29	Date Reported:	05-31-01
Lab ID#:	19929	Date Sampled:	05-29-01
Sample Matrix:	Liquid	Date Received:	05-29-01
Preservative:	Cool	Date Analyzed:	05-30-01
Condition:	Cool and Intact	Chain of Custody:	8675

Parameter	Result	
IGNITABILITY:	**Negative**	
CORROSIVITY:	**Negative**	**pH = 6.39**
REACTIVITY:	**Negative**	

RCRA Hazardous Waste Criteria

Parameter	Hazardous Waste Criterion
IGNITABILITY:	Characteristic of Ignitability as defined by 40 CFR, Subpart C, Sec. 261.21. *(i.e. Sample ignition upon direct contact with flame or flash point < 60° C.)*
CORROSIVITY:	Characteristic of Corrosivity as defined by 40 CFR, Subpart C, Sec. 261.22. *(i.e. pH less than or equal to 2.0 or pH greater than or equal to 12.5)*
REACTIVITY:	Characteristic of Reactivity as defined by 40 CFR, Subpart C, Sec. 261.23. *(i.e. Violent reaction with water, strong base, strong acid, or the generation of Sulfide or Cyanide gases at STP with pH between 2.0 and 12.5)*

Reference: 40 CFR part 261 Subpart C sections 261.21 - 261.23, July 1, 1992.

Comments: **M & R Trucking: Drums.**

Christine M Walters
Analyst

Review

CHAIN OF CUSTODY RECORD

08675

Client / Project Name: Blagg/BP

Project Location: M+R Trucking: Drums

Sampler: J-C. Blagg

Client No.: 94034-010

ANALYSIS / PARAMETERS

Sample No./ Identification	Sample Date	Sample Time	Lab Number	Sample Matrix	No. of Containers	RCI						Remarks
Drum # 1	5/29/01	1241	19922	Liquid	1	X						
Drum # 3	"	1245	19923	"	1	X						
Drum # 6	"	1255	19924	"	1	X						
Drum # 7	"	1330	19925	"	1	X						
Drum # 15	"	1314	19926	"	1	X						
Drum # 16	"	1317	19927	"	1	X						
Drum # 22	"	1330	19928	"	1	X						
Drum # 29	"	1342	19929	"	1	X						

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
J-C. Blagg	5/29/01	1414		5/29/01	1414
Relinquished by: (Signature)			Received by: (Signature)		
Relinquished by: (Signature)			Received by: (Signature)		

ENVIROTECH INC.

5796 U.S. Highway 64
Farmington, New Mexico 87401
(505) 632-0615

Sample Receipt

	Y	N	N/A
Received Intact	✓		
Cool - Ice/Blue Ice	✓		

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #1	Date Reported:	06-07-01
Laboratory Number:	19922	Date Sampled:	05-29-01
Chain of Custody:	8675	Date Received:	05-29-01
Sample Matrix:	Liquid	Date Analyzed:	06-07-01
Preservative:	Cool	Date Digested:	06-06-01
Condition:	Cool & Intact	Analysis Needed:	RCRA Metals

Parameter	Concentration (mg/L)	Det. Limit (mg/L)	Regulatory Level (mg/L)
Arsenic	**ND**	**0.001**	**5.0**
Barium	**ND**	**0.001**	**100**
Cadmium	**ND**	**0.001**	**1.0**
Chromium	**ND**	**0.001**	**5.0**
Lead	**ND**	**0.001**	**5.0**
Mercury	**ND**	**0.001**	**0.2**
Selenium	**ND**	**0.001**	**1.0**
Silver	**ND**	**0.001**	**5.0**

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Note: Regulatory Limits based on 40 CFR part 261 subpart C section 261.24, August 24, 1998.

Comments: **M & R Trucking: Drums.**

Analyst

Christine M Walters
Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #3	Date Reported:	06-07-01
Laboratory Number:	19923	Date Sampled:	05-29-01
Chain of Custody:	8675	Date Received:	05-29-01
Sample Matrix:	Liquid	Date Analyzed:	06-07-01
Preservative:	Cool	Date Digested:	06-06-01
Condition:	Cool & Intact	Analysis Needed:	RCRA Metals

Parameter	Concentration (mg/L)	Det. Limit (mg/L)	Regulatory Level (mg/L)
Arsenic	ND	0.001	5.0
Barium	0.002	0.001	100
Cadmium	0.007	0.001	1.0
Chromium	ND	0.001	5.0
Lead	ND	0.001	5.0
Mercury	ND	0.001	0.2
Selenium	ND	0.001	1.0
Silver	ND	0.001	5.0

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Note: Regulatory Limits based on 40 CFR part 261 subpart C section 261.24, August 24, 1998.

Comments: **M & R Trucking: Drums.**

Analyst

Christine M Walters
Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #6	Date Reported:	06-07-01
Laboratory Number:	19924	Date Sampled:	05-29-01
Chain of Custody:	8675	Date Received:	05-29-01
Sample Matrix:	Liquid	Date Analyzed:	06-07-01
Preservative:	Cool	Date Digested:	06-06-01
Condition:	Cool & Intact	Analysis Needed:	RCRA Metals

Parameter	Concentration (mg/L)	Det. Limit (mg/L)	Regulatory Level (mg/L)
Arsenic	ND	0.001	5.0
Barium	0.299	0.001	100
Cadmium	0.004	0.001	1.0
Chromium	0.001	0.001	5.0
Lead	0.042	0.001	5.0
Mercury	ND	0.001	0.2
Selenium	ND	0.001	1.0
Silver	ND	0.001	5.0

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Note: Regulatory Limits based on 40 CFR part 261 subpart C section 261.24, August 24, 1998.

Comments: **M & R Trucking: Drums.**

Analyst

Christine M Walters

Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #7	Date Reported:	06-07-01
Laboratory Number:	19925	Date Sampled:	05-29-01
Chain of Custody:	8675	Date Received:	05-29-01
Sample Matrix:	Liquid	Date Analyzed:	06-07-01
Preservative:	Cool	Date Digested:	06-06-01
Condition:	Cool & Intact	Analysis Needed:	RCRA Metals

Parameter	Concentration (mg/L)	Det. Limit (mg/L)	Regulatory Level (mg/L)
Arsenic	ND	0.001	5.0
Barium	0.084	0.001	100
Cadmium	ND	0.001	1.0
Chromium	ND	0.001	5.0
Lead	ND	0.001	5.0
Mercury	ND	0.001	0.2
Selenium	ND	0.001	1.0
Silver	ND	0.001	5.0

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Note: Regulatory Limits based on 40 CFR part 261 subpart C section 261.24, August 24, 1998.

Comments: **M & R Trucking: Drums.**

Analyst

Christine M Walters
Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #15	Date Reported:	06-07-01
Laboratory Number:	19926	Date Sampled:	05-29-01
Chain of Custody:	8675	Date Received:	05-29-01
Sample Matrix:	Liquid	Date Analyzed:	06-07-01
Preservative:	Cool	Date Digested:	06-06-01
Condition:	Cool & Intact	Analysis Needed:	RCRA Metals

Parameter	Concentration (mg/L)	Det. Limit (mg/L)	Regulatory Level (mg/L)
Arsenic	ND	0.001	5.0
Barium	0.007	0.001	100
Cadmium	ND	0.001	1.0
Chromium	ND	0.001	5.0
Lead	ND	0.001	5.0
Mercury	ND	0.001	0.2
Selenium	ND	0.001	1.0
Silver	ND	0.001	5.0

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Note: Regulatory Limits based on 40 CFR part 261 subpart C section 261.24, August 24, 1998.

Comments: **M & R Trucking: Drums.**

Analyst

Christine M Walters
Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #16	Date Reported:	06-07-01
Laboratory Number:	19927	Date Sampled:	05-29-01
Chain of Custody:	8675	Date Received:	05-29-01
Sample Matrix:	Liquid	Date Analyzed:	06-07-01
Preservative:	Cool	Date Digested:	06-06-01
Condition:	Cool & Intact	Analysis Needed:	RCRA Metals

Parameter	Concentration (mg/L)	Det. Limit (mg/L)	Regulatory Level (mg/L)
Arsenic	**0.027**	**0.001**	**5.0**
Barium	**0.219**	**0.001**	**100**
Cadmium	**0.025**	**0.001**	**1.0**
Chromium	**0.015**	**0.001**	**5.0**
Lead	**0.136**	**0.001**	**5.0**
Mercury	**ND**	**0.001**	**0.2**
Selenium	**0.011**	**0.001**	**1.0**
Silver	**ND**	**0.001**	**5.0**

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Note: Regulatory Limits based on 40 CFR part 261 subpart C section 261.24, August 24, 1998.

Comments: **M & R Trucking: Drums.**

Analyst

Christine M Walters

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #22	Date Reported:	06-07-01
Laboratory Number:	19928	Date Sampled:	05-29-01
Chain of Custody:	8675	Date Received:	05-29-01
Sample Matrix:	Liquid	Date Analyzed:	06-07-01
Preservative:	Cool	Date Digested:	06-06-01
Condition:	Cool & Intact	Analysis Needed:	RCRA Metals

Parameter	Concentration (mg/L)	Det. Limit (mg/L)	Regulatory Level (mg/L)
Arsenic	**ND**	**0.001**	**5.0**
Barium	**ND**	**0.001**	**100**
Cadmium	**ND**	**0.001**	**1.0**
Chromium	**ND**	**0.001**	**5.0**
Lead	**ND**	**0.001**	**5.0**
Mercury	**ND**	**0.001**	**0.2**
Selenium	**ND**	**0.001**	**1.0**
Silver	**ND**	**0.001**	**5.0**

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Note: Regulatory Limits based on 40 CFR part 261 subpart C section 261.24, August 24, 1998.

Comments: **M & R Trucking: Drums.**

Analyst

Christine M Walters
Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS

Client:	Blagg / BP	Project #:	94034-010
Sample ID:	Drum #29	Date Reported:	06-07-01
Laboratory Number:	19929	Date Sampled:	05-29-01
Chain of Custody:	8675	Date Received:	05-29-01
Sample Matrix:	Liquid	Date Analyzed:	06-07-01
Preservative:	Cool	Date Digested:	06-06-01
Condition:	Cool & Intact	Analysis Needed:	RCRA Metals

Parameter	Concentration (mg/L)	Det. Limit (mg/L)	Regulatory Level (mg/L)
Arsenic	**ND**	**0.001**	**5.0**
Barium	**0.044**	**0.001**	**100**
Cadmium	**ND**	**0.001**	**1.0**
Chromium	**ND**	**0.001**	**5.0**
Lead	**ND**	**0.001**	**5.0**
Mercury	**ND**	**0.001**	**0.2**
Selenium	**ND**	**0.001**	**1.0**
Silver	**ND**	**0.001**	**5.0**

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Note: Regulatory Limits based on 40 CFR part 261 subpart C section 261.24, August 24, 1998.

Comments: **M & R Trucking: Drums.**

Analyst

Christine M Walters
Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

TRACE METAL ANALYSIS
Quality Control / Quality Assurance Report

Client:	QA/QC	Project #:	N/A
Sample ID:	06-07-TM QA/QC	Date Reported:	06-07-01
Laboratory Number:	19922	Date Sampled:	N/A
Sample Matrix:	Liquid	Date Received:	N/A
Analysis Requested:	Total RCRA Metals	Date Analyzed:	06-07-01
Condition:	N/A	Date Digested:	06-06-01

Blank & Duplicate Conc. (mg/L)	Instrument Blank (mg/L)	Method Blank	Detection Limit	Sample	Duplicate	% Diff.	Acceptance Range
Arsenic	ND	ND	0.001	ND	ND	0.0%	0% - 30%
Barium	ND	ND	0.001	ND	ND	0.0%	0% - 30%
Cadmium	ND	ND	0.001	ND	ND	0.0%	0% - 30%
Chromium	ND	ND	0.001	ND	ND	0.0%	0% - 30%
Lead	ND	ND	0.001	ND	ND	0.0%	0% - 30%
Mercury	ND	ND	0.001	ND	ND	0.0%	0% - 30%
Selenium	ND	ND	0.001	ND	ND	0.0%	0% - 30%
Silver	ND	ND	0.001	ND	ND	0.0%	0% - 30%

Spike Conc. (mg/Kg)	Spike Added	Sample	Spiked Sample	Percent Recovery	Acceptance Range
Arsenic	0.500	ND	0.498	99.6%	80% - 120%
Barium	0.500	ND	0.499	99.8%	80% - 120%
Cadmium	0.500	ND	0.500	100.0%	80% - 120%
Chromium	0.500	ND	0.499	99.8%	80% - 120%
Lead	0.500	ND	0.498	99.6%	80% - 120%
Mercury	0.050	ND	0.050	100.0%	80% - 120%
Selenium	0.500	ND	0.497	99.4%	80% - 120%
Silver	0.500	ND	0.499	99.8%	80% - 120%

ND - Parameter not detected at the stated detection limit.

References: Method 3050B, Acid Digestion of Sediments, Sludges and Soils. SW-846, USEPA, December 1996.

Method 6010B, Analysis of Metals by Inductively Coupled Plasma Atomic Emmision Spectorscopy, SW-846, USEPA, December 1996.

Comments: **QA/QC for samples 19922 - 19929 and 19963.**

Analyst

Christine M Walter
Review

CHAIN OF CUSTODY RECORD

08675

Client / Project Name BLAGG/BP	Project Location M+R TRUCKING: DRUMS	ANALYSIS / PARAMETERS
Sampler: J-C. Blagg	Client No. 94034-010	

Sample No./ Identification	Sample Date	Sample Time	Lab Number	Sample Matrix	No. of Containers	RCI		8 RCRA METALS	JC Blagg 6/5/01			Remarks
Drum #1	5/29/01	1241	19922	LIQUID	1	X		X				
Drum #3	"	1245	19923	"	1	X		X				
Drum #6	"	1255	19924	"	1	X		X				
Drum #7	"	1330	19925	"	1	X		X				
Drum #15	"	1314	19926	"	1	X		X				
Drum #16	"	1317	19927	"	1	X		X				
Drum #22	"	1330	19928	"	1	X		X				
Drum #29	"	1342	19929	"	1	X		X				

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
J-C. Blagg	5/29/01	1414		5/28/01	1414
Relinquished by: (Signature)			Received by: (Signature)		
Relinquished by: (Signature)			Received by: (Signature)		

ENVIROTECH INC.

5796 U.S. Highway 64
Farmington, New Mexico 87401
(505) 632-0615

Sample Receipt	Y	N	N/A
Received Intact	✓		
Cool - Ice/Blue Ice	✓		

BLAGG ENGINEERING, INC.
P.O. Box 87, Bloomfield, New Mexico 87413
Phone: (505)632-1199 Fax: (505)632-3903

RECEIVED
APR - 1 1998

March 27, 1998

Ms. Martyne J. Kieling
New Mexico Oil Conservation Division
2040 South Pacheco Street
Santa Fe, New Mexico 87505

Re: Amoco Production Company
Crouch Mesa Waste Management Facility, SW/4 SE/4 Sec. 2 - T29N - R12W
NMOCD Rule 711 Application

Dear Ms. Kieling:

On behalf of Amoco Production Company, Blagg Engineering, Inc. (BEI) is responding to your correspondence dated February 6, 1998 with respect to the Crouch Mesa Waste Management Facility. This is a pre-existing soils landfarm installed and operated prior to adoption of NMOCD Rule 711. Attached, please find a completed Form C-137 with associated documentation. Bonding requirements per Rule 711.B.l.i and 711.B.3 will be addressed separately by Amoco Production Company. Amoco is evaluating its bonding options for this and other waste management facilities located in New Mexico.

Addressed below is a response to your comments and concerns presented in Attachment 1 of your February 6, 1998 correspondence:

2. Berming: The landfarm facility has been divided into four (4) each soil remediation cells. Individual cell berms have been constructed around each cell (see attached diagrams with Form C-137).

3. Setbacks: Existing cells have been constructed with a 100 foot setback. Any future cells will be constructed with a 100 foot setback. No pipelines cross the facility.

4. Compost Soil Spreading and Windrow Maintenance: Contaminated soils at the facility have all been placed into designated cells, constructed into compost piles and surrounded with adequate berms. Future soils delivered to the facility for composting shall be put into compost piles within 72 hours of receipt and berms shall be maintained around each compost cell. Weekly temperature measurements shall be kept on each compost cell, recorded, and maintained for NMOCD inspection.

5. Landfarm Soil Spreading, Disking and Lift Thickness: All landfarm soils at the facility have been thin spread. Future soils delivered to the facility for landfarming shall be thin spread into lifts of 6-inches or less within 72 hours of receipt. Soils will be turned or disked a minimum of one time every two weeks until closure standards have been achieved.

6. Treatment Zone Monitoring and Reporting: Attached with this letter are copies of all treatment

zone monitoring laboratory analytical results from 1992 through 1997. ✓

7. Revised Permit Requirements for Treatment Zone Monitoring and Reporting: Treatment zone monitoring and reporting shall be as described by NMOCD. A summary of this monitoring is presented in the attached Rule 711 application submittal.

9. Free Liquids: No sludge or free liquid stabilization is presently proposed for the Crouch Mesa facility.

10. In State Waste: Only in-state (New Mexico) waste will be accepted at the facility.

11. Above Ground Tanks: Tanks containing free liquids other than fresh water have been bermed.

14. Tank Labeling: Above ground tanks that are in service will be labeled prior to June 1, 1998.

15. Housekeeping: Adequate berms have been constructed around individual compost piles.

17. Ponding, Pooling or Run-off of Water: Natural precipitation will add moisture to augment bioremediation processes. Minor pooling or ponding of this precipitation is a natural process that cannot be avoided, and this moisture will enhance remedial processes. It is not proposed to remove minor ponding or pooling from natural precipitation.

18. Naturally Occurring Radioactive Material (NORM): Pursuant to discussions with the NMOCD, NORM testing will not be required for this facility.

19. Application Requirements for Permit Under New Rule 711: A Form C-137 application is attached.

Questions or comments concerning the this transmittal may be directed to Jeff Blagg of Blagg Engineering at (505)632-1199 or to Buddy Shaw with Amoco at (505)326-9200.

Respectfully submitted:
Blagg Engineering, Inc.

Jeffrey C. Blagg

Jeffrey C. Blagg, P.E.
President

Attachments: Soil Treatment Zone Monitoring Reports
Form C-137 Application

cc: Denny Foust, NMOCD Aztec District Office
B.D. Shaw, Amoco San Juan Operations Center

AMOCO PRODUCTION COMPANY
CROUCH MESA WASTE MANAGEMENT FACILITY
NMOCD FACILITY INSPECTION INFORMATION SUBMITTAL

SITE TREATMENT ZONE MONITORING
LABORATORY REPORTS

GEOWEST
Golden, Inc.

April 16, 1992

Mr. Dave Brown
Amoco Production Company
Environmental Affairs
1670 Broadway
Room 844
Denver, CO 80201

DRAFT

RE: ASSESSMENT OF PROPOSED AMOCO COMPOSTING SITE
SAN JUAN COUNTY, NEW MEXICO

Dear Mr. Brown:

GeoWest Golden, Inc. (GeoWest) has completed an assessment of a proposed Amoco composting site located east of Farmington, New Mexico in San Juan County, as you requested. The assessment consisted of:

- A site inspection;
- Discussions with Mr. Buddy Shaw of Amoco regarding former and proposed operations at the site;
- Drilling of five soil borings;
- Collection of one surface soil grab sample at each soil boring location, and laboratory analysis of three of the grab samples for selected parameters;
- Collection of one soil sample at each soil boring location with a California Sampler, and geotechnical testing of three of the soil samples;
- A review of New Mexico composting regulations.

The focus of the investigation was to assess the potential for environmental impact resulting from proposed composting operations at the site. The general location of the site is shown in Figure 1, and a site map is shown in Figure 2.

9203 01\rp\ort\203asses.rpt.adv

530 Commons Drive • Golden, Colorado 80401 • (303) 526-9838

BACKGROUND

The proposed composting site is a 400' x 250' parcel of land out of a 10-acre tract in the SW 1/4 of the SE 1/4 of Section 2, T29N, R12W, San Juan County, New Mexico. The site is located approximately five miles east of Farmington, New Mexico in an area referred to as Crouch Mesa. The surrounding property is undeveloped.

According to Mr. Buddy Shaw of Amoco, the proposed composting site has been enlarged from an original 1-acre area at the east end of the site that had previously been used to stockpile horse manure over a period of approximately three years. The manure has been removed and stockpiled on the north and east sides of the site, as shown in Figure 2. The southeast section of the site has been backfilled with native surface material from areas adjacent to the site, and the remaining sections have been cleared and graded. The site slopes to the southeast at a rate of approximately 2.5 feet per 100 feet.

A natural depression, approximately 5 feet deep at its south end, is located at the southeast corner of the proposed composting site, as shown in Figure 2. According to Mr. Shaw, this depression will serve as a catch basin for any runoff produced in the composting area during rainstorms. The south and east sides of the composting area will be bermed to divert runoff into the catch basin.

Two dirt service roads border the north and south sides of the composting area. An area on the north side of the north service road, as shown in Figure 2, has been cleared and graded level for use as a future staging area for mixing and processing compost materials prior to application of compost piles in the proposed composting area.

GEOLOGY AND HYDROGEOLOGY

The land surface in the vicinity of the site generally slopes to the southeast, and is comprised of rolling hills sparsely vegetated with pinion trees. The site is located near the drainage divide between the Animas River and San Juan River drainage basins at an elevation of approximately 5,850 feet above mean sea level. The beginning of an unnamed ephemeral watercourse is located approximately 1,000 feet southeast of the site. The climate is arid to semiarid, with an annual precipitation of approximately 9 inches. Almost half of the annual precipitation occurs from the months of July through October. Annual class A pan evaporation near Farmington averages over 67 inches (Brown and Stone, 1979).

The subsurface strata underlying the site consist mostly of alternating layers of clayey, silty sands and weathered sandstone of the Tertiary San Jose Formation. This formation has been characterized as conglomeratic sandstone and mudstone (Brown and Stone, 1979).

No known water wells have been drilled within a one quarter mile radius of the site. A total of eight wells for obtaining drilling water were completed in the San Jose Formation east of the site at depths of 118 to 585 feet below ground surface (bgs) during the 1950's. Ground water in the San Jose Formation exists under confined conditions in thick sandstone units (Brown and Stone, 1979). An unconfined shallow aquifer has not been identified in the Crouch Mesa area. Therefore, there is low potential for the occurrence of usable ground water resources in the vicinity of the proposed composting site.

SOIL BORING RESULTS

Five soil borings were drilled by Western Technologies Inc. of Farmington, New Mexico at the locations shown in Figure 2. Surface soil grab samples were also collected adjacent to each soil boring location. A 7-inch O.D. hollow stem auger was used to drill the soil borings. A California Sampler was used to collect a soil sample at the 4 to 8-inch depth interval in each boring. Split spoon samples were then collected at 5-foot intervals.

Grab samples of surface soils collected at locations SB-2, SB-3, and SB-4 were submitted to Evergreen Analytical Laboratories of Wheat Ridge, Colorado for analysis of Skinner list metals, specific conductance, chloride and sulfate. Analytical results are provided in Attachment 1 and are summarized in Table 1.

Analytical results for the surface grab samples indicate low concentrations of barium, cobalt, copper, and nickel were detected at all three boring locations. The other nine metals analyzed were not detected. All detected metals concentrations are below the range of concentrations reported for natural soils (USGS Prof. Paper No. 574-F). The chloride concentrations detected in the grab samples were all below the average chloride level of 100 mg/Kg reported for natural soils (EPA SW-874). There are no known average sulfate or specific conductance values reported for natural soils.

Samples collected with the California sampler at the 4 to 8-inch depth interval from borings SB-2, SB-3, and SB-4 were submitted to Western Technologies for a sieve analysis and testing of vertical permeability, dry density, and moisture content. Test results are provided in Attachment 2 and are summarized in Table 2. Split spoon samples were examined by GeoWest personnel and described. Drilling logs for the borings are provided in Attachment 3.

In general, a sequence of alternating weathered sandstone and stiff clayey and silty sand strata was encountered in all borings. The borings were terminated at depths of less than 15 feet bgs due to penetration refusal by the drill bit when a fined-grained sandstone was encountered.

Soil Boring SB-1

Soil boring SB-1 is located in the southeast section of the composting site, in an area that had been backfilled with approximately 2 to 3 feet of uncompacted surface soils from areas adjacent to the site. Stockpiled horse manure in this area had been scraped off prior to backfilling. A soil sample collected at the 4 to 8-inch depth interval with the California Sampler was composed of silty fine- to medium-grained sand. Refusal was encountered at a depth of 14 feet bgs at the top of a fine-grained sandstone. No samples from this boring were submitted for analysis or testing.

Soil Boring SB-2

Soil boring SB-2 is located in the northeastern section of the site. Stockpiled manure in this area had been scraped off during the site preparation activities, but small visible patches of residual manure were observed on the surface. A surface soil grab sample was collected near the boring and submitted for analysis. A soil sample was collected at the 4 to 8-inch depth interval with the California Sampler and tested for physical properties. Refusal was encountered at a depth of 12.5 feet bgs at the top of a fined-grained sandstone.

Test results for physical properties of the weathered sandstone sample collected from SB-2 with the California Sampler indicate that it is a fine-grained sandstone, based on the Unified Soil Classification System (USCS), with a moderate permeability and low moisture content. The moderate permeability of the sandstone is most likely a function of secondary porosity resulting from chemical and physical weathering of the sandstone.

Soil Boring SB-3

Soil boring SB-3 is located in an undistubed area in the center of the site. Surface soil conditions in the vicinity of this boring are most likely indicative of native conditions. A surface soil grab sample was collected near the boring and submitted for analysis. A soil sample was collected at the 4 to 8-inch depth interval with the California Sampler and tested for physical properties. Refusal was encountered at a depth of 11.5 feet bgs at the top of a fined-grained sandstone.

Test results for physical properties of the sample collected from SB-3 with the California Sampler indicate that it is a fine-grained sand, based on the USCS, with a low permeability and low moisture content. However, the low permeability (3.0 x 10^{-6} cm/sec) measured in this sample and examination of it indicate that this soil is very dense and contains a significant amount of fines, including silt and clay. This fine-grained soil was also encountered at various depths in borings SB-1, SB-2, SB-4, and SB-5.

Soil Boring SB-4

Soil boring SB-4 is located in the southwest section of the site where tree removal and some grading had occurred. Surface soils in the vicinity of this boring had been slightly compacted by earth-moving equipment. A surface soil grab sample was collected near the boring and submitted for analysis. A soil sample was collected at the 4 to 8-inch depth interval with the California Sampler and tested for physical properties. Refusal was encountered at a depth of 11.5 feet bgs at the top of a fined-grained sandstone.

Test results for physical properties of the sample collected from SB-4 with the California Sampler indicate that it is a silty fine- to medium-grained sand with a moderate permeability and low moisture content.

Soil Boring SB-5

Soil boring SB-5 is located in the northwest section of the site. Surface conditions were very similar to those observed in the vicinity of boring SB-4. A soil sample collected at the 4 to 8-inch depth interval with the California Sampler was composed of silty fine- to medium-grained sand. Refusal was encountered at a depth of 10 feet bgs at the top of a fine-grained sandstone. No samples from this boring were submitted for analysis or testing.

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Conditions observed during the assessment of the proposed composting site and results of the analysis and testing of physical properties of soils indicate that the site should be suitable for proposed composting operations. Laterally continuous fine-grained strata underlying the site at shallow depths will serve as effective low-permeability barriers to vertical migration of liquids that may percolate downward from the compost pile, so that an artificial liner across the composting site should not be required. Runoff from the composting site during rainstorms will be controlled by diversion berms and a collection basin located at the southeast corner of the site. The size of the collection basin is large enough to handle runoff from a 25-year, 6-hour storm.

There is low potential for environmental impact from proposed composting operations at the site due to the remoteness of the site. No shallow ground water aquifers have been identified in the vicinity of the site. The uppermost aquifer identified in the area is a confined aquifer in the San Juan sandstone at a depth of more than 100 feet bgs. There are also no perennial watercourses, water wells, or residences in the immediate vicinity of the site. Analysis of surface soil samples collected from the composting area does not indicate significant levels of constituents in the soil that would potentially impact the environment.

In order to maintain a low potential for environmental impact at the site and assure compliance with state and federal regulations, we recommend the following:

- The composting operations should be conducted in accordance with composting regulations included in the New Mexico Solid Waste Management Regulations promulgated by the New Mexico Environmental Department. Pertinent regulations from the Solid Waste Management Regulations regarding composting are provided in Attachment 4.

- A reinforced concrete pad with containment is recommended in the proposed processing area on the north side of the site in order to prevent percolation of free liquids into the ground during mixing of the compost.
- Prior to application of a batch of the compost mix to the unlined composting area, the batch should pass a Paint Filter Liquids Test (EPA Method SW-846 9095) in order to minimize runoff and percolation of free liquids from the composting pile. A copy of the Paint Filter Test method is provided in Attachment 5.

Minimization of impacts to soils and ground water is dependent on mixing the compost in a controlled area and providing quality assurance control procedures that require materials placed in the composting area have no drainable free liquids.

We appreciate the opportunity to work with Amoco on this project. If you have any questions or need further information, please contact the undersigned.

Sincerely,
GeoWest Golden, Inc.

Andrew D. Eyer
Project Manager

William R. Highland, P.E.

attachments

9203 01\vp\bf\203a[illegible].rpt\ade

TABLE 1

ANALYTICAL RESULTS FOR GRAB SAMPLES OF SURFACE SOILS

(All values reported in mg/Kg, unless noted otherwise)

	Sample ID				
Parameter	SB-2	SB-3	SB-4	Detection Limit	Range Detected in Natural Western U.S. Soils
Specific Conductance (µmhos/cm)	>5000	309	2060	NA	NA
Chloride	94.3	13.9	12.1	NA	NA
Sulfate	1490	11.0	826	NA	NA
Antimony	ND	ND	ND	5	<150 - 500
Arsenic	ND	ND	ND	11	<0.2 - 97
Barium	76	86	140	0.4	70 - 5000
Beryllium	ND	ND	ND	1	<1 - 7
Cadmium	ND	ND	ND	0.8	<1 - 10
Chromium	ND	ND	ND	1.4	3 - 1500
Cobalt	5	6	4	2	<3 - 50
Copper	4.7	5.2	3.8	1.2	2 - 300
Lead	ND	ND	ND	8	<7 - 700
Mercury	ND	ND	ND	0.1	<0.01 - 4.6
Nickel	7	9	7	4	<3 - 700
Selenium	ND	ND	ND	15	<0.1 - 1.4
Vanadium	ND	ND	ND	2	7 - 500

Notes:

1) Samples collected April 4, 1992
2) NA = Not Available
3) ND = Not Detected
4) Specific Conductance Measurement Method: U.S. Department of Agriculture Handbook No. 60, p.89
5) Chloride and Sulfate Analysis Method: EPA 300.0
6) Skinner List Metals Analysis Method: SW-846
7) Natural Soil Ranges for Western U.S. soils from USGS Professional Paper No. 574-F

TABLE 2

PHYSICAL PROPERTIES OF SOIL SAMPLES

	SAMPLE ID		
Physical Property	SB-2	SB-3	SB-4
Coefficient of Permeability (cm/sec)	1.4×10^{-4}	3.0×10^{-6}	3.0×10^{-4}
In-Situ Dry Density (pcf)	112	115	110
In-Situ Moisture Content (%)	7.1	11.2	9.4
Grain Size Based on Sieve Analysis	Fine Sand	Fine Sand	Fine/Medium Sand

Note:

1) Samples were collected with California Sampler on April 4, 1992 at a depth of 4 to 8 inches below ground surface.

2) Sample SB-2 was weathered sandstone.

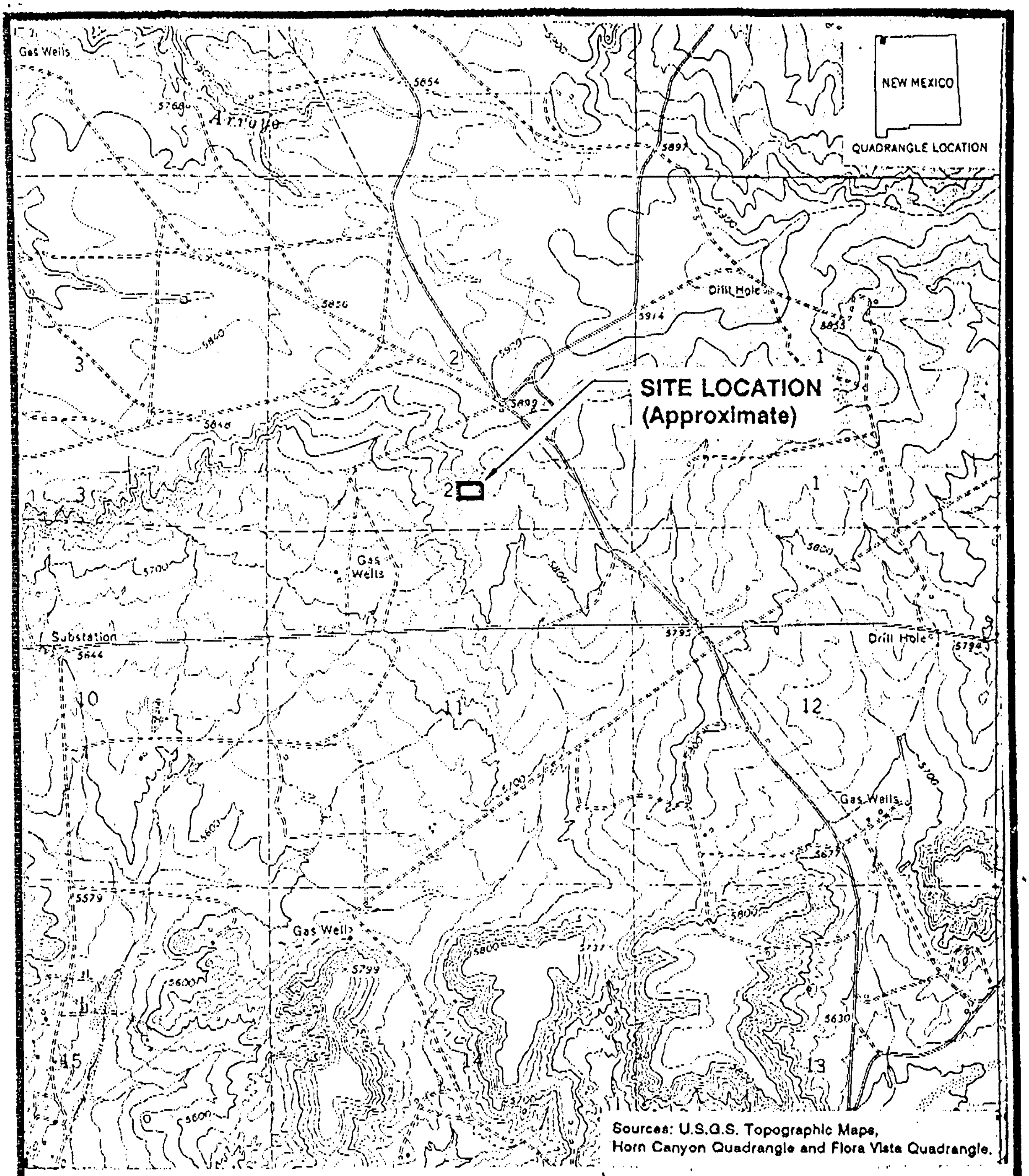
3) Grain size classification based on Unified Soil Classification System.

Checked By:

Drawn By: RHL

Date: 4/13/92

File Name: 2003A1



SITE LOCATION (Approximate)

Sources: U.S.G.S. Topographic Maps, Horn Canyon Quadrangle and Flora Vista Quadrangle.

0 2000 4000

Scale in feet

North

GeoWest
Golden, Inc.

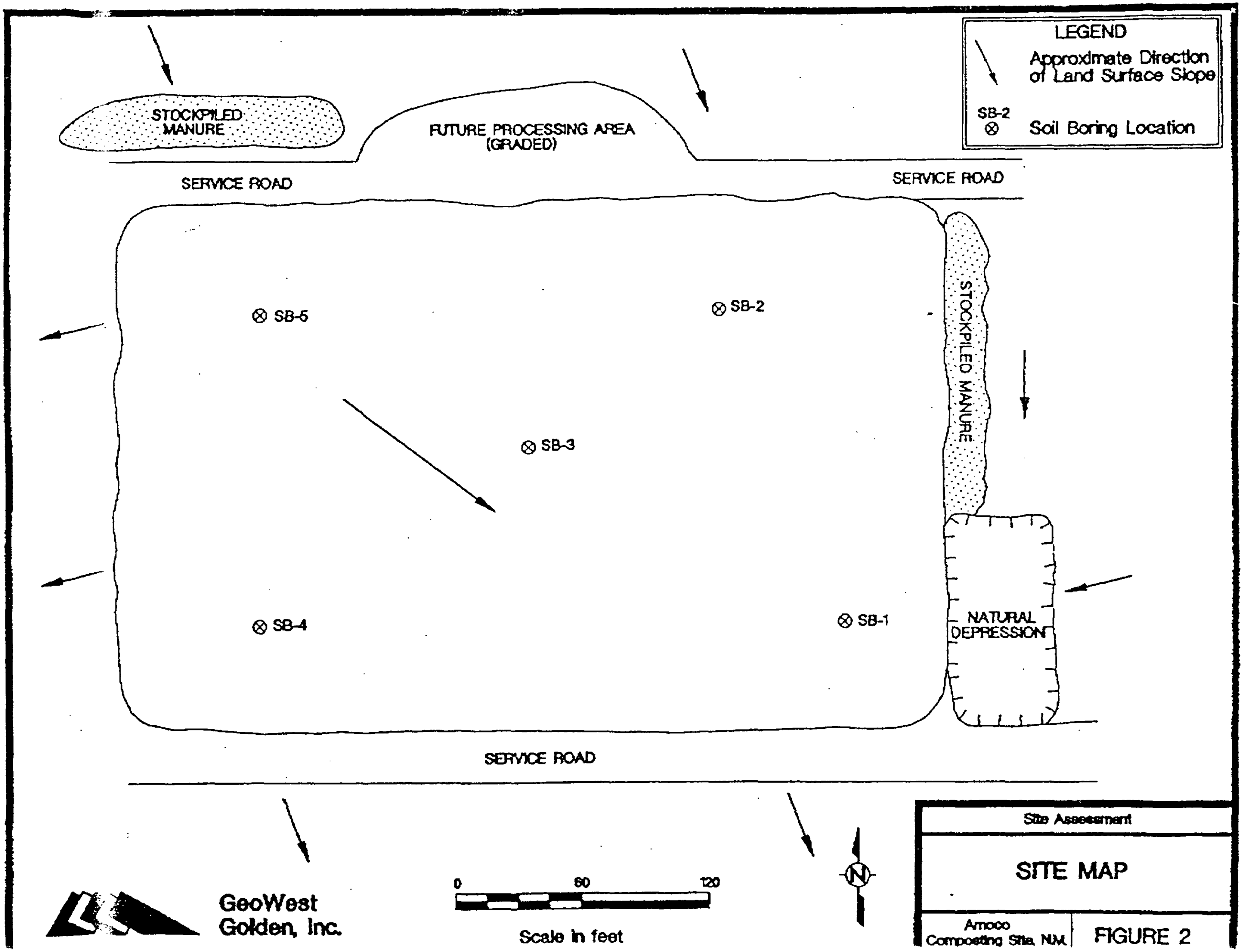
Site Assessment

LOCATION MAP

Amoco Composting Site, N.M.

FIGURE 1

File Name: 2038A2 Date: 4/13/92 Drawn By: RHL Checked By:



Site Assessment

SITE MAP

Amoco Composting Site, N.M.

FIGURE 2

BLAGG ENGINEERING, INC.
P.O. Box 87
Bloomfield, New Mexico 87413
Phone: (505) 632-1199
Fax: (505) 632-3903

August 18, 1997

Mr. Roger Anderson
Environmental Bureau Chief
New Mexico Oil Conservation Division
2040 South Pacheco Street
Santa Fe, New Mexico 87505

RE: Amoco Production Company
Crouch Mesa Compost Facility Site Map
SW/4 SE/4, Sec, 2, T29N, R12W, NMPM, San Juan County, NM

Dear Mr. Anderson:

On behalf of Amoco Production Company and Environmental Protection Company (EPC), Blagg Engineering, Inc. respectfully submits the attached site map of the referenced location. It is our understanding that the original site map from the initial correspondence by EPC was illegible due to photocopying.

If you have any questions regarding the information given, please contact us. Thank you for your cooperation and assistance.

Sincerely,
BLAGG ENGINEERING, INC.

Nelson Velez
Staff Geologist

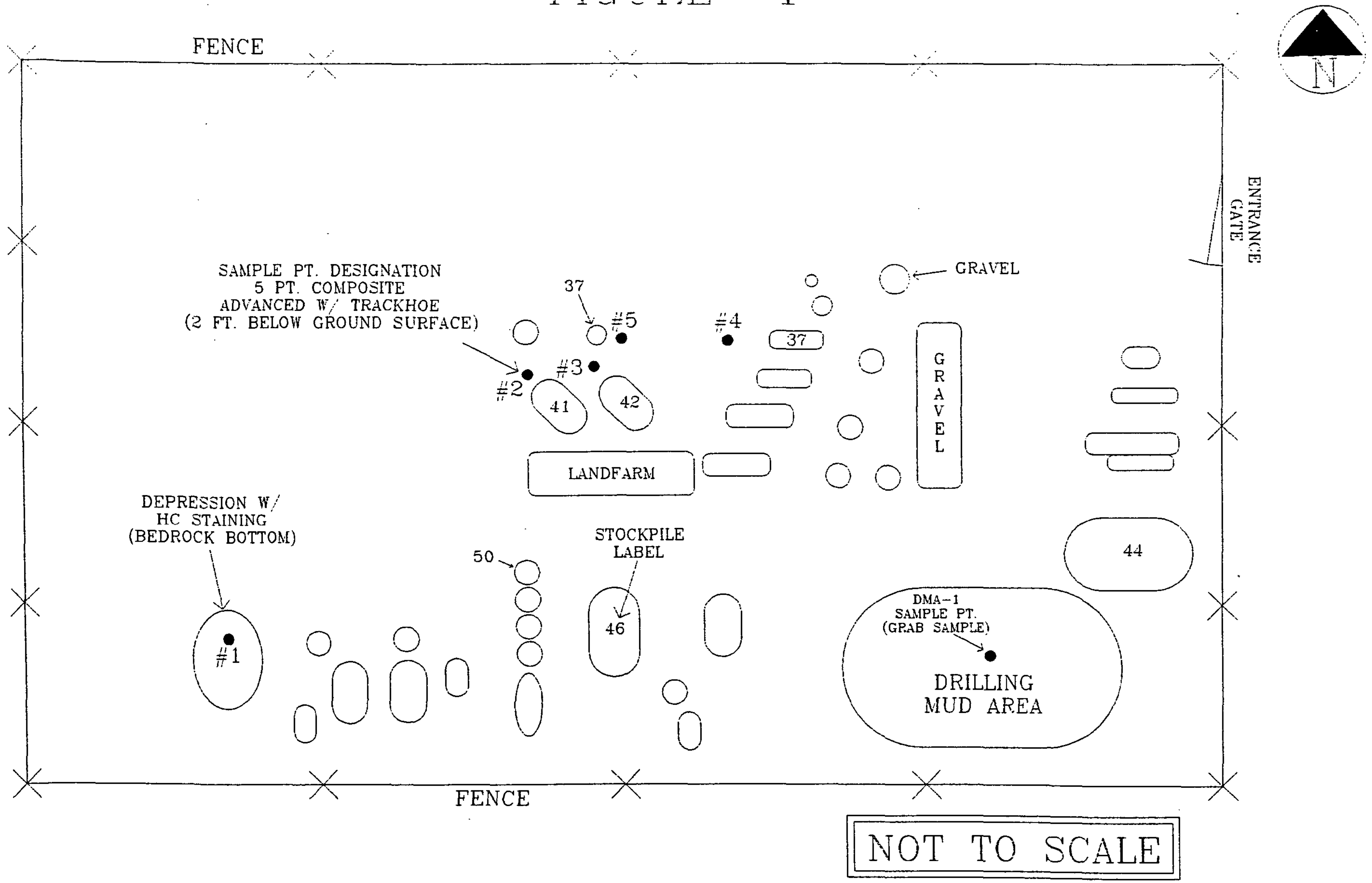
Attachments: Crouch Mesa Compost Facility Site Map

cc: Denny Foust, NMOCD, District Office, Aztec, NM
Buddy Shaw, AMOCO, Farmington, NM
Jake Hatcher, EPC, Farmington, NM

NV/nv

CROUCH.CVL

FIGURE 1



AMOCO PRODUCTION COMPANY
CROUCH MESA COMPOST FACILITY
SW/4, SE/4 SEC. 2, T29N, R12W
SAN JUAN COUNTY, NEW MEXICO

BLAGG ENGINEERING, INC.
CONSULTING PETROLEUM / RECLAMATION SERVICES
P.O. BOX 87
BLOOMFIELD, NEW MEXICO 87413
PHONE: (505) 632-1199

PROJECT: ANN. SAMPLING
DRAWN BY: NJV
FILENAME: CROUCH.SKD

SITE MAP
8/97

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHOD 8015 Modified
Nonhalogenated Volatile Organics
Total Petroleum Hydrocarbons

Client:	Blagg / Amoco	Project #:	04034
Sample ID:	DMA - 1 Drilling Mud Area	Date Reported:	05-14-97
Laboratory Number:	B215	Date Sampled:	05-13-97
Chain of Custody No:	5092	Date Received:	05-13-97
Sample Matrix:	Soil	Date Extracted:	05-13-97
Preservative:	Cool	Date Analyzed:	05-13-97
Condition:	Cool and Intact	Analysis Requested:	8015 TPH

Parameter	Concentration (mg/Kg)	Det. Limit (mg/Kg)
Gasoline Range (C5 - C10)	**ND**	**0.2**
Diesel Range (C10 - C28)	**ND**	**0.1**
Total Petroleum Hydrocarbons	**ND**	**0.2**

ND - Parameter not detected at the stated detection limit.

References: Method 8015, Nonhalogenated Volatile Organics, Test Methods for Evaluating Solid Waste, SW-846, USEPA, July 1992.

Comments: **Amoco Compost Facility. Grab Sample.**

Analyst

Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHOD 8015 Modified
Nonhalogenated Volatile Organics
Total Petroleum Hydrocarbons

Client:	Blagg / Amoco	Project #:	04034
Sample ID:	SPA - 1 5 point Composite	Date Reported:	05-14-97
Laboratory Number:	B216 2' BGS	Date Sampled:	05-13-97
Chain of Custody No:	5092	Date Received:	05-13-97
Sample Matrix:	Soil	Date Extracted:	05-13-97
Preservative:	Cool	Date Analyzed:	05-13-97
Condition:	Cool and Intact	Analysis Requested:	8015 TPH

Parameter	Concentration (mg/Kg)	Det. Limit (mg/Kg)
Gasoline Range (C5 - C10)	**ND**	**0.2**
Diesel Range (C10 - C28)	**34.9**	**0.1**
Total Petroleum Hydrocarbons	**34.9**	**0.2**

ND - Parameter not detected at the stated detection limit.

References: Method 8015, Nonhalogenated Volatile Organics, Test Methods for Evaluating Solid Waste, SW-846, USEPA, July 1992.

Comments: **Amoco Compost Facility. 5 Pt. Composite.**

Analyst

Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHOD 8020
AROMATIC VOLATILE ORGANICS

Client:	Blagg / Amoco	Project #:	04034-10
Sample ID:	DMA - 1 Drilling Mud Area	Date Reported:	05-20-97
Laboratory Number:	B215	Date Sampled:	05-13-97
Chain of Custody:	5092	Date Received:	05-13-97
Sample Matrix:	Soil	Date Analyzed:	05-20-97
Preservative:	Cool	Date Extracted:	05-20-97
Condition:	Cool & Intact	Analysis Requested:	BTEX

Parameter	**Concentration (ug/Kg)**	**Det. Limit (ug/Kg)**
Benzene	**ND**	**8.8**
Toluene	**ND**	**8.4**
Ethylbenzene	**13.6**	**7.6**
p,m-Xylene	**112**	**10.8**
o-Xylene	**24.2**	**5.2**
Total BTEX	**.150** mg/kg	

ND - Parameter not detected at the stated detection limit.

Surrogate Recoveries:	Parameter	Percent Recovery
	Trifluorotoluene	**98 %**
	Bromofluorobenzene	**99 %**

References: Method 5030, Purge-and-Trap, Test Methods for Evaluating Solid Waste, SW-846, USEPA, July 1992.

Method 8020, Aromatic Volatile Organics, Test Methods for Evaluating Solid Waste, SW-846, USEPA, Sept. 1994.

Comments: **Amoco Compost Facility. Grab Sample.**

Analyst

Stacy W. Sendler
Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHOD 8020
AROMATIC VOLATILE ORGANICS

Client:	Blagg / Amoco	Project #:	04034-10
Sample ID:	SPA - 1 5 point Composite	Date Reported:	05-20-97
Laboratory Number:	B216 2' BGS	Date Sampled:	05-13-97
Chain of Custody:	5092	Date Received:	05-13-97
Sample Matrix:	Soil	Date Analyzed:	05-20-97
Preservative:	Cool	Date Extracted:	05-20-97
Condition:	Cool & Intact	Analysis Requested:	BTEX

Parameter	Concentration (ug/Kg)	Det. Limit (ug/Kg)
Benzene	**ND**	**8.8**
Toluene	**ND**	**8.4**
Ethylbenzene	**12.5**	**7.6**
p,m-Xylene	**124**	**10.8**
o-Xylene	**31.9**	**5.2**
Total BTEX	**168**	

ND - Parameter not detected at the stated detection limit.

Surrogate Recoveries:	Parameter	Percent Recovery
	Trifluorotoluene	**99 %**
	Bromofluorobenzene	**99 %**

References: Method 5030, Purge-and-Trap, Test Methods for Evaluating Solid Waste, SW-846, USEPA, July 1992.

Method 8020, Aromatic Volatile Organics, Test Methods for Evaluating Solid Waste, SW-846, USEPA, Sept. 1994.

Comments: **Amoco Compost Facility. 5 Pt. Composite.**

Analyst

Review

CHAIN OF CUSTODY RECORD

Client/Project Name BLAGG / AMOCO	Project Location AMOCO COMPOST FACILITY	ANALYSIS/PARAMETERS
Sampler: (Signature) Nelson Velez	Chain of Custody Tape No. 04034	

Sample No./ Identification	Sample Date	Sample Time	Lab Number	Sample Matrix	No. of Containers	TPH (8015)	BTEX 8020					Remarks
DMA-1	5/13/97	1115	B215	SOIL	1	✓	✓					PRESERV. - COOL
SPA-1	5/13/97	1130	B216	SOIL	1	✓	✓					
												DMA-1 GRAB
												SPA-1 5 PT. COMPOSITE

Added 5-19-97 by N. Velez
D.

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Nelson Velez	5/13/97	1213		5/13/97	1213
Relinquished by: (Signature)			Received by: (Signature)		
Relinquished by: (Signature)			Received by: (Signature)		

ENVIROTECH INC.
5796 U.S. Highway 64-3014
Farmington, New Mexico 87401
(505) 632-0615

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

QUALITY ASSURANCE / QUALITY CONTROL
DOCUMENTATION

5796 U.S. Highway 64-3014 • Farmington, NM 87401 • Tel 505 • 632 • 0615 • Fax 505 • 632 • 1865

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA Method 8015 Modified
Nonhalogenated Volatile Organics
Total Petroleum Hydrocarbons

Quality Assurance Report

Client:	QA/QC	Project #:	N/A
Sample ID:	Laboratory Blank	Date Reported:	05-14-97
Laboratory Number:	05-13-TPH.BLANK	Date Sampled:	N/A
Sample Matrix:	Methylene Chloride	Date Received:	N/A
Preservative:	N/A	Date Analyzed:	05-13-97
Condition:	N/A	Analysis Requested:	TPH

Parameter	Concentration (mg/L)	Det. Limit (mg/L)
Gasoline Range C5 - C10	**ND**	**0.2**
Diesel Range C10 - C28	**ND**	**0.1**
Total Petroleum Hydrocarbons	**ND**	**0.2**

ND - Parameter not detected at the stated detection limit.

References: Method 8015, Nonhalogenated Volatile Organics, Test Methods for Evaluating Solid Waste, SW-846, USEPA, July 1992.

Comments: **QA/QC for sample B208 - B216.**

Analyst

Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHOD 8015 Modified
Nonhalogenated Volatile Organics
Total Petroleum Hydrocarbons
Quality Assurance Report

Client:	QA/QC	Project #:	N/A
Sample ID:	Matrix Duplicate	Date Reported:	05-14-97
Laboratory Number:	8015	Date Sampled:	N/A
Sample Matrix:	Soil	Date Received:	N/A
Preservative:	Cool	Date Analyzed:	05-13-97
Condition:	Cool and Intact	Analysis Requested:	TPH

Parameter	Sample Result (mg/Kg)	Duplicate Result (mg/Kg)	Percent Difference
Gasoline Range (C5 - C10)	**2.9**	**2.9**	**0.0%**
Diesel Range (C10 - C28)	**ND**	**ND**	**0.0%**
Total Petroleum Hydrocarbons	**2.9**	**2.9**	**0.0%**

ND - Parameter not detected at the stated detection limit.

QA/QC Acceptance Criteria:	Parameter	Max Difference
	Petroleum Hydrocarbons	**30%**

References: Method 8015, Nonhalogenated Volatile Organics, Test Methods for Evaluating Solid Waste, SW-846, USEPA, July 1992.

Comments: **QA/QC for sample B208 - B216.**

Analyst

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHOD 8015 Modified
Nonhalogenated Volatile Hydrocarbons
Total Petroleum Hydrocarbons
Quality Assurance Report

Client:	QA/QC	Project #:	N/A
Sample ID:	Matrix Spike	Date Reported:	05-14-97
Laboratory Number:	8015	Date Sampled:	N/A
Sample Matrix:	Soil	Date Received:	N/A
Analysis Requested:	TPH	Date Analyzed:	05-13-97
Condition:	N/A		

Parameter	Sample Result (mg/kg)	Spike Added (mg/kg)	Spiked Sample Result (mg/kg)	Det. Limit (mg/kg)	Percent Recovery
Gasoline Range (C5 - C10)	**2.9**	**250**	**250**	**0.2**	**99%**
Diesel Range (C10 - C28)	**ND**	**250**	**250**	**0.1**	**100%**
Total Petroleum Hydrocarbons	**2.9**	**500**	**500**	**0.2**	**99%**

ND - Parameter not detected at the stated detection limit.

QA/QC Acceptance Criteria:	Parameter	Acceptance Range
	Petroleum Hydrocarbons	**75 - 125%**

References: Method 8015, Nonhalogenated Volatile Organics, Test Methods for Evaluating Solid Waste, SW-846, USEPA, July 1992.

Comments: **QA/QC for sample B208 - B216.**

Analyst

Review

ENVIROTECH LABS
PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHOD 8020
AROMATIC VOLATILE ORGANICS
QUALITY ASSURANCE REPORT

Client:	QA/QC	Project #:	N/A
Sample ID:	Laboratory Blank	Date Reported:	05-20-97
Laboratory Number:	05-20-BTEX.BLANK	Date Sampled:	N/A
Sample Matrix:	Water	Date Received:	N/A
Preservative:	N/A	Date Analyzed:	05-20-97
Condition:	N/A	Analysis Requested:	BTEX

Parameter	Concentration (ug/L)	Det. Limit (ug/L)
Benzene	**ND**	**0.2**
Toluene	**ND**	**0.2**
Ethylbenzene	**ND**	**0.2**
p,m-Xylene	**ND**	**0.2**
o-Xylene	**ND**	**0.1**

ND - Parameter not detected at the stated detection limit.

Surrogate Recoveries:	Parameter	Percent Recovery
	Trifluorotoluene	**98 %**
	Bromofluorobenzene	**100 %**

References: Method 5030, Purge-and-Trap, Test Methods for Evaluating Solid Waste, SW-846, USEPA, July 1992.

Method 8020, Aromatic Volatile Organics, Test Methods for Evaluating Solid Waste, SW-846, USEPA, Sept. 1994.

Comments: **QA/QC for samples B215 - B216 and B258 - B260.**

Analyst

Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHOD 8020
AROMATIC VOLATILE ORGANICS
QUALITY ASSURANCE REPORT

Client:	QA/QC	Project #:	N/A
Sample ID:	Matrix Duplicate	Date Reported:	05-20-97
Laboratory Number:	B258	Date Sampled:	N/A
Sample Matrix:	Water	Date Received:	N/A
Preservative:	HgCl and Cool	Date Analyzed:	05-20-97
Condition:	Cool and Intact	Analysis Requested:	BTEX-MTBE

Parameter	Sample Result (ug/L)	Duplicate Result (ug/L)	Percent Diff.	Det. Limit (ug/L)	Dilution Factor
Benzene	**ND**	**ND**	**0.0%**	**0.2**	**1**
Toluene	**ND**	**ND**	**0.0%**	**0.2**	**1**
Ethylbenzene	**ND**	**ND**	**0.0%**	**0.2**	**1**
p,m-Xylene	**0.6**	**0.6**	**0.0%**	**0.2**	**1**
o-Xylene	**0.1**	**0.1**	**0.0%**	**0.1**	**1**

ND - Parameter not detected at the stated detection limit.

QA/QC Acceptance Criteria:	Parameter	Maximum Difference
	8020 Compounds	**30 %**

References: Method 5030, Purge-and-Trap, Test Methods for Evaluating Solid Waste, SW-846, USEPA, July 1992.

Method 8020, Aromatic Volatile Organics, Test Methods for Evaluating Solid Waste, SW-846, USEPA, Sept. 1994.

Comments: **QA/QC for samples B215 - B216 and B258 - B260.**

Analyst

Review

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

EPA METHOD 8020
AROMATIC VOLATILE ORGANICS
QUALITY ASSURANCE REPORT

Client:	QA/QC	Project #:	N/A
Sample ID:	Matrix Spike	Date Reported:	05-20-97
Laboratory Number:	B258	Date Sampled:	N/A
Sample Matrix:	Water	Date Received:	N/A
Preservative:	Cool	Date Analyzed:	05-20-97
Condition:	Cool and Intact		

Parameter	Sample Result (ug/L)	Spike Added (ug/L)	Spiked Sample Result (ug/L)	Det. Limit (ug/L)	Percent Recovery	SW-846 % Rec. Accept. Range
Benzene	**ND**	**50.0**	**50.3**	**0.2**	**101%**	**39-150**
Toluene	**ND**	**50.0**	**50.4**	**0.2**	**101%**	**46-148**
Ethylbenzene	**ND**	**50.0**	**50.3**	**0.2**	**101%**	**32-160**
p,m-Xylene	**0.6**	**100**	**101**	**0.2**	**100%**	**46-148**
o-Xylene	**0.1**	**50.0**	**50.4**	**0.1**	**100%**	**46-148**

ND - Parameter not detected at the stated detection limit.

References: Method 5030, Purge-and-Trap, Test Methods for Evaluating Solid Waste, SW-846, USEPA, July 1992.

Method 8020, Aromatic Volatile Organics, Test Methods for Evaluating Solid Waste, SW-846, USEPA, Sept. 1994.

Comments: QA/QC for samples B215 - B216 and B258 - B260.

Analyst

Stacy W. Sendler
Review

District I - (505) 393-6161
P. O. Box 1980
Hobbs, NM 88241-1980
District II - (505) 748-1283
811 S. First
Artesia, NM 88210
District III - (505) 334-6178
1000 Rio Brazos Road
Aztec, NM 87410
District IV - (505) 827-7131

New Mexico
Energy Minerals and Natural Resources Department
Oil Conservation Division
2040 South Pacheco Street
Santa Fe, New Mexico 87505
(505) 827-7131

Form C-137
Originated 8/8/95
Revised 6/25/97

Submit Original
Plus 1 Copy
to Santa Fe
1 Copy to appropriate
District Office

APPLICATION FOR WASTE MANAGEMENT FACILITY

(Refer to the OCD Guidelines for assistance in completing the application)

☐ Commercial ☒ Centralized

1. Type: ☐ Evaporation ☐ Injection ☐ Other ______
☒ Solids/Landfarm ☐ Treating Plant

2. Operator: Amoco Production Company

Address: 200 Amoco Ct., Farmington, NM 87401

Contact Person: Buddy Shaw Phone: (505)326-9200

3. Location: SW /4 SE /4 Section 2 Township 29N Range 12W
Submit large scale topographic map showing exact location

4. Is this a modification of an existing facility? ☐ Yes ☒ No APPLICATION PER NEW 711

5. Attach the name and address of the landowner of the facility site and landowners of record within one mile of the site.

6. Attach description of the facility with a diagram indicating location of fences, pits, dikes, and tanks on the facility.

7. Attach designs prepared in accordance with Division guidelines for the construction/installation of the following: pits or ponds, leak-detection systems, aerations systems, enhanced evaporation (spray) systems, waste treating systems, security systems, and landfarm facilities.

8. Attach a contingency plan for reporting and clean-up for spills or releases.

9. Attach a routine inspection and maintenance plan to ensure permit compliance.

10. Attach a closure plan.

11. Attach geological/hydrological evidence demonstrating that disposal of oil field wastes will not adversely impact groundwater. Depth to and quality of ground water must be included.

12. Attach proof that the notice requirements of OCD Rule 711 have been met.

13. Attach a contingency plan in the event of a release of H_2S.

14. Attach such other information as necessary to demonstrate compliance with any other OCD rules, regulations and orders.

15. CERTIFICATION

I hereby certify that the information submitted with this application is true and correct to the best of my knowledge and belief.

Name: Jeffrey C. Blagg Title: Environmental Consultant

Signature: Jeffrey C. Blagg Date: 3-27-98

AMOCO PRODUCTION COMPANY
WASTE MANAGEMENT FACILITY PERMIT
Crouch Mesa FACILITY, SW/4 SE/4 SEC 2 - T29N - R12W NMPM

Pursuant to NMOCD Order R-10411-B, Exhibit "A" (Rule 711), Amoco Production Company is submitting a Form C-137 for the pre-existing Crouch Mesa Waste Management Facility. Section E. (1) of Order R-10411-B outlines the information required for a facility permitted prior to adoption of this Order to include only sections B.1.a, h, i and l. However, Amoco is responding to all sections B.1.a through B.1.l pursuant to the request of NMOCD as outlined in their letter dated February 6, 1998. The Crouch Mesa Waste Management Facility is a pre-existing facility permitted by NMOCD prior to adoption of Order R-10411-B.

B.1.a Name and Address of Facility Applicant:

Amoco Production Company
200 Amoco Ct.
Farmington, NM 87401

B.1.b Topographic Map Indicating Facility Location

A plat of the site is already on file with the NMOCD.

B.1.c Names & Addresses of Surface Owners Adjacent to Facility

Based on a records review at the San Juan County, New Mexico Assessors Office numerous surface land owners are of record within a 1 mile radius of the facility. A rural residential community is located approximately 1/2 mile east of the facility and many small private residences are found in this village. Large property owners of record with the County Assessors Office adjacent to or near the site are listed as follows:

U.S. Bureau of Land Management
1235 La Plata Highway
Farmington, New Mexico 87401

Tierra Environmental Company, Inc.
P.O. Drawer 15250
Farmington, New Mexico 87401

B.1.d Facility Description

The existing facility is an 8.8± acre non-commercial centralized waste management site. Non RCRA oilfield generated wastes resulting from oil and gas production operations are transported to the site for treatment. Wastes include hydrocarbon impacted soils and earthen media.

Site schematics of the facility are attached as Figure 1.

Buffer Zone: The existing waste management facility is currently permitted by NMOCD and the site was constructed prior to NMOCD buffer zone requirements. However, all media placed into the facility for remediation has been move to maintain a 100 foot buffer zone and this zone will be maintained.

Facility Berming: The National Weather Service was consulted with respect to precipitation during a 100 year storm in this area and the maximum rainfall expected is approximately 2.7-inches during a 24 hour period. The complete facility has been constructed with a 4 foot tall berm which is adequate to contain this precipitation. Individual cells, which have been graded to a level surface, are constructed with 3 foot tall minimum berms. Individual compost piles or landfarms within each cell are constructed with 2 foot tall minimum berms.

B.1.e Waste Management Plan

Products deposited at the Crouch Mesa Waste Management Facility include hydrocarbon impacted soils and earthen media. The volume and origination of this material is recorded by Amoco authorized transport drivers using manifests that follow each deposit. Deliveries are stockpiled and then either landfarmed or composted within 72 hours of receipt. Individual compost piles or cells are labelled and bermed.

Material placed into compost cells may be mixed with livestock manure to enhance remediation. Compost cells have weekly temperature measurements that are recorded and maintained for NMOCD review. Compost is turned as found necessary to enhance biodegradation.

Material placed into landfarm cells is maintained with lifts of 6-inches or less. This material is turned or disked as necessary to enhance biodegradation.

Treatment Zone Monitoring & Reporting:

a. One (1) background soil sample will be taken from the center portion of each landfarm or compost cell at a depth of approximately two (2) feet below the native ground surface prior to initial operation of that cell. The sample will be analyzed for TPH, major cations/anions, BTEX and eight (8) RCRA heavy metals. (Note: all existing operating cells at the Crouch Mesa landfarm are currently remediating contaminated media. In the event that additional cells are opened at the landfarm, this background sampling will be conducted.)

b. One random soil sample will be taken from each active cell (not larger than 5 acres in size) on a quarterly basis. This sample will be collected from a depth of approximately three (3) feet below the native cell elevation. The sample will be tested for TPH and BTEX quarterly and for cations/anions and eight (8) RCRA heavy metals annually. Test boreholes will be filled with an impermeable material such as cement.

c. Analytical results from the treatment zone monitoring will be submitted to the NMOCD on an annual basis.

B.1.f Contingence Plan for Spills & Releases

Spills and releases will be treated on site. If an off site release occurs the impacted soils will be excavated and transported to the facility for treatment.

Pursuant to Rule 116, major spills of 25 barrels or more of liquid will be reported to the NMOCD district office and to the Environmental Bureau Chief by telephone or personal communication within 24 hours of the release. A subsequent written notification of the spill on Form C-141 will be submitted in duplicate to the district office and to the Environmental Bureau Chief within 15 days of the spill or incident.

Minor spills of between 5 and 25 barrels of liquid will be reported to the district office and the Environmental Bureau Chief with a subsequent written notification on Form C-141 within 15 days of the spill or incident.

B.1.g Routine Inspection & Maintenance

Inspection and maintenance will be conducted on a weekly basis or immediately following consequential rainstorms or windstorms. This inspection will include determination of facility integrity and security. Repairs to facility defects will be made as soon as possible. If a defect will jeopardize the integrity of a treatment unit, additional wastes will not be placed into the treatment unit until repairs have been completed.

B.1.h Contingence Plan in the Event of H_2S Release

This facility is not permitted to receive liquid wastes. H_2S generation or accumulation requires an anaerobic environment which generally cannot occur in an aerated soil environment. In the rare event that H_2S may develop at the site, a simple turning of the soils will immediately eliminate any potential anaerobic environment. Therefore, an H_2S contingence plan is not appropriate for a soils remediation facility.

B.1.i Closure plan:

At closure site fences will be removed and berms will be recontoured to fit existing grades. Alternatively, if the landowner desires to keep the fences and berms in place for use as a facility not requiring NMOCD permitting, no alterations to these structures will be made.

Five (5) point composite samples will be collected from 2'-3' below each cell area. These samples will be submitted to a qualified laboratory for determination of TPH and BTEX content. If TPH or BTEX are found to exceed existing NMOCD closure standards for the site, a site specific remediation plan will be developed and submitted to NMOCD for acceptance. Otherwise, the site will be permanently closed.

The estimated cost to complete site closure and abandonment, including surface soil sampling and testing, is $15,000.

B.1.j Groundwater Depth, Quality and Resistance to Impacts

Groundwater at the site is believed to be in excess of 150 feet below ground surface. The site is located on a mesa at an elevation of 5,820 feet. Approximately 2 miles northeast of the facility Amoco has conducted groundwater quality monitoring at the Rowland GC 1 wellsite, Section (P)25 - T30N - R12W. Groundwater at this site is found at an elevation of approximately 5,650 feet. The Animas River is located approximately 2.5 miles northwest of the site at an elevation of approximately 5,500 feet.

The surface geology at the site is comprised of the San Jose Formation. This is a massive sandstone ranging in thickness from 1,100 to 2,500 feet. The San Jose sandstone is anticipated to form a sufficient barrier to prevent seepage of surface water to the groundwater surface. Inspection of road cuts and exposed outcrops surrounding the site indicates the presence of competent sandstones and shalestones below the ground surface.

Below the San Jose is the Nacimiento Formation, a shale/mudstone/sandstone that is a main water bearing strata for the region. The groundwater from the Nacimiento is not of high quality. A water sample collected from one of the Rowland GC 1 groundwater monitor wells was tested for general water chemistry in June, 1997. High total dissolved solids (8,400 mg/L) and sulfate (5,250 mg/L) was reported by the testing laboratory. A copy of the laboratory report is attached.

B.1.k Notice Requirements

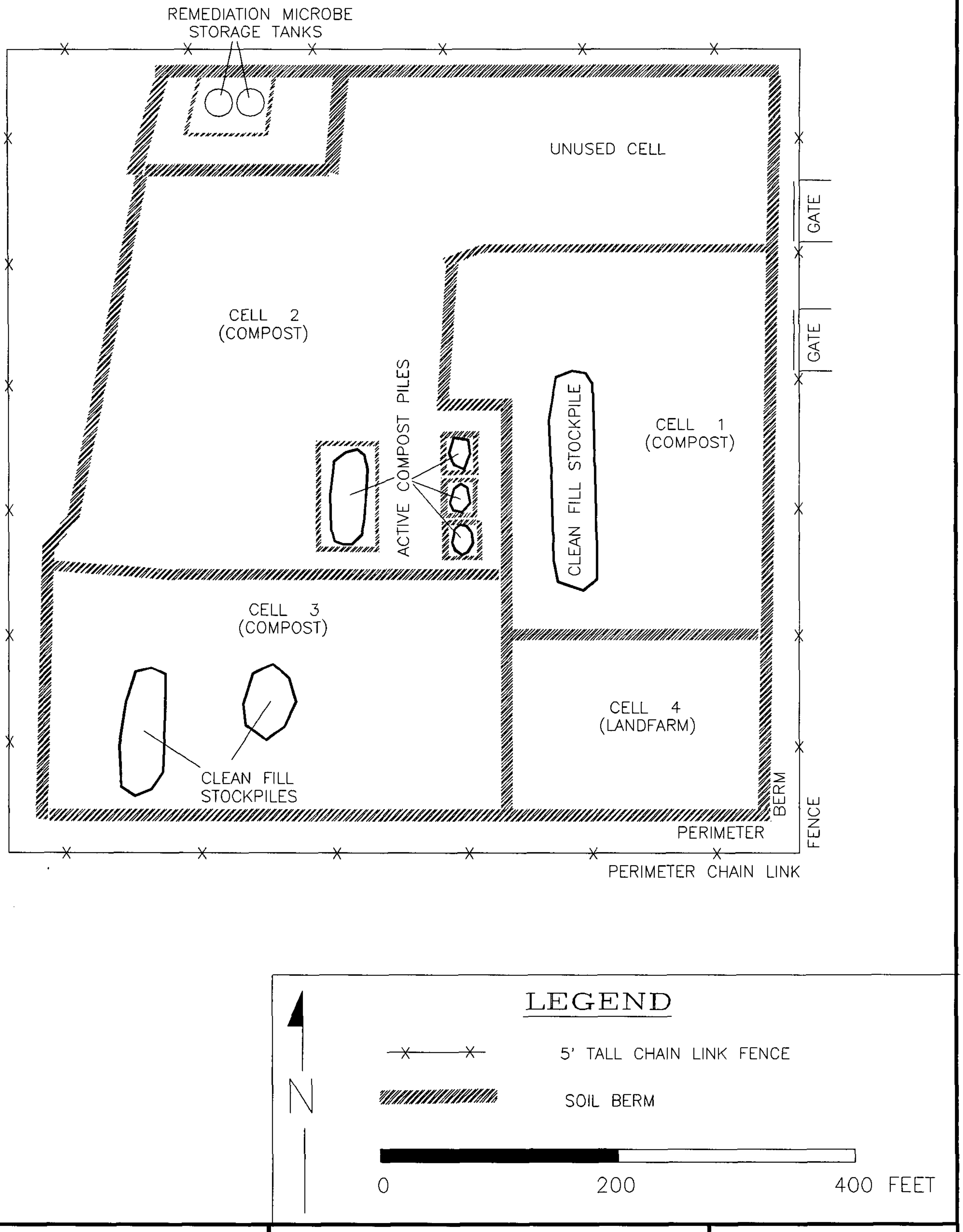
The Crouch Mesa Waste Management Facility is an existing facility previously permitted by the NMOCD. As such, it is grandfathered in as an approved facility and notice requirements are not applicable.

B.1.l Certification by Authorized Representative

An authorized representative has signed an original Form C-137 included with this application.

AMOCO PRODUCTION COMPANY
CROUCH MESA WASTE MANAGEMENT FACILITY
NMOCD RULE 711 APPLICATION

SITE FIGURE



AMOCO PRODUCTION CO.
CROUCH MESA WASTE MGMT FAC
SAN JUAN CO., NEW MEXICO

MARCH 1998

BLAGG ENGINEERING, INC.
CONSULTING ENGINEERING SERVICES

P.O. BOX 87
BLOOMFIELD, NEW MEXICO 87413

PHONE: (505) 632-1199

SITE SCHEMATIC

FIGURE 1

DRWN BY: JCB

CRMESA1

PROJ MGR: JCB

AMOCO PRODUCTION COMPANY
CROUCH MESA WASTE MANAGEMENT FACILITY
NMOCD RULE 711 APPLICATION

BACKGROUND GROUNDWATER QUALITY (SECTION B.1.j)
LABORATORY REPORTS FOR ROWLAND GC 1 MONITOR WELL

ENVIROTECH LABS

PRACTICAL SOLUTIONS FOR A BETTER TOMORROW

CATION / ANION ANALYSIS

Client:	Blagg / Amoco	Project #:	04034-10
Sample ID:	MW #6	Date Reported:	06-26-97
Laboratory Number:	B496	Date Sampled:	06-24-97
Sample Matrix:	Water	Date Received:	06-24-97
Preservative:	Cool	Date Analyzed:	06-25-97
Condition:	Cool & Intact	Chain of Custody:	5115

Parameter	Analytical Result	Units		Units
pH	**7.21**	s.u.		
Conductivity @ 25° C	**16,850**	umhos/cm		
Total Dissolved Solids @ 180C	**8,400**	mg/L		
Total Dissolved Solids (Calc)	**8,390**	mg/L		
SAR	**23.9**	ratio		
Total Alkalinity as CaCO3	**298**	mg/L		
Total Hardness as CaCO3	**1,490**	mg/L		
Bicarbonate as HCO3	**298**	mg/L	4.88	meq/L
Carbonate as CO3	**<1**	mg/L	0.00	meq/L
Hydroxide as OH	**<1**	mg/L	0.00	meq/L
Nitrate Nitrogen	**0.8**	mg/L	0.01	meq/L
Nitrite Nitrogen	**<0.001**	mg/L	0.00	meq/L
Chloride	**278**	mg/L	7.84	meq/L
Fluoride	**3.26**	mg/L	0.17	meq/L
Phosphate	**2.3**	mg/L	0.07	meq/L
Sulfate	**5,250**	mg/L	109.31	meq/L
Calcium	**477**	mg/L	23.80	meq/L
Magnesium	**73.2**	mg/L	6.02	meq/L
Potassium	**4.8**	mg/L	0.12	meq/L
Sodium	**2,120**	mg/L	92.22	meq/L
Cations			122.17	meq/L
Anions			122.29	meq/L
Cation/Anion Difference			**0.10%**	

Reference: U.S.E.P.A., 600/4-79-020, "Methods for Chemical Analysis of Water and Wastes", 1983. Standard Methods For The Examination of Water And Waste Water", 18th ed., 1992.

Comments: **Rowland GC #1.**

Analyst

Stacy W Sendler

Review

OCD/Amoco Meeting 9/3/97 9:00 am

attendees - Bill Olson - OCD Environmental Bureau
Roger Anderson - " "
Denny Foust - OCD Aztec
Martyne Kieling - OCD Environmental Bureau
Buddy Shaw - Amoco

1) Pit Inventory

- Amoco currently selling 900 wells, will be doing site assessments at all these
- Amoco has approximately 2800 wells
- Amoco requested time extension for inventory
- if not will have to spend considerable money to assess/inspect each site
- could give listing of centralized sites by Nov. 1
* and listing of all pits by next year

* OCD will discuss with Director

2) Crouch Mesa

Repermitting under 711
Modifications will be covered in repermitting
No public notice occurs unless there is major modification (ie increase in size)
Inspection report will be coming shortly
Sample analyses show low contamination in mixing areas

- need to resample these sites this fall
- mixing areas will need to be on impermeable pads during repermitting

Roger Anderson

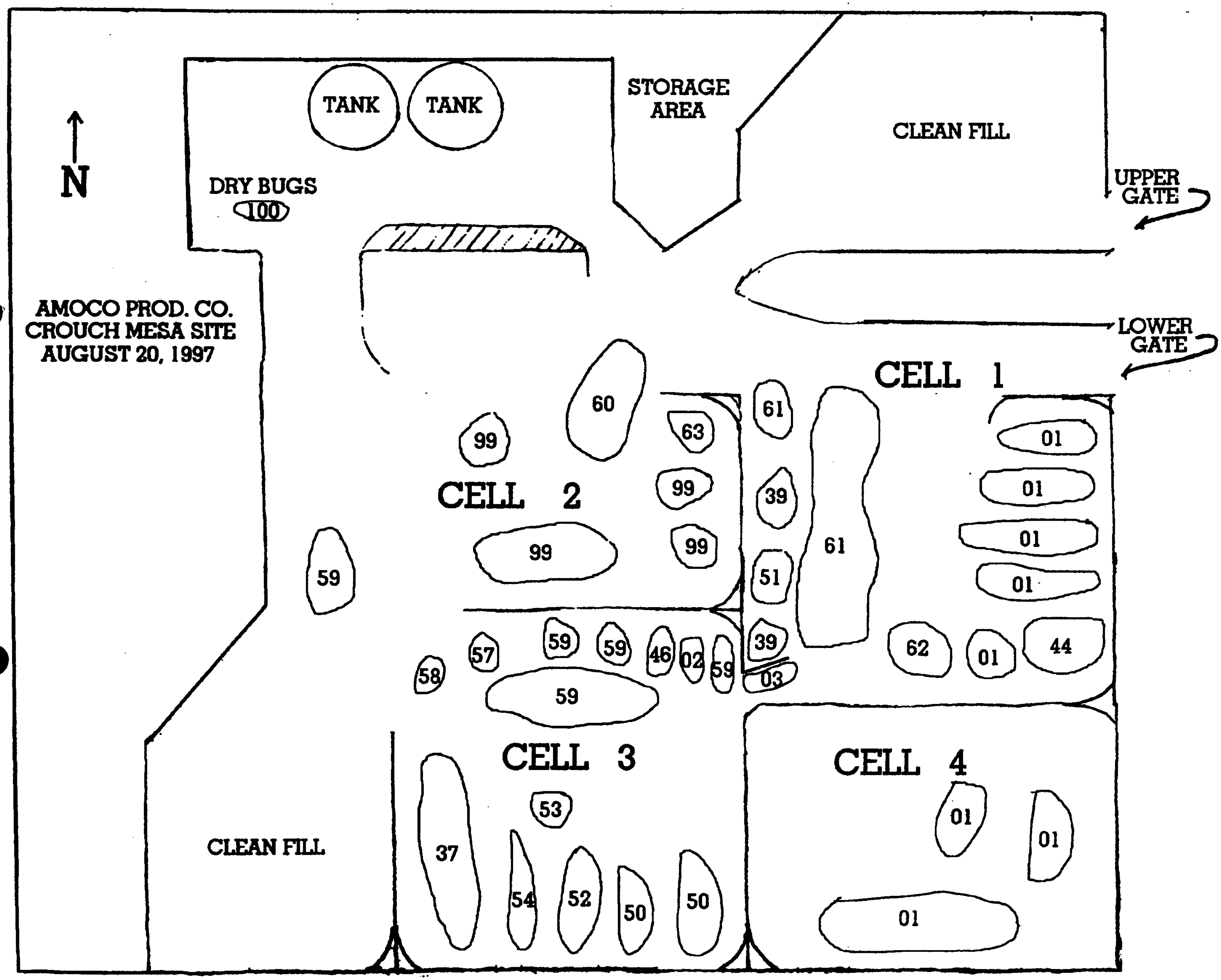
RECEIVED
AUG 28 1997
Environmental Bureau
Oil Conservation Division

AMOCO PRODUCTION COMPANY
CROUCH MESA COMPOST SITE
AUGUST 20, 1997

CELL NUMBER	PILE NUMBER	LOCATION
1	01	TIFFANY INJ. WELL # 6
3	02	TRASH (STICKS & STONES)
1	03	DRY MANURE
1	39	GCU 145 - TANK CLEANED
3	46	BACA GAS COM A # 1
3	50	WEST HAMMOND COMPRESSOR
1	51	3 C COMPRESSOR
3	52	FLORANCE BLS # 14
3	53	PYIAN A # 1
3	54	T L ROADS C # 1 E
3	57	RAMARO GAS COM. A # 1
3	58	MATERIAL FROM MIXING PIT
3	59	STEDGE # 1 E
2	60	HEATON LS # 27
1	61	~~McCORY~~ Mc Coy # 1E
1	62	PESCO (SEPERATORS)
2	63	HWY. 64 COMPRESSOR
2	99	CLEAN FILL
2	100	DRY MICROBES

RECEIVED
AUG 26 1997
OIL CON. DIV.
DIST. 3

MJK
8/24/97



AMOCO PROD. CO.
CROUCH MESA SITE
AUGUST 20, 1997

BLAGG ENGINEERING, INC.
P.O. Box 87
Bloomfield, New Mexico 87413
Phone: (505) 632-1199
Fax: (505) 632-3903

August 18, 1997

AUG 20 1997

Mr. Roger Anderson
Environmental Bureau Chief
New Mexico Oil Conservation Division
2040 South Pacheco Street
Santa Fe, New Mexico 87505

RE: Amoco Production Company
Crouch Mesa Compost Facility Site Map
SW/4 SE/4, Sec, 2, T29N, R12W, NMPM, San Juan County, NM

Dear Mr. Anderson:

On behalf of Amoco Production Company and Environmental Protection Company (EPC), Blagg Engineering, Inc. respectfully submits the attached site map of the referenced location. It is our understanding that the original site map from the initial correspondence by EPC was illegible due to photocopying.

If you have any questions regarding the information given, please contact us. Thank you for your cooperation and assistance.

Sincerely,
BLAGG ENGINEERING, INC.

Nelson Velez
Staff Geologist

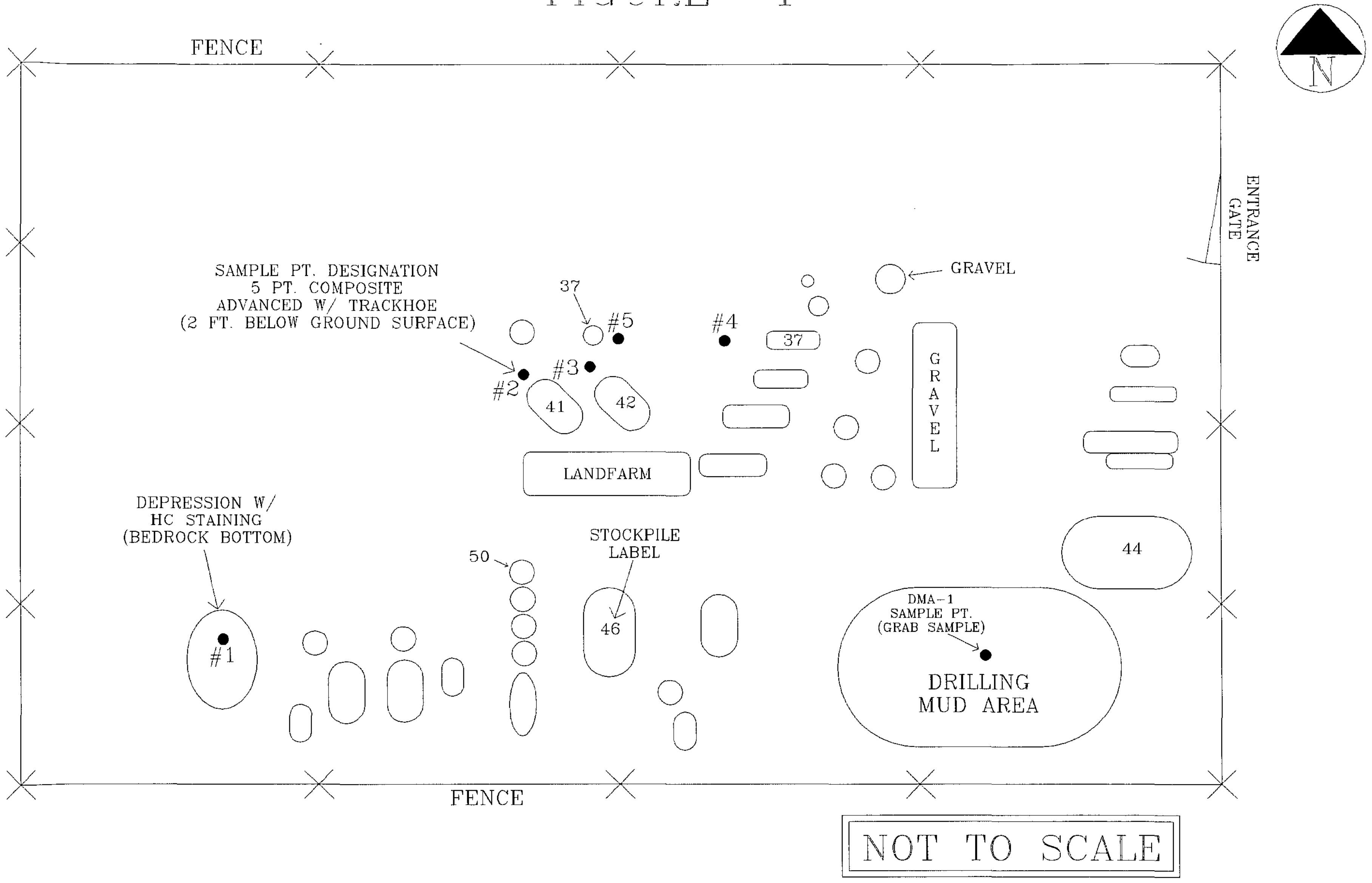
Attachments: Crouch Mesa Compost Facility Site Map

cc: Denny Foust, NMOCD, District Office, Aztec, NM
Buddy Shaw, AMOCO, Farmington, NM
Jake Hatcher, EPC, Farmington, NM

NV/nv

CROUCH.CVL

FIGURE 1



AMOCO PRODUCTION COMPANY
CROUCH MESA COMPOST FACILITY
SW/4, SE/4 SEC. 2, T29N, R12W
SAN JUAN COUNTY, NEW MEXICO

BLAGG ENGINEERING, INC.
CONSULTING PETROLEUM / RECLAMATION SERVICES
P.O. BOX 87
BLOOMFIELD, NEW MEXICO 87413
PHONE: (505) 632-1199

PROJECT: ANN. SAMPLING
DRAWN BY: NJV
FILENAME: CROUCH.SKD

SITE
MAP
8/97

**NEW MEXICO ENERGY, MINERALS
& NATURAL RESOURCES DEPARTMENT**

OIL CONSERVATION DIVISION
AZTEC DISTRICT OFFICE
1000 RIO BRAZOS ROAD
AZTEC, NEW MEXICO 87410
(505) 334-6178 Fax (505)334-6170

GARY E. JOHNSON
GOVERNOR

JENNIFER A. SALISBURY
CABINET SECRETARY

Certified: P-471-215-189

April 29, 1997

Amoco Production Company
Mr B D Shaw
Environmental Coordinator
SJ Oper Ctr
200 S Amoco Crt
Farmington NM 87401

RE: Violations of Rule 105 and of the 711 permit for the Crouch Mesa Composting Facility O-2-29N-12W, San Juan County

Dear Mr. Shaw:

We have not yet received a complete response to our March 24, 1997, letter concerning the referenced violations. Since that letter we have evidence of at least two more incidents where liquids were hauled to the facility and there was no attendant present. A follow-up inspection on April 17 found that the free liquids had not been removed from the area where drilling mud had been dumped.

You are to immediately cease accepting any liquids at the facility. All free liquids are to be removed from the bermed areas within five days. The information required by my March 24 letter is to be submitted within five days.

Further violations may result in shut-down of the facility and fines.

Sincerely,

Frank T. Chavez
District Supervisor

RECEIVED

JUN - 6 1997

Environmental Bureau
Oil Conservation Division

FTC\sh

cc: Operator File
Roger Anderson, OCD Environmental Chief
DF, District III Environmental Geologist

Roger Anderson

San Juan Operations Center

RECEIVED
APR 1 8 1997
OIL CON. DIV.
DIST. 3

APRIL 18, 1997

NMOCD
1000 RIO BRAZOS ROAD
AZTEC,NM 87410

AMOCO CROUCH MESA COMPOST SITE

THIS WILL CONFIRM OUR PHONE CONVERSATION THIS MORNING ON THE ABOVE SUBJECT SITE. LISTED BELOW ARE AMOCO COMMENTS:

1. NO LIQUIDS WILL BE ACCEPTED AT OUR FACILITY UNTIL A PERMIT MODIFICATION IS RECEIVED.
2. ONLY SOLIDS WILL BE COMPOSTED AT THIS SITE.
3. GATE REPAIRS TO IMPROVE SECURITY WILL BE DONE WITHIN A WEEK.
4. EXISTING LIQUIDS WILL BE HAULED TO BASIN DISPOSAL AS SOON AS TRUCKS ARE AVAILABLE.
5. MUD VOLUME INFO HAS NOT BE LOCATED DUE TO SOME DRILLING FOREMAN LAYOFFS. ESTIMATED TOTAL VOLUME IS 1800BBLS.
6. AN ATTENDANT WILL BE REQUIRED TO TAKE DELIVERIES AT THE SITE.
7. WATER SAMPLES HAVE BEEN TAKEN TO CONFIRM CATION/ANION MAKEUP. RESULTS WILL BE FURNISHED TO YOU AS SOON AS WE RECEIVE THEM.

I APOLOGIZE FOR THE DISORGANIZED APPROACH ON THIS MATTER. IT WILL NOT HAPPEN IN THE FUTURE. THANK YOU FOR YOUR PATIENCE.

Buddy Shaw
BUDDY SHAW
ENVIRONMENTAL COORDINATOR
(505) 326-9219

Amoco Exploration and Production 200 Amoco Court Farmington, New Mexico 87401 (505) 326-9200

RECEIVED
APR 24 1997
Environmental Bureau
Oil Conservation Division

MJK
File 5/6/97

NEW MEXICO ENERGY, MINERALS & NATURAL RESOURCES DEPARTMENT

OIL CONSERVATION DIVISION
AZTEC DISTRICT OFFICE
1000 RIO BRAZOS ROAD
AZTEC, NEW MEXICO 87410
(505) 334-6178 Fax (505)334-6170

GARY E. JOHNSON
GOVERNOR

JENNIFER A. SALISBURY
CABINET SECRETARY

Certificate #P 471 215 184

March 24, 1997

Amoco Production Company
Mr B D Shaw
Environmental Coordinator
200 Amoco Court
Farmington NM 87401

RE: Violations of Rule 105 and of the 711 permit for the Crouch Mesa Composting Facility O-2-29N-12W, San Juan County

Dear Mr. Shaw:

During field inspections on March 17 and 24, 1997, we found the following violations:

1) You have hauled drilling fluids to an earthen pit at the Amoco Crouch Mesa Facility. You confirmed to Mr. Foust by telephone on March 19, 1997, that Amoco had hauled drilling mud to the Crouch Mesa Facility. Your permit states, "Only contaminated soils . . ." and "Only solids . . ." will be accepted at the facility and explicitly says, "No free liquids . . . will be accepted at the facility."

2) The facility was not secured because one of the gates had been lifted off of its hinges and was standing open.

3) These fluids were moved without the authorization required by Rule 105.

Beginning immediately Amoco shall not haul any drilling fluids to its Crouch Mesa Compost Facility without a modification of the 711 permit and specific permission from the Aztec District Office. You are to begin removing all free standing liquid from the facility and submit a proposal for further handling of the existing mud volumes. By April 15, 1997, file with the Aztec District Office the information required by your permit for the drilling fluids that have been hauled to the Crouch Mesa Compost Facility and the volumes hauled. Also indicate whether there was an attendant on duty at the facility when the loads were delivered.

Sincerely,

Frank T. Chavez
District Supervisor

FTC\sh

cc: Roger Anderson - Environmental Dept. S/F DF Environmental File

NEW MEXICO ENERGY, MINERALS
& NATURAL RESOURCES DEPARTMENT

OIL CONSERVATION DIVISION
2040 South Pacheco Street
Santa Fe, New Mexico 87505
(505) 827-7131

April 16, 1997

<u>CERTIFIED MAIL</u>
<u>RETURN RECEIPT NO. P-326-936-465</u>

Mr. Buddy Shaw
AMOCO Production Company
San Juan Operations Center
200 Amoco Court
Farmington, New Mexico 87401

RE: AMOCO Crouch Mesa Compost Facility-Discharge Plan
SW/4, SE/4, Sec. 2, T. 29 N, R. 12 W
San Juan County, New Mexico

Dear Mr. Shaw:

According to Oil Conservation Division (OCD) files Amoco Production Company Crouch Mesa Compost Facility (Crouch Mesa) currently has a permit to operate a centralized soils remediation facility at the above location. This permit persuant to OCD Rule 711 A(4) will expire on July 28, 1997. Crouch Mesa does not have or need to renew a surface discharge plan and is not required to pay a Fee. The OCD is returning the check to AMOCO Production Company (attachment 1).

The OCD is currently in the process of re-permitting all surface waste management facilities under the new Rule 711. The Crouch Mesa centralized soil remediation facility is included under the new Rule 711. Please refer to the enclosed attachment 2. The present Crouch Mesa permit will be automatically extended until the new 711 permit is issued.

If you have any questions please do not hesitate to contact me at (505) 827-7153.

Sincerely,

Martyne J Kiely

Martyne J. Kieling
Environmental Geologist

Attachments

xc: OCD Aztec Office

AMOCO

Southern
Rockies
Business
Unit

San Juan Operations Center

ECEIVE
APR 11 1997

APRIL 4,1997

NMOCD
2040 S. PACHECO
SANTA FE, NM 87505

ATTENTION: ROGER ANDERSON

AMOCO CROUCH MESA COMPOST FACILITY-DISCHARGE PLAN

AMOCO PRODUCTION COMPANY REQUESTS APPROVAL TO RENEW OUR SURFACE DISCHARGE PLAN WHICH EXPIRES ON JULY 13,1997. OUR FEE IS ENCLOSED. WE ALSO REQUEST APPROVAL TO AMEND OUR PERMIT TO INCLUDE THE FOLLOWING:

1. HYDROCARBON CONTAMINATED SOILS(COMPOSTING)
2. DRILLING MUD(DRYING ONLY)
3. SEPARATOR SLUDGE-CLEANOUT(COMPOSTING)
4. TANK BOTTOMS(COMPOSTING)

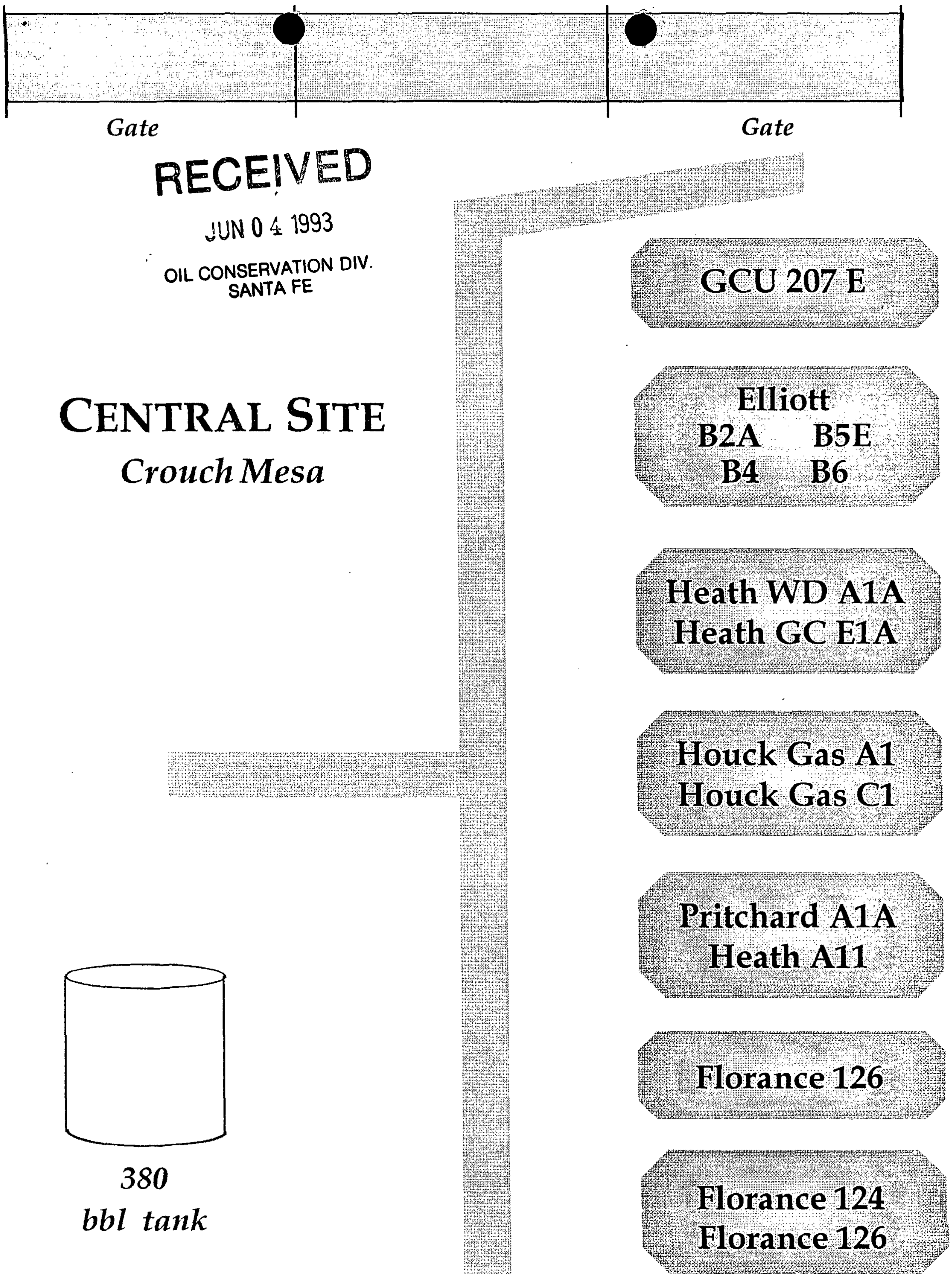
ONLY EXEMPT NON-HAZARDOUS OILFIELD WASTE WILL BE ACCEPTED AT THIS SITE. THANK YOU FOR YOUR HELP AND CONSIDERATION.

B D Shaw

BUDDY SHAW
ENVIRONMENTAL COORDINATOR
326-9219

ENCLOSURE

CENTRAL SITE
Crouch Mesa



CROUCH MESA SUMMARY

Pile	**Site**	**Tons**	***Envirotech Assessment Composite***		***Inter - Mountain Labs Average***		**Date Brought on Site**
			TPH	**BTEX**	**TPH**	**BTEX**	
1	GCU 207E	1,555	29,600	243,200	1,773	ND	9/24/92 to 9/28/92
2	Elliott B 5E	932	22,200	76,986	140	8	9/29/92 to 10/5/92
2	Elliott B 4	155	19,800	21,307	140	8	9/29/92 to 10/5/92
2	Elliott B 2A	75	900	796	140	8	9/29/92 to 10/5/92
2	Elliott B 6	215	1,950	14,290	140	8	9/29/92 to 10/5/92
3	Heath WD A1A	378	10,600	78,760	437	ND	10/5/92 to 10/8/92
3	Heath GC E1A	755	13,700	40,020	437	ND	10/5/92 to 10/8/92
4	Houck Gas A1	199	9,400	9,952	2,888	325	10/9/92 to 10/14/92
4	Houck Gas C1	910	5,100	290,420	2,888	325	10/9/92 to 10/14/92
5	Pritchard A1A	391	20,800	89,717	2,226	455	10/28/92 to 11/11/92
5	Heath A11	303	46,400	97,400	2,226	455	10/28/92 to 11/11/92
6	Florance 126	677	6,400	3,846	142	1,644	12/10/92 to 12/11/92
7	Florance 126	245	8,400	3,846	140	1,336	12/14/92 to 12/18/92
7	Florance 124	432	1,190	335,300	140	1,336	12/14/92 to 12/18/92

**Average values are mathematical averages taken from individual lab sample results.*

AMOCO

Southern
Rockies
Business
Unit

OIL CONSERVATION DIVISION
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'92 OCT 29 AM 8 47

San Juan Operations Center

October 26, 1992

New Mexico Oil Conservaton Division ✓
P. O. Box 2088
Santa Fe, NM 87501

Attention: Bill Olson

File: BDS-33-986

Produced Water Test - Composting

Amoco Production Company requests approval to test the use of produced water at our Crouch Mesa compost site. We would use only one windrow for the test. A maximum of 1000 barrels would be used. Listed below is a range of produced water characteristics for the tests. We would be diverting 80-barrel water trucks from our field operations.

Formation	Characteristic Ranges		Average
Blanco Mesaverde	Sodium	500 - 5000	3120
Basin Dakota	Calcium	50 - 500	170
Pictured Cliffs	Chloride	1500 - 5000	2846
	Sulfate	1000 - 6000	3173
	pH	5.6 - 11.4	9.8
	TDS	4500 - 15000	9221

No Fruitland Coal water will be used for this test. Soil tests (SAR) will be performed from both fresh water windrows and the produced water windrow to compare soil quality.

Please call if you have any qustions (326-9219). Thank you for your consideration in this matter.

BDShaw

B. D. Shaw
Environmental Coordinator

BDS:en

cc: Denny Foust - OCD, Aztec

Amoco Production Company 200 Amoco Court Farmington, New Mexico 87401 (505) 326-9200

WESTERN ADVANCED SYSTEMS & TECHNOLOGIES FOR THE ENVIRONMENT, INC.

W.A.S.T.E.

77-000 Ave, 66
Thermal, California 92274
(619) 397-8123
Fax (619) 397-8126

FAX COVER SHEET

DATE June 10, 1992. TIME:

ATTENTION: Kathy Brown

COMPANY NAME:

REFERENCE:

FROM: Matt Harper

TOTAL NUMBER OF PAGES (INCLUDING COVER PAGE): 2

IF NOT RECEIVED CORRECTLY PLEASE CALL 619 397-8123

MESSAGE:

Per our telecon - we would like to submit this letter as an amendment to our original proposal. [redacted]

Thank you.

Signed Copy Sorry

Environmental Protection Company

June 10, 1992

Oil Conservation Division
P.O.Box 2088
Land Office Building
Santa Fe, N.M. 87504-2088
Attn. Mr. Roger Anderson

Subject: Amendment to Amoco's Crouch Mesa OCD Permit

Dear Sir:

Per Amoco's (Mr. Buddy Shaw) instructions Environmental Protection Company (EPC) requests permission to use remediating bugs on the Crouch Mesa site. This liquid can enhance and/or substitute sewage sludge in Environmental Protection Company's proprietary process, which Amoco is contracting, for the oily dirt remediation. A sample of the product is available upon request.

To date Amoco has not recieved permission from ED to use sewage sludge on the site and it is our desire to use these bugs until such time permission is granted.

Volume:
25 - 50 gallons per ton of oily dirt

Application:
The product will be poured in to a trench formed on top of the windrow. The product will be allowed to soak in and then will be turned evenly through the windrow.

Respectfully yours,

Matt Harder

Matt Harder
Site Superintendent

cc. Mr. Buddy Shaw - Amoco, Environmental Coordinator
Mr. Walt Kolbe - EPC, President

OCD/ED/Amoco Meeting on Composting 5/20/92 9:00am

Attendees -	Bill Olson	- OCD
	Roger Anderson	- "
	Gerald Silva	- ED Solid Waste
	Dave Duran	- " " "
	Buddy Shaw	- Amoco
	Walt Colby	- ~~Amoco~~ Environmental Protection Company
	Chuck	- ED GW Protection & Remediation
	Richard Ohrbom	- ED " " "
	Steve Cary	- " " " "

9

B.S. Intro on concept, pilot test
Estimate 80% of pits remediated on site
" 20% removed offsite for composting
5 year program
Estimate 2500 pits to be cleaned
" 3 week remediation
Also want to eventually do composting onsite for small pits
Manure from XAPI
Need site for 60 site BLM pilot

D.D. Is municipal sludge to be used at all sites
If so solid waste regs apply.
B.S. Amoco feels size limitation (pg 8 solid waste regs) exempts this operation. Request an ED determination on this issue

O.D. Solid waste regs do apply that is either or clause

W.C. part 906 of regs

D.V. ED agrees with concept but can't give interim permits outside full permitting process (180 day or less)
Not allowed to give research, develop permits
ED doesn't like idea of individual site, prefer centralized sites (ie for all pads within 10 miles)
What do you want to do with remediated compost

B.S. Use for backfill at removed sites
Expect 60 site pilot to last for 60-90 days

G.S. ~~EIf~~ If pile temp is over 155° than is this actually composting or transformation. Microbes for composting would die at these temperatures

D.V. ~~W.C.~~ What is GW Bureau position

S.C. Believe solid waste regs more applicable than WQCC regs

D.V. ED will look at regs, likes concepts

B.S. Amoco expects to have approx 12 centralized sites in future

RCA OCD will review by next Fri and draft letter to Amoco

D.V. ED will review and get together with OCD to
discuss in next week
ED will have preliminary review to Amoco by
1st week of June

AMOCO

Southern
Rockies
Business
Unit

San Juan Operations Center

April 21, 1992

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APR 27 1992

OIL CONSERVATION DIV.
SANTA FE

Mr. Roger Anderson
Oil Conservation Division
P. O. Box 2088
Santa Fe, NM 87504

File: BDS-13-986

Amoco Production is requesting OCD permission to remediate hydrocarbon stained soils utilizing the compost technique. We plan to reduce total petroleum hydrocarbons and BTEX below regulatory limits as well as metals (TCLP).

We will be purchasing sewage sludge from nearby municipalities as a key ingredient in one "Bioconversion" process. The processing site is ideal for this project because of the groundwater depth and the attached soil analyses. The area will be totally fenced in and Amoco Production has agreed to assume responsibility for the site.

Monitoring of the site and documenting the operation will be done by Dr. Bruce Dale, Professor of Chemical Engineering and Agricultural Engineering, Director of the Engineering Biosciences Research Center at Texas A & M University. This project is very conservative in nature and because of the implications for all the parties involved you can be assured that this project will be operated with the utmost care.

Sincerely,

BD Shaw

B. D. Shaw
Environmental Coordinator

BDS:en
Attachment

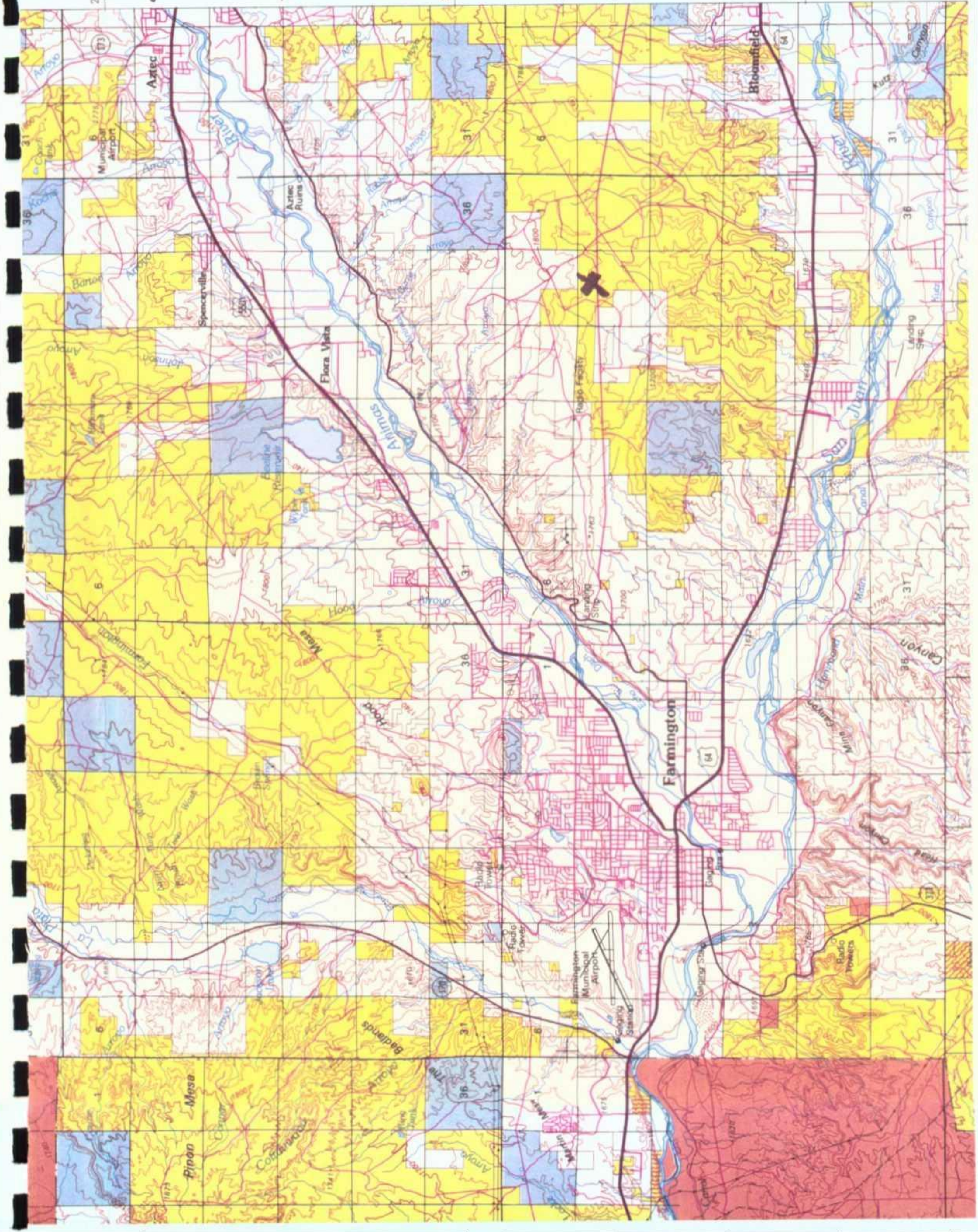
Amoco Production Company 200 Amoco Court Farmington, New Mexico 87401 (505) 326-9200

Table of Contents

LOCATION

The project site is located in San Juan County, New Mexico. It would be referred to as "the Southwest Quarter of the Southwest quarter of the Southeast Quarter (SW 1/4 SW1/4SE1/4) of section two (2), township twenty nine (29), Range twelve (12) west, N.M.P.M., San Juan County, New Mexico.

There is a map on the following page showing the location of the site with respect to the City of Farmington.


2 125
408
T 30 N
2 100
45'
407
T 29 N
2 075
Aztec
Municipal Airport
Aztec Ruins
Animas River
Spencerville
Flora Vista
Radio Facility
Landing Strip
Bloomfield
San Juan River
Landing Strip
Farmington
64
Radio Tower
Radio Tower
Farmington Municipal Airport
Gaging Station
Gaging Station
Radio Towers
Hood Mesa
Farmington Glade
The Badlands
Pinon Mesa
Cottonwood Arroyo
Johnson
Barton
La Plata
Hood
Mine Canyon
Canyon
Kutz Canyon
173
550
371
36
31
6
1

PILOT PROJECT DESCRIPTION

This section contains a technical paper written by Dr. Bruce Dale that chronicles his independent assessment of Bioconversion as a means to remediate oil field wastes.

The actual testing took place in Summer of 1991 and was an unqualified success.

Bioconversion for Remediation of Oil Field Wastes:

A Preliminary Technical/Regulatory Evaluation

Submitted to:
Mr. Buddy Shaw, Environmental Coordinator
AMOCO Production Corporation
200 AMOCO Court
Farmington, New Mexico 87401

Submitted By:
Bruce E. Dale, Ph. D.
Professor of Chemical Engineering
Director, Engineering Biosciences Research Center
Cater-Mattil Hall
Texas A & M University
College Station, Texas 77843-2476

Date: September 25, 1991

Endorsement of this report by Texas A & M University is neither expressed nor implied.

EXECUTIVE SUMMARY

I was retained by Mr. Buddy Shaw, Environmental Coordinator for AMOCO Production Corporation, to provide an independent technical assessment of bioconversion as a means to remediating oil field wastes. The Bioconversion tests were conducted by Mr. Jerry Finney of JWF Associates in Farmington, New Mexico. The Bioconversion mixture consisted of sewage sludge, manure, waste paper and oily dirt.

In short, the Bioconversion tests were successful. A highly active microbial community was maintained within the bioconversion piles over a period of many weeks as evidenced by the high pile temperatures maintained, the disappearance of sewage sludge odor and disintegration of the cardboard boxes. The microbes consumed both the hydrocarbons in the oily dirt and the cellulosios in the cardboard boxes. Benzene, toluene and xylene (BTEX) concentrations were reduced to acceptable limits and eight heavy metals as determined by TCLP were also well under regulatory limits. The analytical test for Total Petroleum Hydrocarbons (TPH) was not originally developed for a sample matrix containing a large fraction of biological material and gave false positives results. These false positives showed TPH increasing in the later stages of Bioconversion and then decreasing again. This is clearly impossible; microbes do not make oil. They do make compounds with carbon-hydrogen bonds which may appear as TPH on the infrared analysis. When the apparent TPH was corrected by subtracting a weighted average of the apparent TPH in the starting Bioconversion materials (Excluding the oily dirt) the TPH in the final Bioconversion products were within the regulatory limits.

Bioconversion therefore appears to be a viable, efficient, environmentally sound alternative to land farming for remediation of oil field wastes. Additional supplies of sewage, sludge and manure beyond those available in the Farmington area will be needed to remediate the large estimated volumes of oily dirt in the San Juan basin and adjacent areas or improved bioconversion methods will need to be developed. Using existing, microbially active, Bioconversion piles as if they were sourdough starters to begin new piles should be a viable option to supplement the existing supplies of sludge and manure. No insuperable technical obstacles to large scale bioconversion for remediation of oil field wastes were uncovered by this test and evaluation.

BACKGROUND AND OVERVIEW

Bioconversion of petroleum-based oil field wastes was investigated as an alternative to land farming of these wastes. Land farming is increasingly restricted as a means of disposing of the contents of oil pits at gas-oil wells in the Farmington area. Restrictions on land farming arise from lack of available space as well as from increasingly strict environmentally more acceptable means of disposing of these oily wastes. The basic principle involved is that the hydrocarbons offer a "substrate" or food for the microorganisms in the Bioconversion mixtures which they consume during growth and their maintenance as living organisms. This is the same principle utilized by the oil-consuming microbes for remediation of oil spills in marine environments. However, the concentration and variety of microbes present in the Bioconversion mixture, as well as the high temperatures in the pile which tend to speed up microbial action, should make the process much more rapid and complete than is possible in dispersed situations such as spills in the open ocean.

CONDUCT OF THE TEST AND ANALYSES

The Bioconversion evaluation was carried out by Mr. Jerry Finney and his associates at an AMOCO production well near the Farmington area. Five different Bioconversion piles were constructed within a fenced area near the oil pit. The oil content in each of these piles generally decreased with increasing pile number from pile one to pile five. The piles consisted of a mixture of municipal sewage sludge, waste paper (mostly cardboard boxes), horse manure and oily dirt from the pit at the site. The bioconversion began in late June and continued for several weeks thereafter.

During the Bioconversion process the piles were monitored for temperature (elevated temperatures are strong evidence for good microbial activity in Bioconversion), total petroleum hydrocarbons (TPH), total BTEX (benzene, toluene and xylene), moisture and other components. In addition, Toxicity Characteristic Leaching Procedures (TCLPs) were run to evaluate a variety of organic chemicals and heavy metals. Except for pile temperatures all analytical tests were run by Inter-Mountain Laboratories (IML) in Farmington. Standard duplicate analyses and recoveries of surrogate samples were run by IML as quality control procedures to verify the validity of the test results. These duplicates and recoveries were always within acceptable ranges, indicating that the tests results were valid and can be used with confidence.

TPH Test Results are Suspect

A difficulty arose during the evaluation of the TPH levels during the test. This test is essentially a Freon extraction of the sample followed by infrared analysis to detect the presence of carbon-hydrogen bonds in the material dissolved in the Freon. All microbes and their decomposition products (dead microbes and their fragments) have abundant carbon-hydrogen bonds and will then show up as false positives in tests for measuring TPH if these microbial components are extracted into the Freon. Simply put, this means that the TPH procedure is unreliable in the presence of microorganisms or microbial decomposition products. Thus the initial drop in TPH observed in many of the piles followed by a rise in TPH is consistent with the idea that the microbes first digest the oil and other carbon sources (such as the cardboard boxes) and then produce additional microbial mass which ages, dies and releases compounds (lipids, carbohydrates, proteins, etc.) which show up as TPH in the test. These cell constituents, however, are **not** petroleum hydrocarbon compounds although they contain carbon-hydrogen bonds and will appear as TPH on the TPH test. Thus compensating for the presence of TPH-false compounds by subtracting a weighted average of the apparent TPH in the starting materials (sludge, paper, manure, etc.) is a reasonable means of correcting for an inadequate experimental method.

RESULTS

Overall Evaluation

Based on the high temperature profiles maintained over several weeks by each of the five piles, the disappearance of the liquid oil from the piles, the disappearance of complex carbohydrates (cardboard boxes, straw residues from manure, etc.) and the smell of the piles, it is obvious that microbial activity in the piles was extensive and long lasting. Even during my visit over two months after beginning the test, the piles were still warm indicating continuing but less vigorous microbial activity. The more oil in the pile, the higher the temperature obtained. Pile #1 maintained temperatures new or above 155 F for almost a month. Other piles had somewhat lower temperatures but all piles maintained temperatures of 130 F or above for many days, which is primary evidence for extensive, aerobic microbial activity. The moisture levels in these bioconversion piles were generally below 30% by weight as opposed to the 65% moisture usually associated with conventional composting. Whether we choose to call this "composting" or not is irrelevant, the fact is that aerobic microbial activity continued for many weeks and consumed both oil and cellulosic materials.

When I visited the site on September 13, there was no oil visible in the piles, even though a video of pile construction showed the oil being poured on the pile. No oily smell was present. Instead the predominant smell of the piles was a musty, moldy smell similar to that found in a root cellar. This smell is consistent with the visible colonization of the piles by large numbers of whitish grey fungi (molds). These molds thrive best in low water environments such as those found in these piles near the end of the Bioconversion cycle.

Laboratory Analyses

BTEX laboratory analyses showed that benzene, toluene, xylene levels in all piles sampled were reduced to well under the regulatory levels of 50 ppb total BTEX with less than 5 ppb benzene. For Pile #1 for instance, the initial level of 48 ppm BTEX was reduced to less than 2 ppb in less than three weeks.

TPH

Total petroleum hydrocarbon levels in Piles #1 and #2 started out at about 10,000 mg/kg or about 1 percent by weight which is one hundred times the regulatory limit of 100 ppm. These TPH levels decreased over the first week or two of Bioconversion and then jumped back up to more than the initial levels before tending to decrease again. Clearly the microbes are not producing oil so these results must be a false positive caused by the presence of some other component in the mixture which is behaving as TPH in the analytical test. Some possible compounds which might be responsible for these false positives were mentioned above.

However, when the TPH results were adjusted by subtracting a weighted average of the apparent TPH in the starting materials (again, except for the oily dirt), the final TPH levels of the piles were within acceptable ranges. The sewage sludge has by far the highest content of apparent TPH microbial content so this is consistent with the idea suggested above that microbes or their breakdown products are responsible for the increase in apparent TPH. Ultimately, a more reliable test for true petroleum hydrocarbons in these bioconversion systems may need to be developed.

TLCP Metals

Leaching of metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver) from the Bioconversion materials was determined by standard EPA procedures. In all cases the leaching of these metals was well under the regulatory levels and for arsenic, chromium, lead, mercury, selenium and silver the metal levels in the leachate are below detection limits. Total metals in these samples were also generally low, except for barium which has 200-350 mg/kg. Detectable amounts of cadmium and chromium (approximately 1mg/kg) as total metals were also found. These metals are known to be present in most sewage sludges.

Section Three

iml

Inter-Mountain Laboratories, Inc.

2506 West Main Street
Farmington, New Mexico 87401
Tel. (505) 326-4737

Sample id	Lab #	TPH mg/Kg	Total BTEX	TKN %	Density lbs/cu ft	Moisture %	pH	Ash %	TOC %	Ammonia %	P_2O_5 %	Potassium %
1	6670	13,400	5,599									
1	6704	10,300	1,450									
1	6748	17,000										
1	6851	8,630		0.41		8.5						
1	6968			0.23		20.7						
1-A	6706	10,500	263									
1-AA	6903			5.66		4.5					15.73	0.12
1-B S	6712	265000	1596000	7.13		2.3						
1-B L	6712	91,800	2404000									
1-BB	6944			0.14								0.08
1-C	6729	25,100	258	22.50		0.2						
1-CC	6959			23.70								
1-D	6730	145000	659500	5.49		1.1						
1-DD	6960			10.30							25.06	0.13
1-E	6747									22.3		
1-E	6751	63,700		10.80								
1-EE	6961			5.40							9.35	

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Sample id	Lab #	TPH mg/Kg	Total BTEX	TKN %	Density lbs/cu ft	Moisture %	pH	Ash %	TOC %	Ammonia %	P_2O_5 %	Potassium %
1-F	6752	15,900										
1-FF	6962			10.30								0.10
1-G	6753	35,300										
1-I	6769									21.8		0.21
1-J	6770	4,930		12.40			7.4					
1-JJ	7083			31.20		5.7			99.1			
1-K	6774									14.61		7.01
1-L	6775	128000		5.52						3.40		
1-M	6797				47.8	14.6						
1-N	6850	7,710		0.61		29.6						
1-O	6813	4,730				8.3						
1-P	6814	4,220				15.6						
1-Q	6815	1,470				13.3						
1-R	6820	4,800		47.23		9.7						
1-S	6816	17,400		11.61		10.9						2.30
1-T	6817			6.91		10.3				0.11	<0.01	4.68
1-U	6818			27.04		18.5				0.02	0.02	0.15

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Sample id	Lab #	TPH mg/Kg	Total BTEX	TKN %	Density lbs/cu ft	Moisture %	pH	Ash %	TOC %	Ammonia %	P_2O_5 %	Potassium %
1-V	6819			9.78		26.4				1.69	6.42	0.23
1-X	6826	41,340		7.26		38.3						
1-Y	6894			6.20								1.06
1-Z	6895			6.53								2.75
1-In	7131	710					7.4					
1-Out	7132	740					7.3					
2	6671	10,400	3,124									
2	6705	7,580	1,084									
3	6680	11,200	621									
3	6749	7,950										
3	6852	3,640		0.38		8.8						
3-In	7133	1,160					7.5					
3-Out	7134	178					7.4					
4	6681	948	ND									
4	6710	1,490	ND									
4	6771	89,600										
5	6682	4,470	808									

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Sample id	Lab #	TPH mg/Kg	Total BTEX	TKN %	Density lbs/cu ft	Moisture %	pH	Ash %	TOC %	Ammonia %	P_2O_5 %	Potassium %
5	6711	7,910	794									
5	7056			0.11		7.5						
5-In	7135	500					7.4					
5-Out	7136	258					7.2					
6	6822	24,281			119.0	11.7						
6	7095	910				14.8						
6	7174	1,430										
6-A	6827			0.66	67.1	9.2	7.2	25.45				
6-B	6828	16,303		0.05	138.8	12.1	7.1	6.56	5.99			
6-C	6829			0.11	2.3	1.9	6.1	80.20				
6-E	6892			0.15		31.9						
6-F	6943			38.00								
6-G	6963					27.2						
Cow	6974	24										
Paper	6975	141										
Crdbrd	6976	307										
WoodCh	6977	258										

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Sample id	Lab #	TPH mg/Kg	Total BTEX	TKN %	Density lbs/cu ft	Moisture %	pH	Ash %	TOC %	Ammonia %	P_2O_5 %	Potassium %
Sludge	6978	2,900										
Horse	6979	130										

****NOTES****

This summary is based upon September 19, 1991 available results for Amoco at GCU-250.

The values for the Ash and Total Organic Carbon (TOC) represent the percent material lost during heating; 850 degrees Celsius and 600 degrees Celsius respectively.

Sample 1-B was divided into a solid (S) and a liquid (L) portion and analyzed separately.

The BTEX results for each component was added together resulting in a single number in ug/Kg. For the individual component concentrations consult the reports for those samples.

Cow = Cow Manure
Crdbrd = Cardboard
Wood Ch = Wood Chips
Horse = Horse Manure

Using the percentages of raw components that were used in preparing the compost a blank value was calculated by multiplying the percentage of the component times the TPH value of the pure component and adding these values together. The result is a raw materials TPH backout value of 969 mg/Kg that can be subtracted from the TPH compost values on sample identifications 1-In, 1-Out, 3-In, 3-Out, 5-In, & 5-Out.

Feel free to contact me with any questions.

Tony Tristano - Senior Analytical Chemist

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Case Narrative

On September 3, 1991 a sample set consisting of seven samples was received by Inter-Mountain Laboratories - Farmington, NM. Enclosed is a copy of the chain of custody indicating the analytical parameters for which analysis was requested.

It is the policy of this laboratory to employ, whenever possible, analytical methods which have been approved by regulatory agencies. The methods which we use are referenced in SW-846, "Test Methods for Evaluating Solid Waste", USEPA, 1986; "Chemical Analysis of Water and Waste", USEPA, 1978; and other references as applicable. All reports in this package have the analytical methods and the references footnoted.

The results from the requested analysis on sample 1-JJ are as follows: TKN of 31.20%, Ammonia of 0.0003% TOC of 99.1%, and Moisture of 5.7%.

Quality Assurance reports have been included in this package. These reports can be identified by the notation in the Sample Id portion of the report.

Please feel free to call if you have any questions.

Tony Tristano

Tony Tristano
Senior Analytical Chemist

Inter-Mountain Laboratories, Inc.

1633 Terra Avenue
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TOXICITY CHARACTERISTIC LEACHING PROCEDURE
TRACE METAL CONCENTRATIONS
Quality Control/Duplicate Analysis

Client: **Amoco Production**
Sample Id: #1 Inside (7084)
Lab Id: 3773
Date: 09/23/91

Parameter:	Initial Sample Result mg/L	Second Sample Result mg/L	Relative Percent Difference
Arsenic	<0.1	<0.1	
Barium	3.0	3.2	6.5
Cadmium	<0.005	<0.005	
Chromium	<0.01	<0.01	
Lead	<0.2	<0.2	
Mercury	<0.001	<0.001	
Selenium	<0.1	<0.1	
Silver	<0.01	<0.01	

Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analyses, USEPA, July 1988.

Comment: ______________________

Prepared by: CB.

TOXICITY CHARACTERISTIC LEACHING PROCEDURE
TRACE METAL CONCENTRATIONS
Quality Control/Matrix Spike

Client:	**Amoco Production**
Sample Id:	**#1 Inside (7084)**
Lab Id:	**3773**
Date:	**09/23/91**

Parameter:	Spiked Sample Result mg/L	Sample Result mg/L	Spike Added mg/L	Percent Recovery
Arsenic	1.8	<0.1	2.2	81.8
Barium	3.6	2.7	1.0	90.0
Cadmium	0.460	<.005	0.575	80.0
Chromium	0.42	<0.01	0.52	80.8
Lead	0.8	<0.2	1.0	80.0
Mercury	0.010	<0.001	0.010	100.0
Selenium	1.9	<0.1	2.2	86.4
Silver	0.05	<0.01	1.08	4.6 *

Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analyses, USEPA, July 1988.

Comments: * Poor recovery due to the precipitation of silver with inorganic chlorides.

Prepared by: CB

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TOXICITY CHARACTERISTIC LEACHING PROCEDURE
TRACE METAL CONCENTRATIONS

Client:	Amoco Productions		
Sample Id:	#3 Inside	Report Date:	09/24/91
Lab Id:	3775/7086	Date Sampled:	09/03/91
Matrix:	Soil	Date Received:	09/04/91
Preservation:	COOL / INTACT	TCLP Extract:	09/10/91
		Date Analyzed:	09/20/91

Parameter:	(units)	Analytical Result	Regulatory Level
Arsenic	mg/L	<0.1	5.0
Barium	mg/L	3.2	100
Cadmium	mg/L	<0.005	1.0
Chromium	mg/L	<0.01	5.0
Lead	mg/L	<0.2	5.0
Mercury	mg/L	<0.001	0.2
Selenium	mg/L	<0.1	1.0
Silver	mg/L	<0.01	1.0

Toxicity Characteristic Leaching Procedure, Final Rule, Federal Register, 40 CFR 261-302, Part V, EPA Vol 55, No. 126 June 29, 1990
Method 6010A: Inductively Coupled Plasma-Atomic Emission Spectroscopy, SW-846, Nov. 1990.
Method 7470A: Mercury in Liquid Waste (Manual Cold-Vapor Technique), SW-846, Nov. 1990.

Prepared by: ____________

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TOXICITY CHARACTERISTIC LEACHING PROCEDURE
TRACE METAL CONCENTRATIONS

Client: Amoco Productions
Sample Id: #5 Inside
Lab Id: 3777/7088
Matrix: Soil
Preservation: COOL / INTACT

Report Date: 09/24/91
Date Sampled: 09/03/91
Date Received: 09/04/91
TCLP Extract: 09/10/91
Date Analyzed: 09/20/91

Parameter:	(units)	Analytical Result	Regulatory Level
Arsenic	mg/L	<0.1	5.0
Barium	mg/L	3.3	100
Cadmium	mg/L	<0.005	1.0
Chromium	mg/L	<0.01	5.0
Lead	mg/L	<0.2	5.0
Mercury	mg/L	<0.001	0.2
Selenium	mg/L	<0.1	1.0
Silver	mg/L	<0.01	1.0

Toxicity Characteristic Leaching Procedure, Final Rule, Federal Register, 40 CFR 261-302, Part V, EPA Vol 55, No. 126 June 29, 1990
Method 6010A: Inductively Coupled Plasma-Atomic Emission Spectroscopy, SW-846, Nov. 1990.
Method 7470A: Mercury in Liquid Waste (Manual Cold-Vapor Technique), SW-846, Nov. 1990.

Prepared by: CB

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TOXICITY CHARACTERISTIC LEACHING PROCEDURE
TRACE METAL CONCENTRATIONS

Client: **Amoco Productions**
Sample Id: #3 Outside
Lab Id: 3776/7087
Matrix: Soil
Preservation: COOL / INTACT

Report Date: 09/24/91
Date Sampled: 09/03/91
Date Received: 09/04/91
TCLP Extract: 09/10/91
Date Analyzed: 09/20/91

Parameter:	(units)	Analytical Result	Regulatory Level
Arsenic	mg/L	<0.1	5.0
Barium	mg/L	2.9	100
Cadmium	mg/L	0.005	1.0
Chromium	mg/L	<0.01	5.0
Lead	mg/L	<0.2	5.0
Mercury	mg/L	<0.001	0.2
Selenium	mg/L	<0.1	1.0
Silver	mg/L	<0.01	1.0

Toxicity Characteristic Leaching Procedure, Final Rule, Federal Register, 40 CFR 261-302, Part V, EPA Vol 55, No. 126 June 29, 1990
Method 6010A: Inductively Coupled Plasma-Atomic Emission Spectroscopy, SW-846, Nov. 1990.
Method 7470A: Mercury in Liquid Waste (Manual Cold-Vapor Technique), SW-846, Nov. 1990.

Prepared by: ____________

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TOXICITY CHARACTERISTIC LEACHING PROCEDURE
TRACE METAL CONCENTRATIONS

Client: Amoco Productions
Sample Id: #3 Outside
Lab Id: 3776/7087
Matrix: Soil
Preservation: COOL / INTACT

Report Date: 09/24/91
Date Sampled: 09/03/91
Date Received: 09/04/91
TCLP Extract: 09/10/91
Date Analyzed: 09/20/91

Parameter:	(units)	Analytical Result	Regulatory Level
Arsenic	mg/L	<0.1	5.0
Barium	mg/L	2.9	100
Cadmium	mg/L	0.005	1.0
Chromium	mg/L	<0.01	5.0
Lead	mg/L	<0.2	5.0
Mercury	mg/L	<0.001	0.2
Selenium	mg/L	<0.1	1.0
Silver	mg/L	<0.01	1.0

Toxicity Characteristic Leaching Procedure, Final Rule, Federal Register, 40 CFR 261-302, Part V, EPA Vol 55, No. 126 June 29, 1990
Method 6010A: Inductively Coupled Plasma-Atomic Emission Spectroscopy, SW-846, Nov. 1990.
Method 7470A: Mercury in Liquid Waste (Manual Cold-Vapor Technique), SW-846, Nov. 1990.

Prepared by: ____

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TOXICITY CHARACTERISTIC LEACHING PROCEDURE
TRACE METAL CONCENTRATIONS

Client: **Amoco Productions**
Sample Id: #5 Outside
Lab Id: 3778/7089
Matrix: Soil
Preservation: COOL / INTACT

Report Date: 09/24/91
Date Sampled: 09/03/91
Date Received: 09/04/91
TCLP Extract: 09/10/91
Date Analyzed: 09/20/91

Parameter:	(units)	Analytical Result	Regulatory Level
Arsenic	mg/L	<0.1	5.0
Barium	mg/L	3.0	100
Cadmium	mg/L	<0.005	1.0
Chromium	mg/L	<0.01	5.0
Lead	mg/L	<0.2	5.0
Mercury	mg/L	<0.001	0.2
Selenium	mg/L	<0.1	1.0
Silver	mg/L	<0.01	1.0

Toxicity Characteristic Leaching Procedure, Final Rule, Federal Register, 40 CFR 261-302, Part V, EPA Vol 55, No. 126 June 29, 1990
Method 6010A: Inductively Coupled Plasma-Atomic Emission Spectroscopy, SW-846, Nov. 1990.
Method 7470A: Mercury in Liquid Waste (Manual Cold-Vapor Technique), SW-846, Nov. 1990.

Prepared by: ______

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TOXICITY CHARACTERISTIC LEACHING PROCEDURE
TRACE METAL CONCENTRATIONS

Client:	**Amoco Production**		
Sample Id:	Internal Lab Blank	Report Date:	09/24/91
Lab Id:	3779	TCLP Extract:	09/10/91
Matrix:	Fluid	Date Analyzed:	09/20/91
Preservation:	Intact		

Parameter:	(units)	Analytical Result	Regulatory Level
Arsenic	mg/L	<0.1	5.0
Barium	mg/L	<0.5	100
Cadmium	mg/L	<0.005	1.0
Chromium	mg/L	<0.01	5.0
Lead	mg/L	<0.2	5.0
Mercury	mg/L	<0.001	0.2
Selenium	mg/L	<0.1	1.0
Silver	mg/L	<0.01	1.0

Toxicity Characteristic Leaching Procedure, Final Rule, Federal Register, 40 CFR 261-302, Part V, EPA Vol 55, No. 126 June 29, 1990
Method 6010A, Inductively Coupled Plasma, Emission Spectroscopy, SW-846, Nov. 1990.
Method 7470A: Mercury in Liquid Waste (Manual Cold-Vapor Technique), SW-846, Nov. 1990.

Prepared by: CB

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Case Narrative

On September 6, 1991 a sample set consisting of six samples was received by Inter-Mountain Laboratories - Farmington, NM. Enclosed is a copy of the chain of custody indicating the analytical parameters for which analysis was requested.

It is the policy of this laboratory to employ, whenever possible, analytical methods which have been approved by regulatory agencies. The methods which we use are referenced in SW-846, "Test Methods for Evaluating Solid Waste", USEPA, 1986; "Chemical Analysis of Water and Waste", USEPA, 1978; and other references as applicable. All reports in this package have the analytical methods and the references footnoted.

A Hewlett-Packard Gas Chromatograph was used for the analysis which determined the presence of target BTEX compounds in all samples.

In addition, the pH values are as follows: 1-In is 7.4, 1-Out is 7.3, 3-In is 7.5, 3-Out is 7.4, 5-In is 7.4, and 5-Out is 7.2.

Quality Assurance reports have been included in this package. These reports can be identified by the notation in the Sample Id portion of the report.

Please feel free to call if you have any questions.

Tony Tristano

Tony Tristano
Senior Analytical Chemist

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VOLATILE AROMATIC HYDROCARBONS

Client:	Amoco	Report Date:	09-24-91
Project Name:	GCU-250		
Sample ID:	#1 Inside	Date Sampled:	09-06-91
Laboratory Number:	7131	Date Received:	09-06-91
Analysis Requested:	BTEX	Date Analyzed:	09-20-91
Sample Matrix:	Soil	Preservative:	Cool
		Condition:	Ambient & Intact

Parameter	Concentration (ug/Kg)	Det. Limit (ug/Kg)
Benzene	97.7	35
Toluene	87.8	35
Ethylbenzene	ND	35
p,m-Xylene	182.5	35
o-Xylene	160.7	35

SURROGATE RECOVERIES:	Parameter	Percent Recovery
	Bromfluorobenzene	79.1 %

Method: Method 8020, Aromatic Volatile Organics, SW-846, USEPA, (Sept. 1986).

ND - Parameter not detected at the stated detection limit.

Comments:

Tony Tristano
Analyst

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VOLATILE AROMATIC HYDROCARBONS

Client: Amoco
Project Name: GCU-250
Sample ID: #1 Outside
Laboratory Number: 7132
Analysis Requested: BTEX
Sample Matrix: Soil

Report Date: 09-24-91
Date Sampled: 09-06-91
Date Received: 09-06-91
Date Analyzed: 09-20-91
Preservative: Cool
Condition: Ambient & Intact

Parameter	Concentration (ug/Kg)	Det. Limit (ug/Kg)
Benzene	85.4	35
Toluene	ND	35
Ethylbenzene	ND	35
p,m-Xylene	ND	35
o-Xylene	ND	35

SURROGATE RECOVERIES:	Parameter	Percent Recovery
	Bromfluorobenzene	67.3 %

Method: Method 8020, Aromatic Volatile Organics, SW-846, USEPA, (Sept. 1986).

ND - Parameter not detected at the stated detection limit.

Comments:

Tony Tristano
Analyst

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VOLATILE AROMATIC HYDROCARBONS

Client:	Amoco	Report Date:	09-24-91
Project Name:	GCU-250		
Sample ID:	#3 Inside	Date Sampled:	09-06-91
Laboratory Number:	7133	Date Received:	09-06-91
Analysis Requested:	BTEX	Date Analyzed:	09-20-91
Sample Matrix:	Soil	Preservative:	Cool
		Condition:	Ambient & Intact

Parameter	Concentration (ug/Kg)	Det. Limit (ug/Kg)
Benzene	67.3	35
Toluene	ND	35
Ethylbenzene	ND	35
p,m-Xylene	ND	35
o-Xylene	98.5	35

SURROGATE RECOVERIES:	Parameter	Percent Recovery
	Bromfluorobenzene	139 %

Method: Method 8020, Aromatic Volatile Organics, SW-846, USEPA, (Sept. 1986).
ND - Parameter not detected at the stated detection limit.

Comments:

Tony Tristano
Analyst

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VOLATILE AROMATIC HYDROCARBONS

Client: Amoco
Project Name: GCU-250
Sample ID: 3 Outside
Laboratory Number: 7134
Analysis Requested: BTEX
Sample Matrix: Soil

Report Date: 09-24-91
Date Sampled: 09-06-91
Date Received: 09-06-91
Date Analyzed: 09-20-91
Preservative: Cool
Condition: Ambient & Intact

Parameter	Concentration (ug/Kg)	Det. Limit (ug/Kg)
Benzene	69.1	35
Toluene	38.0	35
Ethylbenzene	ND	35
p,m-Xylene	54.8	35
o-Xylene	ND	35

SURROGATE RECOVERIES:	Parameter	Percent Recovery
	Bromfluorobenzene	69.8 %

Method: Method 8020, Aromatic Volatile Organics, SW-846, USEPA, (Sept. 1986).

ND - Parameter not detected at the stated detection limit.

Comments:

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VOLATILE AROMATIC HYDROCARBONS

Client:	Amoco	Report Date:	09-24-91
Project Name:	GCU-250		
Sample ID:	#5 Inside	Date Sampled:	09-06-91
Laboratory Number:	7135	Date Received:	09-06-91
Analysis Requested:	BTEX	Date Analyzed:	09-20-91
Sample Matrix:	Soil	Preservative:	Cool
		Condition:	Ambient & Intact

Parameter	Concentration (ug/Kg)	Det. Limit (ug/Kg)
Benzene	57.8	30
Toluene	ND	30
Ethylbenzene	ND	30
p,m-Xylene	ND	30
o-Xylene	ND	30

SURROGATE RECOVERIES:

Parameter	Percent Recovery
Bromfluorobenzene	70.3 %

Method: Method 8020, Aromatic Volatile Organics, SW-846, USEPA, (Sept. 1986).

ND - Parameter not detected at the stated detection limit.

Comments:

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VOLATILE AROMATIC HYDROCARBONS

Client:	Amoco	Report Date:	09-24-91
Project Name:	GCU-250		
Sample ID:	5 Outside	Date Sampled:	09-06-91
Laboratory Number:	7136	Date Received:	09-06-91
Analysis Requested:	BTEX	Date Analyzed:	09-20-91
Sample Matrix:	Soil	Preservative:	Cool
		Condition:	Ambient & Intact

Parameter	Concentration (ug/Kg)	Det. Limit (ug/Kg)
Benzene	76.3	30
Toluene	39.1	30
Ethylbenzene	ND	30
p,m-Xylene	ND	30
o-Xylene	ND	30

SURROGATE RECOVERIES:

Parameter	Percent Recovery
Bromfluorobenzene	84.2 %

Method: Method 8020, Aromatic Volatile Organics, SW-846, USEPA, (Sept. 1986).

ND - Parameter not detected at the stated detection limit.

Comments:

Tony Tristano
Analyst

Inter-Mountain Laboratories, Inc.

1714 Phillips Circle
Gillette, Wyoming 82716

TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

Client:	AMOCO PRODUCTION		
Sample ID:	GCU-250 #1 INSIDE	Report Date:	09/16/91
Laboratory Number:	F7131	Date Sampled:	09/06/91
Analysis:	TRPH	Date Received:	09/10/91
Sample Matrix:	SOIL	Date Extracted:	09/11/91
Preservative:	COOL	Date Analyzed:	09/11/91
Condition:	INTACT		

Parameter	Concentration (mg/Kg)	Detection Limit (mg/Kg)
Total Recoverable Petroleum Hydrocarbons	1110	25

Method: Method 418.1, Petroleum Hydrocarbons, Total Recoverable, Chemical Analysis of Water and Waste, USEPA, 1978.
Sample was placed in basic solution overnight and extracted as a water sample.

Comments:

Analyst

Inter-Mountain Laboratories, Inc.

1714 Phillips Circle
Gillette, Wyoming 82716

TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

Client: AMOCO PRODUCTION
Sample ID: GCU-250 #1 INSIDE
Laboratory Number: F7131
Analysis: TRPH
Sample Matrix: SOIL
Preservative: COOL
Condition: INTACT

Report Date: 09/16/91
Date Sampled: 09/06/91
Date Received: 09/10/91
Date Extracted: 09/10/91
Date Analyzed: 09/11/91

Parameter	Concentration (mg/Kg)	Detection Limit (mg/Kg)
Total Recoverable Petroleum Hydrocarbons	710	25

Method: Method 418.1, Petroleum Hydrocarbons, Total Recoverable, Chemical Analysis of Water and Waste, USEPA, 1978.
Extraction by acid + base modification.

Comments: Sample was treated with concentrated nitric acid then pH adjusted to a pH >10 and then extracted as outlined in the procedure.

Analyst

nter-Mountain Laboratories, Inc.

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Gillette, Wyoming 82716

TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

Client:	AMOCO PRODUCTION		
Sample ID:	GCU-250 #1 OUTSIDE	Report Date:	09/16/91
Laboratory Number:	F7132	Date Sampled:	09/06/91
Analysis:	TRPH	Date Received:	09/10/91
Sample Matrix:	SOIL	Date Extracted:	09/11/91
Preservative:	COOL	Date Analyzed:	09/11/91
Condition:	INTACT		

Parameter	Concentration (mg/Kg)	Detection Limit (mg/Kg)
Total Recoverable Petroleum Hydrocarbons	1250	25

Method: Method 418.1, Petroleum Hydrocarbons, Total Recoverable, Chemical Analysis of Water and Waste, USEPA, 1978.
Sample was placed in basic solution overnight and extracted as a water sample.

Comments:

Analyst

Inter-Mountain Laboratories, Inc.

1714 Phillips Circle
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TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

Client: AMOCO PRODUCTION
Sample ID: GCU-250 #1 OUTSIDE
Laboratory Number: F7132
Analysis: TRPH
Sample Matrix: SOIL
Preservative: COOL
Condition: INTACT

Report Date: 09/16/91
Date Sampled: 09/06/91
Date Received: 09/10/91
Date Extracted: 09/10/91
Date Analyzed: 09/11/91

Parameter	Concentration (mg/Kg)	Detection Limit (mg/Kg)
Total Recoverable Petroleum Hydrocarbons	740	25

Method: Method 418.1, Petroleum Hydrocarbons, Total Recoverable, Chemical Analysis of Water and Waste, USEPA, 1978.
Extraction by acid + base modification.

Comments: Sample was treated with concentrated nitric acid then pH adjusted to a pH >10 and then extracted as outlined in the procedure.

Analyst

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1714 Phillips Circle
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TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

Client:	AMOCO PRODUCTION		
Sample ID:	GCU-250 #3 INSIDE	Report Date:	09/16/91
Laboratory Number:	F7133	Date Sampled:	09/06/91
Analysis:	TRPH	Date Received:	09/10/91
Sample Matrix:	SOIL	Date Extracted:	09/11/91
Preservative:	COOL	Date Analyzed:	09/11/91
Condition:	INTACT		

Parameter	Concentration (mg/Kg)	Detection Limit (mg/Kg)
Total Recoverable Petroleum Hydrocarbons	1850	25

Method: Method 418.1, Petroleum Hydrocarbons, Total Recoverable, Chemical Analysis of Water and Waste, USEPA, 1978.
Sample was placed in basic solution overnight and extracted as a water sample.

Comments:

Analyst

Inter-Mountain Laboratories, Inc.

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TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

Client: AMOCO PRODUCTION
Sample ID: GCU-250 #3 INSIDE
Laboratory Number: F7133
Analysis: TRPH
Sample Matrix: SOIL
Preservative: COOL
Condition: INTACT

Report Date: 09/16/91
Date Sampled: 09/06/91
Date Received: 09/10/91
Date Extracted: 09/10/91
Date Analyzed: 09/11/91

Parameter	Concentration (mg/Kg)	Detection Limit (mg/Kg)
Total Recoverable Petroleum Hydrocarbons	1160	25

Method: Method 418.1, Petroleum Hydrocarbons, Total Recoverable, Chemical Analysis of Water and Waste, USEPA, 1978.
Extraction by acid + base modification.

Comments: Sample was treated with concentrated nitric acid then pH adjusted to a pH >10 and then extracted as outlined in the procedure.

Analyst

TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

Client: AMOCO PRODUCTION
Sample ID: GCU-250 #3 OUTSIDE
Laboratory Number: F7134
Analysis: TRPH
Sample Matrix: SOIL
Preservative: COOL
Condition: INTACT

Report Date: 09/16/91
Date Sampled: 09/06/91
Date Received: 09/10/91
Date Extracted: 09/11/91
Date Analyzed: 09/11/91

arameter	Concentration (mg/Kg)	Detection Limit (mg/Kg)
Total Recoverable etroleum Hydrocarbons	208	25

Method: Method 418.1, Petroleum Hydrocarbons, Total Recoverable, Chemical Analysis of Water and Waste, USEPA, 1978.
Sample was placed in basic solution overnight and extracted as a water sample.

Comments:

nalyst

Inter·Mountain Laboratories, Inc.

1714 Phillips Circle
Gillette, Wyoming 82716

TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

Client:	AMOCO PRODUCTION		
Sample ID:	GCU-250 #3 OUTSIDE	Report Date:	09/16/91
Laboratory Number:	F7134	Date Sampled:	09/06/91
Analysis:	TRPH	Date Received:	09/10/91
Sample Matrix:	SOIL	Date Extracted:	09/10/91
Preservative:	COOL	Date Analyzed:	09/11/91
Condition:	INTACT		

Parameter	Concentration (mg/Kg)	Detection Limit (mg/Kg)
Total Recoverable Petroleum Hydrocarbons	178	25

Method: Method 418.1, Petroleum Hydrocarbons, Total Recoverable, Chemical Analysis of Water and Waste, USEPA, 1978.
Extraction by acid + base modification.

Comments: Sample was treated with concentrated nitric acid then pH adjusted to a pH >10 and then extracted as outlined in the procedure.

Analyst

Inter-Mountain Laboratories, Inc.

1714 Phillips Circle
Gillette, Wyoming 82716

TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

Client:	AMOCO PRODUCTION		
Sample ID:	GCU-250 #5 INSIDE	Report Date:	09/16/91
Laboratory Number:	F7135	Date Sampled:	09/06/91
Analysis:	TRPH	Date Received:	09/10/91
Sample Matrix:	SOIL	Date Extracted:	09/11/91
Preservative:	COOL	Date Analyzed:	09/11/91
Condition:	INTACT		

Parameter	Concentration (mg/Kg)	Detection Limit (mg/Kg)
Total Recoverable Petroleum Hydrocarbons	450	25

Method: Method 418.1, Petroleum Hydrocarbons, Total Recoverable, Chemical Analysis of Water and Waste, USEPA, 1978.
Sample was placed in basic solution overnight and extracted as a water sample.

Comments:

Analyst

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1714 Phillips Circle
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TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

Client:	AMOCO PRODUCTION		
Sample ID:	GCU-250 #5 INSIDE	Report Date:	09/16/91
Laboratory Number:	F7135	Date Sampled:	09/06/91
Analysis:	TRPH	Date Received:	09/10/91
Sample Matrix:	SOIL	Date Extracted:	09/10/91
Preservative:	COOL	Date Analyzed:	09/11/91
Condition:	INTACT		

Parameter	Concentration (mg/Kg)	Detection Limit (mg/Kg)
Total Recoverable Petroleum Hydrocarbons	500	25

Method: Method 418.1, Petroleum Hydrocarbons, Total Recoverable, Chemical Analysis of Water and Waste, USEPA, 1978.
Extraction by acid + base modification.

Comments: Sample was treated with concentrated nitric acid then pH adjusted to a pH >10 and then extracted as outlined in the procedure.

Analyst

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Gillette, Wyoming 82716

TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

Client:	AMOCO PRODUCTION		
Sample ID:	GCU-250 #5 OUTSIDE	Report Date:	09/16/91
Laboratory Number:	F7136	Date Sampled:	09/06/91
Analysis:	TRPH	Date Received:	09/10/91
Sample Matrix:	SOIL	Date Extracted:	09/11/91
Preservative:	COOL	Date Analyzed:	09/11/91
Condition:	INTACT		

Parameter	Concentration (mg/Kg)	Detection Limit (mg/Kg)
Total Recoverable Petroleum Hydrocarbons	280	25

Method: Method 418.1, Petroleum Hydrocarbons, Total Recoverable, Chemical Analysis of Water and Waste, USEPA, 1978.
Sample was placed in basic solution overnight and extracted as a water sample.

Comments:

Analyst

Inter-Mountain Laboratories, Inc.

1714 Phillips Circle
Gillette, Wyoming 82716

TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

Client: AMOCO PRODUCTION
Sample ID: GCU-250 #5 OUTSIDE
Laboratory Number: F7136
Analysis: TRPH
Sample Matrix: SOIL
Preservative: COOL
Condition: INTACT

Report Date: 09/16/91
Date Sampled: 09/06/91
Date Received: 09/10/91
Date Extracted: 09/10/91
Date Analyzed: 09/11/91

Parameter	Concentration (mg/Kg)	Detection Limit (mg/Kg)
Total Recoverable Petroleum Hydrocarbons	258	25

Method: Method 418.1, Petroleum Hydrocarbons, Total Recoverable, Chemical Analysis of Water and Waste, USEPA, 1978.
Extraction by acid + base modification.

Comments: Sample was treated with concentrated nitric acid then pH adjusted to a pH >10 and then extracted as outlined in the procedure.

Analyst

Inter-Mountain Laboratories, Inc.

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Gillette, Wyoming 82716

** QUALITY ASSURANCE REPORT
MATRIX SPIKE - TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

Laboratory Number: F7135
Analysis: TRPH
Sample Matrix: SOIL
Preservative: COOL
Condition: INTACT

Date Extracted: 09/10/91
Date Analyzed: 09/11/91

Parameter	Spike Added (mg/Kg)	Sample Result (mg/Kg)	Spiked Sample Result (mg/Kg)	Percent Recovery
TRPH	565	500	814	56

QA ACCEPTANCE CRITERIA: Administrative control limit for accuracy set at 42-124% recovery.

Method: Method 418.1, Petroleum Hydrocarbons, Total Recoverable, Chemical Analysis of Water and Waste, USEPA, 1978.
Sample was treated with concentrated nitric acid then pH adjusted to a pH >10 and then extracted as outlined in the procedure.

Comments:

Analyst

ter-Mountain Laboratories, Inc.

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** QUALITY ASSURANCE REPORT
MATRIX DUPLICATE - TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

Laboratory Number: F7135
Analysis: TRPH
Sample Matrix: SOIL
Preservative: COOL
Condition: INTACT

Date Extracted: 09/10/91
Date Analyzed: 09/11/91

Parameter	Sample Result (mg/Kg)	Duplicate Result (mg/Kg)	Percent Difference
TRPH	500	490	2.0

QA ACCEPTANCE CRITERIA: Administrative control limit for precision set at 30% difference.

Method: Method 418.1, Petroleum Hydrocarbons, Total Recoverable, Chemical Analysis of Water and Waste, USEPA, 1978.
Sample was treated with concentrated nitric acid then pH adjusted to a pH >10 and then extracted as outlined in the procedure.

Comments:

Analyst

TRACE METAL CONCENTRATIONS

Client:	**Amoco Productions**		
Sample Id:	#1 Inside	**Report Date:**	09/24/91
Lab Id:	3706/7131	**Date Sampled:**	09/06/91
Matrix:	Soil	**Date Received:**	09/10/91
Preservation:	COOL / INTACT	**Date Analyzed:**	09/21/91

Parameter:	(units)	Analytical Result	Regulatory Level
Arsenic	mg/L	<0.1	5.0
Barium	mg/L	6.6	100
Cadmium	mg/L	0.010	1.0
Chromium	mg/L	0.09	5.0
Lead	mg/L	0.3	5.0
Mercury	mg/L	<0.001	0.2
Selenium	mg/L	<0.1	1.0
Silver	mg/L	0.01	1.0

Method 6010A: Inductively Coupled Plasma-Atomic Emission Spectroscopy, SW-846, Nov. 1990.
Method 7470A: Mercury in Liquid Waste (Manual Cold-Vapor Technique), SW-846, Nov. 1990.

Prepared by: C.B

TRACE METAL CONCENTRATIONS
Quality Control/Duplicate Analysis

Client:	**Amoco Production**
Sample Id:	#1 Inside
Lab Id:	3706/7131
Date:	09/24/91

Parameter:	Initial Sample Result mq/L	Second Sample Result mg/L	Relative Percent Difference
Arsenic	<0.1	<0.1	
Barium	6.6	6.6	0.0
Cadmium	0.010	0.010	0.0
Chromium	0.09	0.09	0.0
Lead	0.3	0.2	40.0
Mercury	<0.001	<0.001	
Selenium	<0.1	<0.1	
Silver	0.01	0.01	0.0

Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analyses, USEPA, July 1988.

Comment: ______________________

Prepared by: CB

TRACE METAL CONCENTRATIONS
Quality Control/Matrix Spike

Client: **Amoco Productions**
Sample Id: #1 Inside
Lab Id: 3706/7131
Date: 09/24/91

Parameter:	Spiked Sample Result mg/L	Sample Result mg/L	Spike Added mg/L	Percent Recovery
Arsenic	1.8	<0.1	2.2	81.8
Barium	7.6	6.6	1.0	100.0
Cadmium	0.462	0.010	0.575	78.6
Chromium	0.52	0.09	0.52	82.7
Lead	1.1	0.3	1.0	80.0
Mercury	0.009	<0.001	0.010	90.0
Selenium	1.9	<0.1	2.2	86.4
Silver	0.33	0.01	1.08	29.6 *

Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analyses, USEPA, July 1988.

Comments: * Poor recovery due to precipitation of silver with inorganic chlorides.

Prepared by: CB

Inter-Mountain Laboratories, Inc.

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TRACE METAL CONCENTRATIONS

Client: **Amoco Productions**
Sample Id: #1 Outside
Lab Id: 3707/7132
Matrix: Soil
Preservation: COOL / INTACT

Report Date: 09/24/91
Date Sampled: 09/06/91
Date Received: 09/10/91
Date Analyzed: 09/21/91

Parameter:	(units)	Analytical Result	Regulatory Level
Arsenic	mg/L	<0.1	5.0
Barium	mg/L	7.5	100
Cadmium	mg/L	0.006	1.0
Chromium	mg/L	0.09	5.0
Lead	mg/L	0.2	5.0
Mercury	mg/L	<0.001	0.2
Selenium	mg/L	<0.1	1.0
Silver	mg/L	0.01	1.0

Method 6010A: Inductively Coupled Plasma-Atomic Emission Spectroscopy, SW-846, Nov. 1990.
Method 7470A: Mercury in Liquid Waste (Manual Cold-Vapor Technique), SW-846, Nov. 1990.

Prepared by: ____________

TRACE METAL CONCENTRATIONS

Client:	**Amoco Productions**		
Sample Id:	#3 Inside	Report Date:	09/24/91
Lab Id:	3708/7133	Date Sampled:	09/06/91
Matrix:	Soil	Date Received:	09/10/91
Preservation:	COOL / INTACT	Date Analyzed:	09/21/91

Parameter:	(units)	Analytical Result	Regulatory Level
Arsenic	mg/L	<0.1	5.0
Barium	mg/L	5.2	100
Cadmium	mg/L	0.006	1.0
Chromium	mg/L	0.09	5.0
Lead	mg/L	0.2	5.0
Mercury	mg/L	<0.001	0.2
Selenium	mg/L	<0.1	1.0
Silver	mg/L	0.02	1.0

Method 6010A: Inductively Coupled Plasma-Atomic Emission Spectroscopy, SW-846, Nov. 1990.
Method 7470A: Mercury in Liquid Waste (Manual Cold-Vapor Technique), SW-846, Nov. 1990.

Prepared by: CB

Inter-Mountain Laboratories, Inc.

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Sheridan, Wyoming 82801

TRACE METAL CONCENTRATIONS

Client:	**Amoco Productions**		
Sample Id:	#3 Outside	Report Date:	09/24/91
Lab Id:	3709/7134	Date Sampled:	09/06/91
Matrix:	Soil	Date Received:	09/10/91
Preservation:	COOL / INTACT	Date Analyzed:	09/21/91

Parameter:	(units)	Analytical Result	Regulatory Level
Arsenic	mg/L	<0.1	5.0
Barium	mg/L	4.4	100
Cadmium	mg/L	0.007	1.0
Chromium	mg/L	0.09	5.0
Lead	mg/L	0.2	5.0
Mercury	mg/L	<0.001	0.2
Selenium	mg/L	<0.1	1.0
Silver	mg/L	0.01	1.0

Method 6010A: Inductively Coupled Plasma-Atomic Emission Spectroscopy, SW-846, Nov. 1990.
Method 7470A: Mercury in Liquid Waste (Manual Cold-Vapor Technique), SW-846, Nov. 1990.

Prepared by: ____

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TRACE METAL CONCENTRATIONS

Client:	Amoco Productions		
Sample Id:	#5 Inside	Report Date:	09/24/91
Lab Id:	3710/7135	Date Sampled:	09/06/91
Matrix:	Soil	Date Received:	09/10/91
Preservation:	COOL / INTACT	Date Analyzed:	09/21/91

Parameter:	(units)	Analytical Result	Regulatory Level
Arsenic	mg/L	<0.1	5.0
Barium	mg/L	4.4	100
Cadmium	mg/L	0.008	1.0
Chromium	mg/L	0.08	5.0
Lead	mg/L	0.2	5.0
Mercury	mg/L	<0.001	0.2
Selenium	mg/L	<0.1	1.0
Silver	mg/L	0.02	1.0

Method 6010A: Inductively Coupled Plasma-Atomic Emission Spectroscopy, SW-846, Nov. 1990.
Method 7470A: Mercury in Liquid Waste (Manual Cold-Vapor Technique), SW-846, Nov. 1990.

Prepared by: ____________

TRACE METAL CONCENTRATIONS

Client:	**Amoco Productions**		
Sample Id:	#5 Outside	Report Date:	09/24/91
Lab Id:	3711/7136	Date Sampled:	09/06/91
Matrix:	Soil	Date Received:	09/10/91
Preservation:	COOL / INTACT	Date Analyzed:	09/21/91

Parameter:	(units)	Analytical Result	Regulatory Level
Arsenic	mg/L	<0.1	5.0
Barium	mg/L	4.1	100
Cadmium	mg/L	0.007	1.0
Chromium	mg/L	0.09	5.0
Lead	mg/L	0.2	5.0
Mercury	mg/L	<0.001	0.2
Selenium	mg/L	<0.1	1.0
Silver	mg/L	0.01	1.0

Method 6010A: Inductively Coupled Plasma-Atomic Emission Spectroscopy, SW-846, Nov. 1990.
Method 7470A: Mercury in Liquid Waste (Manual Cold-Vapor Technique), SW-846, Nov. 1990.

Prepared by:

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TRACE METAL CONCENTRATIONS

Client:	Amoco Productions		
Sample Id:	IML Blank	Report Date:	09/24/91
Lab Id:	3712	Date Sampled:	09/06/91
Matrix:	Fluid	Date Received:	09/10/91
Preservation:	COOL / INTACT	Date Analyzed:	09/21/91

Parameter:	(units)	Analytical Result	Regulatory Level
Arsenic	mg/L	<0.1	5.0
Barium	mg/L	<0.5	100
Cadmium	mg/L	<0.005	1.0
Chromium	mg/L	<0.01	5.0
Lead	mg/L	<0.2	5.0
Mercury	mg/L	<0.001	0.2
Selenium	mg/L	<0.1	1.0
Silver	mg/L	<0.01	1.0

Method 6010A: Inductively Coupled Plasma-Atomic Emission Spectroscopy, SW-846, Nov. 1990.
Method 7470A: Mercury in Liquid Waste (Manual Cold-Vapor Technique), SW-846, Nov. 1990.

Prepared by: ____________

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MODIFICATION OF EPA METHOD 418.1 FOR THE ANALYSIS OF TOTAL PETROLEUM HYDROCARBONS IN COMPOST

BY

HARRY HOWELL
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The analysis of Total Petroleum Hydrocarbons by EPA method 418.1 is performed by extracting a sample with Fluorocarbon 113 followed by the addition of silica gel to remove non-petroleum hydrocarbons and then measurement at about 2930 cm^{-1} with Infrared Spectrophotometer and direct comparison with standards.

When Compost samples were analyzed according to this procedure, results appeared to be abnormally high, indicating a potential interference. The extracts were then scanned from 4000 cm to 2800 cm^{-1} (limited by the range on the infrared grade glass cells) to check for interferences. A significant peak was observed (fig 1) at 3600 cm^{-1} in addition to the peak at 2930 cm^{-1}, indicating the presence of an -OH functional group. The -OH group is present in organic acids and alcohols. Since short chain alcohols are water soluble, a water wash was employed to see if they were present. A marked decrease in TPH concentration was obtained for compost samples when a water wash was employed (Table 1). Spiked analyses were performed with no apparent effect upon recovery. The extracts were scanned from 4000 cm^{-1} to 2800 cm^{-1} to check for the effect of the wash. The peak at 3600 cm^{-1} was decreased (fig 2), but not eliminated, indicating that longer chain alcohols and/or organic acids were also present.

Humic and fulvic acids are commonly found in compost. They are only very slightly soluble in water, however are quite soluble in basic solutions. A compost sample was placed in a basic solution and another in water overnight. In the morning the basic extract was highly colored and the water extract was not, indicating the presence of these acids. The basic extract and the water extract were then extracted with fluorocarbon 113 as in the method. The water extract yielded the same results as received when a water wash was employed. The basic extract yielded considerably lower results. A spiked analysis was performed with recovery well within the acceptable range.

In addition to compost samples, the raw materials used in the composting process were analyzed by 418.1 and by the above mentioned basic modification (Table 2). Lower values were obtained with the basic modification than were obtained with 418.1. The analysis of spiked samples showed acceptable recoveries for 418.1 and the basic modification. The extracts from both procedures were concentrated by evaporation and put onto salt plates to scan the infrared region from 4000 cm^{-1} to 600 cm^{-1} (fig 3). These scans indicated the presence of carboxylic acid group in the compost as well as many of the raw materials in the 418.1 extract. The carboxylic acid group did not appear to be present in the basic modification. There did appear to still be some interferents present, possibly some long chain alcohols (fig 4).

In an effort to break up the longer chain alcohols and make them more water soluble, a sample was treated with nitric acid. The sample was then made basic to a pH >10 and extracted as outlined in 418.1. This yielded lower results than obtained for the basic modification. Three spiked samples were prepared. One with #1 diesel fuel, one with a parafin oil, and the other with the oily substance supplied by the client. Acceptable recoveries were obtained for all three spikes. This acid-base modification was then employed for the analysis of compost samples as well as the raw materials. In all cases results were lower than previously obtained. These extracts were concentrated and full infrared spectrums were run. In these spectrums there does not appear to be any significant presence of contamination (fig 5).

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TABLE 1
TPH RESULTS (mg/L) BEFORE AND AFTER WATER WASH

	418.1	418.1 WITH WATER WASH	% DECREASE
1	8,630	4,270	51%
2	32,570	24,280	25%
3	51,340	41,340	19%
4	17,320	16,300	6%
5	9,660	4,730	51%
6	2,150	1,470	32%
7	20,770	17,400	16%
8	5,600	4,800	14%

TABLE 2
TPH RESULTS (mg/L) BY VARIOUS METHODS

	418.1	418.1 WITH BASE MODIFICATION	418.1 WITH ACID-BASE MODIFICATION
COW MANURE	233	114	24
HORSE MANURE	270	243	130
PAPER	823	455	141
WOOD CHIPS	469	236	258
CARDBOARD	328	312	307
SLUDGE	2490	1200	1760
COMPOST	13500	2870	590

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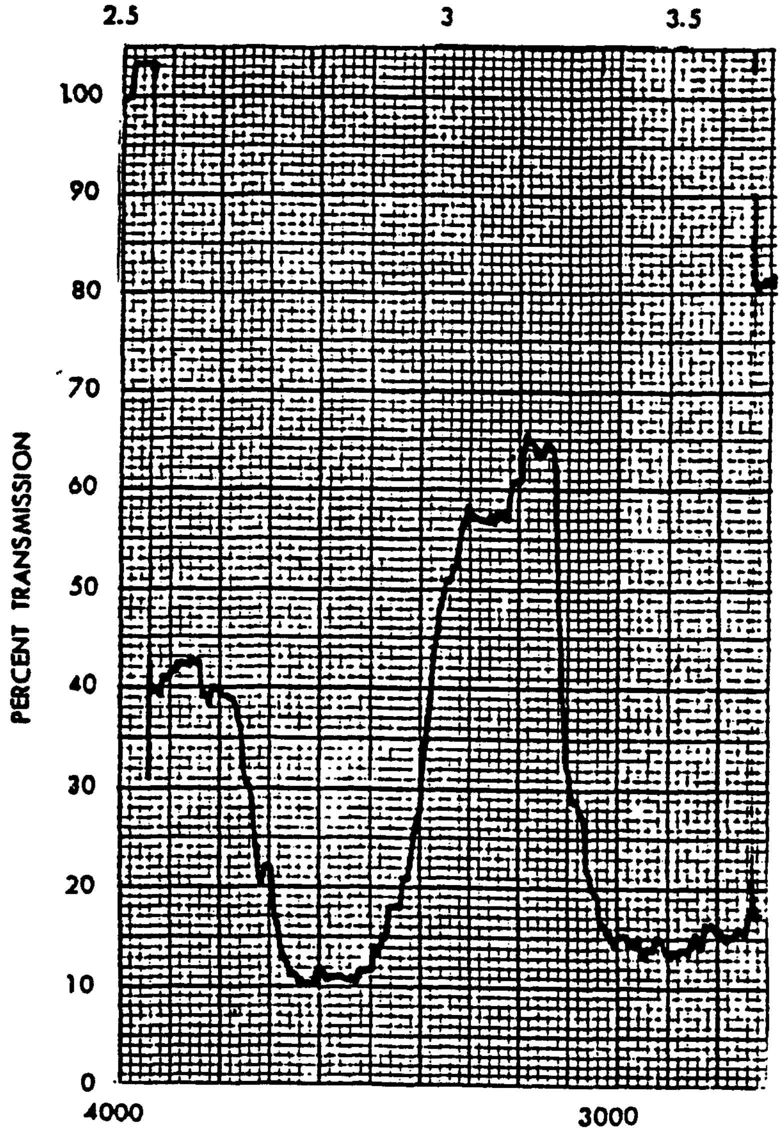
TABLE 3
AVERAGE SPIKE RECOVERY OBTAINED BY DIFFERENT METHODS

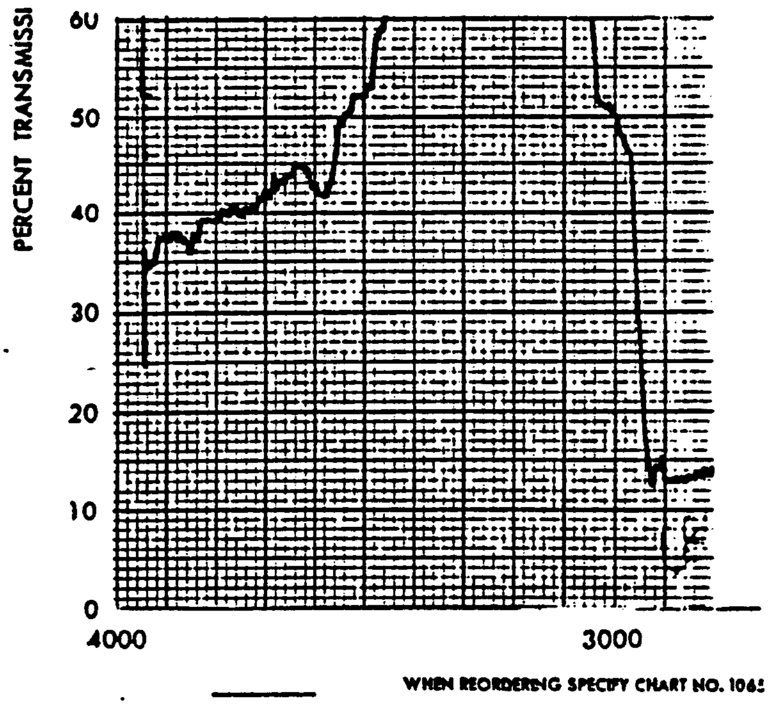
	PARAFIN OIL	#1 DIESEL	OIL/WAX
418.1, NO MODIFICATION	85.8%	---	---
418.1, WATER WASH	77.0%	---	---
418.1, BASE MODIFICATION	71.7%	---	---
418.1, ACID-BASE MODIFICATION	96.9%	85.0%	111%

FIGURE 1



WHEN REORDERING SPECIFY CHART NO. 1065

FIGURE 2


PERCENT TRANSMISSI
60
50
40
30
20
10
0
4000
3000
WHEN REORDERING SPECIFY CHART NO. 106

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Gillette, Wyoming 82716

FIGURE 3

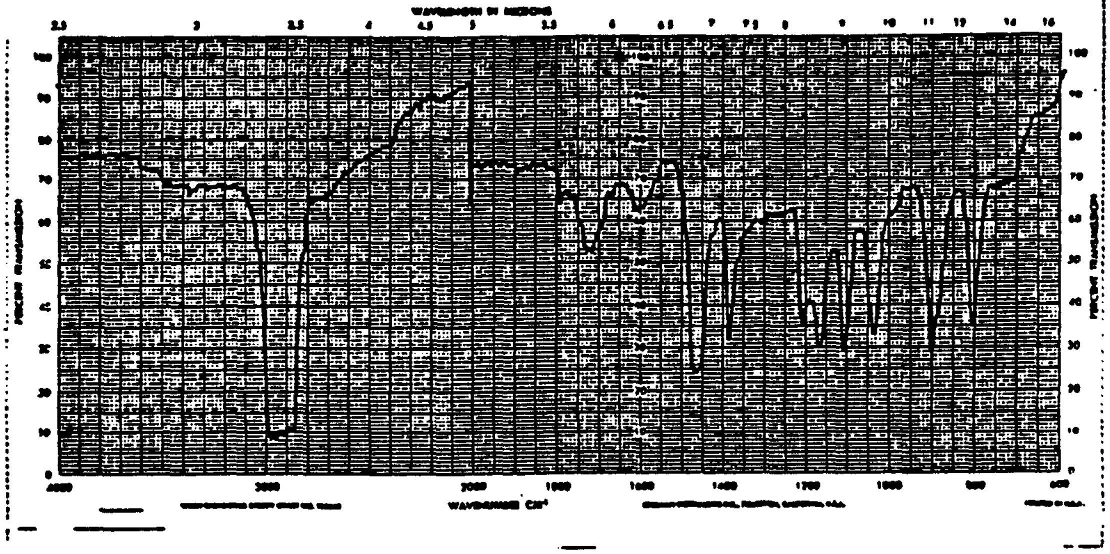
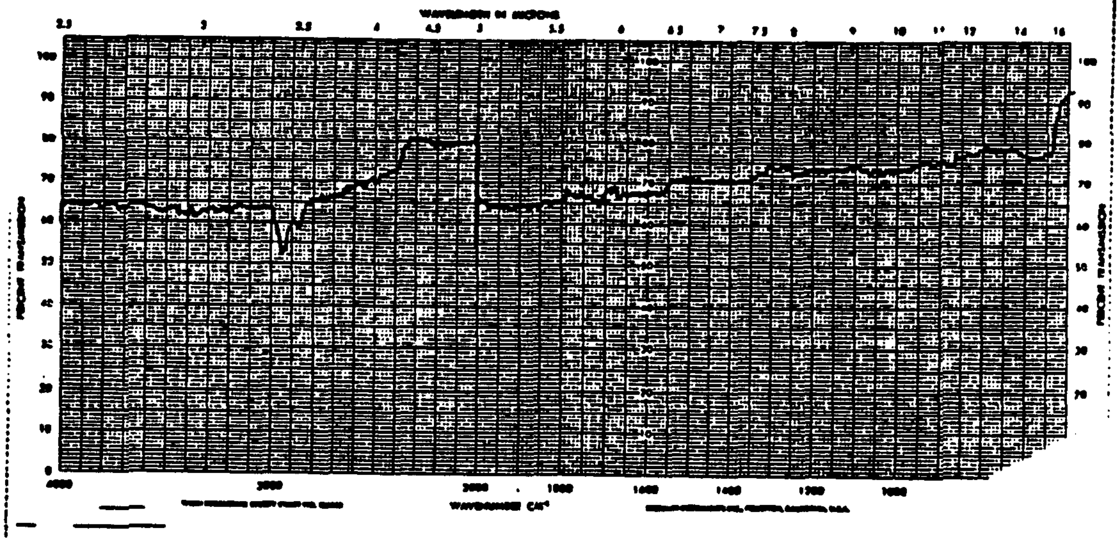


FIGURE 4


WAVELENGTH IN MICRONS
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PERCENT TRANSMISSION
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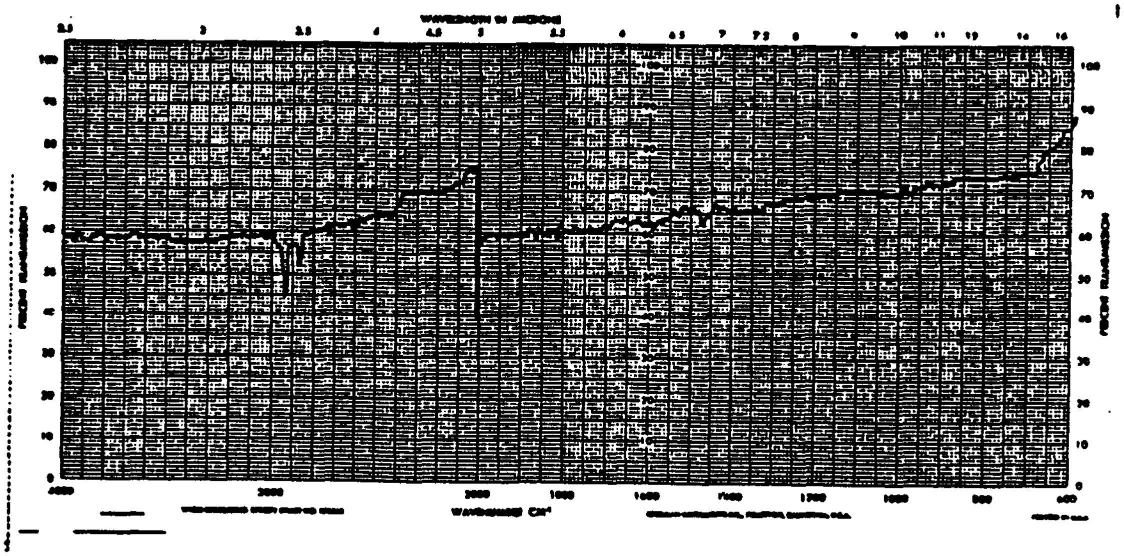
WAVENUMBER CM-1

FIGURE 5


WAVELENGTH IN MICRONS
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PERCENT TRANSMISSION
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800
600
WAVENUMBER CM⁻¹

Section Four

Engineering Biosciences Research Center
Cater-Mattil Hall • Texas Engineering Experiment Station • The Texas A&M University System • College Station, Texas 77843-2476 • Office: 409/845-3046 • Fax: 409/845-2744

February 10, 1992

Mr. Buddy Shaw, Environmental Coordinator
Amoco Production Corporation
200 Amoco Court
Farmington, New Mexico 87401

Dear Mr. Shaw,

This letter is being written at the request of Mr. Walt Kolbe of the Environmental Protection Company in response to several questions which I understand you have regarding the bioconversion process demonstrated by Mr. Jerry Finney on your oily wastes. I understand your questions revolve around: 1) comparing the bioconversion process to landfarming or landfilling, 2) leachate generation in the bioconversion process and 3) emissions of volatile organic compounds (VOCs) during the bioconversion process. I will address each in turn although they are actually strongly linked.

Comparison with Landfarming or Landfilling

During landfarming the rate of microbial activity on the oily wastes is undoubtedly much less than it is during the bioconversion process because there are so many more microbes present in Mr. Finney's intensive bioconversion process. In fact, it is likely that the chief means of removal of petroleum hydrocarbons during landfarming is by volatilization rather than by microbial conversion. Bioconversion is an active, highly aerobic process. In contrast, landfilling is essentially an anaerobic process and comparatively little microbial activity occurs in landfilling; organic wastes (including, presumably, oily wastes) remain intact for decades in landfills. For instance, people digging up old landfills have found whole hot dogs and have been able to read newspapers that are 20 years old. In my opinion, neither landfarming nor landfilling can be regarded as effective treatments for oily wastes. In contrast, the bioconversion process has proven itself effective in treating oily wastes.

Leachate Generation

I have observed two tests of the bioconversion process; in neither case was there observable leachate generation. (However, both of these tests were in dry climates.) For the bioconversion process to work properly, the moisture content must be well below levels which are likely to produce leachate. I believe any leachate generation, should it occur, can be minimized or eliminated by proper site design and process management. The fact that the bioconversion process is a controlled, above-ground process makes it amenable to careful management. In contrast, conventional landfilling is notorious for generating leachate and its attendant problems.

VOC Emissions

VOC emissions were not monitored in either of the bioconversion tests that I have observed. I have strongly recommended that this be done as soon as possible. Nonetheless, VOC emissions in the bioconversion process should be much less than in landfarming since so much more exposed surface area for VOC emissions is created in landfarming and since the time scales involved are so much longer. Landfarming is essentially a horizontal process in which any VOCs produced can immediately escape. In contrast, the vertical design of the bioconversion windrow allows VOCs produced deep in the pile to be adsorbed higher up in the pile and then biologically converted rather than immediately escaping, as in landfarming.

I hope that these comments will help clarify the issues for you. Please feel free to call or write if you wish more information.

Sincerely yours,

Bruce E. Dale, Professor and Director

cc Mr. Walt Kolbe

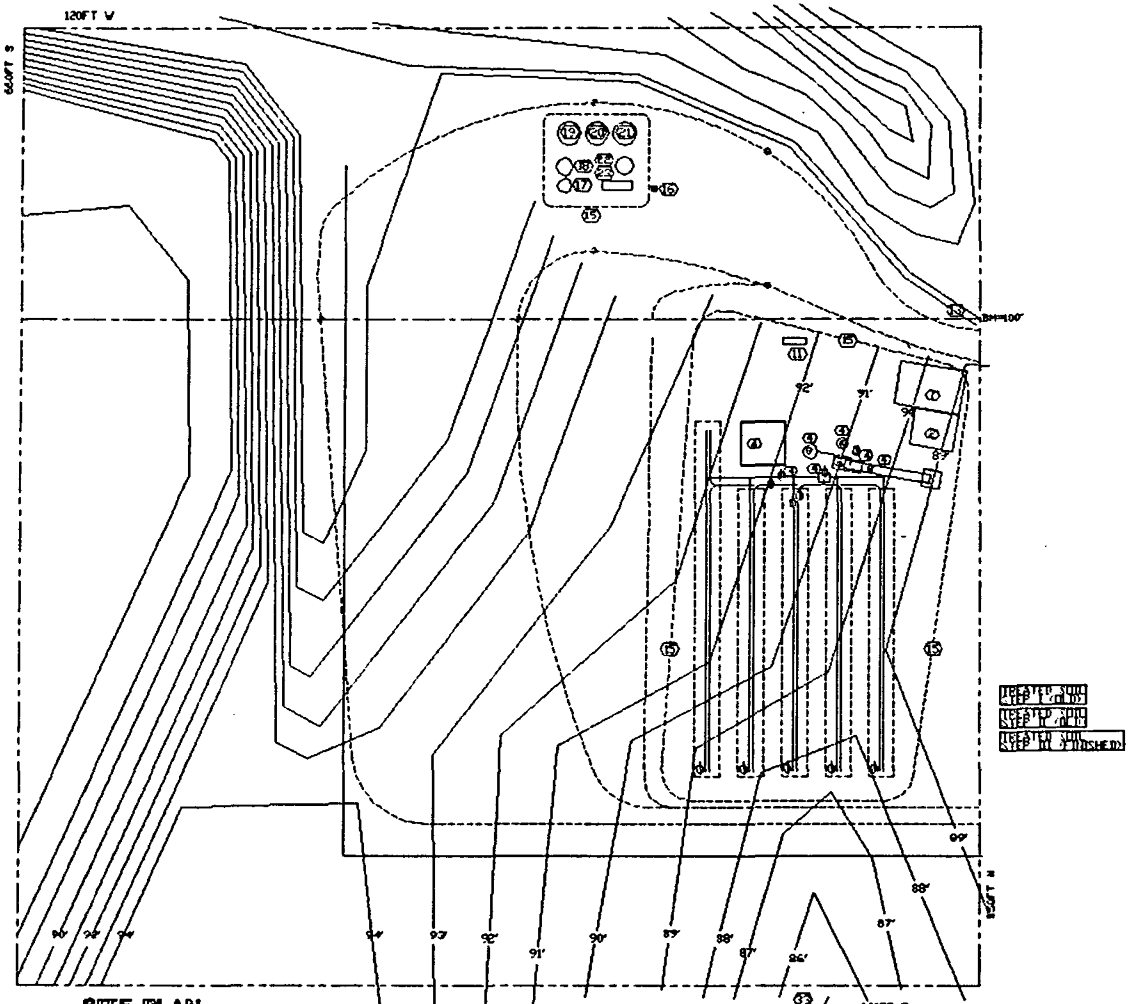
PROPOSED OPERATION

Described herein is both an interim operation that will be employed during a demonstration project of 50 pits and a full scale operation which will clean up 600 additional pits this year.

INTERIM OPERATION

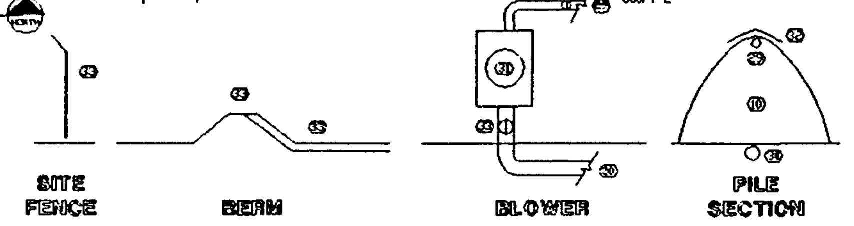
The purpose of the interim project is to confirm the repeatability of the process on a large scale as well as testing the viability of building remediation product that can be utilized at "satellite" sites in the future. The major difference is that the interim operation will not have the structures shown on the site plan. However, in terms of processing equipment (e.g. tub grinder, pug mills and blower) and containment area (e.g. clay liner, fencing, berms, culverts) the operations are identical. In this way, the environmental safeguards will be in place as well the actual processing equipment so that both will be demonstrated prior to a full scale project. EPC will excavate and transport hydrocarbon contaminated soils as directed by Amoco Production Company to our remediation site in San Juan County. When the material reaches the site it will be mixed with sewage sludge, manure and/or yard waste and/or paper in proprietary portions and sequence in order to bioconvert hydrocarbons in the contaminated soil. Mixing will be accomplished, using a specially modified pug mill. A tub grinder will be used to prepare any materials that are not the proper particle size. Since this is a predominantly aerobic process, aeration will be accomplished by pile turning and/or forced air. Pile turning will be accomplished by a Catepillar 966 front end loader. Forced air will be introduced utilizing a engine driven centrifugal blower and a manifold system. All the mechanical systems described above are presently on site ready to begin operations.

Critical operational parameters such as moisture content, temperature, oxygen level and particle size distribution will be monitored and recorded on a daily basis. All data will be computer logged and will be graphically represented along with other data in a monthly report.



SITE PLAN

SCALE 1" = 40FT



FACILITY DETAILS

NOT TO SCALE

KEYED NOTES

① OILY DIRT STORAGE
② MANURE STORAGE
③ NUTRIENT STORAGE BLDG
④ PAPER STORAGE BLDG
⑤ TUB GRINDER
⑥ STIRRED SLUDGE 500 BBL
6a 4" STL LIQUID FLOW LINE
⑦ STIRRED REACTOR 500 BBL
⑧ PUG MILL
⑨ PUG MILL CONVEYOR
⑩ TREATED SOIL STORAGE
⑪ SITE OFFICE
⑫ 16 FT GATE
⑬ 6FT CHAIN LINK FENCE w/BARBED WIRE
⑭ INTERIOR ACCESS ROAD
⑮ 3FT BERM 2:1 SLOPE 1FT CLAY LINER
⑯ NEW FILL/PUMP CONNECTION
⑰ WATER STORAGE TANK
⑱ FINISHED PRODUCT TANK
⑲ WET OIL STORAGE TANK #1
⑳ WET OIL STORAGE TANK #2
㉑ PIT OIL STORAGE TANK
㉒ SEDIMENT FILTER TANK
㉓ COALESER
㉙ 6"ø RETURN DUCT
㉚ 12"ø SUCTION
㉛ GAS POWERED BLOWER
㉜ PLASTIC ROW COVER
㉝ AIR MANIFOLD VALVE
㉞ 6FT CHAIN LINK FENCE 3 STRAN BARBED WIRE

PROJECT INFO

1 ACTIVE STORAGE OF TREATED SOIL 6,850cy

2 PROJECT SITE: SW/4, SE/4 SEC 2, T29N, R12W, NMPM 10 ACRE ±

DATE	REVISION	BY
4/8/92	REVISED SITE PLAN	GEB

PECOS BILL SPECIALTIES

P.O.Box 1284
Farmington, NM 87499-1284
(505) 327-6400
fax (505) 325-7765

SITE PLAN & PROJECT INFO

AMOCO COMPOSTING PROJECT
SITE #1 - HORN CANYON

AMOCO PRODUCTION COMPANY
200 AMOCO COURT, FARMINGTON, NM 87401

DATE: MAR'92
DRAWN BY: GEB
PROJ: 92801
SCALE: NA
SHEET C2
OF 2

OPERATOR TRAINING

Operator training will be done by the inventor of the bioconversion process, Mr. Jerry Finney, Mr. Walter Kolbe, Project Director, Mr. Mathew Harder, Superintendent, and Dr. Bruce Dale, Research Director.

1. **Classroom training covering the following:**
   - A. General safety practices
   - B. Fundamental capabilities of Bioconversion processes.
   - C. Operational control methods for treatment processes.
   - D. Fundamentals of sampling, analysis and quality assurance.
   - E. Interpretation of analytical data and application of this data to actual site operations.
   - F. Operating data management, regulatory data reporting, and plant operations data reporting.

2. **On the Job ("hands-on") training as follows:**
   - A. Equipment and operations safety
   - B. Hands-on experience with specific treatment processes.
   - C. Collection and analysis of various samples within the treatment process.
   - D. Field interpretation and application of laboratory data.
   - E. Preventative maintenance training.
   - F. Record system comprehension and management.

MONTHLY REPORT

A monthly report will be submitted no later than the 15th day of the following month to Oil Conservation Division and Amoco Production Company regarding the prior months' operations. Included in the report will be summary of any significant events. Operational data such as oxygen levels, moisture content, particle size distribution, temperature, pH, etc. will be reported and graphically illustrated.

Laboratory analysis with respect to heavy metals, BTEX, TPH, TKN, and VOC's will be included as they relate to the contaminated soils, sewage sludges and the site itself.

SPILL CONTINGENCY PLAN

In the event of a leak or spill the following procedure will be employed:

1) Stop the leak
2) Notify OCD immediately by phone and include in monthly report if spill is quarter than 100 gallons.
3) Include in monthly report if less than 100 gallons
4) Clean up spill and incorporate the material along with any contaminated soil in active "Bioconversion" piles.
5) Notify OCD immediately when spill has been cleaned up (if over 100 gallons)
6) The site location and design would contain a spill larger than several tanker loads. There is 3 foot high berms, a 2 foot natural clay liner and great depth to groundwater.

PROJECT MANAGEMENT

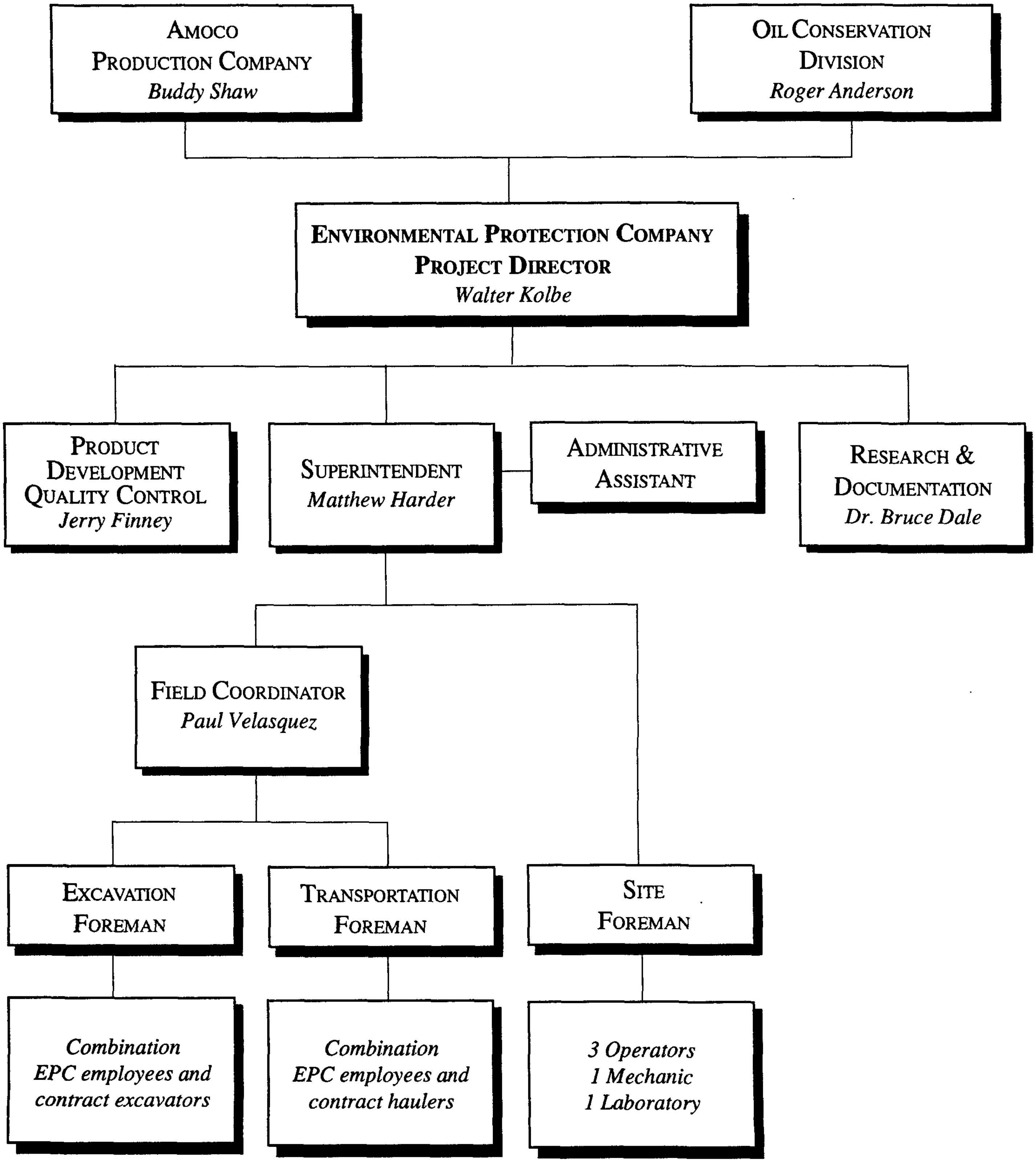
Amoco Production Company and Oil Conservation Division will be assured rapid response to any concerns as Walter Kolbe, President of EPC will serve as Project Director. However, both Amoco and OCD will have the option to direct communication to Mr. Kolbe or Mr. Matthew Harder, Superintendent as it best serves their requirements. Mr. Harder brings 16 years experience in the oil industry to the project and will be responsible for day to day operational and administrative aspects of the project.

Mr. Jerry Finney, the inventor of the "Bioconversion" process, will be responsible for product development and quality control. Mr. Finney will be working intimately with all staff members during start up as well as visiting the site on a regular basis.

Dr. Bruce Dale will be heading research and documentation. He will be working in conjunction with Dr. K.C. Donnelly who will be giving special attention to VOC's.

Mr. Paul Velesquez will serve as Field Coordinator and will direct EPC employees as well as coordinate subcontractors with all aspects as it relates to excavation and transportation of hydrocarbon contaminated soils.

PROJECT ORGANIZATION



LEACHATE CONTROL

In our pilot project there was no observable leachate and we expect that the same situation will prevail here. However, the Bioconversion piles will be maintained so that there are no free liquids. To assure no leachate penetration the ground beneath the piles will be cored every quarter to a depth of 3 feet and tested for moisture, TKN and metals.

Dr. Bruce Dale qualitatively discussed leachate as it relates to our process in section 4.

SITE CLOSURE

Upon closure, testing will be performed on soils impacted by the bioconversion. Testing will include representative samples for organics, TKN, and heavy metals. Any soil affected will be incorporated into active Bioconversion piles and removed when finished. Residuals in any tanks will be flushed out and incorporated into active Bioconversion piles and removed when finished.

The processing areas will be revegetated to be compatible with native vegetation in the surrounding area.

Before "Pathways" Addition

After "Pathways" Addition

"Pathways" (Dark Green Stalks) Versus Chemical Fertilizer

RESEARCH AREAS

We have already documented the production of important amino acids as a by-product of the Bioconversion process. The commercial potential is enormous in this area. Included here is an article by Dr. Edward Stiefel that discusses some of the potential in this area. As Dr. Stiefel says " Biomass will continued to be used as a fuel source, but much research effort has shifted to the conversion of it to useful chemicals."

The Technological Promise of the Biological Sciences

The ongoing revolution in molecular biology will continue making dramatic changes to the chemical industry.

Edward I. Stiefel, Exxon Research and Engineering Co., Annandale, NJ 08801

We live in a biologically-shaped world. Biological forces, unleashed more than 3.5 billion years ago, have merged with geological forces to determine the compositions of the atmosphere, the oceans and the uppermost layers of the earth's crust. The O_2 in the air we breathe and the carbonaceous fossil deposits that we combust and convert are each legacies of myriad communities of organisms that preceded us in geological time.

In the industrial technological era, barely 100 years old, we have added to this biogeochemical processing a new large-scale perturbation to a system that had existed in subterranean quiescence for millions of years. The buried and converted biomass of ancient eras is being rapidly depleted for the purpose of heating, moving, feeding and clothing the multitude of *Homo sapiens* that our planet supports. First coal and now petroleum and natural gas have become the primary sources of both fuels and chemicals that feed the world's industrial economies.

To date, the technology used to process these raw materials has been largely chemical. Distillations, adsorptions and catalytic conversions lie at the heart of massive processing operations carried out continually on a world-wide scale. In the discovery and processing of fossil fuel raw materials, chemistry, physics and the engineering disciplines have been vigorously applied. Although the fossil-derived starting materials are biological in their origins, to date neither the biological sciences themselves nor the knowledge these sciences have uncovered have been brought to bear in a significant way on exploration, recovery or processing of these fossil fuels.

Biological systems have historically had minor technological roles in the petroleum and petrochemicals industry except in the area of environmental control. There is, however, a widespread conviction that the recent developments in molecular biology will increasingly change this situation. The impact of molecular genetics is already being felt in the pharmaceutical and health care industries. All plant-science-based industries and large portions of the chemicals industry may be dramatically affected.

Revolution in biology

Revolutions in science are often spurred by advances in techniques or theory. In biology, the last ten years have seen the development of new techniques based on biological phenomena, which give technological potential not even dreamed of a few short years before. When combined with the latest chemical, physical and theoretical tools, the total capabilities available to scientists and engineers position them to influence, potentially in a dominant way, some of the heretofore chemically-based industries.

The ongoing revolution in biology is fueled by the tools of *molecular genetics* and *molecular immunology*. These fields are themselves undergoing intense and continuing study. However, even if no further developments were to occur in these fields, the discoveries and resultant capabilities already in hand — recombinant DNA and monoclonal antibody technologies — will fuel extraordinary advances. While these tools will continue to be honed by specialists, they will be used more routinely by numerous and varied practitioners of the biological sciences. The applications of molecular genetics have become sufficiently pragmatic that the appellation of "genetic engineering" has been aptly tendered.

Concurrent with these advances in biology, physicists and chemists have developed sets of tools that provide a completely different, yet complementary, capability. *Microchemical analysis* allows the identification of minute quantities of material, which facilitates the powerful approaches of molecular genetics. Synchrotrons, lasers, neutron sources and superconducting magnets have each been harnessed as tools of *biophysics* to bring molecular resolution to biological systems. Likewise, modern *theory*, coupled with com-

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E. I. Stiefel *is senior research associate and head of the Molecular and Biological Chemistry Group at Exxon Research and Engineering Co. where his research centers on bioinorganic chemistry and the role of metal ions in biology and catalysis. Before joining Exxon, he was a faculty member at the State Univ. of New York at Stony Brook and a senior investigator in the Charles F. Kettering Research Lab. He earned his B.S. degree at New York Univ. and his M.S. and Ph.D. degrees at Columbia Univ.*

puter graphics, allows us to more nearly understand biological structure and dynamics at the molecular level. The resulting knowledge provides targets that are pursued through the manipulative techniques of molecular genetics. It is the synergism among the latest biological, biochemical and biophysical approaches that will continue to foment dramatic changes in chosen areas of study.

Three objects of study within the biological sciences will be considered for the unusual breadth and potentially large technological impacts they encompass. These are *enzymes*, *biopolymers*, and *membrane/bioenergetic systems*, key components of biological systems. Each may be studied either within or separated from the biological system (*in vivo* or *in vitro*, respectively). The excitement in each case comes from our growing ability to understand these entities at the atomic/molecular level, *i.e.*, to make the structure-function correlations that can initiate great scientific progress. For these three systems, the new-found understanding has implications for their improved utilization, modification, extension and mimicry.

What is biology?

Biology is the study of living organisms and their components. In living systems, the cell is the basic building block. Cells are separated from their environment by membranes and in the case of plants and most bacteria by cell walls. The cell contains thousands of components, small molecules and macromolecules (biopolymers), inorganic and organic substances, hydrophobic and hydrophilic molecules all combined in a quasiorganized array.

The major classes of macromolecule in the cell are the nucleic acids, the proteins and the polysaccharides. The nucleic acids, DNA and RNA, store and carry the genetic message. DNA and RNA are linear polymers of nucleotides that contain sugar phosphate backbones with one of four N-heterocyclic molecules (bases) bound to the sugar group. The variation of the base type along the chain provides the information—the code that must be translated for the gene to be expressed. Replication of DNA involves complementarity of the base pairs, Figure 1. Translation involves protein synthesis, in which the groups on the protein chain are directly related to the linear code on the DNA, Figure 2. Complex apparatus within the cell (called ribosomes) translates the message and synthesizes the specific proteins that carry out the functions of the cell.

Proteins are linear polymers of α-amino acids joined head to tail by amide linkages, referred to as peptide bonds. The great diversity of structure possible in proteins comes about from the variability of the amino-acid side chain, which can be any of 20 different types embodying acidic, basic, aliphatic, aromatic, heterocyclic, alcoholic, hydrophobic and hydrophilic functionalities, Figure 3. Even a small protein of only 50 amino acids can be assembled in any of 10^{65} possible ways. Typical proteins have hundreds of amino acids. Clearly the possibility for variation is enormous. Proteins display recognition, catalytic, structural and regulatory roles in cellular metabolism.

Within the class of proteins are enzymes, the catalysts of the cell. Enzymes consist of proteins specifically folded in

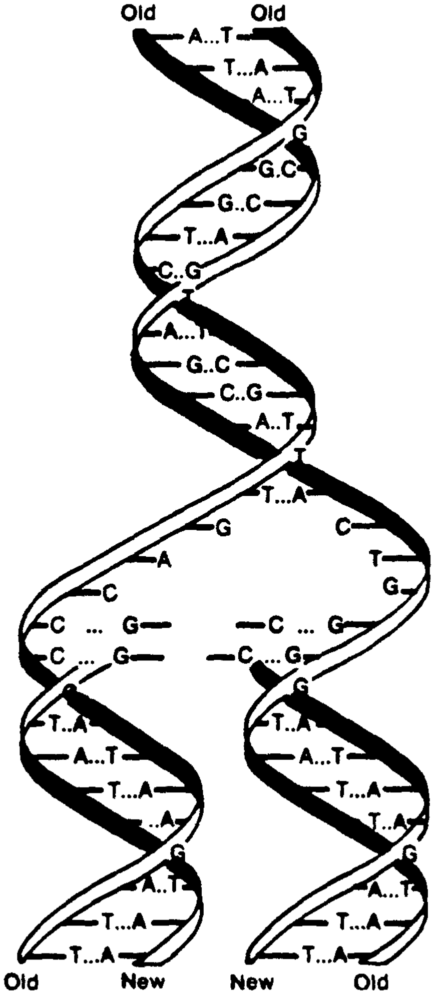

Figure 1. Replication of DNA: Adenine(A), Thymine(T), Guanine(G), and Cytosine(C), whose ordering specifies the sequence of amino acids coded for by the DNA.

From J. D. Watson, "Molecular Biology of the Gene," Benjamin/Cummings, Menlo Park, CA (1970).

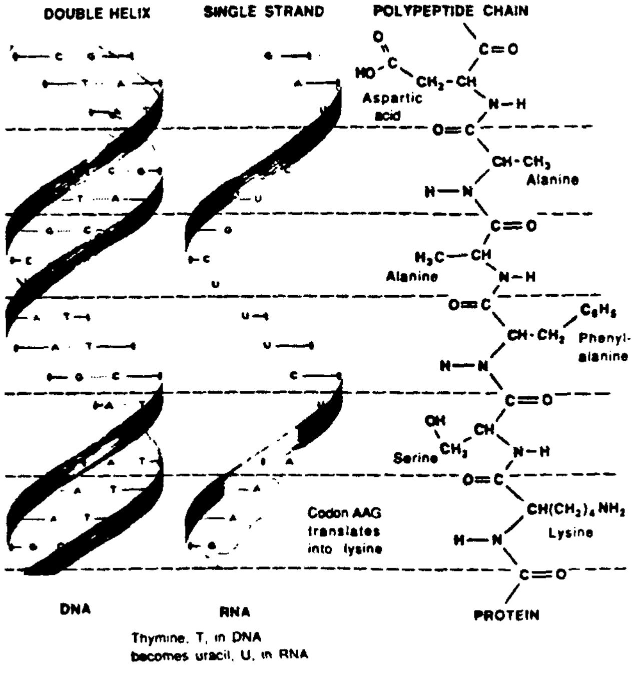

Figure 2. Transfer of information from DNA to RNA to protein.

> *In medicine, monoclonal antibodies are considered a "quantum leap" forward because they can be used to diagnose and, in some cases, treat diseases.*

three-dimensional structures such that a catalytically-active site is formed in a small region of the macromolecule, Figure 4. In addition to the protein residues, metal ions and/or nonprotein organic groupings (called cofactors or prosthetic groups) may be present at the active site of the enzyme. Enzymes carry out and control the chemistry of the cell, *i.e.*, its metabolism. Genetic systems regulate the synthesis of enzymes providing an additional level of control.

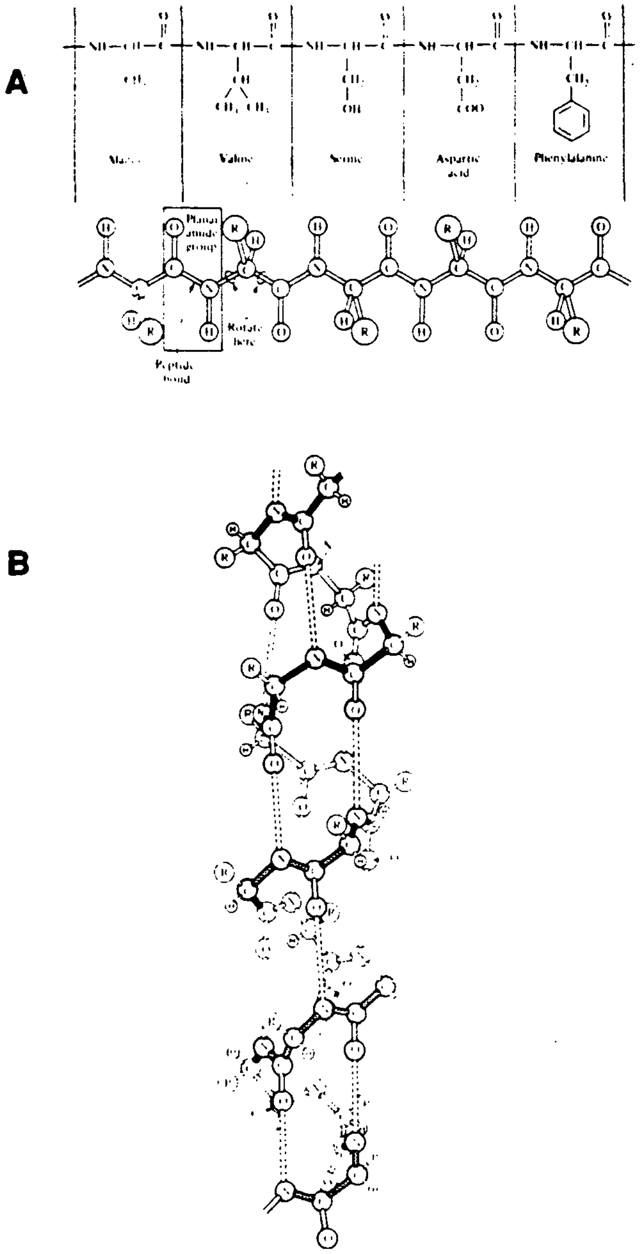

Figure 3. Each* R *group is one of 20 substituents specified by the gene coding for the protein. The variability of* R *and three-dimensional structure impart unique structural and functional properties to particular proteins.

A: structure of a protein showing the "polyamide" nature of molecule.

B: α-helix structure of proteins, one of the main motifs is responsible for the three-dimensional structure of proteins.

From J. C. Kendrew*, Scientific American *(Dec., 1961).

A third major class of biological macromolecules is the polysaccharides. There are dozens of saccharides, *i.e.*, sugars such as glucose or galactose that serve as monomeric building blocks for the formation of polysaccharides. The polysaccharides, linear polymers often with structurally significant side chains, can be crystalline or amorphous, soluble or insoluble. Polysaccharides play a major role in the structural integrity of cells and tissues. They are, for example, a major part of the structure of cell walls and of plants in the form of cellulose, a simple linear polymer of glucose, Figure 5. Cellulose is the most abundant organic compound on our planet's surface. Lignin, a cross-linked aromatic polymer, is present in plants along with cellulose. The resultant composite material, lignocellulose, provides the major structural support for plants (wood).

Of the small molecules present in cells, the lipids are a most significant class. These fat (oil) soluble components consist of saturated long-chain fatty acids and their esters as well as unsaturated and cycloaliphatic molecules. In many cases, the lipids have polar "head" groups that cause them to have both hydrophilic and hydrophobic character. This explains their crucial role in membrane formation wherein the interior of a typical lipid bilayer membrane is hydrophobic while its exterior is hydrophilic, Figure 6. Many proteins are sufficiently hydrophobic in parts of their structure that they reside in or span lipid bilayer membranes. Lipids are also synthesized by organisms for long-term chemical energy storage (in fats, seeds, etc.) or by aquatic organisms for flotation. Lipids are the major biomarkers used in petroleum exploration.

There are numerous other small molecules necessary for the functioning of all cells. One of these, adenosine triphosphate (ATP), serves as an energy storage and delivery molecule, Figure 7. Many cellular reactions are driven in what otherwise would be an uphill process by the controlled concomitant energy-yielding hydrolysis of ATP. The mechanism of ATP production, while understood in outline, is yet to be understood at the molecular level and is one of the central issues of bioenergetics. Other cofactor molecules will not be enumerated here. However, we note that many transition metals including Mn, Fe, Co, Cu, Zn, Mo, and, in some organisms, Ni and V, are essential elements. Transition elements often form key parts of those metalloenzyme-active sites that participate in many of the most relevant biological reactions.

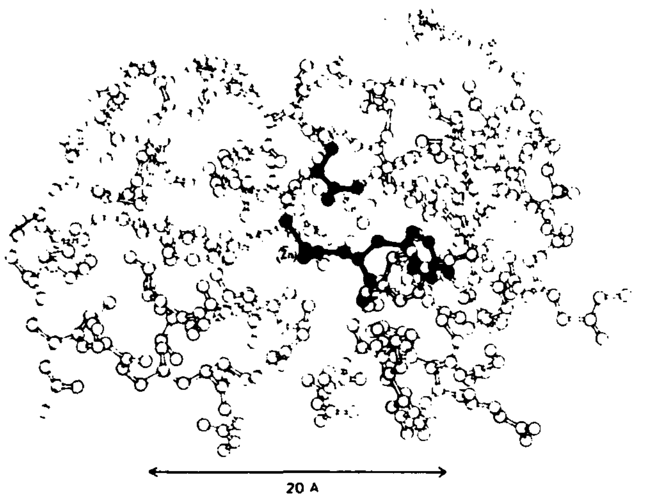

Figure 4. Portion of the active site structure of carboxypeptidase A. The three-dimensional array of the amino acid side chains and the single Zn^{2+} ion are organized to catalyze the hydrolysis of amide linkages such as that of glycyl tyrosine.

From W. N. Lipscomb, **Proc. Robert A. Welch Found. Conf. Chem. Res.,** ***15*** **p. 140 (1971).**

Molecular genetics

New techniques are revolutionizing the study of biochemical and biological systems. Most of these techniques represent independent fields. Their impact comes from their application to specific objects of scientific study.

Genes (DNA) specify (code for) proteins. The genetic heritage of an organism (its genome) and the *expression* of its genes in the form of protein synthesis determine the nature of the organism. The protein gene products can be enzymes, antibodies, structural units, electron carriers, binders and carriers of small molecules, or messengers (*e.g.*, hormones). It is now possible to cut DNA at specific sites and to relink the resulting fragments, *i.e.*, splice the genes, recombine the DNA, Figure 8. Excised DNA pieces can be fully, accurately and rapidly sequenced providing genetic data at a remarkably fast and accelerating rate. The DNA sequence gives directly the amino acid sequence of the protein for which the gene codes. "Gene machines" synthesize fragments of DNA such that genes modified (mutated) at specific sites can be produced. This long-dreamed-of *site-directed mutagenesis* is now a reality, which provides an exceedingly powerful probe of structure-function relationships.

The altered genes (DNA) can be (re)inserted into an organism such that the genes can reproduce along with the organism, *i.e.*, be cloned. Further, the organism's metabolism often can be controlled to overproduce the protein gene product. The techniques allow one to insert and express (translate) foreign DNA in an organism such that a new protein may be produced, harvested, and used. Alternatively, the newly formed organism may itself have exploitable properties. The revolutionary impact of these genetic capabilities cannot be overstated.

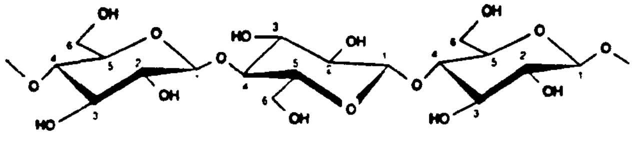

Figure 5. Portion of the structure of cellulose showing the polymeric structure formed by the β(1→4) linking of glucose units.

Despite the euphoria over capabilities, there are limitations, which current research is seeking to overcome. Genetic data are currently being accumulated faster than they can be assimilated. Gene banks have been set up as repositories for the wealth of information. Biologists, mathematicians and computer scientists are joining forces to develop new and more sophisticated data management and analysis techniques to handle this increasing load of information and to help extract meaningful patterns. Computer automation and newer procedures are increasing yet again the amount of data that can be collected. Some biological problems that are currently overwhelming because of their complexity in development, brain function, and ecology may yet respond to the increasing data management sophistication in the community of biological scientists.

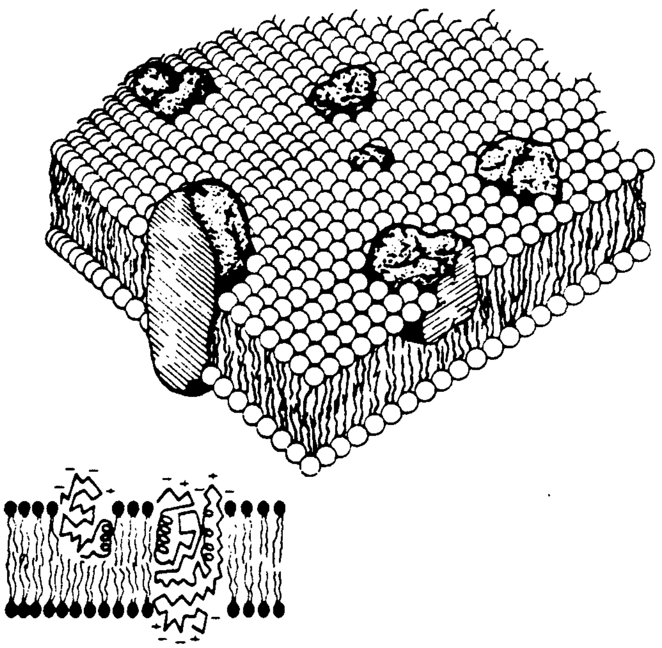

Figure 6. Fluid Mosaic Model of lipid bilayer membrane showing polar hydrophilic head groups, hydrophobic tail groups, and membrane proteins embedded in the lipid bilayer.

From S. J. Singer and G. L. Nicolson, **Sci.,** ***175*** **p. 723 (1972).**

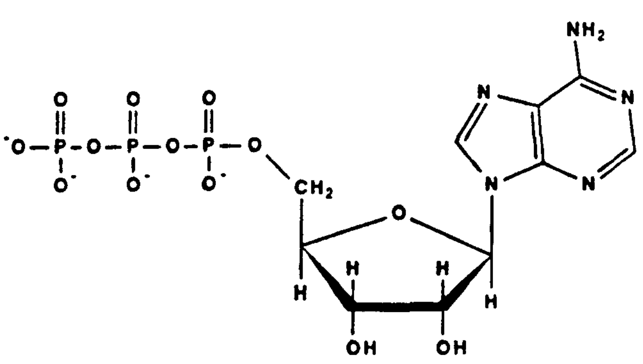

Figure 7. Structure of adenosine triphosphate (ATP). The P-O-P linkages are unstable to hydrolysis but kinetically relatively inert. The cell uses enzymes to catalyze the hydrolysis and capture the free energy released for other cellular processes.

> *Membrane biology and the vectorial chemistry it supports are maturing areas of study.*

The genetic manipulation of bacteria is now well in hand, with *Escherichia coli, (E. coli)*, being the bacterium in which many of the techniques and concepts have been developed. Other species of bacteria will soon become accessible to the genetic control now available for *E. coli*, including species of *Clostridium, Pseudomonas, Staphylococcus, Rhizobium, Bacillus* and *Corynebacterium.* It is generally felt that any bacterium, given sufficient attention, will yield to and become manipulable by the techniques of modern molecular genetics. Even if a given organism proves recalcitrant to *in vivo* genetic manipulation, it is always possible to move some of its key genes to organisms such as *E. coli*, where they may be explored and/or exploited.

The genetic understanding and manipualbility of plants and animals lag far behind that of bacteria. The genomes of plants and animals are far more complicated than those of bacteria due in part to the need for development and cell differentiation to be programmed into the organism. The mechanisms of development of multicellular organisms are not yet understood and present a significant challenge to molecular biology. However, our ability to analyze the more complex plant and animal genomes is greatly enhanced by the ability to transfer selected genes to bacteria. Moreover, the generation of whole plants from cell tissue culture is now possible for some species and this capability is spreading to agronomically important species.

The new genetic tools have had their greatest impact on biological research, with ripples toward commercial development. Although much undoubtedly remains to be discovered, the genetic tools at hand are largely adequate to a vast number of tasks in biology and a long period of applying them is anticipated. For example, site-directed mutagenesis is now capable of creating new enzymes on demand. However, we have much to learn about protein chemistry before we are able to design enzymes. Genetic approaches will aid in gathering the information needed.

Molecular immunology

Antibodies (Abs) are soluble proteins that are part of the immune system of higher organisms. Each Ab recognizes and binds with high affinity to a specific molecular structure (designated the antigen). A wide variety of molecular structures can serve as antigens, each recognized by a different Ab molecule. The immune system recognizes and destroys entities that contain the antigen. In a normal animal there are millions of different antibody molecules. Immunology attained molecular-level capabilities when techniques were developed for preparing large quantities of antibody molecules specific for a single antigen. These are called monoclonal antibodies (MAbs). MAbs are prepared by fusing single specific antibody-producing spleen cells with tumor cells (which multiply uncontrolled), thereby forming an immortal cell line (hybridoma) that produces only the single MAb. In medicine, MAbs are considered a "quantum leap" forward because they can be used to diagnose and, in some cases, treat diseases. MAbs specific to tumor antigens may be invaluable in control of cancer.

Monoclonal antibodies have potential use in areas other than medicine. For example, because of their specificity toward rather small antigenic sites on enzymes, they are potentially useful in determining which sites on complex enzymes are concerned with catalytic activity. Immobilized MAbs may allow one-step purifications of desired protein components such as enzymes from complex mixtures. This may be a great boon in enzyme technology. Much time is now spent in purifying enzymes from complex mixtures. Commercial production of enzymes, proteins or carbohydrates may use MAb-based affinity adsorbants for rapid purification.

A new area of great potential excitement is the development of antibodies with catalytic functionality. This accomplishment could allow production of antibody enzymes with the antigenic specificity of antibodies that catalyze reactions of molecules for which no natural enzyme exists.

Microchemical analysis

Microchemical analysis provides access to the treasures of biology. Some of the most potent biological molecules are also the scarcest. Biological systems are frugal, and seldom of their own volition make more than they need. The deadliest toxins, the most powerful pheromones (attractants), and the most active enzymes are often present in the smallest amounts. These amounts can be amplified tremen-

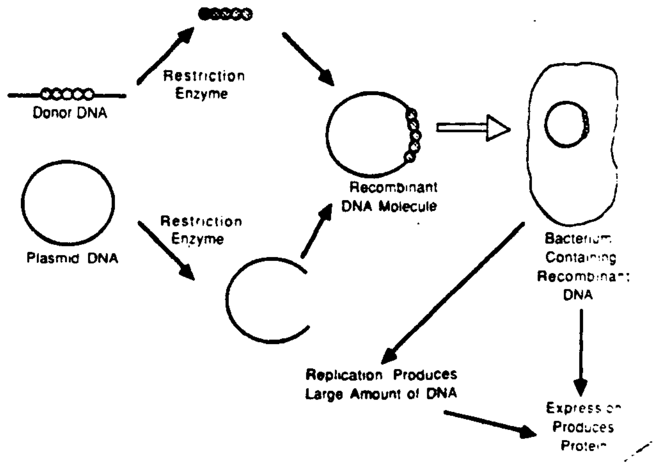

Figure 8. Strategy involved in recombinant DNA technology. A section of DNA (donor DNA) is excised out of one organism and recombined with DNA of a vector such as a plasmid of another organism to produce a new recombinant DNA molecule. This vector is used to place donor DNA into a new organism where it can be expressed in protein synthesis.

dously by the techniques of genetic engineering. However, first one must identify the protein. New microanalysis techniques using high-pressure liquid chromatography (HPLC), gas chromatography, mass spectrometry, and chemical derivitization give one the capability of separating and analyzing picomole quantities of proteins. A complete sequence can be determined on less than one microgram of a protein 70 amino acids long. Once the sequence is known, part of the gene specifying that protein can be synthesized and used as a probe to select the whole gene from a gene bank of the organism. The gene can then be cloned and expressed, with biosynthesis of the desired protein monitored using monoclonal antibodies. This combined use of microanalysis, molecular genetics, and immunology is now close to routine in the major laboratories where modern molecular biochemical research is pursued.

Biophysics and theoretical biology

The most powerful techniques in the physicists' and chemists' arsenals are now being brought to bear on problems in the biological sciences. Biological systems often provide motivation and an initial testing ground for the development of the newest probes that physical science can provide. Picosecond spectroscopy is now measuring the primary events in the photosynthetic process, while synchrotron radiation is probing details of enzyme-active sites through X-ray absorption spectroscopy. X-ray crystallography has provided detailed structure of over 500 proteins and the recent inclusion of larger (molecular weights greater than 100,000) and membrane-bound proteins (reaction centers of photosynthetic bacteria) insures that further insights will be forthcoming from this field.

In parallel, there has been an increasing application of neutron scattering to biological structure ranging from membranes to the giant protein-nucleic acid complexes, ribosomes and nucleosomes. Advances in electron microscopy have increased the resolution of the ultrastructure of organisms and cells. A less anticipated, but no less exciting, development has been the application of nuclear magnetic resonance (NMR) spectroscopy to biological systems. The advent of pulsed, multinuclear, two-dimensional and spatially-resolved NMR has led to advances in understanding the structure and dynamics of proteins in solution, to the ability to trace metabolic processes *in vivo* in real time, and to NMR tomographic resolution of molecular distributions in larger organisms.

In parallel with, but somewhat lagging behind, these advances in physical methods for structure and dynamics determination have been advances in theoretical biology. The approaches of quantum chemistry, molecular mechanics, and statistical thermodynamics are being brought to bear on problems in the biological sciences. In this growing field, there are a cadre of people who are able to recognize both the most sophisticated theoretical treatments and the important biological situations where they apply. An area of recent progress has been the prediction of secondary and tertiary structure of globular proteins and their ability to bind small molecules (substrates or inhibitors). Here, theoretical, X-ray crystallographic and molecular computer graphics studies combine to give a vivid and often edifying picture of the molecular architecture of proteins. Such approaches (when combined with the design and utilization of chemical-active-site probes by bioorganic and bioinorganic chemists) have led to powerful quantitative structure-function correlations that now are used avidly in the pharmaceutical industy.

The tools of biophysics, together with the techniques of molecular genetics, provide understanding and new capabilities for deliberate modification of proteins. While there is little doubt that such molecular level control will be forthcoming, at present the ability of the genetic engineer to modify and produce proteins may exceed the rapidity with which biophysicists can determine protein structures.

The new techniques and knowledge enhance our ability to study virtually any aspect of a biological system. The impact of these techniques comes through the particular biochemical and biological areas in which they are used. In the case of enzymes, biopolymers and biomembranes, the studies have reached the molecular level.

Enzymes

Enzymes are catalysts of high activity and great specificity. Some enzymes already form the basis for million ton/yr industries. For example, the conversion of glucose to fructose by the enzyme glucose isomerase is the basis for the high-fructose corn syrup industry. Enzymes have long been involved in production of foods and specialty chemicals, especially pharmaceuticals, where the product has high added value. However, among the reactions that enzymes catalyze, there are many that are of interest in the petroleum and chemicals industry. These include $CH_4 \rightarrow CH_3OH$, $N_2 \rightarrow NH_3$, $C_3H_6 \rightarrow C_3H_6O$ (propylene oxide), other partial oxidations, one-carbon conversions and isomerizations. The enzymes work under mild conditions of temperatures and pressure. Why have these systems not found industrial application? The answer lies in the lack of isolability, availability, stability or adaptability of the desired enzymes. This situation may change significantly in the coming decade.

The potential of genetic techniques in enzymology has not yet been significantly exploited. Advances in genetic manipulation using site-directed mutagenesis allow the substitution of single or multiple amino acids that can alter the basic catalytic properties of an enzyme. One may change the affinity or specificity of the enzyme, its ability to withstand nonaqueous solvents, its temperature optimum, or even its turnover number. It is now possible to reconstruct an enzyme for a desired purpose different than its physiological purpose. Moreover, information on how enzymes function may lead to construction *de novo* of specific enzymes starting only with amino acids and, if needed, cofactors or metal centers (iron-sulfur clusters, porphyrins, etc.). This extrapolation would have seemed absurd only a decade ago, but the new techniques truly lay bare this possibility. The question in most scientists' minds is not whether artificial enzymes will be made in this manner but when this accomplishment will be realized.

A cause of exuberance has been the increasingly common use of site-directed mutagenesis on enzymes. Selective

> *The biotechnology of the future will use unusual organisms or their enzymes in new processes.*

change of a single amino acid has caused activity or stability to be increased. Clearly, one can systemically change every amino acid in the active-site region to assess its effect and thereby establish a complete structure-function correlation. The success of initial experiments shows that site-directed mutagenesis will allow scientists to establish the rules of enzyme structure, action and stability, and ultimately create totally new enzymes.

Other recent results cause added excitement. First, it has been found that enzymes can function in organic solvents. In fact, certain enzymes actually exhibit increased activity and thermal stability when placed in organic solvents. Specifically, hydrogenase, the enzyme that activates molecular hydrogen, is active in dimethylsulfoxide, while lipase catalyzes a transesterification reaction in anhydrous heptanol-tributyrin. Remarkably, for lipase, activity increases and the enzyme remains stable at 100°C. It is anticipated that organic solvents will be used increasingly as a medium for enzyme reactions.

A second area of excitement lies in the isolation of enzymes from organisms that occupy unusual niches. Enzymes from thermophilic organisms are found to be far more heat-stable than enzymes from the more commonly studied mesophilic organisms. The investigation of related enzymes from several types of organisms should allow the identification of those features of the enzyme that impart the thermal stability desired for many processes.

Finally, there is cause for excitement in the identification and synthetic duplication of some of the metal sites in enzymes. Following the crystallographic identification of the active site of ferredoxin as an iron-sulfur cluster, inorganic chemists duplicated the structural, spectroscopic and reactivity properties of the cluster in synthetic systems. Such knowledge of biological metal centers has provided entries into areas of interesting new chemistry. Synthetic inorganic chemists are now preparing analogs to natural centers having different metals and different reactivity properties. Soon chemists/biologists will begin to assemble artificial enzymes where the protein and/or the metal center may be altered to achieve the desired catalytic effect.

At present a handful of the simplest enzymes are now understood on the molecular level from a combination of X-ray crystallographic analysis, NMR spectroscopy, kinetic studies and clever design of bioinorganic and bioorganic probes of structure. The availability of synchrotron radiation, the potential ability to grow larger crystals (*e.g.*, in space), and new techniques for crystallization of membrane proteins should extend the range of enzymes whose structure may be determined crystallographically. In parallel, the overproduction of desired enzymes through gene cloning is becoming common if not routine. The field of enzymology will benefit from application of all of the techniques previously discussed. This may lead both to the increased usage of improved enzyme-catalyzed reactions and to the enhanced ability to create biomimetic or semisynthetic enzyme-like systems.

Biopolymers

In addition to the informational polymers (DNA and RNA) and the three-dimensional catalytic polymers (enzymes), biological systems produce an array of more regular polymeric systems. A wide variety of microorganisms, including bacteria, yeasts and filamentous fungi, produce an equally wide variety of extracellular polymers as well as numerous other molecules having surface-active properties. These include certain polyamides (peptides), polyesters, polysaccharides, and combinations of these with one another and with lipids. These molecules are usually linear polymers but may be branched and often have heavily derivatized side chains. Biopolymers are used by biological systems for viscosity control, energy storage, and structural containment (*e.g.*, cell walls). Some organisms secrete biopolymers in vast amounts for protection and to modify their environment; others secrete biopolymers as a mechanism of attachment to surfaces. A number of microbial biopolymers have been commercialized; one of these is xanthan gum.

Xanthan, produced by the bacterium *Xanthomonas campestris*, is a linear polymer of glucose with short sugar side chains. Its viscosifying properties find major application in foods (gravies, salad dressings, milk shakes, etc.), as stabilizers of suspensions or emulsions in agricultural sprays, paints and cosmetics, in mining (ore settling, flocculation, slurry pumping) and in petroleum operations (drilling muds, in enhanced oil recovery.)

Other polysaccharides are potent bioemulsifiers potentially useful in cleaning oily sludges from storage tanks, barges and barrels, as well as for pipeline transport of heavy crudes, fuel oils, or coal slurries.

Poly-β-hydroxybutyric acid (PHB), a plastic-like polyester, is produced by a variety of bacteria. Potential uses for PHB (as well as for other biopolymers) include biodegradable bottles and packaging, and slow-release medical or agricultural formulations. PHB also has piezoelectric properties that might be exploited.

Determination of structure-function relationships in biopolymers is a relatively new and potentially fertile field. Novel microbial biopolymer molecules are continually being discovered, and many of these may have unique and exploitable physical and chemical properties. Research in the area is growing and will likely focus on the development of biopolymers with specific properties, *e.g.*, polymers for enhanced oil recovery having improved thermal stability, and salt-tolerance. Such studies will be aided by the ability to work with unusual organisms that in their natural habitats cope with such environmental extremes. Once the biosynthetic pathways for the production of the polymers become known, the techniques of genetic engineering may be employed to produce new "bio" polymers with desired compositions or properties.

Membrane biology

Organized membrane-based structures are the energy harvesting and converting apparatus of cells. The chloroplast (site of photosynthesis in plants), the mitochondrion (principal respiration site in multicellular organisms), and the membranes of bacteria consist of quasiorganized arrays of lipids, proteins and small molecule electron carriers that allow reactions to occur in a spatially-ordered (vectorial) as well as temporally-ordered sense. Many bioenergetic systems temporarily store the input energy increment, *e.g.*, photonic excitation or oxidation by O_2, as a concentration and/or charge gradient across a membrane. The controlled discharge of this gradient leads to long-term storage of the captured energy in the form of "high-energy," biosynthetically-useful molecules such as ATP. The transport of ions across membranes is a crucial component of this intermediate biological energy storage system.

Membrane biology and the vectorial chemistry it supports are maturing areas of study. The broad picture of how biological membranes effect energy transductions seems well understood. The chemical details are likely to become increasingly accessible through the application of new techniques in biophysics and molecular genetics. A major breakthrough achieved is the development of techniques for crystallization of membrane proteins, which suddenly allows for X-ray crystallography of the important complexes from photosynthetic, respiratory and other membranes. We now know how chlorophyll is oriented in bacterial photosynthetic reaction centers. Soon we shall know how electron carriers in the cytochrome chain relate to one another; and perhaps the structure of the coupling factor (ATPase) will reveal how a proton gradient stored across a membrane drives ATP synthesis. The answer to this question could suggest other ways to use charge or ion gradients to drive chemical reactions. These studies are proceeding optimally and are interactively coupled both with site-directed mutagenesis approaches for experimentally altering protein structures and with molecular mechanics/computer modeling.

A second breakthrough in biomembrane study has been the ability to disassemble and reassemble natural membranes to create artificial systems that contain various combinations of natural and synthetic components. These constructions can often carry out partial reactions of the intact biological systems and may offer insights into biological photovoltaics and the role of the field effect in biological energy transductions. Through their use, coupled with the analysis of mutant systems, the so-called "water splitting," O_2-evolving reaction of photosynthesis, may soon be understood and it is possible that relatively efficient H_2-evolution in photo-driven systems will be achieved. Further, the mechanism of membrane transport for many ions and molecules will likely be understood, providing important input into the construction of biomimetic permselective membranes.

New microorganisms

The identification of new microscopic forms of life is one of the prime activities of classical microbiology. The drive for this activity continues to be provided by medical needs and to a lesser extent by agricultural, ecological and geological considerations. Within the last ten years, it has become clear that there is greater diversity within the realm of bacteria than had been realized previously.

A whole new kingdom, the archaebacteria (literally "ancient bacteria") has been identified to stand alongside the eubacteria ("true bacteria" such as *E. coli*) as the two divisions of the bacterial world. The archaebacteria include methanogens (CO or $CO_2 \rightarrow CH_4$), halophiles (salt loving), and some sulfate reducers ($SO_4^{2-} \rightarrow S^{2-}$), thermophiles (heat loving), and acidophiles (acid loving). The archaebacteria differ from eubacteria in their cell wall structure, photosynthetic apparatus, trace element compositions, enzymes, cofactors and types of lipids.

Among the archaebacteria are halophiles that thrive in such unlikely places as the "Dead" Sea. Enzymes isolated from halophiles were found to be inactive in the absence of high concentrations of salt, and dramatic structural differences exist between halophilic cell wall/membrane systems and those of other bacteria. A unique pigment, bacteriorhodopsin, forms the basis of a light-driven energy transduction system totally different from that of plant or eubacterial photosynthesis. The newly-found diversity considerably broadens the range of substances and phenomena available for study from the bacterial world. The work on archaebacteria is accelerating and may have significant biogeochemical ramifications.

Microorganisms are now known to be capable of occupying and surviving in the most extreme environments of this planet, from the depths of the oceans surrounding the deep-sea hydrothermal vents to the cold dry valleys of Antarctica. There are thermophiles (confirmed up to 107°C, proposed but disputed up to 250°C), psychrophiles (to -7°C), acidophiles (to pH 1 in sulfuric acid), alkaliphiles (to pH 12 in ammonia), halophiles (to 40% salt in the Great Salt Lake and the Dead Sea), and barophiles (surviving only at > 200 atm on the sea bottom). Bacteria have been isolated from oil wells at least 5,000 ft (1,500 m) deep. Further, there are organisms that will tolerate and often thrive in so-called "chemical wastes" or at high metal concentrations that are toxic to most other species. Metabolic flexibility and rapid evolution allow microorganisms to occupy virtually every conceivable ecological niche where they can live off the available free-energy change of an existing chemical disequilibrium. The diverse chemistry of the available energy

> *Biopolymers, already used extensively in food, viscosification and flocculation, are likely to see increased usage as new biopolymers are discovered, engineered, and marketed.*

sources drives the biological diversity of the microbial world.

Beyond this natural diversity it is possible to direct evolutionary change in microbial cultures using unnatural growth media (selective pressure) carefully controlled to allow an organism to evolve gradually in a desired direction (*e.g.*, to live on and "detoxify" a particular pollutant). For example, organisms capable of removing organic sulfur from coal have been obtained following growth of mixed bacterial cultures on soils enriched in organosulfur compounds. Such directed evolution can be accelerated even further by selective mutagenesis techniques. Before true molecular enzyme engineering through genetic manipulation becomes available on a routine basis, such directed evolution will remain a prime methodology for getting new metabolic and enzymatic capabilities into microorganisms.

The newly isolated unusual life forms will have metabolic capabilities that provide options for chemical processing using those organisms. Moreover, each newly discovered capability also adds genes to the pool available for manipulation. By using these gene resources, new organisms will continue to be created and patented, for example, organisms having the capability to convert CH_4, CH_3OH or CO directly to valuable products such as biopolymers or long-chain alcohols. The biotechnology of the future will use unusual organisms or their enzymes in new processes. Alternatively, the genes from these new organisms may be used to transfer unusual capabilities to existing, more manageable strains. Further, the ability to isolate and study enzymes from organisms that live in different chemical environments will provide insights not only into the enzymes themselves but also into the limits of chemical catalysis.

Finally, the ability of many microorganisms to bind and concentrate trace elements raises exciting possibilities. For many trace elements, including Fe, Ni, V, Cr, Co, Mo, Mn, Ca, Mg, Hg, Cd, Pb, Se, As, and U, there are organisms that hyperaccumulate the element from extremely dilute (sometimes ppb) solutions. For Fe and Hg, the genetic requirements and chemical mechanisms for this capability will soon be understood in depth at the chemical level. With appropriate effort this information could be attained for any trace element. Such efforts could lead to organisms or biochemicals having remarkable capabilities in metal accumulation, which would be valuable either in environmental cleanup or in land or sea mining.

Emerging fields: biomimetic chemistry and hybrid systems

Biological systems carry out chemical detections, conversions, separations and energy transductions in manners that are often the envy of the chemist or chemical engineer. For many of these processes, understanding at the molecular level is, or soon will be, in hand. The resultant knowledge has proved inspirational for scientists who are seeking to mimic the chemistry done by biological systems. The resultant emerging field, called biomimetic chemistry, is featured prominently in "Opportunities in Chemistry" (The Pimentel Study). The field is potentially very broad, but its outlines are beginning to emerge, and in selected cases, exciting new chemical conversions and separations are being accomplished.

In addition to purely mimetic systems, there is significant activity in the construction of hybrid systems containing both biological and synthetic components. Such systems, often called semisynthetic, use to the utmost what chemistry and biology have to offer to address a particular problem.

Biosensor Construction. Biological receptors, antibodies and enzymes are capable of specifically recognizing and binding with high affinity to minute concentrations of appropriate molecules. The molecular nature of this affinity is now understood in a number of cases. The emergent general principles of binding of macromolecules to one another and to small molecules allow the design of related synthetic systems with similar capabilities. An extensive area of "host-guest" chemistry is being pursued largely by organic chemists to develop specific binding systems for designated molecules or molecular types.

This binding/recognition capability of biomolecules is already being exploited in the growing field of biosensor construction. Biosensors are based on the activities of tissues, cells, organelles, enzymes or antibodies, which are immobilized at the surface of a transducer device such that a reaction involving the biological material can be detected and measured. Immobilization may be via physical entrapment in an inert matrix or via covalent binding, *e.g.*, with a bifunctional reagent such as glutaraldehyde. The transducers used include those based on potentiometric, amperometric, optical and calorimetric phenomena. The biosensor usually is totally selective and often extremely sensitive. It is used for analytical applications in clinical diagnosis and monitoring (of glucose, cholesterol, urea), environmental monitoring (of pollutants in waste streams such as NTA, TNT and formaldehyde), and in pharmaceutical or chemical manufacturing processes (for penicillin, L-amino acids, and lactic acid). Biosensors will be integral components of such devices as the implantable artificial kidney or pancreas. As their thermal stability increases and the range of detectable substances broadens, they are likely to be used increasingly in the chemical processing industry.

O_2 Binding and Activation. Chemists have already made

great strides in synthetically reproducing or approximating the active sites of metalloproteins and in developing biomimetic O_2 carriers. Many of the O_2-binding characteristics of hemoglobin and myoglobin have been duplicated. This fundamental development has potential applications in artificial blood and in O_2 separation and storage systems. Further, the O_2-binding studies are prerequisite to the ongoing study of O_2 activation with respect to partial oxidation, peroxidation or epoxidation reactions. Recent results make it likely that "bioinorganic epoxidations" will be exploited, at least in laboratory syntheses, and in the long run, perhaps commercially.

Semisynthetic/Artificial Enzyme Systems. Research in enzymatic catalysis is giving new insights, and molecular genetics is providing new manipulative capabilities to scientists seeking modified enzymes for specific new tasks. A complementary approach of bioinorganic chemistry involves the replacement of the metals normally present in enzymes or the addition of metals to nonmetal-bearing sites on proteins. The resultant systems may have startlingly different reactivity compared to their native analogs. For example, if ruthenium is incorporated into myoglobin, catalytic activity is imparted to the normally noncatalytic myoglobin protein.

Another example, involving bioorganic chemistry, is the addition of a flavin group to the enzyme papain. This enzyme normally hydrolyzes peptides in a nonredox process. However, the flavin-substituted papain catalyzes a redox reaction, the oxidation of dihydropyridines. Other studies have involved the use of synthetic and natural polymers functionalized to simulate enzymatic activity. Metal complexes have found use as templates for enzyme-like activation of substrates towards hydrolytic or synthetic reactions.

The synthetic and semisynthetic constructions made to date have been based on current perceptions of enzyme mechanisms. These perceptions are finely honed only for a limited number of enzymes. There is intense activity aimed at understanding enzymes that activate such simple molecules as N_2, H_2, O_2, CO, CO_2, C_2H_2, CH_4 and NH_3 as well as more complex groupings such as porphyrins, polycycloalkanes, aromatics and aromatic side chains. As our knowledge of enzyme mechanism increases, the design of additional biomimetic enzyme-like catalysts should prove feasible. The new systems are potentially far more versatile than the biological systems upon which they are based. They can call upon a broader range of metal centers, supports, temperatures, solvent systems and structural configurations.

The catalysts of the present are homogeneous, heterogeneous, or biological. However, some of the catalysts of the future will be hybrid systems embodying the best features of each of these catalyst types.

Biomimetic Separations. Biological systems are capable of selectively accumulating metals and specific organic compounds out of highly dilute solutions. The processes use the recognition capability of receptors or antibodies, the chelating ability of specifically elaborated organic molecules and/or the selective permeability of cellular membranes (permselectivity). Synthetic analogs of the metal chelates and permselective membranes are now in hand. The former are finding use as metal-chelating drugs. The latter have been cleverly combined with substrate specific enzymes to build membrane reactors that allow execution of the tasks of reaction, optical resolution, separation and concentration using a single operation. Such reactions and separations have been demonstrated in the processing of amino acids and esters. These new reactors are biomimetic in that they use integrated processing systems related to cellular metabolism and manipulation rather than sequential systems based on the unit operations of the chemical engineer. The more general applicability of such membrane reactors will undoubtedly increase with time.

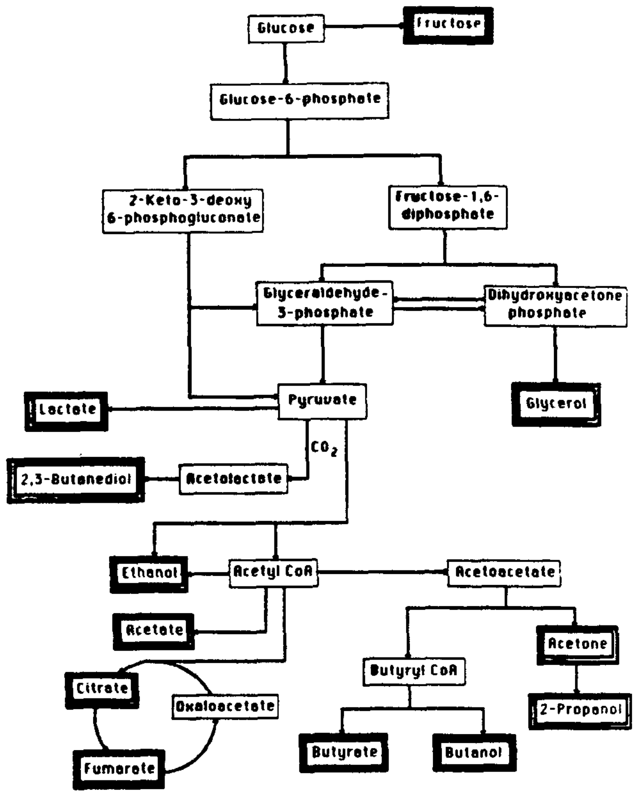

Figure 9. Number of key biochemical intermediates made from glucose through anaerobic metabolic conversions (fermentations).

Biomimetic/Semisynthetic Energy Conversions. Many of the energy-transducing systems in biology are membrane-based and use the vectorial transport of material (*e.g.*, protons) as a means of temporary energy storage. Biophysical chemists have learned much about the reconstitution of natural membrane systems and have used this knowledge to develop artificial membrane systems as well. Components of natural membrane systems such as photosynthetic reaction centers can be incorporated into these synthetic membranes in a manner that allows the component to retain its natural functions. These functional membrane systems are monolayer or multilayer films that may presage the use of related systems in energy transductions. For example, films containing photosynthetic reaction centers have been placed on electrodes, and the use of light to effect efficient charge separation has been demonstrated. The concept has been adapted by chemists who have constructed similar systems using synthetic inorganic complexes embedded in membranes as the light absorbing entities. The diversity of energy transductions that biological systems can carry out offers numerous opportunities for biomimesis, which are increasingly being pursued by academic scientists. The leads discovered could ultimately allow development of new devices.

Systems Analysis. In many ways a chemical plant or a refinery is analogous to a biological cell. Both take raw materials or feedstocks and convert them to products that have higher value to the consumer or organism. Cellular metabolism uses separations, conversions, control and feedback loops in a manner that may be worthy of emulation. For example, organisms can adjust their enzyme levels to cope with variable nutrients (feedstock variability) and/or adjust their output depending on the needs of the organism (market output sensitivity). Perhaps there is something to be learned from the economical way in which organisms accomplish these tasks.

Use of biotechnology for chemicals production

Indirectly, all fuels and most chemicals are the products of ancient or modern biochemical conversion. It is therefore not surprising that biological systems and technologies based upon them can produce or use many of these chemicals. The question of choice of a chemical or biological process is based on economics. Recent progress in biological sciences and especially advances in bioengineering should make bioprocessing relatively more competitive.

One can envision biological conversion processes that use either biologically-derived starting materials or fossil resources. In the former case, anaerobic organisms can be used to produce a multitude of chemicals through fermentation. The generation of ethanol, 2-propanol, 1-butanol, 2,3-butanediol, and lactic acid from glucose represent well-established fermentative processes, Figure 9. These products will be recognized as the hydrated forms of ethylene, propylene, 1-butylene, 1,3-butadiene and acrylic acid, respectively, Figure 10. Schemes for the incorporation of the bio-based intermediate into the chemical industry often involve dehydration steps that are potentially costly. However, many desired end products contain oxygen, and alternative technologies may make more direct use of the hydrated analogs.

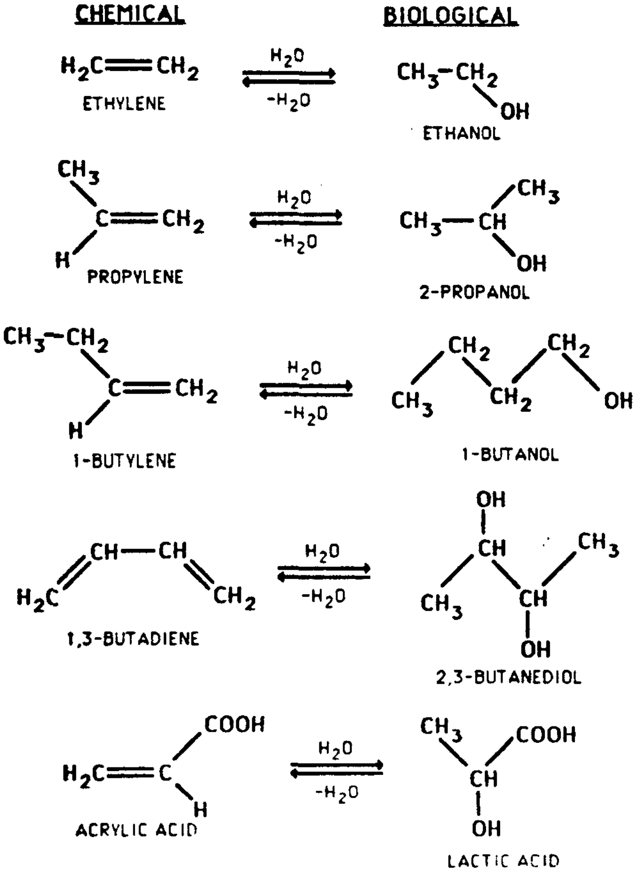

Figure 10. Relationship between common chemical and metabolic intermediates. Note the difference between the molecules on the left and the right is simply a water molecule.

Organisms growing anaerobically generate reductant (electrons) in large excess of their biosynthetic needs. These electrons are used often to reduce oxidized carbon compounds, *e.g.*, pyruvic acid → lactic acid or ethanol, or CO_2 → formic acid, but they can also be harnessed to reduce protons to H_2 using the enzyme hydrogenase.

One can envision two pathways to harness H_2 generation. First, during fermentative growth, anaerobic organisms can generate H_2 directly. Here bacteria may be engineered to use available sources of reducing power. Dilute and/or waste streams are possible sources in an integrated operation. A second pathway involves using the isolated enzyme hydrogenase. Stabilized forms of the enzyme could be coupled with reductant-generating pathways to give an H_2-generating system. A viable reductant could be generated using a photosynthetic-type membrane process. Although small amounts of H_2 have been generated in a mixed hydrogenase/chloroplast system, a real breakthrough could make artificial or semisynthetic H_2 production viable.

The ability to use hydrogenase either to produce or take up H_2 may also have implications in separations involving H_2. In addition to H_2, biological catalysts utilize CO, CO_2, H_2S, CH_4 and C_2H_2, making all these gases amenable at least in theory to biological/biochemical processing/separations.

In the manufacture of high-value-added products, biological processes have tremendous potential. In the pharmaceutical and health care industry, biotechnology based on the new biology is already having significant impacts. Human insulin, growth hormone, blood-clotting factor, vaccines and diagnostic products are already produced by this new technology. In agriculture, potent new pesticides, herbicides and growth control agents are being produced by analogous biotechnology, potentially in conjunction with genetically-engineered plants. The new capabilities in plant manipulation will present many opportunities for the sale of new specialty chemicals along with plants, seeds and microbial inocula (of symbiotic or frost-preventing organisms).

The infiltration of biotechnology into specialty chemicals production seems only a matter of time. Biopolymers, already used extensively in food, viscosification and flocculation, are likely to see increased usage as new biopolymers are discovered, engineered, and marketed. Particularly exciting is the potential for using genetically-programmed organisms to make biopolymers directly from inexpensive sources such as CH_4 and O_2 or CO. (There are organisms that live in 100% CO, using it as their sole carbon and energy source.) However, even from glucose, biopolymers and bioemulsifiers represent a significant opportunity in the field of higher-value-added chemicals. Biological systems are also uniquely able to make optically-active products, which as monomers have the potential for making regular or crystalline polymers that are inaccessible by chemical routes. Finally, in the area of specialty chemicals, specific chelating agents that are able to bind particular metals or the metals themselves may become chemical products of biotechnology, useful, for example, as antioxidants.

In the making of commodity chemicals that are already in large-scale production, biotechnology will in general be slow to displace current technology. However, it is possible that through biotechnology new commodity chemicals will become available that will displace more traditional products. An example in the food industry is the production of high-fructose corn sweetener from corn starch using the immobilized glucose isomerase enzyme. This sweetener, made at the scale of 2×10^9 lb/yr in the U.S. alone, has totally replaced sugar-cane-derived sucrose for certain applications and should continue to do so. Any of the intermediates in Figure 9 could become a candidate for biotechnology-based commodity chemical production. In addition, oxy-chemicals potentially available through biological hydroxylations, epoxidations and partial oxidations are candidates for biocatalyzed conversion of conventional petrochemical feedstocks (such as propylene → propylene oxide, *n*-octane → *n*-octanol).

From biomass to chemicals

In the 1970s, spearheaded by federal funding, there was increased activity in renewable plant resources and waste materials (biomass) as sources of fuels and chemicals. Biomass utilization was expected to provide a significant supply of fuel in the form of methane and ethanol. Although large cuts in federal funding have markedly slowed research on biomass, a considerable body of literature as well as a number of biomass-to-energy processes have emerged. Biomass is and will continue to be used as a fuel source where raw material is readily available. However, research effort has shifted to the conversion of biomass to useful chemicals.

Biomass-based feedstocks include materials from diverse sources. In some cases, these are waste materials whose utilization provides an additional credit in waste treatment. Potential feedstocks include: forest products, both "wild" and in the form of dedicated "plantations" (trees and woody plants, forestry wastes, wood chips, sawdust); food crops (corn, sugar cane); agricultural wastes (corn stover, sugar cane bagasse); industrial and municipal wastes; marine and aquatic plants (giant kelp, algae). The future may see integrated processing schemes that include the hydrolysis of starch or cellulose to glucose and the biochemical conversion of glucose to any of several products (acetic acid, acetone, butanol, isopropanol, 2,3-butanediol, citric acid) in addition to the already economically-significant production of ethanol.

Constraints in biomass utilization include the problems of collection and storage, cyclic availability, heterogeneity of the material, and competition with food crops for arable land. The most desirable starting material from the point of view of cost and availability, lignocellulose, requires extensive pretreatment. The lignin component is at present much less easily handled, although uses for lignin and alternative ways of processing it are under intense study.

The above represents the classical picture of biomass-based feedstocks. In the longer term, 10-15 years, it becomes possible to picture *tailored biomass*. Plants or microorganisms would be genetically engineered with the purpose of preparing a given product or slate of products. Organisms with high hydrocarbon content might be developed and/or exploited. Chemical manufacturers of the future will probably have to choose from a multitude of feeds, some of which will be biofeedstocks. Ng *et al.* estimate that "the production of oxychemicals and their derivatives from renewable resources could amount to about 100 billion lb/yr or about one-half the U.S. production of organic chemicals."

New processes for the production of specific chemicals from biomass are likely to be developed and commercialized.

Environmental/contaminant control

Entire biological (ecological) communities have evolved to utilize the waste of certain organisms. The wastes of man, both personal and industrial, are no exception. Bioprocessing makes possible the elimination of waste and the simultaneous production of such valuable products as methane, fertilizer, feed, biopolymers or chemicals. Integrated systems of the future may strive to reach such an ideal situation.

For the present we consider two classes of control problems: those in which microorganisms are used to clean up undesirable products and those in which the microorganisms themselves are the undesirables (contaminants or foulers). Almost all "naturally occurring" (biosynthetic) organic compounds are subject to relatively rapid biodegradation when exposed to microorganisms in the environment or in waste treatment facilities. In contrast, many man-made compounds are more recalcitrant and persist in the soil or in water for long periods of time (*e.g.*, DDT, PCBs, plastics). Components of crude oil or fuel oil vary in their susceptibility to biodegradation. A great deal of work has been done on the biodegradation of such environmental pollutants. Attempts at developing "superbugs" to deal with these problems are in their infancy, although the "oil-eating bug" developed via genetic manipulation by Chakrabarty won recognition as the subject of the favorable Supreme Court decision on patenting of microorganisms. Breakthroughs in the biodegradation of recalcitrant pollutants can be expected from continued work on directed evolution and genetic manipulation, wherein biochemical pathways from two or more organisms are combined in a single organism or mixed culture to provide a complete mechanism for degradation.

Commercial preparations of microorganisms for cleanup

> *Biomass will continue to be used as a fuel source, but much research effort has shifted to the conversion of it to useful chemicals.*

of specific pollutants are on the market. Evidence for efficacy is sparse. A major concern in adding organisms to the environment is that they would not be able to compete with the indigenous population. Nevertheless, it is likely that existing and new microorganisms will be part of future environmental control operations.

An area related to environmental control involves the use of bacteria for the leaching of ores. This area is already being exploited in the processing of Cu, Fe, and U ores where these metals occur in association with sulfide deposits. The bacteria, usually acidophilic thiobacilli, use O_2 to oxidize sulfide or disulfide ions in the ores to sulfate ions. In the process, the pH drops drastically, but the organisms thrive, even in 0.05M H_2SO_4 at 60°C. The resulting acid solutions contain ferric ion and dissolve parts of the remaining ore. The solutions which result are further processed by chemical means. The use of similar microorganisms for the removal of pyrites from coal has been demonstrated and claimed to be commercially viable. Microbial leaching of inorganic sulfides appears to be a growing commercial field whose chemical and microbiological underpinnings are largely understood.

In contrast, the accumulation of metals by organisms is a field in which the chemistry and physiology involved are often not at all understood. For Fe and Hg there is understanding of the processes involved. Organisms have devised specific chelating agents to bind and/or transport iron (siderophores) and have elaborated efficient storage proteins (ferritins) to sequester iron in a form where access can be controlled. In the case of Hg, a specific enzyme catalyzes the formation of volatile Hg metal which leaves the vicinity of the organism. There is work in progress on the accumulation of other elements as well, but as yet, the molecular mechanisms involved for such elements as Ni, V, Cr, Co, Mo, Mn, Ca, Mg, Cd, Pb, As, Se, and U are not understood. Nevertheless, the technological potential of organisms, biochemicals, or biomimetric processes that exploit these biological capabilities is high in the area of mining and extraction as well as in pollution control.

There are many ways of detecting undesired microorganisms in chemical processing equipment. The growing understanding of organisms thriving in such habitats will allow control or suppression of those organisms should this be required. Microbial fouling is not uncommon in chemical storage facilities, cooling towers, tanker holds, pipelines, drilling muds, and well control fluids. Optimum procedures to control such microorganisms are based on familiarity with the chemistry and materials involved and the potential of a milieu as a microbial habitat. Optimum control procedures involve microbiologists intimately in the analysis of the problem and its solution.

A global environmental consideration involves the buildup of CO_2 and the levels of other trace gases in the atmosphere. Of particular concern is the "greenhouse effect" and the resultant projected global warming. However, the CO_2 rise could also have a dramatic direct effect on biological systems, causing increased photosynthesis and plant growth that could serve to moderate somewhat its impact. Clearly, the response of specific organisms and ecosystems to the CO_2 level must be taken into account in any overall assessment of impact. Moreover, there may be biologically-based ways of decreasing the CO_2 rise while increasing primary photosynthetic production.

In conclusion

The biological sciences have joined the physical sciences in providing the underpinning for technological advance. The chemical industry of the future will be different as it assimilates the new knowledge and techniques of biological sciences in its continued evolution. The benefits accrued could be enormous. ■

Acknowledgment

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Glossary

Antibody: A protein produced by higher animals in response to a specific antigen and characterized by specific binding to that antigen.

Antigen: A substance, usually a protein or carbohydrate which, when introduced into the body of a higher animal, stimulates the production of an antibody that reacts specifically with it.

Cellulase: The enzyme that digests cellulose to glucose.

Cellulose: A polymer of the six-carbon sugar, glucose, which is found in all plant matter; the most abundant biological compound on earth.

Clone: A group of genetically identical cells or organisms produced asexually from a common ancestor.

Cloning: The amplification of segments of DNA, usually genes.

Coding sequence: The region of a gene (DNA) that encodes the amino acid sequence of a protein.

Cofactors: Additional molecules besides proteins needed for enzymatic function.

Escherichia coli (E. coli): A species of bacteria that inhabits the intestinal tracts of most vertebrates. Some strains are pathogenic to humans and animals. Many nonpathogenic strains are used experimentally as hosts for recombinant DNA.

Gene amplification: An increase in the number of genes of a given type such that the protein for which the gene codes is produced at elevated levels.

Section Eight

RESUME

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AWARDS AND DISTINCTIONS

National Merit Scholar
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Halliburton Outstanding Young Faculty Award (1982)
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Greatest Entropy Award (1988) – Teaching Award Presented by Student Chapter of AIChE at Colorado State University to the Outstanding Professor
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Editor, Bioresources Technology (1991)

LANGUAGE PROFICIENCY

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RESEARCH INTERESTS

Utilization of cellulose and other renewable resources, behavior of biological reactors (immobilized cells and immobilized enzymes), thermodynamic properties of biopolymers and biological reactions, analysis of cellular metabolism using nuclear magnetic resonance (NMR) spectroscopy, bioremediation.

CONSULTING EXPERIENCE

Atlantic Richfield Corporation, Dublin, California
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Adolph Coors Corporation, Golden, Colorado
Saskatchewan Research Council, Saskatchewan, Canada
Tennessee Valley Authority, Muscle Shoals, Alabama
Coors Biotech Products Corporation, Fort Collins, Colorado
Chemical Process Corporation, Milwaukee, Wisconsin
Synergen Corporation, Boulder, Colorado
Solar Energy Research Institute, Golden, Colorado

National Bureau of Standards, Boulder, Colorado
Stearns–Rogers Corporation, Denver, Colorado
Quaker Oats Corporation, Barrington, Illinois
Syntex Corporation, Boulder, Colorado
Abbott Laboratories, Chicago, Illinois
Wheelock Associates, Dallas, Texas
Sphinx Pharmaceuticals, Durham, North Carolina
Amoco Production Corp., Farmington, New Mexico

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Dale, B. E. 1984. "Protein and Ethanol from Alfalfa: Energy Efficient Production of Food and Fuel from Biomass." Presented at the National Meeting on Biomass R&D for Energy Applications, Arlington, Virginia, October 1-3.

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Roetheli, J. C., J. W. Barrier, B. Amin-Arsala and B. E. Dale. 1985. "Forage Processing in Developing Countries." Presented at the Symposium on Sustainable Development of Natural Resources in Third World, Ohio State University, Columbus, Ohio, September.

Dale, B. E. 1986. "Biochemical Reactor Engineering: Putting Some Meat on the Models." Invited Seminar presentation to the Department of Chemical Engineering, University of Colorado, Boulder, Colorado, March 13.

Dale, B. E., R. J. Gillies and D. D. Drury. 1986. "Nuclear Magnetic Resonance Analysis of an Oxygen-Limited Mammalian Cell Bioreactor." Presented at the 192nd Annual Meeting of the American Chemical Society, Anaheim, California, September 7-12.

Chresand, T. J., B. E. Dale and R. J. Gillies. 1986. "Substrate Delivery in Cell-Collagen Matrices: Problems and Solutions." Presented at the 192nd Annual Meeting of the American Chemical Society, Anaheim, California, September 7-12.

Dale, B. E. 1986. "Agricultural Residues." Section 4.2 in Solar Energy Research Institute Publication "Fuel Alcohol Technical and Economic Evaluation."

Alvarez-Martinez, L., B. E. Dale and J. M. Harper. 1986. "Modeling Fungal Growth on Extrusion Cooked Corn by Solid Substrate Fermentation. Presented at the Winter Meeting of the American Society of Agricultural Engineers, Chicago, Illinois, December 16-19.

Dale, B. E. 1987. "Value of Residual Protein in Acid and Enzyme Hydrolyzates of Forages." Final Report to Tennessee Valley Authority, Jan. 22.

Dale, B. E. 1987. "NMR Applications to Design of Dense Cell Culture Apparatus." Invited seminar to the Dept. of Chemical Engineering, Univ. of California at San Diego, Feb. 4.

M'Nasira, H., B. E. Dale, A. Beba and E. Nebot. 1987. "Design and Modeling of a Rotary Drum Solid State Fermenter." Presented at the Ninth Symposium on Biotechnology for Fuels and Chemicals, Boulder, Colorado, May 5-7.

Dale, B. E. 1987. "A Simple Correlation for Predicting the Enthalpy and Heat Capacity Change of Protein Unfolding." Presented at the 42nd Annual Calorimetry Conference, Boulder, Colorado, July 26-31.

Alvarez-Martinez, L. R. and B. E. Dale. 1987. "Engineering Models for the Growth of Filamentous Fungi on Extruded Corn by Solid Substrate Fermentation." Presented at the National Meeting of the American Institute of Chemical Engineers, Minneapolis, Minnesota, August 16-19.

Dale, B. E. and H. A. Schroeder. 1987. "Mechanisms of Plant Cell Wall Resistance to Polysaccharide Degrading Enzymes: A Study Using Nuclear Magnetic Resonance Analysis." Biochemical Conversion Program Annual Review Meeting, Solar Energy Research Institute, Golden, Colorado, October 13-15.

Blute, T. J., B. E. Dale and R. J. Gillies. 1987. "On-Line Measurement of Cell Number in Hollow-Fiber Bioreactors." Presented at the Annual Meeting of the American Institute of Chemical Engineers, New York, NY, November 15-17.

Dale, B. E. and R. J. Gillies. 1987. "Nuclear Magnetic Resonance Spectroscopy of Dense Cell Populations for Metabolic Studies: What NMR Can and Can't Do." Presented at the Annual Meeting of the American Institute of Chemical Engineers, New York, NY, November 15-17.

Dale, B. E. 1987. "A Thermodynamic Correlation for Prediction of Protein Stability." Presented at the Annual Meeting of the American Institute of Chemical Engineers, New York, NY, November 15-17.

Dale, B. E. 1987. "Thermodynamic Correlations to Predict Protein Stability." Invited presentation to Pfizer Chemical Corp., Groton, CT, Nov. 20.

Dale, B. E. 1987. "Development of a Thermodynamic Correlation to Predict Protein Stability." Invited presentation to the National Bureau of Standards, Gaithersburg, Maryland, November 23.

Dale, B. E. 1988. "Can the Protein Molecule be Treated as a Phase?" Invited presentation to the Department of Chemical Engineering, University of Arizona, Tucson, Arizona, February 24.

Dale, B. E. 1988. "Can the Protein Molecule be Treated as a Phase?" Invited presentation to the Department of Chemical Engineering, University of California, Los Angeles, California, February 26.

Dale, B. E. 1988. "Predicting Protein Unfolding Equilibria" presented at the 4th Engineering Foundation Conference on Recovery of Bioproducts, Keauhou-Kona, Hawaii, April 17-22.

Grohmann, K., M. E. Himmel, D. Mitchell, B. E. Dale and H. A. Schroeder. 1988. "The Role of Ester Groups in Resistance of Cell Wall Polysaccharides to Enzymatic Hydrolysis." presented at the 10th symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, Tennessee, May 8-11.

Jachim, S. W. and B. E. Dale. 1988. "Renaturation of Recombinant SLPI - A Protease Inhibitor." presented at the Third Chemical Congress of North America, Toronto, Canada, June 5-11.

Hanson, S. L., B. E. Dale and R. J. Gillies. 1988. "Oxygen Diffusion in the Inter-fiber Gel/Cell Matrix of NMR-Compatible Hollow Fiber Bioreactors" presented at the Third Chemical Congress of North America, Toronto, Canada, June 5-11.

Gillies, R. J. and B. E. Dale. 1988 "Design of Hollow Fiber Bioreactors and Probes for NMR Studies of Intact Mammalian Cells." presented at the International Conference on Magnetic Resonance in Biological Systems, Madison, Wisconsin, August 12-19.

Dale, B. E., D. Mitchell, K.Grohmann and H. A. Schroeder. 1988. "Nuclear Magnetic Resonance Studies of Cell Wall Structure Changes." paper 15d presented at the Annual Meeting of the American Institute of Chemical Engineers, Washington, D. C., November 28-December 1.

Dale, B. E. 1988. "Testing a Thermodynamic Method for Predicting Protein Stability." paper 10d presented at the Annual Meeting of the American Institute of Chemical Engineers, Washington, D. C., November 28-December 1.

Dale, B. E. 1988. "How Engineers Participate in the Commercialization of Biotechnology" invited presentation at the Biotech Symposium sponsored by Texas A&I University, Kingsville, Texas, November 11.

Dale, B. E. 1988. "Predicting the Heat Capacity Change of Protein Unfolding by Group Contribution Methods" invited presentation to the Department of Chemical Engineering, Washington State University, Pullman, Washington, December 8.

Dale, B. E. 1989. "Application of Protein Stability Thermodynamics to Separation Processes" paper 22d presented at the Petro. Expo. Meeting of the American Institute of Chemical Engineers, Houston, Texas, April 3-7.

Dale, B. E., P. J. H. Sharpe and J. H. Hsaio. 1989. "Application of Integrated Rate Theory to Modelling Biotransformation of Toxic Compounds" Meeting of the American Chemical Society, Dallas, Texas, April 9-14.

Dale, B. E. 1989. "Understanding Cellular Reaction Networks Using NMR Spectroscopy: Pitfalls and Possibilities" Invited presentation to the Department of Chemical Engineering, Auburn University, April 25.

Dale, B. E. 1989. "Development and Use of a Thermodynamic Method for Predicting Protein Stability" Invited paper at the American Society for Microbiology Conference on Biotechnology, Orlando, Florida, June 22-25.

Dale, B. E. and J. T. Hsiao. 1989. "Observable Moduli for Assuring Kinetic Control in Bioreactors" paper 30a (presented at the Annual Meeting of the American Institute of Chemical Engineers, San Francisco, California, November 5-10).

Raghunand, N., B. E. Dale and R. J. Gillies. 1989. "Use of NMR Spectroscopy to Obtain In Vivo Metabolic Information from Mammalian Cells" paper 148i presented at the Annual Meeting of the American Institute of Chemical Engineers, San Francisco, California, November 5-10.

Bringi, V. and B. E. Dale. 1989. "Experimental Evidence for Convective Nutrient Transport in an Immobilized Cell Support" paper 150h presented at the Annual Meeting of the American Institute of Chemical Engineers, San Francisco, California, November 5-10.

Dale, B. E. 1989. "A Phase Equilibrium Approach to Predicting the Thermodynamic Parameters of Protein Stability" invited seminar to the Department of Pharmaceutical Chemistry, University of California at San Francisco, Nov. 9.

Dale, B. E., R. J. Gillies and N. Raghunand. 1990. "Mathematical Modeling of Metabolic Networks and On-line NMR Spectroscopy of Whole Cells – Two Fields Converging for Quantitative Physiology" paper presented at the 8th Annual Conference on Biomedical Engineering Research in Houston, Texas, February 15-16.

Dale, B. E. and J. A. McBennett. 1990. "Development of a Phase Equilibrium Thermodynamic Approach to Predict Protein Stability" paper presented at the 8th Annual Conference on Biomedical Engineering Research in Houston, Texas, February 15-16.

Rodriguez, M. E. and B. E. Dale. 1990 "Biotransformation of Aflatoxin B1: A Chemical Engineering Perspective" paper presented at the Symposium on Biodegradation of Hazardous Wastes, Utah State University, Logan, Utah, April 9-10.

Turner, N. D., F. M. Byers, C. M. McDonough, M. T. Holtzapple, J-H Jun, B. E. Dale, and L. W. Greene, "Disruption of Forage Structure with an Ammonia Fiber Explosion Process," American Society of Animal Science Meeting, Reno, July 10-13, 1990.

Dale, B. E., M. T. Holtzapple, and E. J. Rykiel, Jr. 1990. "A New Technology for Sustainable Production of Food and Fuel from Biomass: Energy, Economics, and Ecology" Meeting on the Ecological Economics of Sustainability sponsored by the World Bank, Washington, D. C., May 21-23.

Holtzapple, M. T., J-H Jun, B. E. Dale. 1990. "The Ammonia Freeze Explosion (AFEX) Process: A Practical Lignocellulose Pretreatment, Twelfth Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN, May 7-11.

Holtzapple, M. T., J-H Jun, and B. E. Dale. 1990. "Ammonia Fiber Explosion (AFEX) Process for Treatment of Plant Residue in CELSS, Advanced Regenerative Life Support Systems Research Conference, Texas A&M University, College Station, TX, April 24-25.

Raghunand, N., Dale, B. E. and R. J. Gilles. 1990. "Analysis of Carbohydrate Metabolism in Hybridomas by Magnetic Resonance Spectroscopy and Metabolic Control Theory," 200th National Meeting of the American Chemical Society, Washington, D. C., August 26-31.

Dale, B. E. and J. P. McBennett. 1990. "Thermodynamic Approaches to Predict Protein Stability in Unusual Environments," 200th National Meeting of the American Chemical Society, Washington, D. C., August 26-31.

Dale, B. E. 1990. "Can Protein Unfolding be Treated as a Phase Transition?" invited seminar at the Department of Chemical Engineering, Rice University, Sept. 20.

Dale, B. E. 1990. "Chemical Engineering for Toxicologists" invited seminar to the Environmental Toxicology and Pharmacology Group, Texas A&M University, Oct. 15.

Dale, B. E. 1990. "Thermodynamic Approaches to Predict Protein Stability" Seminar presented to Abbott Laboratories, North Chicago, IL, Nov. 12.

Dale, B. E. and S. M. Cosgrove. 1990. "Protein Separations by Porous Silicon Membranes," paper number 105 h presented at the Annual Meeting of the American Institute of Chemical Engineers, Chicago, IL, Nov. 11-16.

Dale, B. E., V. Latimer and J. Phiffer. 1990. "Engineering Hollow Fiber Bioreactors for Insect Cell Cultivation and Baculovirus Infection" paper number 110c presented at the Annual Meeting of the American Institute of Chemical Engineers, Chicago, IL, Nov. 11-16.

Holtzapple, M. T. and B. E. Dale. 1990. "Ammonia Freeze Explosion (AFEX) Pretreatment of Lignocellulosic Wastes" paper number 286c presented at the Annual Meeting of the American Institute of Chemical Engineers, Chicago, IL, Nov. 11-16.

Williams, G. W. and B. E. Dale. 1991. "Prospects for High Value Crop and Livestock Products in the Nineties: Advances in Production and Processing Technology" Invited presentation at the world Bank Symposium or Agricultural Issues in the Nineties, Washington, D.C., January 9-11, published in Proceedings of the Eleventh Agriculture Sector Symposium, L. Garbus, A. Pritchard and O. Knudsen, eds., pgs. 228-237.

Rodriguez, M. E., T. J. Phillips and B. E. Dale. 1991. "A Chemical Engineering Approach to Aflatoxin Biotransformation in the Liver" presented at the Ninth Annual Conference on Biomedical Engineering Research in Houston, Houston, Texas, February 7–8.

Wu, S. C., D. Gupta, V. Latimer, J. C. Liao and B. E. Dale. 1991 "Effect of Lactate on Cultured Insect Cells" presented at the Ninth Annual Conference on Biomedical Engineering Research in Houston, Houston, Texas, February 7–8.

Raghunand, N., R. J. Gillies and B. E. Dale. 1991. "Glycolytic Control and Pathway Modeling in Hybridomas" presented at the Ninth Annual Conference on Biomedical Engineering Research in Houston, Houston, Texas, February 7–8.

Holtzapple, M. T., J. H. Jun, G. Ashok, S. Patibandla and B. E. Dale. 1991 "The Ammonia Fiber Explosion (AFEX) Process: A Novel Cellulose Pretreatment" presented at the Ninth Annual Conference on Biomedical Engineering Research in Houston, Houston, Texas, February 7–8.

Dale, B. E. 1991. "Thermodynamic Approaches to Predict Protein Stability" Seminar presented to the Department of Chemical Engineering, Worcester Polytechnic Institute, Worcester, MA, February 25.

Dale, B. E. 1991. "Food and Biochemical Engineering" Seminar presentation to AGEN 489 Sophomore Seminar, March 1.

Dale, B. E. 1991. "Integrating Engineering and the Life Sciences" Invited Lecture at the Inaguration of the Affiliation between Texas Women's University with the Texas Engineering Experiment Station, Denton, TX, April 10.

Dale, B. E. and Y. Wang. 1991. "Thermodynamics of High Temperature Enzymes: A New Predictive Model" Invited paper at the Symposium on Biocatalysis Near or Above 100°C, National Meeting of the American Chemical Society, Atlanta, GA, April 15-19.

Dale, B. E. 1991. "Cellulose Pretreatments: Research Directions for the Nineties" Invited panel review paper presented at the Symposium on New Developments in Biological Fuel Production, National Meeting of the American Chemical Society, New York, NY, August 26-30.

Holtzapple, M., J. E. Lundeen and B. Dale. 1991. "Ammonia Fiber Explosion (AFEX) Pretreatment of Municipal Solid Wastes," paper presented at the National Meeting of the American Chemical Society, New York, NY, August 26-30.

Holtzapple, M., S. Patibandla, G. Ashok, J. Lundeen and B. Dale. 1991. "Ammonia Fiber Explosion (AFEX) Pretreatment of Lignocellulose" presented at the Energy for Biomass and Wastes Conference, Washington, DC, March 25-29.

THESES, DISSERTATIONS, BOOKS, CHAPTERS OF BOOKS, CLASS NOTES, SYMPOSIA CHAIRED, SHORT COURSES, INTERNATIONAL ACTIVITIES

Dale, B. E. 1974. Kinetics and mass transfer characteristics of pancreatic ribonuclease immobolized on porous titania. M. A. Thesis. Department of Chemical Engineering, University of Arizona, Tucson.

Dale, B. E. 1979. A microcalorimetric study of cellulose and its metal complex solvents. Ph.D. Dissertation. Department of Chemical Engineering, Purdue University, West Lafayette, Indiana.

Cochairman of Symposium on Protein Separations, Summer National Meeting of American Institute of Chemical Engineers, Detroit, Michigan, August 16-19, 1981.

Cochairman of Symposium on Fuels and Chemicals from Biomass, 182nd National Meeting of the American Chemical Society, New York, New York, August 23-28, 1981.

Chairman of Symposium on Biomass Refining: Developing the Whole Plant Concept, 186th National Meeting of the American Chemical Society, Washington, D. C., August 28-September 2, 1983.

Cochairman of Symposium on Reaction Kinetics in Foods and Food Processing, Summer National Meeting of the American Institute of Chemical Engineers, Denver, Colorado, August 28-31, 1983.

Coordinator and lecturer for short course "Industrial Bioprocessing," Colorado State University, August 1984, June 1985, June 1986, June 1987, September 1988, October 1989, October 1990.

Cochairman of Symposium on Fundamentals of Anaerobic Fermentations. Annual Meeting of the American Institute of Chemical Engineers, San Francisco, California, November 25-30, 1984.

Invited Participant, U. S./Spain Joint Workshop on Biochemical Engineering, Sponsored by National Science Foundation, Valencia, Spain, November 1984.

Invited Lecturer, Intensive Course (in Spanish) "Advances in Biotechnology," Sponsored by the Mexican Society for Biotechnology and Bioengineering. Mexico City, March 1985.

Chairman of Symposium on Pretreatment and Processing of Lignocellulosic Materials, 190th Annual Meeting of the American Chemical Society, Chicago, Illinois, September 8-13, 1985.

Cochairman of Symposium on Molecular Changes in Proteins in Chemical Engineering. Annual Meeting of the American Institute of Chemical Engineers. Miami Beach, Florida, November 2-7, 1986.

Dale, B. E., L. R. Alvarez-Martinez, R. P. Tengerdy, E. Nebot and H. M'Nasira. 1987. "Design of Solid Substrate Fermenters." Invited presentation (in Spanish) at the Latin American Seminar: Biotechnology in Biomass Production and Waste Management." Antigua, Guatemala, February 18-20.

Dale, B. E. 1987. "Desarrollo Integrado de Processos para Convertir Las Materias Lignocelulosicas." (in Spanish.) Presented at the Second National Meeting of the Sociedad Mexicana de Biotecnologia y Bioingenieria, Durango, Mexico, June 23-26. Invited Keynote Speaker.

Cochairman of Symposium on Biosensors at the Conference on Frontiers in Bioprocessing. Sponsored by the National Bureau of Standards, Boulder, Colorado, June 28-July 2, 1987.

Cochairman of Symposium on Engineering Fundamentals of Food Processing Systems. 1987 National Meeting of the American Institute of Chemical Engineers, Minneapolis, Minnesota, August 16-19, 1987.

Fundamentals of Biochemical Engineering, Short Course (29 hours) presented to Stearns-Rogers Corp., Denver, Colorado. January - March 1988.

Cochairman of Meeting Program for the Division of Microbial and Biochemical Technology of the American Chemical Society at the Third Chemical Congress of North America, Toronto, Canada, June 5-11, 1988.

Cochairman of the General Papers Session of the Division of Microbial and Biochemical Technology of the American Chemical Society at the Third Chemical Congress of North America, Toronto, Canada, June 5-11, 1988.

Chairman of the Symposium on Membrane Applications in Bioseparations for the Division of Industrial and Engineering Chemistry of the American Chemical Society at the Third Chemical Congress of North America, Toronto, Canada, June 5-11, 1988.

Chairman of the Symposium on Technical and Economic Aspects of New Processes for Adding Value to Agricultural Raw Materials at the National Meeting of the American Institute of Chemical Engineers, Denver, Colorado, August 21-24, 1988.

Chairman of the Symposium on Ethanol Production and Use in Fuels at the National Meeting of the American Institute of Chemical Engineers, Denver, Colorado, August 21-24, 1988.

Cochairman of the Symposium on Monitoring and Modelling of Toxic Waste Degradation at the Meeting of the American Chemical Society, April 9-14, 1989.

Lecturer in Short Course "Progress in Recombinant DNA Technology" at Lindenwood College, St. Charles, Missouri, June 27, 1989.

Cochairman of Symposium on Separation of Bioactive Compounds: Engineering Fundamentals at the Annual Meeting of the American Institute of Chemical Engineers, San Francisco, California, Nov. 5-10, 1989.

Invited Participant in the Workshop "Cattle on the Land," Carlsbad, California, Dec. 12-15, 1990.

Dale, B. E. and R. J. Gillies. 1990. "Nuclear Magnetic Resonance Spectroscopy of Dense Cell Populations for Metabolic Studies and Bioreactor Engineering: A Synergistic Partnership chapter in Animal Cell Bioreactors, eds. C. S. Ho and D. I. C. Wang (in press).

Dale, B. E. 1991. "Ethanol Production from Cereal Grains" chapter 24 in Handbook of Cereal Science and Technology, eds. K. J. Lorenz and K. Kulp Marcel Dekker, Inc., NY.

Lecturer in "International Short Course on Engineering of Biological Reactions and Processes" at Central American Research Institute for Industry, Guatemala City, Guatemala, May 13-25, 1991.

Chairman of the Working Group on Risk Assessment, National Workshop on Food Safety, Texas A&M University, College Station, Texas, June 25-29, 1991.

Participant in the NASA Workshop on Resource Recovery from Wastes Generated in Lunar/Mars Controlled Ecological Life Support Systems (CELSS), League City, Texas, August 12-14, 1991.

PATENTS

Tsao, G. T., M. R. Ladisch, and B. E. Dale. 1981. Nontoxic cellulose solvent and process for forming and utilizing the same. U. S. Patent No. 4,265,675.

Dale, B. E. 1986. Method for increasing the reactivity of cellulose. U. S. Patent No. 4,600,590.

Dale, B. E. 1986. Method for increasing the reactivity of cellulose. Australia Patent No. 555217.

Dale, B. E. 1986. Method for increasing the reactivity of cellulose. Brazil Patent No. 8205849.

Dale, B. E. 1987. Method for increasing the reactivity of cellulose. New Zealand Patent No. 202057.

Dale, B. E. 1987. Method for increasing the reactivity of cellulose. South Africa Patent No. 82/7241

Dale, B. E. 1991. Process for increasing the reactivity of cellulose – containing materials. U.S. Patent No. 5, 037, 663.

FUNDED RESEARCH

Title	Amount	Date	Sponsor
Protein Recovery from Corn Residue	430	9/79-6/80	Colorado State Univ.
Kinetics of Cellulose Recrystallization	4,198	6/80-4/81	Colorado Energy Research Institute
Protein and Alcohol Production from Alfalfa	9,300	6/80-12/80	Western Alfalfa Corp.
Protein Recovery from Leafy Crop Residues during Biomass Conversion	16,565	1/81-9/81	Solar Energy Research Institute
Differential Scanning Calorimeter for Food and Energy Research	37,590	4/81-9/81	National Science Foundation-Colorado State Univ.
Methanol Production from Fermentor Off-Gases	42,672	7/81-6/82	Dept. of Energy
Alfalfa: A Promising Biomass Energy Resource	79,200	9/81-9/83	U. S. Department of Agriculture
Water Efficient Crops for Colorado	16,954	4/82-3/83	Colorado Commission on Higher Education
Kinetics of Leaf Protein Coagulation	25,000	6/82-5/85	Atlantic Richfield Corporation
A Freeze–Explosion Method for Increasing Cellulose Hydrolysis	79,082	8/82-7/84	U. S. Department of Agriculture
Travel to Seventh International Biotechnology Symposium	1,750	2/84	National Science Foundation
Travel to New Zealand	1,800	2/84	U. S. Department of Agriculture
Porous Agitators for Immobilized Cell Bioreactors	35,073	4/84-3/85	Manville Corporation
Freeze Explosion Treatment of Salt-Tolerant Grasses	8,900	4/84-6/85	Saskatchewan Research Council
Diffusion and Reaction Phenomena in Immobilized Cell Bioreactors	24,500	9/84-9/85	National Bureau of Standards

FUNDED RESEARCH (Cont.)

Title	Amount	Date	Sponsor
NMR Analysis of Cations and the Proliferative Response	133,638	4/85-3/87	National Science Foundation
Mammalian Cell Bioreactor Analysis by On-Line NMR	12,000	7/85-6/86	Colorado Advanced Tech. Institute
Wiped Film Reactor Characterization	13,800	10/85-9/86	Chemical Process Corp.
Enzymatic vs. Acid Hydrolysis of Forges	9,800	9/85-8/86	Tennessee Valley Authority
Solid Substrate Fermentation/Cellulose Hydrolysis	41,500	1/86-12/88	National Science Foundation
Moisture and Temperature Control in Solid Substrate Fermentation	95,000	12/86-11/88	National Science Foundation
NMR Analysis of Mechanisms of Resistance of Cell Wall Materials	39,000	6/87-5/88	Solar Energy Research Institute
Increasing Oxygen Delivery in Hollow-Fiber Bioreactors	7,500	11/87-5/88	Colorado Advanced Tech. Institute
Kinetics of Enzymatic Reactions	17,439	10/87-1/88	Quaker Oats Corp.
Cell Density Measurement in Hollow-Fiber Bioreactors	3,225	10/87-6/88	Graduate School
Development of a Resource for NMR of Mammalian Cells	297,000	8/88-5/91	National Institutes of Health
Testing a Model for Predicting Protein Stability	29,005	6/88-12/88	National Science Foundation
Development of High Density Insect Cell Cultures	160,000	1/89-12/90	Institute for Biosciences and Technology
Critical Reaction Path Modeling of Glycolysis	33,000	9/89-8/91	Texas Agricultural Experiment Station
Protein Separations using Porous Silicon Membranes	170,000	1/90-12-91	Texas Advanced Technology Program
Liquid Fuel Production from AFEX-treated Municipal Solid Waste	18,500	8/90-7/91	Center for Energy and Mineral Resources
Engineering Biosciences Research Center	300,000	5/90-8/92	Texas Engineering Experiment Station
Development of a Process to Produce Protein and Ethanol from Texas Grasses	150,000	1/91-12/92	Energy Research Applications Program

FUNDED RESEARCH (Cont.)

Title	Amount	Date	Sponsor
Fundamental Factors Affecting the AFEX Process	49,500	4/91-3/92	United States Dept. of Agriculture
Technical Partnership for Crop Commercialization	43,000	8/91-7/92	United States Dept. of Agriculture
An Integrated Approach to Understanding the Factors Controlling the Biodegradation of Military Toxic Wastes	2,328,000	5/92-4/97	Army Research Office
Toxicology Training Grant	85,000	6/92-5/97	National Institutes of Health

GRADUATE STUDENTS ADVISED BY DR. BRUCE E. DALE

Ravindranath S. Joshi M.S. 1981 "Protein Extraction from Alfalfa"

Jerald A. Andersen M.S. 1982 "Alfalfa Refinement for Feed and Fuel"

Maria Silvia Bertran M.S. 1983 "Cellulose Crystallinity: Influence on Enzyme Hydrolysis and Estimation by a Proposed Calorimetric Method"

Steven C. Lindbergh M.S. 1983 " The Acetone-Butanol Fermentation of Cheese Whey"

Michael G. Doremus M.S. 1983 "Agitation and Pressure Effects on the Acetone-Butanol Fermentation"

Kalif Y. Ahmed M.S. 1984 "Thermal Coagulation Kinetics of Alfalfa Leaf Proteins"

Venkataraman Bringi M.S. 1985 "A Comparative Kinetic Study of Free and Immobilized Yeast Cells"

Ming Shiang M.S. 1985 "Production, Action and Denaturation of the Cellulases of *Trichoderma reesei* Rut-C3) on Different Celluloses"

Kate M. V. Baptie M.S. 1985 "Cellulase Recycle by Induced Desorption via pH and Temperature Changes"

Michael R. Melick M.S. 1985 "Mathematical Modeling of Ethanol Production by Immobilized *Zymomonas mobilis* in a Packed Bed Reactor"

David D. Drury M.S. 1986 "Design of an Oxygen-Limited Bioreactor for Use in a Nuclear Magnetic Resonance Spectrometer"

Margaret L. Hevezi M.S. 1986 "A Study of Activated Sludge Bulking: Microorganisms, Growth Kinetics and Modeling"

Chih-Ming Li M.S. 1986 "Cellulase Desorption in a Batch Reactor"

Lucas R. Alvarez-Martinez Ph.D. 1987 "Modeling Fungal Growth on Extruded Corn by Solid Substrate Fermentation"

Thomas J. Chresand M.S. 1987 "Diffusion and Reaction in a Hollow Fiber Mammalian Cell Bioreactor"

Shari L. Hanson M.S. 1988 "Enhanced Oxygen Transfer to Hybridomas in a Hollow Fiber Bioreactor by Perfluorocarbon Emulsions"

Linda M. Barstow M.S. 1988 "Temperature and Moisture Content Control of a Solid Substrate Fermentation on Extruded Corn"

Habib M. M'Nasria Ph.D. 1988 "Modeling Sugar Consumption by Fungi Growing on Solid Substrates"

David R. Mitchell M.S. 1988 "Nuclear Magnetic Resonance Studies of Cell Wall Components and Their Enzymatic Transformation"

Thomas J. Blute M.S. 1988 "Cell Density Measurements in Hollow Fiber Bioreactors"

Sarah Waterman Jachim M.S. 1988 "Renaturation Kinetics of Recombinant Secretory Leucoprotease Inhibitor"

Natarajan Raghunand M.S. 1990 "Modeling Glycolysis in Hybridomas"

Mayra E. Rodriguez M.S. 1990 "Kinetic and Thermodynamic Characterization of Aflatoxin B, Biotransformation in the Rodent Liver."

Jorge D. Blasig M.S. 1991. "Volatile Fatty Acid Fermentation of AFEX-Treated Newspaper and Bagasse by Rumen Microorganisms."

Kun-Jiang Hsiao Ph.D. 1992. "Modeling NMR Compatible Hollow Fiber Bioreactors."

COMMITTEE SERVICE AT TEXAS A&M UNIVERSITY

DEPARTMENT

- Safety Committee, Summer 1991
- Chemical Engineering Graduate Committe, 1989-present
- JETS Conference (Agricultural Engr) 1990
- Agricultural Engineering Graduate Affairs Committee, 1989-present
- Representative to University Library Committee, 1979-1986
- Graduate Student Recruitment Committee, 1982-1984 (included preparation of a full color recruitment brochure)
- Department Head Search Committee, 1984
- Ph. D. Administration Committee, 1984-1988
- Tenure and Reappointment Committee, 1984-1988
- Career Days Presentation, 1985, 1986
- Advisor to Omega Chi Epsilon (Chemical Engineering Honor Society) 1985

COLLEGE

- Invention Evaluation Committee, 1989-present
- Applied Science Program Committee, 1989-present
- Coordinator of Student Exchange Program with the Monterrey Institute of Technology, Monterrey, Mexico, 1981-1985
- College Representative to Committee on Libraries, 1982-1986
- Minority Mentoring Program, 1984-1986
- Preview CSU Program (introduction to university for entering freshmen), 1985-1986
- Member of ad hoc committee reporting to the Committee on Academic Programs to evaluate the Agricultural Engineering Program
- Undergraduate Admissions Committee, 1980-1986
- Faculty Advisor to the Student Chapter of the American Institute of Chemical Engineers, 1984-1986

UNIVERSITY

- Committee on Toxic Chemicals, 1990 – 1991(Chairman Pro Tem, 1991)
- Faculty Senate ad hoc Committee on the Life Sciences, 1988-1989.
- Institute for Food Science and Engineering Planning Committee, 1990
- Toxicology Faculty Executive Committee, 1989-present
- Ad hoc Steering Committee for Center for Protein and Cellular Engineering, 1989-present
- Search Committee for Director of Libraries, 1985
- Chairman of the Committee on Libraries, 1985
- Conducted University-wide Survey of Priorities for the Library, 1986
- University-wide Grievance Committee (1986)

REVIEWER FOR

- Biotechnology and Bioengineering, 1990 (2), 1991 (1)
- ACS Symposium Series, 1990 (1)
- McGraw Hill Book Corp., 1990 (1)
- Dept. of Chemical Engineering, Univ. of Minnesota, 1990 (Promotion/Tenure Review)
- Applied Biochemistry and Biotechnology, 1991 (1)

ATTACHMENT A

BIOGRAPHICAL DATA

Donnelly, Kirby C.

Environmental Mutagenesis Laboratory Director, Soil and Crop Sciences Dept.
Assistant Professor, Soil and Crop Sciences; Vet. Public Health; Vet. Physiology and Pharmacology

Professional Interests: Remediation of contaminated environments, Fate of Mutagens and Carcinogens in Environment, Monitoring Waste Disposal, Biodegradation of Waste, Mutagenesis Test Systems.

Education:

Ph.D., Toxicology, Texas A&M University, 1988.
B.S., Microbiology, Texas A&M University, 1974.

Short Courses:

Intensive Laboratory Training Course on Microbial Tests for Detecting and Characterizing Mutagens and Potential Carcinogens, University of Texas System Cancer, 1979.
Training Course on the Safe Handling of Chemical Carcinogens in the Research Laboratory, National Cancer Inst., North Carolina, 1980
Laboratory Training Course on the Use of *Aspergillus nidulans* for Detecting and Characterizing Mutagens and Potential Carcinogens, Univ. of Texas System Cancer Center, April 1980.
Personal Protection and Safety Course for Hazardous Waste Workers, Texas Engineering Extension Service, Aug., 1988.

Society Memberships

Environmental Mutagen Society
Society of Environmental Toxicology and Chemistry

Awards

1991 - Editorial Board, Environmental Toxicology and Chemistry
1988 - Superior Achievement Award for Technical Support, Soil & Crop Sciences Dept., TAMU.
1986 - Environmental Mutagen Society Student Travel Award
1986 - Southwest Environmental Mutagen Society Outstanding Oral Presentation.
1985 - Southwest Environmental Mutagen Society Outstanding Oral Presentation
1972 - Air Force ROTC Vice-Commandant Award

Experiences:

Assistant Professor - Departments of Veterinary Public Health, Veterinary Physiology and Pharmacology, and Soil and Crop Sciences.

Faculty of Toxicology - Texas A&M University. 1990. Appointed member of interdepartmental faculty of toxicology. Assisted in preparation and instruction of laboratory for Genetic and Molecular Toxicology class.

Lecturer - Soil and Crop Sciences Dept., 1989-1991. Taught graduate level course on Biodegradation and Bioremediation.

Program Manager - Texas Research Center for Toxic Waste. 1989. Responsible for managing research grants for Superfund program funded by National Institute of Health and Environmental Protection Agency.

Post-doctoral Research Associate - Soil and Crop Sciences Dept., TAMU, 1989. Supervised graduate students and technicians working on various Superfund research projects.

Health and Safety Officer - Soil Physics Dept., Texas A&M University. 1984-present. Responsible for training under State of Texas "Right to Know" and USEPA-RCRA regulations employees involved in hazardous waste field and laboratory research.

Laboratory Director - 1981-present Environmental Mutagenesis Laboratory, Soil and Crop Sciences Department. Developed Quality Assurance/Quality Control Program and supervised development of standard operating procedures for all laboratory operations. Performed duties as outlined in Quality Assurance Program for study director for various studies on environmental mutagens.

Technician II - 1980-1988, Soil and Crop Sciences Department, Texas A&M University. Supervised research to evaluate the mutagenic activity of hazardous industrial waste; directed laboratory study to determine the rate of biodegradation of two industrial wastes.

Laboratory Technician - 1975-1980. Conducted laboratory study to monitor waste biodegradation, supervised field project.

Technical Assistant - 1972-1975. Maintained field plots for septic tank disposal project; conducted analysis to monitor passage and accumulation of bacteria and viruses from septic tank disposal.

Consulting

1. Texaco, Inc., Port Arthur, Texas (Use of Bacterial Systems to Detect Mutagens in Wastewater).
2. New Jersey Pinelands Commission, (Passage of Pathogenic Organisms to Groundwater from Septic Tanks).

3. US Environmental Protection Agency, Cincinnati, OH (Manual on Land Treatment of Hazardous Industrial Waste).

4. Bioassay Systems Corporation, Woburn, MA (Quality Assurance Manager for various genotoxic studies).

5. Environment Canada (Plant Extraction and Uptake of Mutagens).

6. Sprint Sand and Gravel, Houston, Tx. (Potential for Food Chain Contamination from Application of Municipal Sewage to Dairy Pasture).

7. U.S. Environmental Protection Agency, Regions I, III, V, VI and VII (Moderator and Instructor, Seminar on Interpretation of Soils Data from Superfund Sites).

8. State of Maine, Dept. of Environmental Quality (Land Treatment of Oil Hydrocarbons).

9. GCA Technology Division (Degradation and Volatilization of Benzene in Groundwater).

10. U.S. Environmental Protection Agency, Ada, OK (Guidance Document on Land Treatment Demonstrations).

11. U.S. Environmental Protection Agency, Las Vegas, NV (Development of Procedures for Preparation of Environmental and Waste Samples for Mutagenicity Testing).

12. Exxon, Inc., Beaumont, TX (Literature Review for Land Treatment Part B Permit).

13. Mobil Oil Co., Ferndale, WA (Mutagenicity of Waste Amended Soils).

14. U.S. Environmental Protection Agency, OSW, Washington, D.C. (Instructor, RCRA Facility Assessment Course, Regions I through X).

15. A. T. Kearney, Inc. Alexandria, Va. (Development of Program of Monitoring Worker Health and Safety).

16. U.S. Environmental Protection Agency, Regions I, III, IV, V, VI, and VII (Visual Site Inspections, Sampling Visits-RCRA Program).

17. Ministry of Petroleum, Govt. of Mexico (Refinery Waste Disposal).

18. Lantana Resources Corp., Houston, Texas (Toxic Effects of Soil Near Refinery Landfill).

19. Murphy Oil Co., New Orleans, LA (Land Treatment Demonstration Refinery Waste).

20. The City of Ft. Worth, TX (Land Application of Municipal Sewage).

21. Waste Management Incorporated (Risk Associated with Leachate Water from Hazardous Waste Landfills).

22. Shell Oil Development Corp. (Clean-up of Rocky Mountain Arsenal).

23. Harding Lawson and Associates (Quality Control Overview of RCRA Sampling Visits).

24. Law Firm (Health and Safety Procedures for Workers at a Superfund Site).

25. Confidential Client (Risk Assessment at Abandoned Manufacturing Facility).

26. Campbel Wells, Inc. (Review of Bioremediation Procedures).

27. U.S. Environmental Protection Agency (Review of RCRA Facility Investigation Work Plans and Corrective Action Plans).

28. British Petroleum Company (Receptor Assessment at Land Treatment Facility).

29. El Paso Natural Gas (Risk Assessment for Contaminated Soils and Groundwater).

30. Schuyler County Missouri Concerned Citizens (Risk Assessment for Municipal Landfill).

31. Du Pont Corp. (Bioremediation of Contaminated Soil in Vadose Zone).

32. City of Scranton, PA (Expert Witness on Biodegradation and Municipal Landfills).

33. U.S. Environmental Protection Agency Region I (Reviewer of baseline risk assessments for Superfund sites).

34. U.S. Environmental Protection Agency Region VII and VIII (Consultant on bioremediation of Superfund sites).

35. Radian Corporation (Reviewer of Land Treatment Demonstration and No-Migration Petition report).

36. Donley Environmental Services (Baseline risk assessment for Superfund site).

37. Waste Management Incorporated (Mutagenic potential of soils from a land treatment facility).

Invited Lecturer

Civil Engineering 301 (Sanitary Bacteriology), Agronomy 617 (Degradation of Mutagens in Soil), Vet. Pharm. and Physiol. 639 (*Bacillus* DNA repair assay; *Aspergillus* methionine assay).

Graduate Students Supervised

1. Davol, P. (M.S.): Mutagenicity of Runoff Water from Hazardous Waste Amended Soils. Soil and Crop Sciences Dept.
2. Maggard, L. A. (M.S.): Extraction Efficiency of Mutagenic Compounds from Soil. Soil and Crop Sciences Dept.
3. Bailey, H. R. (Ph.D.): Mutagenicity of Binary Mixtures of Mycotoxins. Food Science Dept.
4. Keller, T. A. (M.S.): Interactions of Components of Diesel Soot. Chemical Engineering.
5. Fiedler, D. A. (M.S.): Plant Uptake of Mutagens from Municipal Sludge Amended Soil. Soil and Crop Sciences Dept.
6. Wall, F. R. (M.S.) Mutagenic Potential of Aflatoxin and Benzo(a)pyrene following Activation by Fetal and Maternal Microsomes. Veterinary Anatomy Dept.
7. Schrab, G. A. (M.S.). Bacterial mutagenicity of leachate water from municipal landfills, Soil and Crop Sciences Dept.
8. Markiewicz, K.V. (Ph.D.) Effect of biodegradation on the toxicity of contaminated soils from Superfund sites.
9. Shan, Y.C. (M.S.) Bioremediation of dimethylnaphthalene, pentachlorophenol, and trichloroethylene in the vadose zone.
10. Heubner, H.A. (M.S.) Development of Extraction procedures for contaminated soils.
11. Hong, M.D. (Ph.D.) Integrated Chemical and Biological Detoxification of Hazardous Industrial waste.
12. Kiel, J.M. (Ph.D.) Assessment of the Toxicity of Sediment samples from areas adjacent to Superfund sites.
13. Bokelman, A.M. (M.S.) Development of procedures to assess the toxicity of wood preserving sites.
14. Green, T.A. (M.S.) Evaluation of supercritical fluid extraction for hazardous waste contaminated soils.

Publications and Manuscripts

1. Jones, S. G., K. W. Brown, L. E. Deuel, Jr., and K. C. Donnelly. 1978. Influence of rainfall on the retention of sludge heavy metals by the leaves of forage crops. J. Environ. Qual. 8: 69-72.
2. Brown, K. W., H. W. Wolf, K. C. Donnelly and J. F. Slowey, 1979. The movement of fecal coliform and coliphage below septic lines. J. Environ. Qual. 8: 121-125.

3. Brown, K. W., S. G. Jones, and K.C. Donnelly. 1980. The influence of simulated rainfall on residual bacteria and virus on grass treated with sewage sludge. J. Environ. Qual. 8: 69-72.

4. Brown, K. W. and K. C. Donnelly. 1980. Mutagenic potential of the effluent from a waste oil storage pond. Bull. Environ. Contam. Toxicol. 28:424-429.

5. Donnelly, K. C. and K. W. Brown. 1981. Development of laboratory and field studies to determine the fate of mutagenic compounds from land applied hazardous waste. In: Land Disposal: Hazardous Waste. Proc. 7th Annual Research Symposium, p. 224-239.

6. Jones, D. H., H. L. Kim, and K. C. Donnelly. 1981. DNA damaging effects of three sesquiterpene lactones in repair-deficient mutants of *Bacillus subtilis*. Res. Comm. in Path and Pharm. 34(1):161-164.

7. Brown, K. W., K. C. Donnelly, L. E. Deuel and J. C. Thomas. 1981. The influence of environmental parameters on the biodegradation of oil sludge. In: Land Disposal/Hazardous Waste-Proceedings, 7th Annual Symposium, p. 188-199.

8. Brown, K. W., K. C. Donnelly and B. R. Scott. 1982. The fate of mutagenic compounds when hazardous wastes are land treated. In: Land Disposal: Hazardous Waste. Proceedings of the Eighth Annual Research Symposium. D. W. Schultz (ed.).

9. Brown, K. W. and K. C. Donnelly. 1983. Influence of soil environment in biodegradation of refinery and a petrochemical sludge. Environ. Poll. (Series B) 6. 119-132.

10. Brown, K. W., K. C. Donnelly, and L. E. Deuel, Jr. 1983. Influence of nutrient additions, sludge application rate and frequency on biodegradation of two oily sludges. Microbial Ecology 9:363-373.

11. Donnelly, K. C., K. W. Brown, and R. M. Saltarelli. 1983. The use of *B. subtilis* in a pre-incubation assay for the detection of DNA-modifying agents. Res. Comm. in Path. and Pharm. 42(1):135-142.

12. Brown, K. W., K. C. Donnelly, J. C. Thomas and J. F. Slowey. 1984. The movement of N through three soils below septic fields. J. Environ. Qual. 13:3, pp.460-465.

13. Brown, K. C. and K. C. Donnelly. 1984. Mutagenic activity of runoff and leachate water from soils amended with a refinery and a petrochemical waste. Environ. Pollut. 35(3)229-245.

14. Brown, K. W. and K. C. Donnelly. 1984. Mutagenic Activity of the Liquid Waste from the Production of Acetonitrile. Bull. Environ. Contam. Tox. 32:742-748.

15. Donnelly, K. C., K. W. Brown, and P. Davol. 1987. Chemical and biological characterization of a wood-preserving bottom sediment waste. I. Prokaryotic bioassays and chemical analysis. Mutat. Res. 180:31-42.

16. Donnelly, K. C., K. W. Brown, and B. R. Scott. 1987. Chemical and biological characterization of a wood-preserving bottom sediment. II. Eukaryotic bioassays. Mutat. Res. 180:43-53.

17. Donnelly, K. C. and K. W. Brown. 1984. Protocol for preparation of soil and sediment samples for mutagenicity testing. USEPA EPA/600/4-85/058.

18. Brown, K. W., K. C. Donnelly, J. C. Thomas, P. Davol and B. R. Scott. 1985. Mutagenicity of three agricultural soils. Sci. of Total Environ. 41:173-186.

19. Brown, K. W., K. C. Donnelly, J. C. Thomas, P. Davol, and D. Kampbell. 1985. Hydrocarbon degradation in hazardous waste amended soils. Waste Manag. Res. 3:27-39.

20. Atlas, E. L., K. C. Donnelly, and A. R. McFarland. 1985. Chemical and biological characterization of emissions from a firepersons' Training Facility. Atmos. Environ. Am. Ind. Hyg. Assoc. J. 46(9):532-540.

21. Donnelly, K. C., J. C. Thomas, K. W. Brown, B. R. Scott, and D. Kampbell. 1985. Chemical and biological evaluation of two refinery wastes. Haz. Waste 2(2):191-208.

22. Brown, K. W., K. C. Donnelly, J. C. Thomas, P. Davol and B. R. Scott. 1985. Degradation of mutagenic compounds in soils amended with two refinery waste. Water, Air and Soil Poll. 29:1-13.

23. Donnelly, K. C., D. H. Jones, and S. Safe. 1985. The bacterial mutagenicity of nitropolychlorinated dibenzo-p-dioxins. Mutat. Res. 169:17-22.

24. Donnelly, K. C., K. W. Brown, D. H. Jones and S. H. Safe. 1987. Mutagenic potential of mixtures of nitro-dibenzo-p-dioxins and related compounds. Chemosphere 15:1961-1941.

25. Maggard, L. A., Brown, K. W., and K. C. Donnelly. 1987. The efficiency of two standardized procedures for extraction of mutagenic chemicals from soils. Chemosphere 16(6):1243-1255.

26. Donnelly, K. C., P. Davol, K. W. Brown, M. Estiri and J. C. Thomas. 1987. Mutagenic Activity of Two Soils Amended with a Wood Preserving Waste. Environ. Sci. Technol. 21(1):57-64.

27. Rhee, K. S., K. C. Donnelly and Y. A. Ziprin. 1987. Reduced mutagenicity of beef hamburgers cooked with glandless cottonseed flour. J. Food Protection 50(9) 753-755.

28. McBee, K., J. W. Bickham, K. C. Donnelly and K. W. Brown. 1987. Detection of environmental mutagens: Frequency of chromosome aberrations in exposed wildlife populations. Arch. Toxicol. 16:681.

29. Donnelly, K. C., T. R. Irvin and H. R. Bailey. 1988. Bacterial Mutagenicity of Binary Mixtures of Aflatoxin B, and Related Mycotoxins. Toxicol Appl. Pharm. (In Review).

30. Donnelly, K. C. 1988. Detection of Potential Carcinogens in Environmental Samples Using Microbial Bioassays. Revista del Instituto del Petroleo. Mexico.

31. Brown, K. W. and K. C. Donnelly. 1988. An Estimation of Risk Associated with the Organic Constituents of Hazardous and Municipal Waste Landfill Leachate. Haz. Waste Haz. Mat. 5(1):1-30.

32. Donnelly, K. C., K. W. Brown, M. Estiri, D. H. Jones and S. Safe. 1988. Mutagenic potential of binary mixtures of nitro-pochlorinated dibenzo-o-dioxins and related compounds. J. Toxicology and Environ. Health, 24: 345-356.

33. Donnelly, K. W., Brown, K. W. and D. G. DiGuillio. 1988. Mutagenic characterization of soil and water samples from a Superfund site. Nuclear and Chemical Waste Management, Vol. 8:135-141.

34. Donnelly, K. C., K. W. Brown and C. P. Chisum. 1988. Mutagenic potential of municipal sewage sludge amended soil. In: Chemical and Biological Characterization of Sludges, Sediments, Dredge Spoils, and Drilling Muds. ASTM STP 976. J. J. Lichtenberg, J. A. Winter, C. I. Weber, and L. Fradkin, Eds., American Society for Testing and Materials, Philadelphia, pp. 288-299.

35. Carvajal, M., L. Campos, P. Pereda, G. Valencia, T. R. Irvin and K. C. Donnelly. 1988. Mycotoxins of "Tortillas", its carcinogenic and cytotoxic effects. In: Proceedings of the Japanese Association of Mycotoxicology. August 20-27, 1988.

36. Davol, P., K. W. Brown and K. C. Donnelly, J. C. Thomas, M. Estiri and D. H. Jones. 1989. The mutagenicity potential runoff water from soils amended with three hazardous industrial wastes. Environ. Tox. Chem. 8, pp. 189-200.

37. Overton, F. E., B. P. Harper, K. C. Donnelly and T. R. Irvin. 1989. Combined use of microbial bioassays and thermal chromatography to assess the toxicity of contaminated soils. Toxicity Assessment (In Review).

38. Brown, K. W. and K. C. Donnelly. 1989. A comparison of two different procedures for the extraction of organic mutagens from sewage sludge. Chemosphere (In press).

39. Donnelly, K. C., K. W. Brown and J. C. Thomas. 1990. Mutagenic potential of leachate water from soils amended with municipal sewage sludge. Environ. Tox. & Chem. 9:443-451.

40. Fiedler, D. A., K. W. Brown, J. C. Thomas and K. C. Donnelly. 1990. Influence of plant extracts on the bacterial mutagenicity of organic chemicals. Archives Environ. Contam. & Tox. 20:385-390.

41. Donnelly, K. C., K. W. Brown and J. C. Thomas. 1989. Mutagenic potential of municipal sludge amended soils. Water, air & soil Pollution 48:435-449.

42. Gage, S. R., J. R. Robertson and K. C. Donnelly. 1991. Chemical and biological characterization of asphalt samples. Arch. Environ. Toxicol. and Chem. (In press).

43. Donnelly, K.C., J.C. Thomas, C.S. Anderson and K.W. Brown. 1990. The influence of application rate on the bacterial mutagenicity of soil amended with municipal sewage sludge. Environ. Pollution 68:147-159.

44. Donnelly, K.C., S. Safe and K.W. Brown. 1990. Metabolism and bacterial mutagenicity of binary mixtures of benzo(a)pyrene and polychlorinated aromatic hydrocarbons. Environ. & Molec. Mutag.16:238-245.

45. Brown, K.W., J.C. Thomas and K.C. Donnelly. 1990. Bacterial mutagenicity of municipal sewage sludge. Environ. Sci. Health. A26:395-413.

46. Giam, C.S., T.L. Holiday, R. Evans, Y. Zheng, R. Li, K.W. Brown, C.S. Anderson and K.C. Donnelly. 1991. Bioassay-directed chemical characterization of hazardous organic chemicals in soil. Contaminated Soil Treatment. pp. 159-161.

47. Donnelly, K. C., K. W. Brown, C.S. Anderson, J. C. Thomas. 1991. Bacterial mutagenicity and acute toxicity of solvent and aqueous extracts of soil samples from an abandoned chemical manufacturing site. Environ. Toxicol. and Chem. 10:1123-1131.

48. Barbee, G.C., K.W. Brown, and K.C. Donnelly. 1991. Fate of mutagenic chemicals in soil amended with wood preserving sludges. Waste Management and Research (In press).

49. Schrab, G. E., J. C. Thomas, K. W. Brown, C. S. Anderson and K. C. Donnelly. 1989. Chemical and biological characterization of municipal landfill leachate (In review).

50. C.S. Anderson, K.C. Donnelly and K.W. Brown. 1992. The development of a Comprehensive Testing Protocol for Superfund Sites - American Society of Testing and Materials Special Publication (In review).

51. Donnelly, K.C., C.S. Anderson, K.V. Markiewicz, K.W. Brown and C.S. Giam. (In preparation) Mutagenic potential of Materials from a Coal Gasification Site. Environmental Science and Technology.

52. Donnelly, K.C., C.S. Anderson, J.C. Thomas, K.W. Brown and C.S. Giam. (In preparation) Chemical and Biological analysis of extracts of landfill leachate. Environmental Toxicology and Chemistry.

53. Brown, K.W., C.S. Anderson and K.C. Donnelly. (In preparation) Acute toxicity and Mutagenicity of soil samples from Refinery Waste Bioremediation Facilities. Chemosphere.

54. Anderson, C.S., K.C. Donnelly, J.C. Thomas and K.W. Brown. (In preparation) Acute toxicity and Mutagenicity of soil samples from Abandoned Refineries and Waste Oil Facilities (Bulletin Environmental Contamination and Toxicology.

55. Donnelly, K.C., Anderson, C.S., Markiewicz, K.V., Kiel, J.M. and K.W. Brown (In preparation) Acute and Genetic Toxicity of Soil and Waste samples from a Solvent Recovery Facility. Environmental Toxicology and Chemistry.

56. Howie, L.E., K.V. Markiewicz, S.H. Safe and K.C. Donnelly (In review) Mutagenic potential of Binary and Complex mixtures using different Enzyme Induction systems. Environmental and Molecular Mutagenesis.

57. Donnelly, K.C. and K.W. Brown (In preparation) Mutagenic potential of materials from several Superfund sites. Environmental Pollution.

58. Donnelly, K.C., C.S. Anderson, K.V. Markiewicz and K.W. Brown (In preparation) Mutagenic potential of soil samples from abandoned Wood Preserving Facilities. Water, Air and Soil Pollution.

59. Anderson, C.S., K.V. Markiewicz, K.C. Donnelly, J.C. Thomas, K.W. Brown and C.S. Giam (In preparation) Mutagenic potential of soil samples from an In-situ Bioremediation Facility. Hazardous Waste, Hazardous Materials.

60. Donnelly, K.C., C.S. Anderson, K.V. Markiewicz and K.W. Brown (In preparation) Mutagenic potential of soil samples from an abandoned Munitions Facility. Environmental Toxicology and Chemistry.

61. Donnelly, K.C., K.W. Brown, D.H. Jones and S.H. Safe (In preparation) Mutagenic potential of synthetic wastes. Environmental Toxicology and Health.

62. Donnelly, K.C., Thomas, J.C., Brown, K.W., and C.S. Giam (In preparation) Biodegradation of dimethylnaphthalene in undisturbed soil cores.

63. Donnelly, K.C., K.V. Markiewicz, J.M. Kiel and K.W. Brown (In preparation) Mutagenic potential of sediment samples collected near Superfund sites. Environmental Toxicology and Chemistry.

64. Markiewicz, K.V. and K.C. Donnelly (In preparation) Mutagenic potential of soils from a solid phase bioreactor. Environmental Toxicology and Chemistry.

Book Chapters

1. Donnelly, K. C., K. W. Brown, B. R. Scott. 1982. The use of short-term bioassays to monitor the environmental impact of land treatment of hazardous wastes. pp. 59-78. In: M. D. Waters, S. S. Sandhu, J. Lewtas, L. Claxton, N. Chernoff and S. Nesnow (eds.)., Short-Term Bioassays in the Analysis of Complex Mixtures III, Plenum Press, New York, New York, U.S.A.

2. Smith, C., D. C. Kissock, J. C. Thomas and K. C. Donnelly. 1983. The Treatment Medium. pp. 85-126. In: K. W. Brown, G. B. Evans and B. D. Frentrup (eds). Hazardous Waste Land Treatment. Butterworth Publishers, Woburn, MA.

3. Adams, J., K. C. Donnelly and D. C. Anderson. 1983. Hazardous Waste Streams. pp. 126-182. In: K. W. Brown, G. B. Evans and B. D. Frentrup (eds). Hazardous Waste Land Treatment. Butterworth Publishers, Woburn, MA.

4. Evans, G. B., K. W. Brown and K. C. Donnelly. 1983. Preliminary Tests and Pilot Studies on Waste-Site Interactions. pp. 401-446. In: K. W. Brown, G. B. Evans and B. D. Frentrup (eds). Hazardous Waste Land Treatment. Butterworth Publishers, Woburn, MA.

5. Donnelly, K. C., C. P. Chisum and K. W. Brown. 1988. Bacterial Mutagenicity and Variability of Municipal Sewage Sludge. In: J. J. Lichtenburg, J. A. Winter, C. I. Weber and L. Fradkin (eds.). Chemical and Biological Characteratization of Sludges, Sediments, Dredge Spoils and Drilling Muds. Amer. Soc. for Testing and Materials Special Publication 976:288-299.

6. Brown, K. W. and K. C. Donnelly. 1985. Mutagenicity of Runoff and Leachate Water from Soils Amended with Hazardous Waste. In: Proceedings of the Conference Municipal Solid and Industrial Waste. University of Miami, Miami, Florida.

7. Donnelly, K. C. 1990. Monitoring Biodegradation of Hazardous Materials With Microbial Bioassay. In: T. R. Irvin (ed.). The Development of Procedures to Monotor Uncontrolled Hazardous Waste Sites. American Chemical Society Special Publication (In Press).

8. Donnelly, K. C. 1990. Soil Toxicology. In: L. G. Cockerham and B. S. Shane (eds.). Basic environmental Toxicology. (In review).

9. Donnelly, K.C. 1992. Biodegradation and Bioremediation. Technomics Publ. (in preparation).

Abstracts Published

1. Jones, S., K. W. Brown, L. E. Deuel, and K. C. Donnelly. 1977. Influence of rainfall on the persistence of metals on grasses following application of liquid digested sludge. Agron. Abst. p. 28.

2. Brown, K. W., K. C. Donnelly, J. C. Thomas and J. F. Slowey. 1979. The movement of nitrogen through three soils below septic fields. Agron. Abst. p. 136.

3. Donnelly, K. C. and K. W. Brown. 1980. Mutagenic activity of leachate and runoff water from land treatment disposal of industrial wastes. Agron. Abst.

4. Donnelly, K. C., K. W. Brown, and B. R. Scott. 1983. An evaluation of the mutagenic potential of a wood-preserving bottom sediment using three short-term bioassays. Eniron. Mut.

5. K. W. Brown, K. C. Donnelly and P. Davol. 1983. Mutagenic activity of runoff water from soils amended with a wood-preserving waste. Agron. Abst. p. 153.

6. Davol, P., K. C. Donnelly and K. W. Brown. 1983. An evaluation of the mutagenic activity of three agricultural soils. Agron. Abst. p. 154.

7. Donnelly, K. C., K. W. Brown and P. Davol. 1984. Degradation of mutagenic compounds in two refinery wastes applied to soils. Agron. Abst., p. 26.

8. Davol, P., K. C. Donnelly and K. W. Brown 1984. Mobility of Mutagenic Constituents from Wood-Preserving Waste Applied to Soil. Agronomy Abstract p. 25

9. Donnelly, K. C. and K. W. Brown. 1985. A comparison of leachate water quality data using the microtox assay, *Salmonella*/microsome assay, and chemical analysis. Land Treatment: A Hazardous Waste Management Alternative.

10. Donnelly, K. C., K. W. Brown, J. C. Thomas, G. Barbee, and P. Davol. 1985. Fate and mobility of organic constituents in a wood-preserving waste amended soil. Agron. Abst.

11. Donnelly, K. C., T. R. Irvin and H. R. Bailey. 1986. Interactions of binary mixtures of mycotoxins. Toxicol. Appl. Pharm.

12. Donnelly, K. C., K. W. Brown, S. H. Safe and D. H. Jones. 1986. bacterial mutagenicity of binary mixtures of benzo(a)pyrene and related compounds. Environ. Mut. 8:98.

13. Donnelly, K. C., P. Davol and K. W. Brown. 1986. Mutagenicity of hazardous waste amended soils: Four years of environmental monitoring. USEPA Complex Mixture Symposium.

14. Keller, T. A., T. R. Irvin and K. C. Donnelly. 1987. Bacterial mutagenicity of binary mixtures of nitro-aromatic hydrocarbons. Environ. Mut.

15. Fielder, D. A., K. W. Brown and K. C. Donnelly. 1987. Mutagenicity of plants fertilized with mutagenic municipal sewage sludge. Agron. Abst. p. 26.

16. Irvin, T. R., Stevens, E., and K. C. Donnelly. 1988. Embryo Toxicity of Municipal Sewage Sludges. Toxicology Abstract.

17. Donnelly, K. C., K. W. Brown and J. C. Thomas. 1988. Bacterial mutagenicity of municipal sewage sludge amended soils. Agron. Abstract.

18. Donnelly, K. C., K. W. Brown and J. C. Thomas. 1988. Bacterial mutagenicity of leachate water from municipal sludge amended soils. Environmental Toxicology and Chemistry Abstract.

19. Shoemaker, C. S., K. C. Donnelly and K. W. Brown. 1988. Mutagenic potential of soil samples from a Texas Superfund site. S.W. Environ. Mutag. (Abstract).

20. Donnelly, K. C., C.S. Anderson, J. C. Thomas, K. W. Brown, D. H. Jones and S. H. Safe. 1989. Bacterial mutagenicity and metabolism of binary mixtures of benzo(a)pyrene and related compounds. Internat. Symposium on Complex Mixtures in the Environ. Abstract.

21. Shoemaker, C. S., K. w. Brown, J. C. Thomas and K.C. Donnelly. 1989. Bacterial mutagenicity of soil samples from a solvent recovery facility. Internat. Symposium. on Complex Mixtures in the Environ. Abstract.

22. Anderson, C. S., K. C. Donnelly, J. C. Thomas and K. W. Brown, 1989. Mutagenic potential of soil samples from an abandoned coal gasification site. Agron. abstracts.

23. Lyne, T.B., K. W. Brown, J. H. Bickham and K. C. Donnelly. 1989. A comparison of the acute and chronic toxicity of aqueous and organic extracts of soil samples from a Superfund site. Environ. Chem. & Toxicol. Abstract.

24. Donnelly, K. C., C. S. Anderson, J. C. Thomas, and K. W. Brown. 1989. A comparison of the acute and chronic toxicity of aqueous and organic extracts of soil samples from a Superfund site. Environ. Chem. & Toxicol. Abstract.

25. Markiewicz, K.V., S. H. Safe, K. W. Brown, C. S. Anderson and K. C. Donnelly. 1989. Bacterial mutagenicity of aqueous and organic extracts of soil samples from an abandoned munitions site. SWEMS, Abstract.

26. Manek, D. M., C. S. Anderson, J. C. Thomas, K. W. Brown and K. C. Donnelly. 1989. Bacterial mutagenicity of soil samples from an abandoned wood preserving facility. SWEMS, Abstract.

27. Markiewicz, K.V., K.C. Donnelly, T.L. Chase, K.C. Donnelly and K.W. Brown. 1991. Bioremediation of soils contaminated with wood preserving waste. Environ. Tox. and Chem., Abstract.

28. Kiel, J.M., K.V. Markiewicz, K.W. Brown and K.C. Donnelly. 1991. Mutagenic potential of sediment samples from areas adjacent to a coal gasification site. Environ. Tox. and Chem., Abstract.

29. Donnelly, K.C., K.V. Markiewicz, C.S. Anderson and K.W. Brown. 1992. Mutagenic potential of soils following treatment in a solid phase bioreactor. Environ. Molecular Mutagen., Abstract.

Titles and Grants in which I have been Active:

A. "Fate of metals applied in sewage to land wastewater disposal sites." 1973-1974. Sponsored by U.S. Army Medical Crops. Federal Funds amount to $137,780.

B. "Accumulation and passage of pollutants in domestic septic tank disposal fields." 1973-1975. Sponsored by U.S. Environmental Protection Agency. Federal Funds amount to $249,043.

C. "The influence of Petro-S on the infiltration rate and water holding capacity of soil." 1974-1975. Sponsored by the Petro-Chemical Co. Inc. funds amount to $8,280.

D. "An investigation of the feasibility of soil disposal of wastewater from the Jefferson Chemical Co." 1975. Funded by the Jefferson Chemical Co. for $16,600.

E. "Soil Disposal of API Pit Waste". 1977-1980. Sponsored by the U.S. Environmental Protection Agency. Funds amount to $184,104.

F. "The use of bioassays to evaluate the environmental impact of land treatment of hazardous industrial wastes." 1980-1983. Sponsored by the US Environmental Protection Agency. Funds amount to $636,985.

G. "Chemical and Biological Analysis of Particulate Samples from a Diesel Oil Fire". 1980-1981. Sponsored by the Texas Fireman's Training School.

H. "Efficiency of Soil Core and Soil-Pore Liquid Monitoring". 1983-1985. Sponsored by US Environmental Protection Agency. Funds amount to $202,635.

I. "Carcinogenic, Mutagenic, and Teratogenic Risks Associated with Land Application of Municipal Sewage and sludge". 1984-1987. Sponsored by the US Environmental Protection Agency. Funds amount to $691,240.

J. "Genetic Toxicity of Aflatoxin and Mixture of Mycotoxins". 1984-1986. Sponsored by the Texas Agricultural Experiment Station.

K. "Isolation and Interactions of Components of Diesel Soot". 1985-1986. Sponsored by Texas Engineering Experiment Station.

L. "Development of a Comprehensive Testing Protocol to Assess the Health Hazard of an Uncontrolled Hazardous Waste Site. Funded by USEPA, 1987-1990, $330,000.

M. "Development of Fermentation Techniques for Detoxification of Hazardous Waste" 1987-1990. Sponsored by New Brunswick Scientific Corp.

N. "Evaluation of the Bacterial Mutagenicity and Chemical Characteristics of Municipal Landfill Leachate" 1988-1990. Sponsored by Texas Department of Water Resources, $47,500.

O. "Development of Procedures to Enhance Biodegradation in the Vadose Zone". 1989-1992. Funded by North Carolina State and TAMU Hazardous Substance Research Center, $109,000.

P. "Bioassay Directed Chemical Characterization of Hazardous Organic Chemicals in Waste Contaminated Environments." Funded by National Institute of Health, 1989-1992, $422,000.

Q. "The Use of Short-term Bioassays to Assess the Human Health Hazard of Uncontrolled Hazardous Waste Sites." Funded by National Institute of Health, 1989-1992, $607,000.

R. "The Use of Acute and Chronic Toxicity Assays to Assess Migration of Hazardous Chemicals Beneath a Refinery Landfarm". Funded by Texaco, Inc., British Petroleum, Inc., and Atlantic Refinery, 1989-1990. $36,000.

S. "The Effect of Waste Management Alternatives on the Toxicity of Municipal Solid Waste" Submitted as part of an Exploratory Environmental Research Center Grant.

T. "The Combined use of Cytogenetic and Microbial Bioassays to monitor Remediation at a Superfund Site". Submitted to USEPA Office of Exploratory Research.

U. "An Integrated Approach to Understanding the Factors Controlling Biodegradation of Military Toxic Wastes". Submitted to US Army Research Office.

V. "The Development of Procedures to Assess the Human Health Hazard of a Superfund Site". Renewal submitted to NIEHS.

W. "The Integrated Chemical and Biological Detoxification of Hazardous Industrial Waste". Submitted to Gulf Coast Hazardous Substance Research Center.

Section Nine

Environmental Protection Company

April 16, 1992

Julie Hunter
City of Bloomfield
915 N. First Street
Bloomfield N.M. 87413

Dear Julie,

I wanted to express my gratitude to yourself for seeing me on such short notice this past April 8th. I apologize that I was unable to get back to you sooner, but much has happened this past week. In the final analysis events have turned to the mutual benefit of all parties. Our company is offering to purchase your sludge as a remediation product. We will purchase sludge delivered to our site for $30.75 per tanker load. I believe with the volumes that we discussed that Bloomfield would realize over $20,000 in revenue in addition to cost savings associated plant operations and sludge disposal. We would appreciate your earliest possible review of our offer as we will be obliged to make alternate arrangements if you are unable to commit your sludge at this time. If I can answer any questions please don't hesitate to call.

Sincerely,

W. Kolbe

Walter Kolbe
President

44 Montgomery St. Suite 500 • San Francisco, CA 94104 • (415) 955-0535 Fax (415) 397-6309

Environmental Protection Company

April 16, 1992

Tom Wethington
City of Farmington

Dear Tom,

I wanted to update you on the progress of our project. There have been modifications in the permitting of our site that allows us to offer the City of Farmington $30.25 per tanker load of sludge delivered to our site to be utilized as a remediation product. This will not only accord the City of Farmington tens of thousands of dollars of new revenues but will also mean substantial cost savings in terms of disposal. We would appreciate your earliest possible review of our offer as we will be obliged to make alternate arrangements if you cannot commit your sludge at this time. If I can answer any questions please don't hesitate to call.

Sincerely,

W. Kolbe

Walter Kolbe
President

44 Montgomery St. Suite 500 • San Francisco, CA 94104 • (415) 955-0535 Fax (415) 397-6309

Environmental Protection Company

April 17, 1992

Geoff McMahon
Morningstar Corporation
#61 Road 3950
P.O. Drawer 9
Farmington, NM 87499

Dear Geoff,

We are preparing to begin our Bioconversion project within the next few days next to your property. Since the permit was originally issued to you I'm sure your well acquainted with the details. We spoke on my last visit of the other 150 acres that you have available. I am interested in acquiring the other acreage if the price is right. I will be travelling the next few weeks but if you would be kind enough to advise my office of your asking price I will get back to you.

Sincerely,

Walt

Walter Kolbe
President

44 Montgomery St. Suite 500 • San Francisco, CA 94104 • (415) 955-0535 Fax (415) 397-6309

GEOWEST
Golden, Inc.

April 16, 1992

Mr. Dave Brown
Amoco Production Company
Environmental Affairs
1670 Broadway
Room 844
Denver, CO 80201

DRAFT

**RE: ASSESSMENT OF PROPOSED AMOCO COMPOSTING SITE
SAN JUAN COUNTY, NEW MEXICO**

Dear Mr. Brown:

GeoWest Golden, Inc. (GeoWest) has completed an assessment of a proposed Amoco composting site located east of Farmington, New Mexico in San Juan County, as you requested. The assessment consisted of:

- A site inspection;
- Discussions with Mr. Buddy Shaw of Amoco regarding former and proposed operations at the site;
- Drilling of five soil borings;
- Collection of one surface soil grab sample at each soil boring location, and laboratory analysis of three of the grab samples for selected parameters;
- Collection of one soil sample at each soil boring location with a California Sampler, and geotechnical testing of three of the soil samples;
- A review of New Mexico composting regulations.

The focus of the investigation was to assess the potential for environmental impact resulting from proposed composting operations at the site. The general location of the site is shown in Figure 1, and a site map is shown in Figure 2.

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530 Commons Drive • Golden, Colorado 80401 • (303) 526-9838

DRAFT

BACKGROUND

The proposed composting site is a 400' x 250' parcel of land out of a 10-acre tract in the SW 1/4 of the SE 1/4 of Section 2, T29N, R12W, San Juan County, New Mexico. The site is located approximately five miles east of Farmington, New Mexico in an area referred to as Crouch Mesa. The surrounding property is undeveloped.

According to Mr. Buddy Shaw of Amoco, the proposed composting site has been enlarged from an original 1-acre area at the east end of the site that had previously been used to stockpile horse manure over a period of approximately three years. The manure has been removed and stockpiled on the north and east sides of the site, as shown in Figure 2. The southeast section of the site has been backfilled with native surface material from areas adjacent to the site, and the remaining sections have been cleared and graded. The site slopes to the southeast at a rate of approximately 2.5 feet per 100 feet.

A natural depression, approximately 5 feet deep at its south end, is located at the southeast corner of the proposed composting site, as shown in Figure 2. According to Mr. Shaw, this depression will serve as a catch basin for any runoff produced in the composting area during rainstorms. The south and east sides of the composting area will be bermed to divert runoff into the catch basin.

Two dirt service roads border the north and south sides of the composting area. An area on the north side of the north service road, as shown in Figure 2, has been cleared and graded level for use as a future staging area for mixing and processing compost materials prior to application of compost piles in the proposed composting area.

GEOLOGY AND HYDROGEOLOGY

The land surface in the vicinity of the site generally slopes to the southeast, and is comprised of rolling hills sparsely vegetated with pinon trees. The site is located near the drainage divide between the Animas River and San Juan River drainage basins at an elevation of approximately 5,850 feet above mean sea level. The beginning of an unnamed ephemeral watercourse is located approximately 1,000 feet southeast of the site. The climate is arid to semiarid, with an annual precipitation of approximately 9 inches. Almost half of the annual precipitation occurs from the months of July through October. Annual class A pan evaporation near Farmington averages over 67 inches (Brown and Stone, 1979).

The subsurface strata underlying the site consist mostly of alternating layers of clayey, silty sands and weathered sandstone of the Tertiary San Jose Formation. This formation has been characterized as conglomeratic sandstone and mudstone (Brown and Stone, 1979).

No known water wells have been drilled within a one quarter mile radius of the site. A total of eight wells for obtaining drilling water were completed in the San Jose Formation east of the site at depths of 118 to 585 feet below ground surface (bgs) during the 1950's. Ground water in the San Jose Formation exists under confined conditions in thick sandstone units (Brown and Stone, 1979). An unconfined shallow aquifer has not been identified in the Crouch Mesa area. Therefore, there is low potential for the occurrence of usable ground water resources in the vicinity of the proposed composting site.

DRAFT

SOIL BORING RESULTS

Five soil borings were drilled by Western Technologies Inc. of Farmington, New Mexico at the locations shown in Figure 2. Surface soil grab samples were also collected adjacent to each soil boring location. A 7-inch O.D. hollow stem auger was used to drill the soil borings. A California Sampler was used to collect a soil sample at the 4 to 8-inch depth interval in each boring. Split spoon samples were then collected at 5-foot intervals.

Grab samples of surface soils collected at locations SB-2, SB-3, and SB-4 were submitted to Evergreen Analytical Laboratories of Wheat Ridge, Colorado for analysis of Skinner list metals, specific conductance, chloride and sulfate. Analytical results are provided in Attachment 1 and are summarized in Table 1.

Analytical results for the surface grab samples indicate low concentrations of barium, cobalt, copper, and nickel were detected at all three boring locations. The other nine metals analyzed were not detected. All detected metals concentrations are below the range of concentrations reported for natural soils (USGS Prof. Paper No. 574-F). The chloride concentrations detected in the grab samples were all below the average chloride level of 100 mg/Kg reported for natural soils (EPA SW-874). There are no known average sulfate or specific conductance values reported for natural soils.

Samples collected with the California sampler at the 4 to 8-inch depth interval from borings SB-2, SB-3, and SB-4 were submitted to Western Technologies for a sieve analysis and testing of vertical permeability, dry density, and moisture content. Test results are provided in Attachment 2 and are summarized in Table 2. Split spoon samples were examined by GeoWest personnel and described. Drilling logs for the borings are provided in Attachment 3.

In general, a sequence of alternating weathered sandstone and stiff clayey and silty sand strata was encountered in all borings. The borings were terminated at depths of less than 15 feet bgs due to penetration refusal by the drill bit when a fined-grained sandstone was encountered.

Soil Boring SB-1

Soil boring SB-1 is located in the southeast section of the composting site, in an area that had been backfilled with approximately 2 to 3 feet of uncompacted surface soils from areas adjacent to the site. Stockpiled horse manure in this area had been scraped off prior to backfilling. A soil sample collected at the 4 to 8-inch depth interval with the California Sampler was composed of silty fine- to medium-grained sand. Refusal was encountered at a depth of 14 feet bgs at the top of a fine-grained sandstone. No samples from this boring were submitted for analysis or testing.

Soil Boring SB-2

Soil boring SB-2 is located in the northeastern section of the site. Stockpiled manure in this area had been scraped off during the site preparation activities, but small visible patches of residual manure were observed on the surface. A surface soil grab sample was collected near the boring and submitted for analysis. A soil sample was collected at the 4 to 8-inch depth interval with the California Sampler and tested for physical properties. Refusal was encountered at a depth of 12.5 feet bgs at the top of a fined-grained sandstone.

Test results for physical properties of the weathered sandstone sample collected from SB-2 with the California Sampler indicate that it is a fine-grained sandstone, based on the Unified Soil Classification System (USCS), with a moderate permeability and low moisture content. The moderate permeability of the sandstone is most likely a function of secondary porosity resulting from chemical and physical weathering of the sandstone.

DRAFT

Soil Boring SB-3

Soil boring SB-3 is located in an undistubed area in the center of the site. Surface soil conditions in the vicinity of this boring are most likely indicative of native conditions. A surface soil grab sample was collected near the boring and submitted for analysis. A soil sample was collected at the 4 to 8-inch depth interval with the California Sampler and tested for physical properties. Refusal was encountered at a depth of 11.5 feet bgs at the top of a fined-grained sandstone.

Test results for physical properties of the sample collected from SB-3 with the California Sampler indicate that it is a fine-grained sand, based on the USCS, with a low permeability and low moisture content. However, the low permeability (3.0×10^{-6} cm/sec) measured in this sample and examination of it indicate that this soil is very dense and contains a significant amount of fines, including silt and clay. This fine-grained soil was also encountered at various depths in borings SB-1, SB-2, SB-4, and SB-5.

Soil Boring SB-4

Soil boring SB-4 is located in the southwest section of the site where tree removal and some grading had occurred. Surface soils in the vicinity of this boring had been slightly compacted by earth-moving equipment. A surface soil grab sample was collected near the boring and submitted for analysis. A soil sample was collected at the 4 to 8-inch depth interval with the California Sampler and tested for physical properties. Refusal was encountered at a depth of 11.5 feet bgs at the top of a fined-grained sandstone.

Test results for physical properties of the sample collected from SB-4 with the California Sampler indicate that it is a silty fine- to medium-grained sand with a moderate permeability and low moisture content.

Soil Boring SB-5

Soil boring SB-5 is located in the northwest section of the site. Surface conditions were very similar to those observed in the vicinity of boring SB-4. A soil sample collected at the 4 to 8-inch depth interval with the California Sampler was composed of silty fine- to medium-grained sand. Refusal was encountered at a depth of 10 feet bgs at the top of a fine-grained sandstone. No samples from this boring were submitted for analysis or testing.

DRAFT

o 0 o

Conditions observed during the assessment of the proposed composting site and results of the analysis and testing of physical properties of soils indicate that the site should be suitable for proposed composting operations. Laterally continuous fine-grained strata underlying the site at shallow depths will serve as effective low-permeability barriers to vertical migration of liquids that may percolate downward from the compost pile, so that an artificial liner across the composting site should not be required. Runoff from the composting site during rainstorms will be controlled by diversion berms and a collection basin located at the southeast corner of the site. The size of the collection basin is large enough to handle runoff from a 25-year, 6-hour storm.

There is low potential for environmental impact from proposed composting operations at the site due to the remoteness of the site. No shallow ground water aquifers have been identified in the vicinity of the site. The uppermost aquifer identified in the area is a confined aquifer in the San Juan sandstone at a depth of more than 100 feet bgs. There are also no perennial watercourses, water wells, or residences in the immediate vicinity of the site. Analysis of surface soil samples collected from the composting area does not indicate significant levels of constituents in the soil that would potentially impact the environment.

We appreciate the opportunity to work with Amoco on this project. If you have any questions or need further information, please contact the undersigned.

Sincerely,
GeoWest Golden, Inc.

Andrew D. Eyer
Project Manager

William R. Highland, P.E.

attachments

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TABLE 1

ANALYTICAL RESULTS FOR GRAB SAMPLES OF SURFACE SOILS

(All values reported in mg/Kg, unless noted otherwise)

	Sample ID				
Parameter	SB-2	SB-3	SB-4	Detection Limit	Range Detected in Natural Western U.S. Soils
Specific Conductance (µmhos/cm)	>5000	309	2060	NA	NA
Chloride	94.3	13.9	12.1	NA	NA
Sulfate	1490	11.0	826	NA	NA
Antimony	ND	ND	ND	5	<150 - 500
Arsenic	ND	ND	ND	11	<0.2 - 97
Barium	76	86	140	0.4	70 - 5000
Beryllium	ND	ND	ND	1	<1 - 7
Cadmium	ND	ND	ND	0.8	<1 - 10
Chromium	ND	ND	ND	1.4	3 - 1500
Cobalt	5	6	4	2	<3 - 50
Copper	4.7	5.2	3.8	1.2	2 - 300
Lead	ND	ND	ND	8	<7 - 700
Mercury	ND	ND	ND	0.1	<0.01 - 4.6
Nickel	7	9	7	4	<3 - 700
Selenium	ND	ND	ND	15	<0.1 - 1.4
Vanadium	ND	ND	ND	2	7 - 500

Notes:

1) Samples collected April 4, 1992

2) NA = Not Available

3) ND = Not Detected

4) Specific Conductance Measurement Method: U.S. Department of Agriculture Handbook No. 60, p.89

5) Chloride and Sulfate Analysis Method: EPA 300.0

6) Skinner List Metals Analysis Method: SW-846

7) Natural Soil Ranges for Western U.S. soils from USGS Professional Paper No. 574-F

TABLE 2

PHYSICAL PROPERTIES OF SOIL SAMPLES

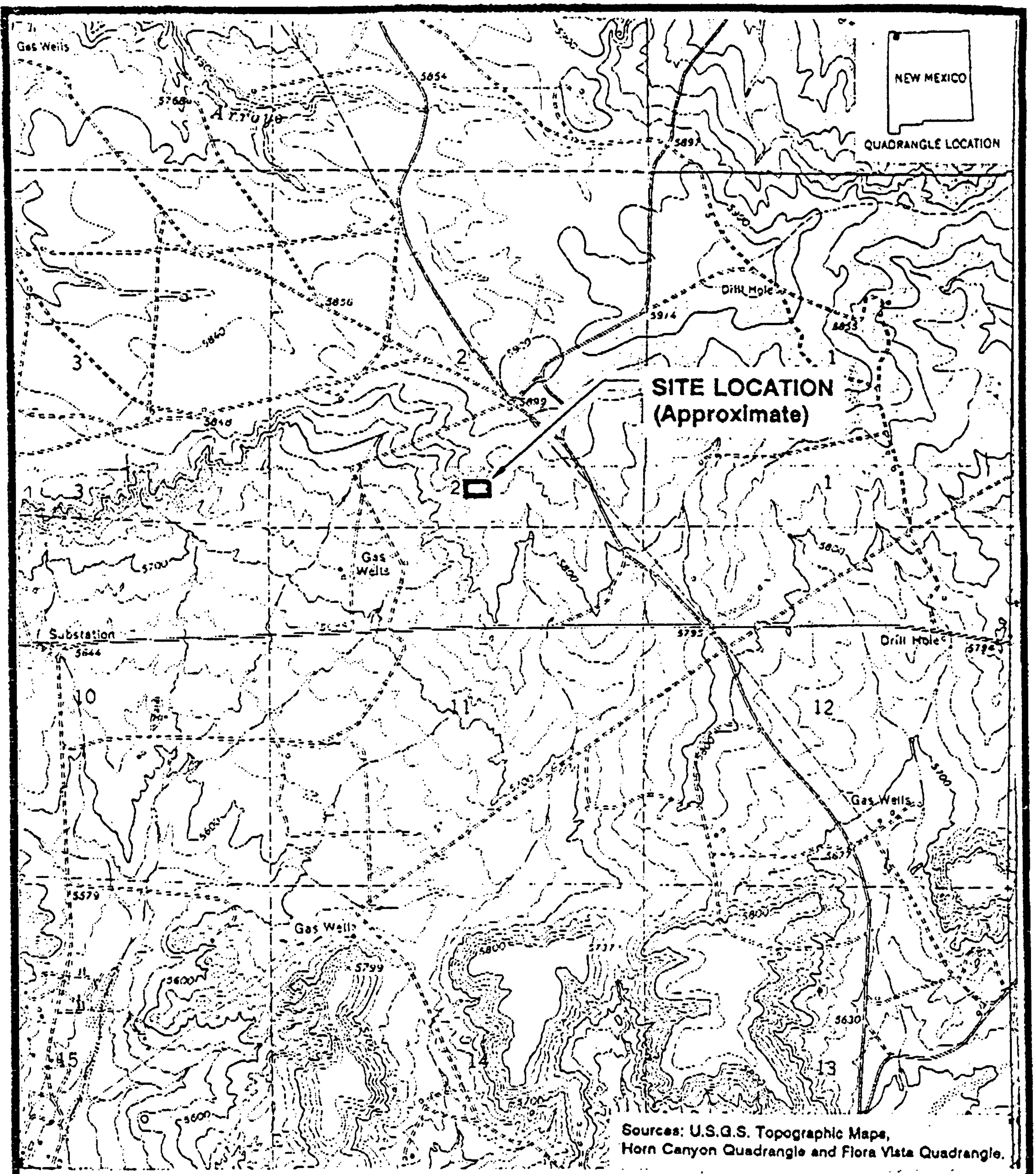
	SAMPLE ID		
Physical Property	SB-2	SB-3	SB-4
Coefficient of Permeability (cm/sec)	1.4×10^{-4}	3.0×10^{-4}	3.0×10^{-4}
In-Situ Dry Density (pcf)	112	115	110
In-Situ Moisture Content (%)	7.1	11.2	9.4
Grain Size Based on Sieve Analysis	Fine Sand	Fine Sand	Fine/Medium Sand

Note:

1) Samples were collected with California Sampler on April 4, 1992 at a depth of 4 to 8 inches below ground surface.

2) Sample SB-2 was weathered sandstone.

3) Grain size classification based on Unified Soil Classification System.



Sources: U.S.G.S. Topographic Maps, Horn Canyon Quadrangle and Flora Vista Quadrangle.

0 2000 4000

Scale in feet

North

GeoWest
Golden, Inc.

Site Assessment

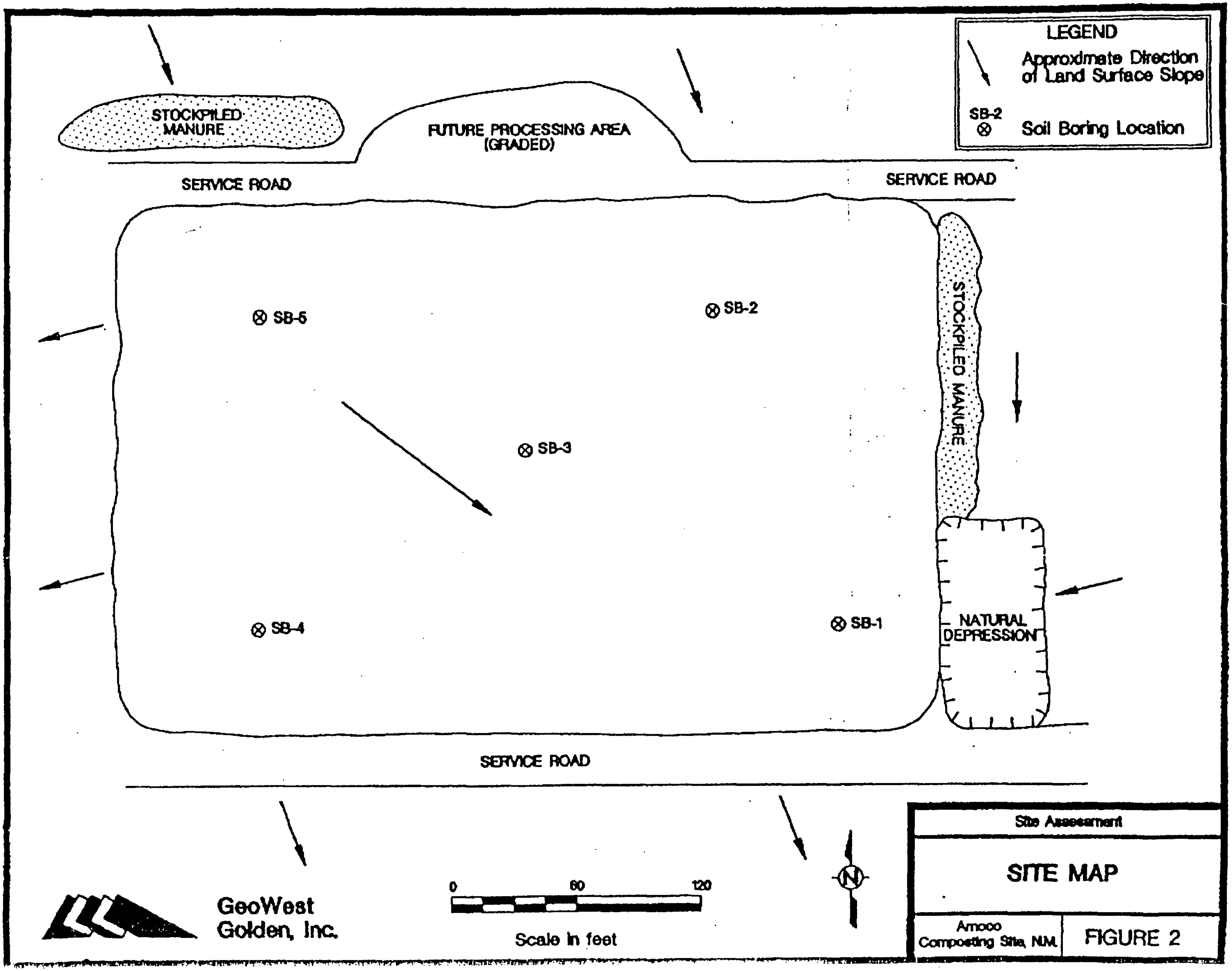
LOCATION MAP

Amoco
Composting Site, N.M.

FIGURE 1

File Name: 2003AJ
Date: 4/13/92
Drawn By: R.H.L.
Checked By:

File Name: 2036A2 Date: 4/13/92 Drawn By: RHL Checked By:



GeoWest Golden, Inc.

Site Assessment

SITE MAP

Amoco Composting Site, N.M.

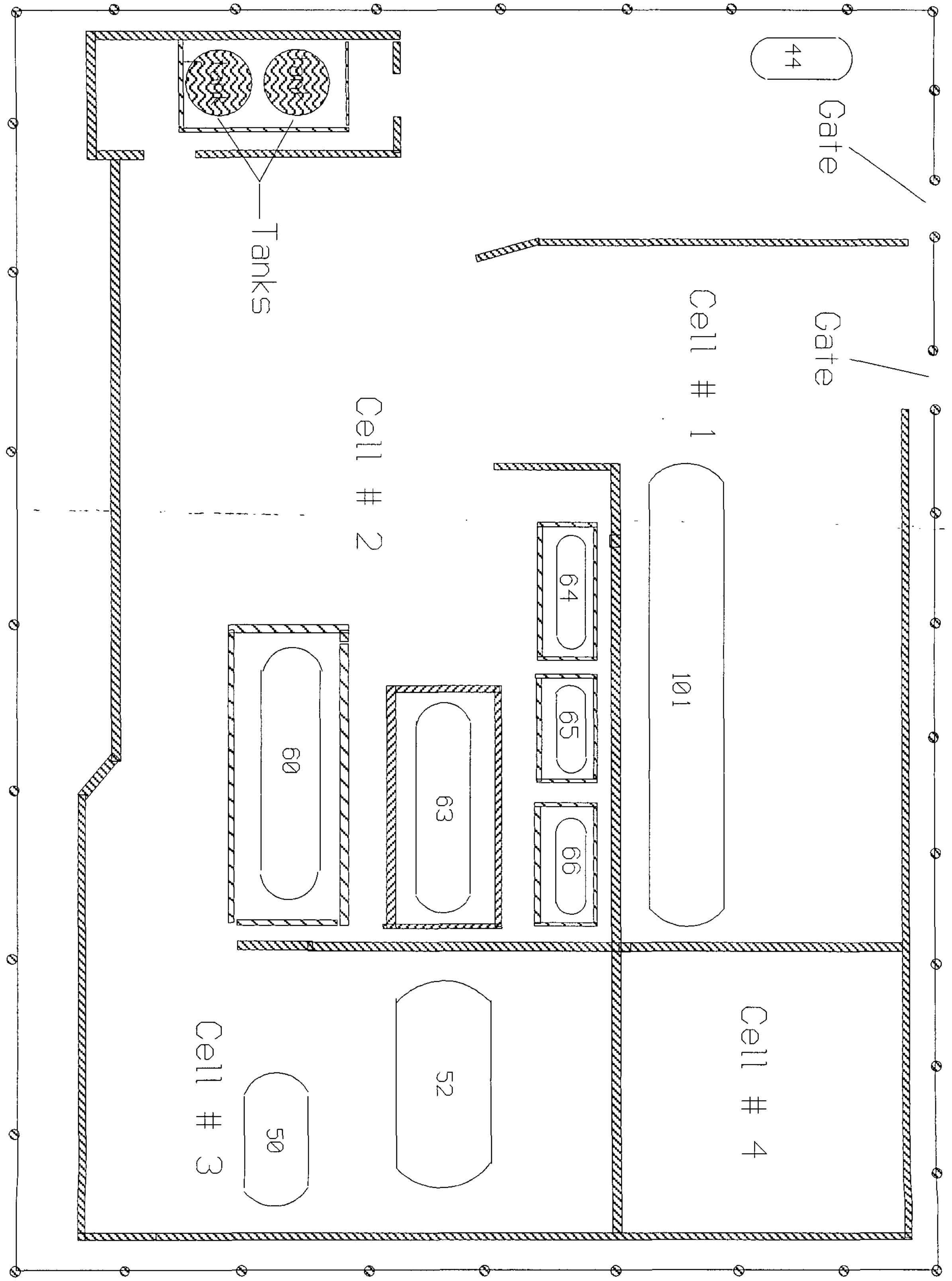
FIGURE 2

AMOCO CROUCH MESA SITE
APRIL 20, 1998

CELL NUMBER	PILE NUMBER	ORIGIN
1	101	CLEAN FILL (ROCK)
2	44	CLEAN (SANDSTONE)
2	60	WHITE GAS COM # 1
2	64	BARNES LS 8 A
2	65	EATON GAS COM B # 1
2	66	AMOCO YARD (DRUMS)
2	63	CORNELL B # 1
3	50	CLEAN FILL (ROCK)
3	52	CLEAN FILL (DIRT)

CELL # 4 IS CURRENTLY EMPTY

AMOCO CROUCH MESA SITE



State of New Mexico
ENVIRONMENT DEPARTMENT

BRUCE KING
GOVERNOR

JUDITH M. ESPINOSA
SECRETARY

RON CURRY
DEPUTY SECRETARY

April 20, 1992

Walter R. Kolbe
Environmental Protection Co.
44 Montgomery St. Suite 500
San Francisco, Ca. 94104

Dear Mr. Kolbe:

This letter is to confirm the issues discussed at a meeting of April 10, 1992, regarding the Amoco Composting Project, Site #1, Horn Canyon. The proposed facility meets the definition of a composting facility under the Solid Waste Management Regulations, therefore a solid waste permit would be required prior to construction and operation. The existing Ground Water Discharge Plan DP-536, does not provide interim since the actual composting did not occur prior to January 30, 1992.

Hydrocarbon releases may require an Air Quality permit. Please contact Bruce Nicholson at 827-0067 regarding the issue. A Storm Water Permit for the facility may also be required. For your information, enclosed is a copy of the Storm Water Fact Sheet and the Industrial Permit Application Questions and Answers. Please contact the EPA Region 6 Hotline at (214) 655-7185, for more information regarding the Storm Water Program. In addition, EPA would need to be notified if you intend to remove sludge directly from the City of Farmington digester or any digester in the area. The contact person at EPA Region 6 is Pam Teel, Enforcement Branch, at (214) 655-6475.

DRUG FREE

Please advise me if you wish to have a preapplication meeting on the solid waste permit in order to provide you with the details of process.

Sincerely,

J. David Duran
Program Manager
Permitting & Compliance Section

JDD/DMT:dmt

cc: Ernest Rebuck, Ground Water Protection & Remediation Bureau
Bruce Nicholson, Air Quality Bureau
Garth Graves, District Manager, Dist. I

State of New Mexico
ENVIRONMENT DEPARTMENT
Harold Runnels Building
1190 St. Francis Drive, P.O. Box 26110
Santa Fe, New Mexico 87502
(505) 827-2850

BRUCE KING
GOVERNOR

JUDITH M. ESPINOSA
SECRETARY

RONCURRY
DEPUTY SECRETARY

April 14, 1992

RECEIVED

APR 20 1992

OIL CONSERVATION DIV.
SANTA FE

The Honorable Darla Whitney-Welles
Box 99
Aztec, NM 87410

Dear Representative Whitney-Welles:

This is in response to our telephone conversation a few days ago regarding the permitting of a proposed composting project to be managed by Environmental Protection Company with funding from Amoco.

The following is a brief summary of the above project. Environmental Protection Co. wants to obtain horse manure from San Juan Downs and sludge from the City of Farmington and compost the two at a site near San Juan County's present landfill. At this same site they plan to truck in hydrocarbon contaminated soils from the oil patch and mix with the manure-sludge compost and recompost. They also expect to market the final product to gardeners and landscapers.

The following is the information assembled to date regarding the above:

1) An NMED solid waste permit will be required, because of sewage sludge from Farmington. The NMED has not yet received an application. However there is a jurisdictional question because of the hydrocarbon contaminated soils from the oil patch, which generally are handled by the Oil Conservation Division (OCD).

2) The NMED discussed the project with the OCD. Amoco Production Co. submitted an application on April 9, 1992 for the same site for a permit under OCD Rule 711, Surface Waste Disposal Facility. Processing this permit application could require OCD at least 4 months.

3) Project doesn't qualify for interim status under the NMED solid waste regulations since it wasn't operational when the regulations were adopted on December 31, 1991. In fact it has never operated.

4) Environmental Protection Co. has indicated verbally that it wants to remove sludge from the City of Farmington digester. If so, EPA must be formally notified, and Farmington would have possible liability at this site.

5) The NMED Ground Water Section approved a ground water discharge plan, DP-536, on June 27, 1988 for this same site. However this proceeded the promulgation of the solid waste regulations.

6) NMED previously approved DP-453 for a similar operation by some of the same individuals at another location. The NMED enforced against these persons for violations of the discharge plan. After filing in San Juan District Court, the Company settled with the NMED on July 25, 1989, remediated the site and paid a penalty of $1500.

7) Certain of the same individuals also received a treating plan permit from OCD under OCD Rule 312. The OCD in 1988 revoked the permit because of numerous violations of permit conditions.

Please let me know, if I can be of further assistance.

Sincerely,

Judith M. Espinosa

Judith M. Espinosa
Secretary, NMED

cc: Kathleen M. Sisneros, Director, NMED Water and Waste Management Division
David Vackar, Director, NMED Environmental Protection Division

Environmental Protection Company

FAX COVER PAGE

This transmittal consists of 2 page(s) including this page.

Date 4-15-92 Time 1⁰⁰ p. PST

TO:

Company OCD

Attention Roger Anderson

Remarks I spoke with Buckly Shaw and he asked that I draft a letter for you and give you a call to discuss.

FROM: Walt Kolbe.

44 Montgomery St. Suite 500 • San Francisco, CA 94104 • (415) 955-0535 Fax (415) 397-6309

Environmental Protection Company

Roger Anderson
Oil Conservation Division
State of New Mexico

Dear Mr. Anderson,

As you are aware our company planned to begin a contract with Amoco Production Company to Bioconvert hydrocarbon contaminated soils next week. Our thoughts originally were to use our existing composting permit to build a remediation product to take to "satellite" locations in order to save on transportation costs for our client. However, since this project was first discussed over a year ago with a successful pilot this past summer and subsequent efforts to start a full scale project late last year and early this year there has never been any mention of any solid waste facility permit until last week. Obviously, if this was brought up a year ago we could expect to be done with that process by now. But rather than delay this clean up project I'm suggesting that we proceed with this process utilizing only our central site until we can sort out any regulatory questions prior to initiating a satellite project. In this way we would be bringing sewage sludge to be incorporated directly with the contaminated soils. In doing so we would end up with a product that would exceed federal standards for both sewage sludge and contaminated soils. For instance to reach EPA's highest standard for pathogen reduction for sludge we need only achieve temperatures of 70°C for 30 minutes. We would expect to be in that temperature range for weeks. The site itself has a 2 foot natural clay liner and is over 150 feet to groundwater. The area will be totally fenced in and Amoco Production has agreed to assume responsibility for the site. Monitoring of the site and documenting the operation will be Dr. Bruce Dale, Professor of Chemical Engineering and Agricultural Engineering, Director of the Engineering Biosciences Research Center at Texas A & M University. This project is very conservative in nature and because of the implications for all the parties involved you can be assured that this project will be operated with the utmost care.

We are specifically requesting your approval to proceed as described above. Since the only "composting" that will be done adjacent to this project will be manure, which when processed in an area less that 5 acres is specifically exempt from the definition of solid waste facility we will be fully aligned with all regulations.

It is our intent to proceed with the application for a solid waste facility permit and would expect that process to be complete before June 1993 when our current permit would come up for renewal.

Sincerely,

W. Kolbe
Walter Kolbe
President

44 Montgomery St. Suite 500 • San Francisco, CA 94104 • (415) 955-0535 Fax (415) 397-6309

Westech Laboratories Inc.

37[illegible]7 East Broadway Road
Phoenix, Arizona 85040
(602) 437-1080 • fax 437-8706

CLIENT FARMINGTON, CITY OF
ENVIRONMENTAL DIVISION
ATTN: JUDY BIRD
800 MUNICIPAL DRIVE
FARMINGTON, NM 87041

SAMPLE NO. : 9202272
INVOICE NO.: 22120388
REPORT DATE: 03-16-92
REVIEWED BY My AGN
PAGE : 1 OF 1

CLIENT SAMPLE ID : FMN-SLUDGE 1
SAMPLE TYPE .....: SLUDGE
SAMPLED BY ......: D. ROQUEMORE
SUBMITTED BY ....: J. BIRD
SAMPLE SOURCE ...: SLUDGE PILE COMPOSITE

AUTHORIZED BY : J. BIRD
CLIENT P.O. : C08907-1124
SAMPLE DATE ...: 02-27-92
SUBMITTAL DATE : 02-28-92
EXTRACTION DATE: --

REMARKS -

* Analysis performed by Barringer Laboratories Inc.

Inorganic Chemistry - Total Metals

DATA TABLE

Parameter	Result	Unit	Detection Limit	Analysis Date
Total Arsenic ....:	<2.5	mg/Kg	2.5	03-11-92
Total Barium ....:	610.	mg/Kg	5.0	03-09-92
Total Cadmium ....:	7.9	mg/Kg	2.5	03-09-92
Total Chromium ....:	51.	mg/Kg	2.5	03-09-92
Total Lead ....:	120.	mg/Kg	5.0	03-09-92
Total Mercury ....:	1.8	mg/Kg	0.25	03-10-92
Total Selenium ....:	<2.5	mg/Kg	2.5	03-12-92
Total Silver ....:	24.	mg/Kg	2.5	03-09-92
Total Uranium ....:	*3.6	pCi/g	N/A	03-30-92

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Inorganic Non-Metals

DATA TABLE

Parameter	Result	Unit	Detection Limit	Analysis Date
Cyanide, Total(Distillation) .....:	2.0	mg/Kg	1.0	03-03-92
Fluoride ....:	<0.10	mg/Kg	0.10	03-10-92
Nitrate Nitrogen ....:	240.	mg/Kg	0.50	03-10-92

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EXTRACTION DATE: --

REMARKS -

* Analysis performed by Barringer Laboratories Inc.

Radiological

DATA TABLE

Parameter	Result	Unit	Detection Limit	Analysis Date
Radium 226 ....:	*1.1 ± 0.6	pCi/g	<0.6	03-30-92
Radium 228 ....:	*1.2 ± 1.9	pCi/g	<1.0	03-30-92

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SUBMITTED BY ....: J. BIRD
SAMPLE SOURCE ...: SLUDGE PILE COMPOSITE
ANALYST ....: M. EASTWOOD

AUTHORIZED BY : J. BIRD
CLIENT P.O. : CO8907-1124
SAMPLE DATE ...: 02-27-92
SUBMITTAL DATE : 02-28-92
EXTRACTION DATE: 03-12-92
ANALYSIS DATE .: 03-21-92

Method 8080 - PCB'S

DATA TABLE

Parameter	Result	Unit	Detection Limit
PCB 1016	<100.	ug/Kg	100.
PCB 1221	<2500.	ug/Kg	2500.
PCB 1232	<660.	ug/Kg	660.
PCB 1242	<300.	ug/Kg	300.
PCB 1248	<100.	ug/Kg	100.
PCB 1254	<100.	ug/Kg	100.
PCB 1260	<200.	ug/Kg	200.

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ANALYST ....: I. HRABOVSKY

AUTHORIZED BY : J. BIRD
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SAMPLE DATE ...: 02-27-92
SUBMITTAL DATE : 02-28-92
EXTRACTION DATE: 03-09-92
ANALYSIS DATE .: 03-12-92

Method 8100 - Polynuclear Aromatic Halocarbons

DATA TABLE

Parameter	Result	Unit	Detection Limit
Benzo(a)pyrene ....:	<200.	ug/Kg	200.
Napthalene ....:	<200.	ug/Kg	200.
1-Methylnaphthalene ....:	<200.	ug/Kg	200.

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ANALYST ....: I. HRABOVSKY

AUTHORIZED BY : J. BIRD
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SAMPLE DATE ...: 02-27-92
SUBMITTAL DATE : 02-28-92
EXTRACTION DATE: 03-10-92
ANALYSIS DATE .: 03-10-92

Method 8260 - Volatile Organics

DATA TABLE

Parameter	Result	Unit	Detection Limit
1,1,1-Trichloroethane ....:	<50.	ug/Kg	50.
1,1,2,2-Tetrachloroethane ....:	<50.	ug/Kg	50.
1,1,2,2-Tetrachloroethene ....:	<50.	ug/Kg	50.
1,1,2-Trichloroethane ....:	<50.	ug/Kg	50.
1,1-Dichloroethane ....:	<50.	ug/Kg	50.
1,1-Dichloroethene ....:	<50.	ug/Kg	50.
1,2-Dibromoethane ....:	<50.	ug/Kg	50.
1,2-Dichloroethane ....:	<50.	ug/Kg	50.
Benzene ....:	<50.	ug/Kg	50.
Total Xylenes ....:	<50.	ug/Kg	50.
Carbon tetrachloride ....:	<50.	ug/Kg	50.
Chloroform ....:	<50.	ug/Kg	50.
Dichloromethane ....:	<50.	ug/Kg	50.
Ethylbenzene ....:	<50.	ug/Kg	50.
Toluene ....:	72.	ug/Kg	50.
Trichloroethene ....:	<50.	ug/Kg	50.
Vinyl chloride ....:	<100.	ug/Kg	100.

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10/90

State of New Mexico
Energy, Minerals and Natural Resources Department
OIL CONSERVATION DIVISION
P.O. Box 2088
Santa Fe, NM 87501

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APR 09 1992
OIL CONSERVATION DIV.
SANTA FE

APPLICATION FOR SURFACE WASTE DISPOSAL FACILITY

(Refer to OCD Guidelines for assistance in completing the application.)

I. Type: ☐ Produced Water ☐ Drilling Muds ☐ Treating Fluids
☒ Solids ☒ Other Sewer Sludge

II. OPERATOR: Amoco Production Company
ADDRESS: 200 Amoco Court, Farmington, NM 87401
CONTACT PERSON: Buddy Shaw PHONE: 326-9219

III. LOCATION: SW /4 SE /4 Section 2 Township 29N Range 12W
Submit large scale topographic map showing exact location.

IV. IS THIS AN EXPANSION OF AN EXISTING FACILITY? ☐ Yes ☒ No

V. Attach the name and address of the landowner of the disposal facility site and landowners of record within one-half mile of the site.

VI. Attach description of the facility with a diagram indicating location of fences, pits, dikes, and tanks on the facility.

VII. Attach detailed engineering designs with diagrams prepared in accordance with Division guidelines for the construction/installation of the following: pits or ponds; leak-detection systems; aerations sytems; enhanced evaporation (spray) systems; waste treating systems and security systems.

VIII. Attach a contingency plan for reporting and clean-up of spills or releases.

IX. Attach a routine inspection and maintenance plan to ensure permit compliance.

X. Attach a closure plan.

XI. Attach geological/hydrological evidence demonstrating that disposal of oil field wastes will not adversely impact fresh water.

XII. Attach proof that the notice requirements of OCD Rule 711 have been met. (Commercial facilities only.)

XIII. Attach a contingency plan in the event of a release of H_2S.

XIV. Attach such other information as is necessary to demonstrate compliance with any other OCD rules, regulations and/or orders.

XV. CERTIFICATION

I hereby certify that the information submitted with this application is true and correct to the best of my knowledge and belief.

Name: Buddy Shaw Title: Environmental Coordinator
Signature: BA Shaw Date: April 6, 1992

DISTRIBUTION: Original and one copy to Santa Fe with one copy to appropriate Division District Office.

Plan for Disposal

Compost mixture consists of the following:

1. Oily soil from Amoco pits
2. Manure from NAPI and San Juan Downs
3. Sewer Sludge from Farmington
4. Paper Products diverted from Regional Landfill

TCLP composite tests will be conducted on the final compost sites prior to use as backfill material for ongoing pit cleanups across the San Juan Basin. The site will be fenced for security purposes (6' chain-linked with barbed wire).

Contingency Plan

All liquids will be contained in tankage. The site will be bermed and fenced. Should a leak or spill occur it will be contained on site. Any such occurrence will be reported to the OCD office in Aztec immediately. Cleanup will consist of re-entry into the compost pile. Cleanup equipment will be onsite.

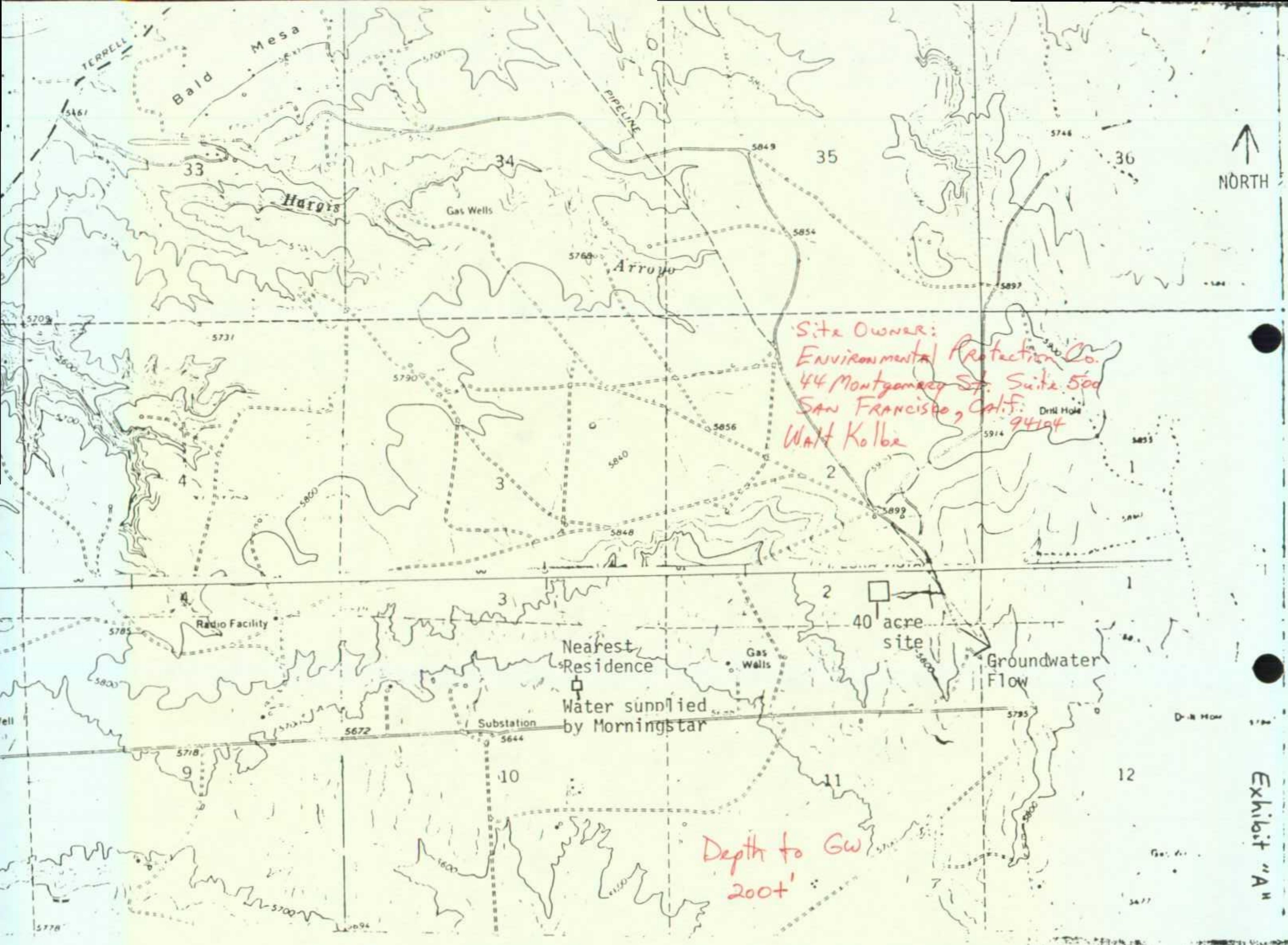
Inspection and Maintenance Plan

Site equipment and berm will be inspected daily. Any needed repairs will be made immediately. Random sampling of the sewer sludge will be conducted to ensure that no hazardous conditions exist prior to movement to the compost site.

Closure Plan

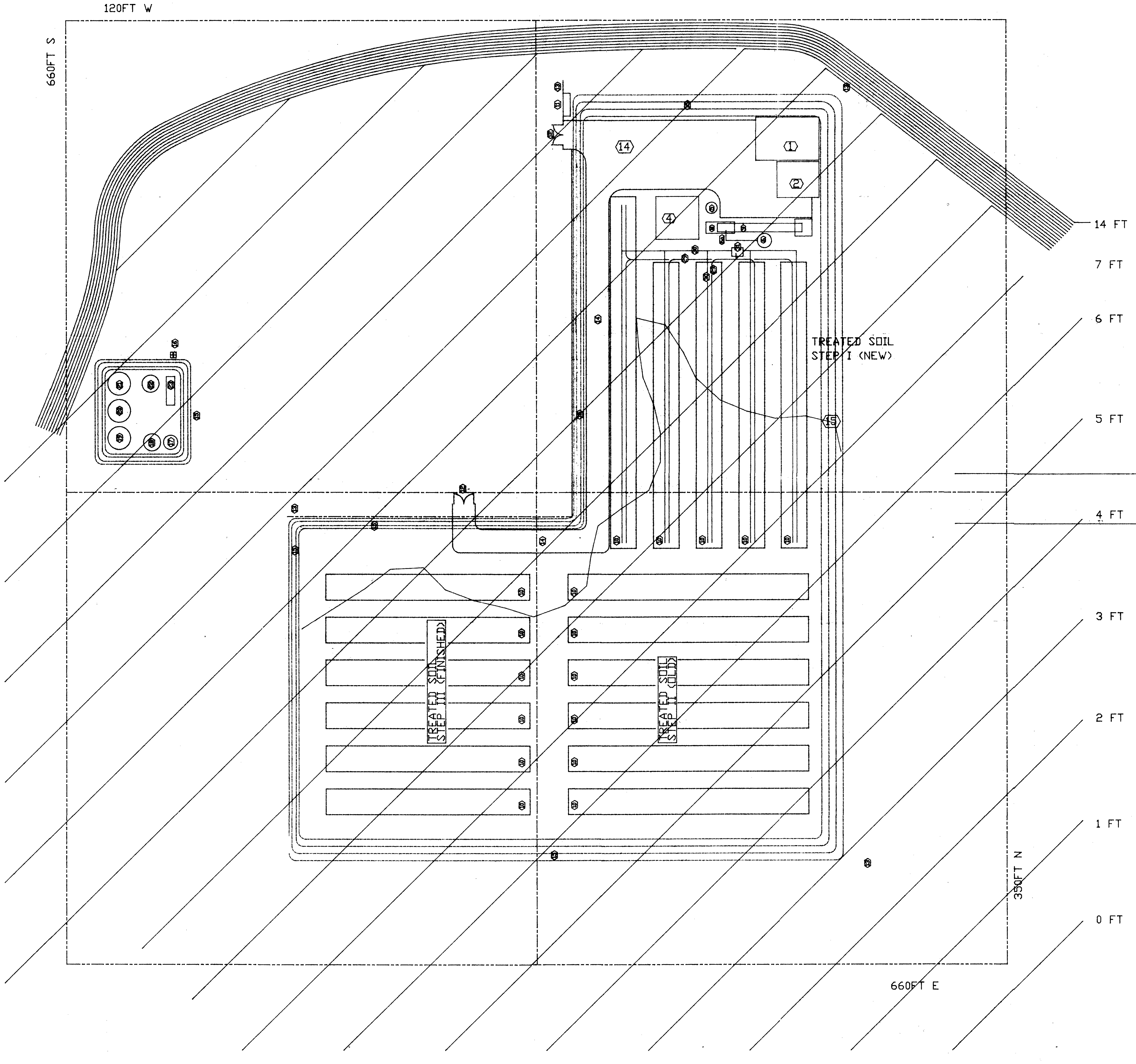
Soil sampling has been conducted to establish a baseline for the site. Additional testing will be conducted at the end of the project to make sure no contamination has occurred. Test results will be furnished as they are received.

Exhibit "A"



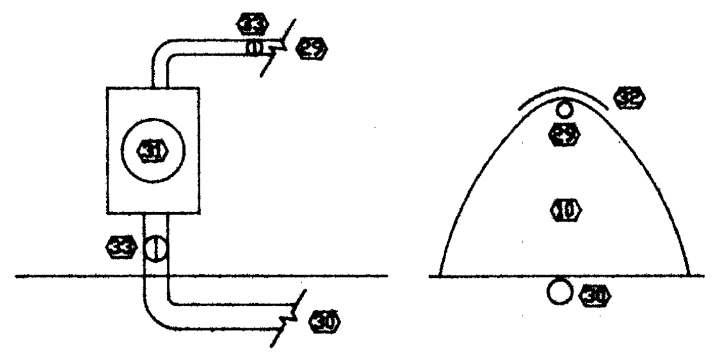
Site Owner:
Environmental Protection Co.
44 Montgomery St. Suite 500
San Francisco, Calif. 94104
Walt Kolbe

Depth to GW 200+'



SITE PLAN

SCALE 1" = 40FT



KEYED NOTES

①	OILY DIRT STORAGE
②	MANURE STORAGE
③	NUTRIENT STORAGE BLDG
④	PAPER STORAGE BLDG
⑤	TUB GRINDER
⑥	STIRRED SLUDGE 500 BBL
6a	4" STL LIQUID FLOW LINE
⑦	STIRRED REACTOR 500 BBL
⑧	PUG MILL
⑨	PUG MILL CONVEYOR
⑩	TREATED SOIL STORAGE
⑪	SITE OFFICE
⑫	16 FT GATE
⑬	6FT CHAIN LINK FENCE w/BARBED WIRE
⑭	INTERIOR ACCESS ROAD
⑮	CONTAINMENT BERM
⑯	NEW FILL/PUMP CONNECTION
⑰	WATER STORAGE TANK
⑱	FINISHED PRODUCT TANK
⑲	WET OIL STORAGE TANK #1
⑳	WET OIL STORAGE TANK #2
㉑	PIT OIL STORAGE TANK
㉒	SEDIMENT FILTER TANK
㉓	COALESER
㉙	8"ø RETURN DUCT
㉚	12"ø SUCTION
㉛	GAS POWERED BLOWER
㉜	PLASTIC ROW COVER
㉝	AIR MANIFOLD VALVE

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APR 0 9 1992
OIL CONSERVATION DIV
SANTA FE

PROJECT INFO

1 ACTIVE STORAGE OF TREATED SOIL 6,850cy

2 PROJECT SITE: SW/4, SE/4 SEC 2, T29N, R12W, NMPM 10 ACRE ±

DATE	REVISION	BY

PECOS BILL SPECIALITIES
P.O.Box 1264

SITE PLAN & PROJECT INFO
AMOCO COMPOSTING PROJECT
SITE #1 - HORN CANYON

DATE: MAR
DRAWN BY:
PROJ. 92
SCALE:
SHEET C
OF