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ORIGINAL
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R-585-8-5-38

SOIL TESTING REPORT
BLOSENSKI LANDFILL

PREPARED UNDER

TDD NO. F3-8506-25
EPA NO.
CONTRACT NO. 68-01-6699

FOR THE

HAZARDOUS SITE CONTROL DIVISION
U.S. ENVIRONMENTAL PROTECTION AGENCY

AUGUST 30, 1985

NUS CORPORATION
SUPERFUND DIVISION

SUBMITTED BY	REVIEWED BY	APPROVED BY
ATWOOD DAVIS CHEMIST	THOMAS FROMM ASSISTANT MANAGER	GARTH GLENN MANAGER, FIT III

Disclaimer: This report has been prepared for the U.S. Environmental Protection Agency (EPA) under Contract No. 68-01-6699. The content does not necessarily reflect the views and policies of EPA nor does the mention of trade names or common products constitute endorsement by EPA.

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SECTION 1

1.0 INTRODUCTION

1.1 Authorization

NUS Corporation performed this work under Environmental Protection Agency Contract No. 68-01-6699. This specific report was prepared in accordance with Technical Directive Document No. F3-8506-25 for the Blosenski Landfill located in West Caln Township, Chester County, Pennsylvania.

1.2 Scope of Work

NUS FIT III was tasked to perform soil testing utilizing the Photo-Vac 10A10 portable gas chromatograph. The purpose of the testing was to attempt to characterize and evaluate the off-site migration of volatile organic compounds using volatile headspace analysis procedures on the soil samples collected. The procedure was developed to try to determine the presence, extent, and direction of a contaminant plume from the landfill.

In addition, 3 residential well water samples were taken and analyzed for fecal coliforms. The purpose of these analyses was to rule out the possibility of sewage infiltration, and, hence, tank cleaning compounds, into the residential wells. These well water samples were also analyzed for volatile organics using the same headspace procedure and the Photo-Vac 10A10 as in the soil samples.

1.3 Site Description and History

The Blosenski Landfill is an inactive landfill, approximately 10 acres in size, located along Kings Highway Route 340 in West Caln Township, Chester County, Pennsylvania.

The landfill was owned and operated by Joseph Blosenski during the 1970s. Operating without a permit, the landfill received industrial waste (including solvents, paints, and other unknown industrial waste), municipal waste, and demolition wastes.

Past sampling conducted by NUS Corporation and recent sampling conducted by EPA Region III Central Regional Laboratory have indicated the presence of benzene and trichloroethene (TCE) in monitoring wells and residential wells near the site. Based upon this information, it was decided that the presence/absence of these 2 compounds in the soil gas samples could be used to determine any possible patterns of migration from the monitoring wells to similarly affected residential wells.

1.4 Sampling Locations

Based upon the most recent sampling results (see appendix 3), the highest levels of TCE and benzene occurred in monitoring well (MW) nos. 2 and 3, respectively. Upon completion of preliminary method development Phase I (see appendix 2, sampling/work plan letter), a sampling grid, 600 feet east to west and 90 feet north to south with 60 feet east to west/30 feet north to south sampling intervals, was established between MW nos. 2 and 3 and the residences of interest. A total of 44 soil sampling locations were placed by the grid (see site location map).

The 3 residential wells were chosen by EPA personnel on site on the day of their sampling. The Bardsley well and the Cahull well were chosen because they had previously shown measurable concentrations of TCE and benzene. The Hartmetz well was chosen because it is located near the Bardsley residence, yet had not previously shown any contamination.

SECTION 2

2.0 FIELD TRIP REPORT

2.1 Summary

On July 12, 1985, FIT III personnel Atwood Davis, David Side, and Thomas Fromm performed soil gas sampling trials on a hole augered near MW no. 2 using the Spittler soil gas sampling apparatus, as described in the NUS Work Plan WP-SI Rev. 1 prepared for this site (see appendix 2) as stage 1 of the sampling plan letter. Results for this technique were inconclusive. The chromatograph operated properly, but TCE and benzene did not appear in the soil gas samples; interferences were present in the chromatograms.

On July 16, 1985, Atwood Davis and David Side returned to the site to conduct further trials of the soil gas sampler. After trial sampling of soil gases on freshly augered holes near MW nos. 2 and 4 with no positive results, a soil sample was taken from the bottom of the hole augered at MW no. 2. This sample was placed in a sealed hypo-vial and allowed to equilibrate as a headspace sample. The sample prepared in this manner revealed detectable concentrations of benzene and TCE. Basd upon this result and further consultation with Dr. Thomas Spittler, of EPA Region I Central Region Laboratory, and Mr. Timothy Travers and Mr. Edward Schoener, of EPA Region III, the NUS Work Plan was amended to use headspace sampling as the methodology in this study (see Work Plan, appendix 2 and telecons, appendix 5).

On July 17, 1985, Atwood Davis and David Side returned to the site to set up the sampling grid. A 600 feet grid, east to west, was set up, but a field revision to 90 feet, north to south, was established because of the proximity of residential yards and outbuildings. In addition, MW nos. 2 and 3 were sounded for water levels and total depths and HNU readings were taken at the well heads. These results are listed in appendix 8.

On July 22, 1985, Atwood Davis and David Side sampled at grid line A, points 1 through 11, AA-11, and B-11.

On July 23, 1985, Atwood Davis, David Side, and Timothy Travers, of EPA Region III, continued sampling the grid system. Atwood Davis and Timothy Travers collected the residential well samples for fecal coliforms and volatile headspace analysis. The fecal coliform samples were shipped that afternoon from the FIT III office to EPA Region III Central Regional Laboratory for analysis. James Jerpe, of EPA Region III Central Regional Laboratory, and Steven Way, of EPA Headquarters, Washington, DC, were also on site as observers.

On July 24, 1985, Atwood Davis and David Side completed sampling of the sample grid. James Jerpe and Steven Way were again on-site observers.

2.2 PHOTOGRAPH LOG

Photo 1 -
Power augering hole at AA-4.

Photo 2 -
Taking sample from tube at A-1.

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Photo 3 -
Decon procedure at A-3.

Photo 4 -
Photo -VAC 10A10.

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Photo 5 -
Photo-VAC 10A10 and sample vials.

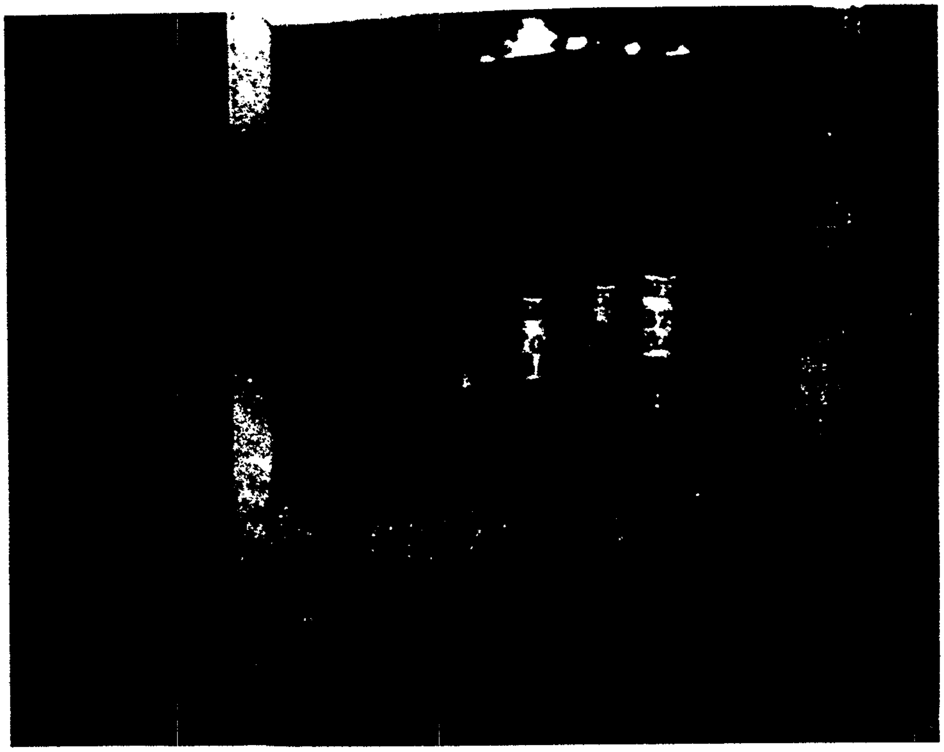

Photo 6 -
Samples equilibrating in drying oven.

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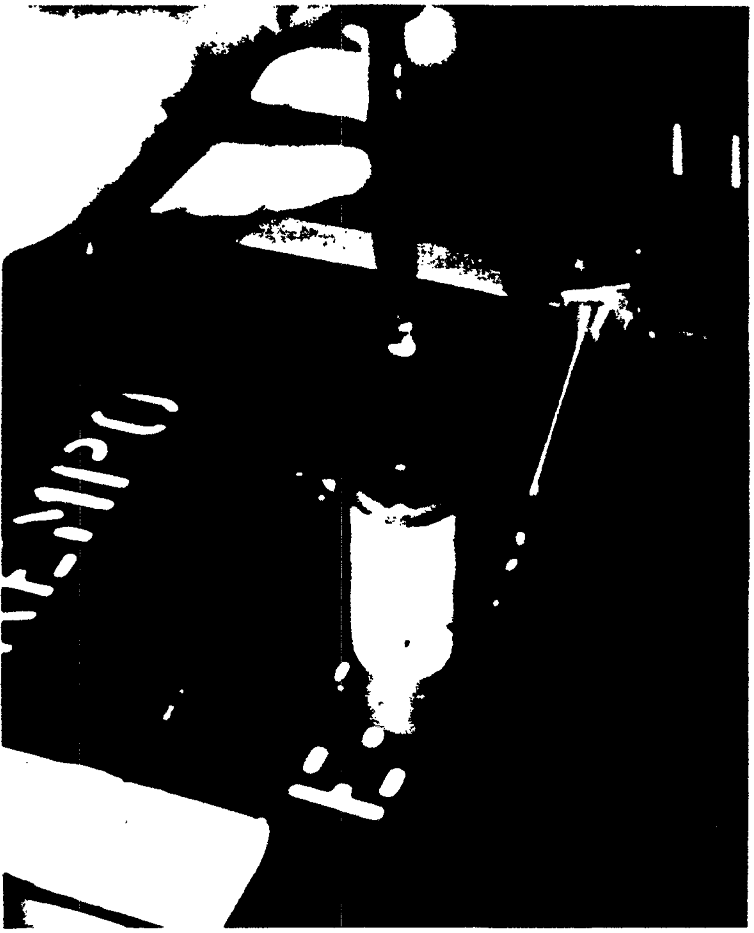

Photo 7 -
Sampling equilibrated headspace.

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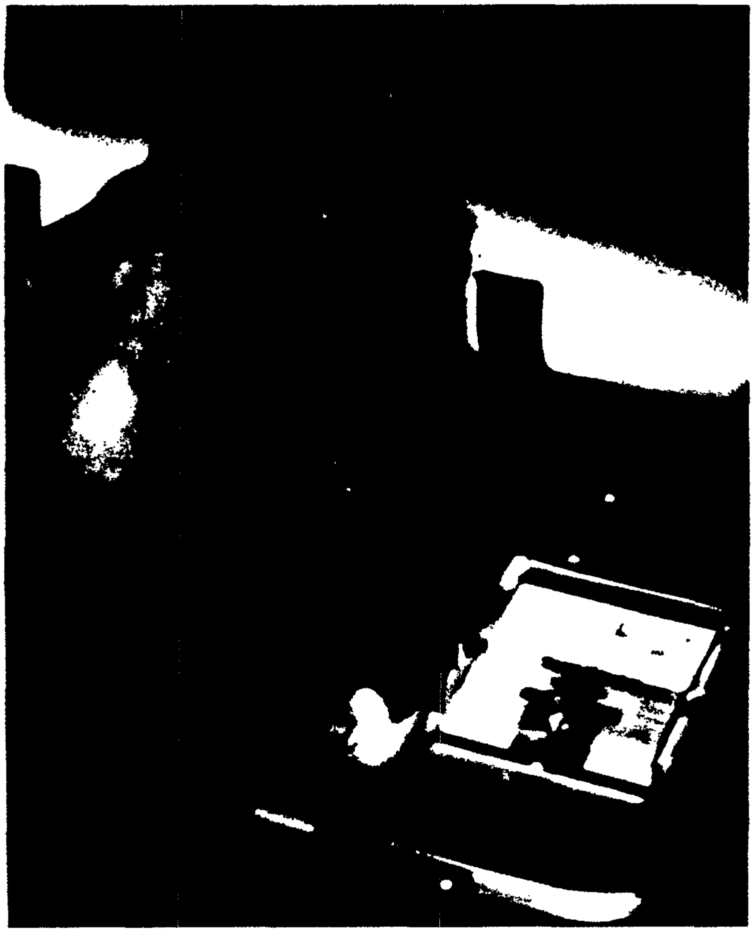

Photo 8 -
Sample injection into chromatograph.

SECTION 3

3.0 OBSERVATIONS

3.1 Sampling Methodology

Grid sampling points were placed at 60-foot intervals, east to west, and 30-foot intervals, north to south. Sampling holes were augered with a 2-man power auger using a 2.5-inch diameter auger bit to a depth of 2.5 feet. Soil samples were taken from the bottom of the auger hole using a 3-foot section of plastic pipe with the sampling end cut at a 45° angle. The sampling pipe was driven into the bottom of th auger hole with a wooden mallet. The resulting soil core was then removed from the pipe with a stainless steel scoop and placed directly into a standard 40 ml volatile organic analysis (VOA) vial. The VOA vial was filled approximately 2/3 full and sealed. On return to the FIT van, 10 ml of organic grade blank water was placed in each vial and immediately resealed, leaving approximately 90 ml of headspace in each vial. Two field blanks (30 ml of organic grade blank water) were poured at this time for each sampling day. Field duplicates were taken each day using the sample procedure outlined for 10 percent of the samples collected. The samples were placed in plastic bags and stored, with the vials inverted on ice, until analysis in the FIT III office. These samples were kept on ice until the completion of data evaluation.

3.2 Analysis Methodology

The Photo-Vac 10A10 portable gas chromatograph was used for the headspace gas analysis. The instrument was set up and maintained per the operator manual instructions. The instrument operational conditions were as follows:

Instrument: Photo-Vac Model 10A10 SN A 468
Column: 5 percent SE-30 on 60 to 80 mesh Chromosorb G, 4 feet by 1/8 inch packed Tfe column in column 2 position
Instrument Attenuation: 1 X 10
Gas flow: 10 ml/min. Zero grade air
Recorder: Linear Instruments Corporation Model 142 SN CO3974
Setting: 10 mV full scale, 115 VAC
Chart Speed: 0.5 cm/min.

All samples/standards/blanks were run at the above settings unless otherwise noted on the run chronicles and chromatograms (see appendices 6 and 7).

The instrument was calibrated daily using freshly made standards. A standard was run a minimum of once every 10 samples. Field duplicate and duplicate injections were also run at a minimum of 10 percent of the sample injections. Sample, blank, and standard chromatograms were labeled on the chromatogram and numbered in the order in which they were run. These samples were then registered in a run chronicle (included as appendix 6).

All samples were stored, inverted, on ice until analysis. All samples were run within contract laboratory program specified holding times of 7 days (see appendix 6).

The samples were removed from storage prior to analysis and allowed to equilibrate in a laboratory oven set at 55°C for a minimum of 1/2 hour before injection into the chromatograph. The sampling syringe was flushed with clean air and heated in the laboratory oven between injections to prevent sample carry-over.

SECTION 4

4.0 SUMMARY AND CONCLUSIONS

Results for soil sample volatile organics analyses revealed the presence of TCE and benzene in the headspace trial sample taken on July 16 near MW no. 2. Benzene was identified in samples A11 and B11. No TCE results could be positively identified.

Volatile organics analysis for the home wells showed no identifiable peaks in the Hartmetz well sample. TCE was identified in the Canull well sample. TCE and trace-level benzene were identified in the Bardsley well sample.

Actual concentrations of these compounds in the samples could not be calculated because the soil samples could not be weighed at the time of sample collection. However, since all samples were collected and treated in the same manner, it is possible to estimate relative concentrations in the samples to the standards prepared in gas phase. These relative concentrations are reported in the following table:

Relative Concentrations

Sample	Benzene mg/L*	TCE mg/L*
A11	4.89	Not found
A11 Reinjection	6.07	Not found
A11 Field Duplicate	4.89	Not found
B11	0.57	Not found
Headspace Trial 7/16	0.06	0.39
Canull Well	Not found	0.27
Bardsley Well	0.07	30.50
Hartmetz Well	Not found	Not found

---

*mg/l in 500 ul equilibrated headspace

In addition, 5 unknown compound peaks were present in most of the sample chromatograms. These peaks were labeled I, II, III, IV, and V on the chromatograms. Based on relative retention times, these peaks may be identified as methanol, methylene chloride, unknown, trans-1,2-dichloroethene, and 1,2-dichloroethane, respectively. However, without actual standards run on the analysis column, these peaks cannot be positively identified. These results are presented graphically and the highest levels (relative levels, since no concentration estimated can be assigned) are noted on the enclosed maps. In particular, trans-1,2-dichloroethene may be identified as a breakdown product of TCE.

Results for the fecal analyses have not been received. Verbal communication between Mr. Timothy Travers and EPA Region III Central Regional Laboratory has indicated that no significant results for fecal coliforms were noted. This would appear to indicate that sewage tank cleaning compounds and fecal coliform bacteria have not infiltrated the residential wells tested. When the final report of these results is received, they will be included in the final field trip report.

Including Blanks?.

- need Cont. locations map
- is it possible to graphically present results on map w/ relative retentions @ each point.

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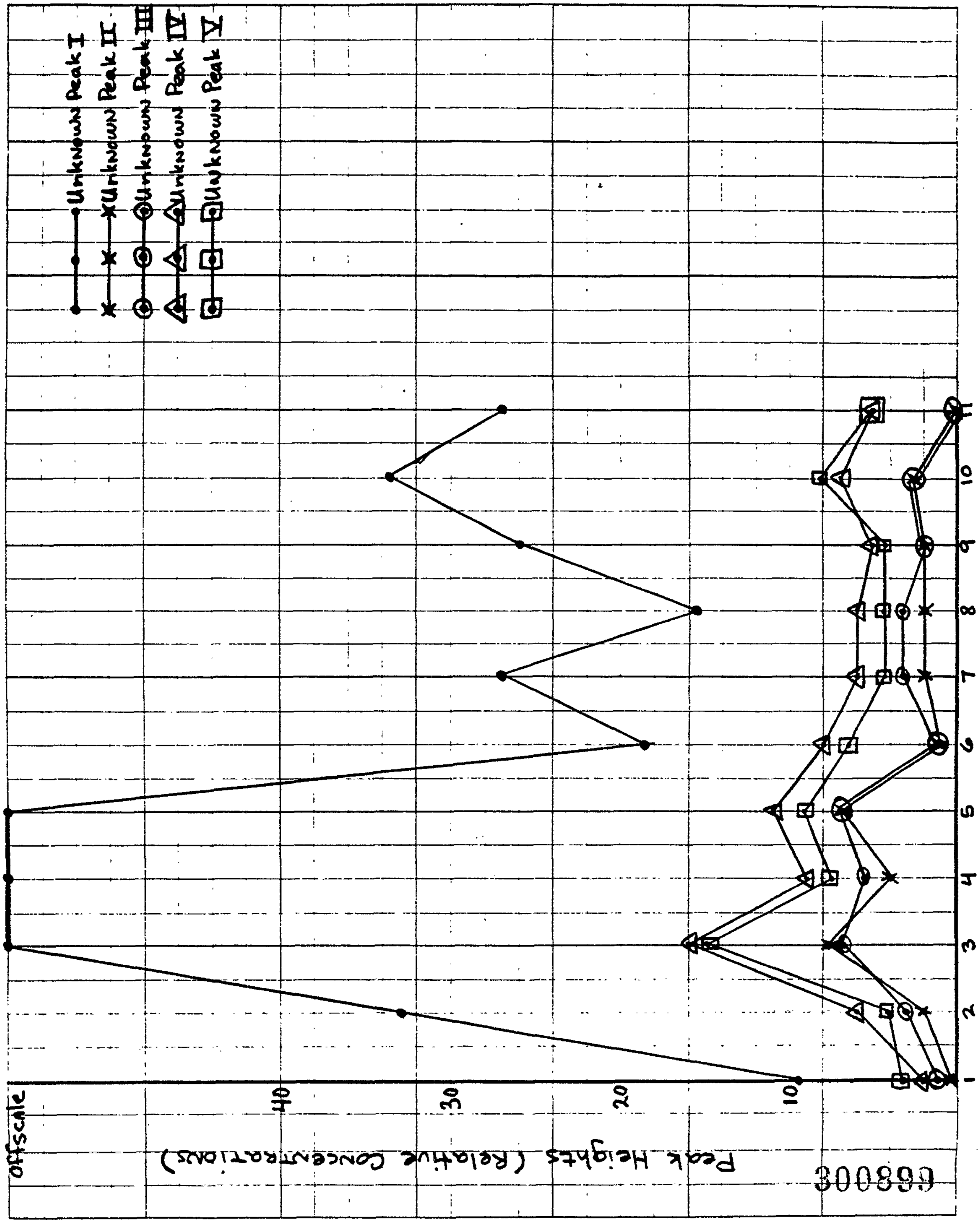
Unidentified Peaks

CLIENT EPA FILE NO. F3-8506-25

SUBJECT Blosenski Landfill Grid Line A



NUS CORPORATION

Unidentified Peaks

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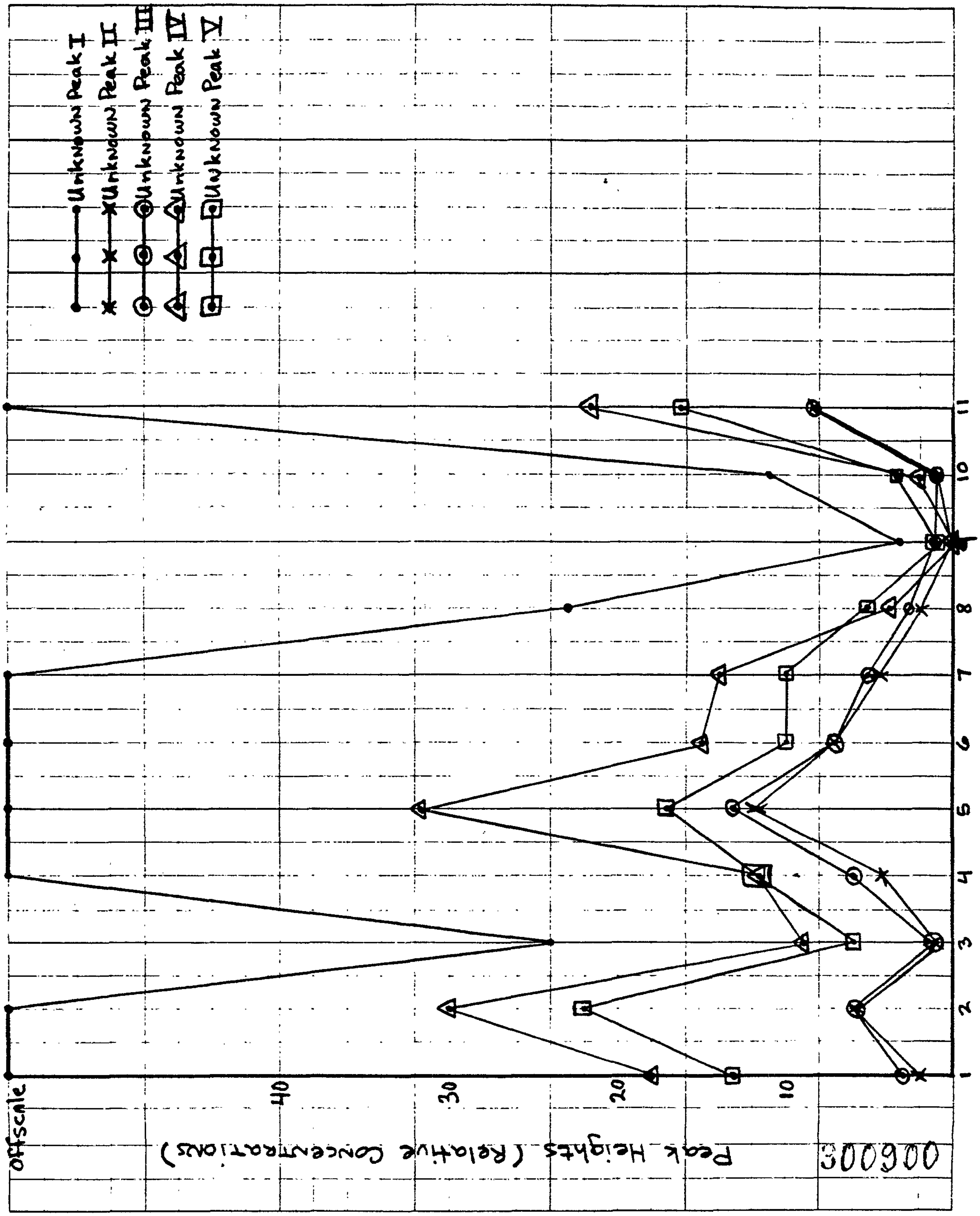
CLIENT EPA FILE NO. F3-8506-25

SUBJECT Blosenski Landfill Grid Line AA



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Unidentified Peaks

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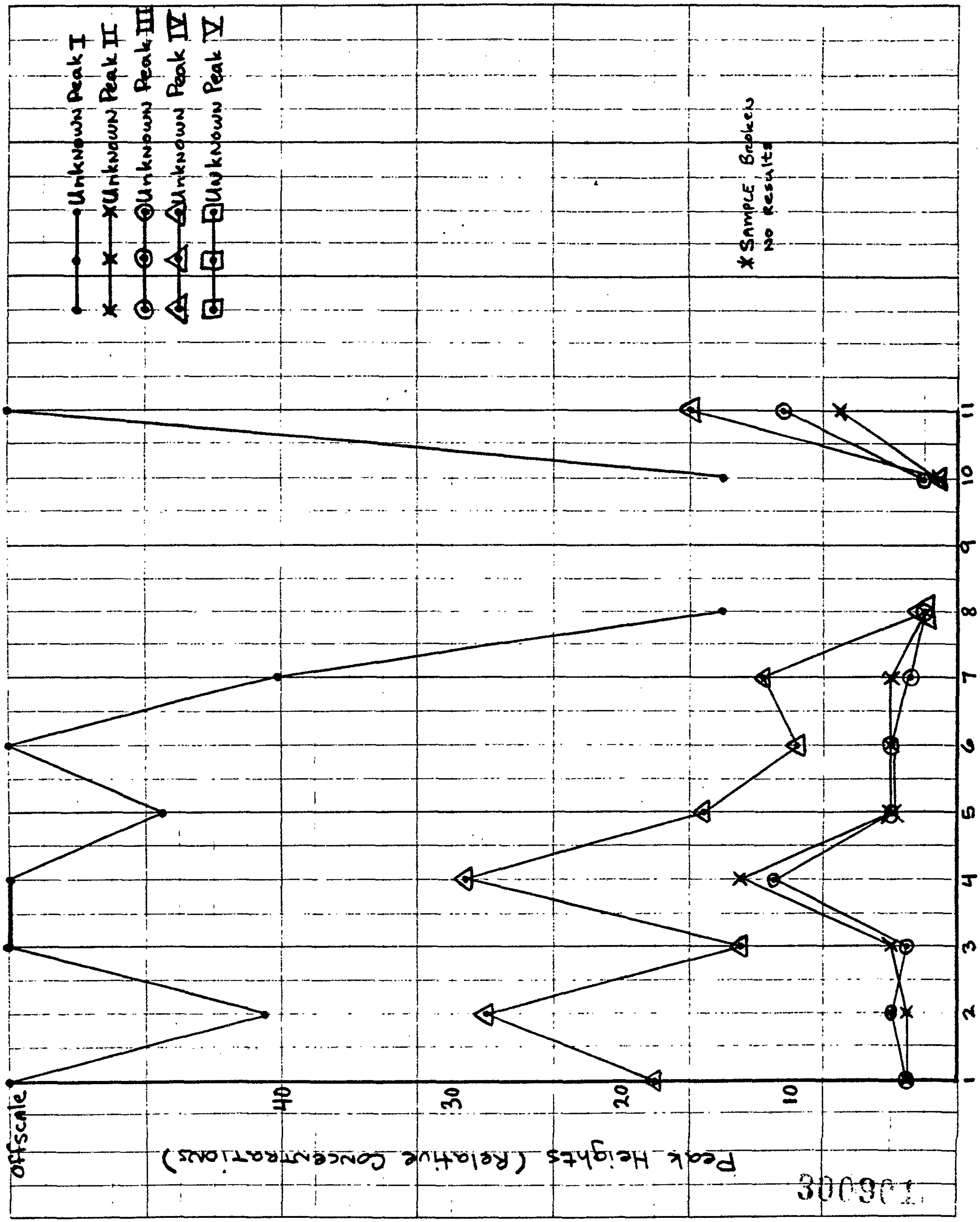
CLIENT EPA FILE NO. F3-8506-25

SUBJECT Blosenski Landfill Grid Line B



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Unidentified Peaks

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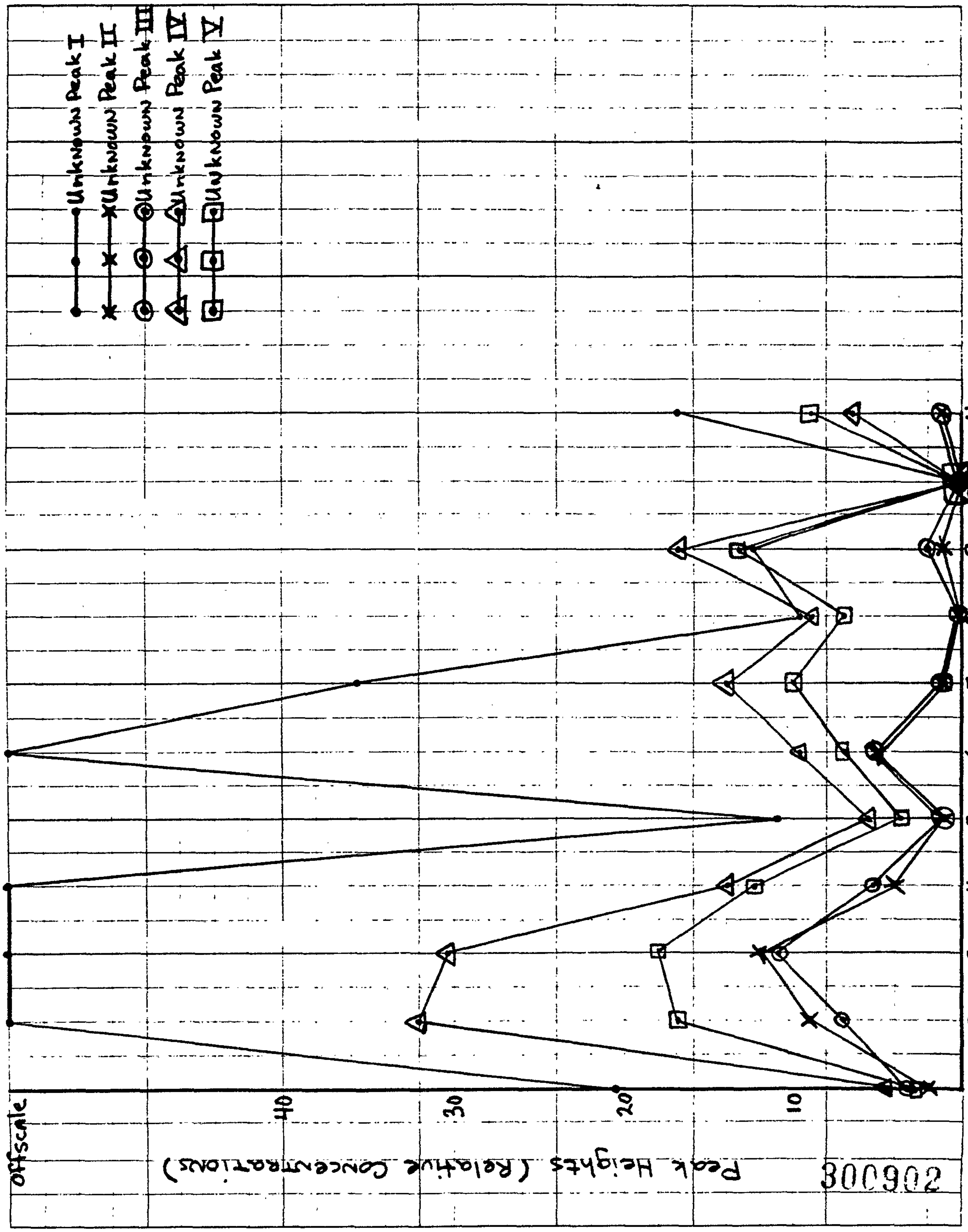
CLIENT EPA FILE NO. F3-8506-25
SUBJECT Blosenski Landfill Grid Line BB



APPENDIX 1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region III - 6th & Walnut Sts.
Philadelphia, Pa. 19106

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SUBJECT: Request Assistance from FIT Office

DATE: 6/12/85

FROM: Tim Travers, Compliance Officer
Remedial
CERCLA Enforcement Section (3HW12)

THRU: Kathy Hodgkiss, Chief,
CERCLA Remedial Enforcement

TO: Butch Byer, FIT Regional Project Officer
Site Investigation and Support Section(3HW23)

THRU: Edmund Skernolis, Chief
Site Investigation and
Support Section (3HW23)

I. SITE NAME: BLOSENSKI LANDFILL (41 DSN)

II. LOCATION: WEST CALN TOWNSHIP, CHESTER COUNTY, PA.

III. WORK ASSIGNMENT:

___	Preliminary Assessment	___	Quality Assurance Review of Data
___	Site Inspection	___	Re-Sampling/Full Field Investigati
___	Hazard Ranking System	___	Peer Review Corrections
___	Toxicology Assessment	X	Other (See VI below)
X	Enf Supp		

IV. PRIORITY:

X High(*) ___ Medium ___ Low

V. ~~Preferred Deadline:~~ HGB

~~Date:~~

VI. EXPLANATION OF TASK (* To include justification for high priority):

* PERFORM SOIL GAS TESTING IN VARIOUS DIRECTIONAL COMPONENTS FROM THE LANDFILL UTILIZING THE PORTABLE PHOTOVAC GAS CHROMATOGRAPH. THE OBJECT OF THIS TESTING WILL BE TO CHARACTERIZE AND EVALUATE THE OFFSITE MIGRATION OF VOLATILE ORGANIC COMPOUNDS AND TO DETERMINE THE EXTENT AND DIRECTION OF ANY PLUME FROM THE LANDFILL. IN ADDITION, SECURE APPROXIMATELY (FOUR) RESIDENTIAL WELL SAMPLES AND ANALYZE FOR FECAL COLIFORM.

VII. To be completed by FIT RPO only:

Task complete date by FIT: Field Work by July 31-85. Draft Trip Report by Aug 31-85 wi PhotoVac strip results, plo plume maping if found

Hours allocated: 250

Chemist will operate photovac

Don'T Blow iT!!!
- HGB

* ALL WORK EFFORTS ARE TO BE COORDINATED THROUGH EPA TIM TRAVERS

[illegible] will [illegible] for soil gas Testing proced

APPENDIX 2

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__ Controlled Copy No. __
__ Uncontrolled Copy No. __
Issued to ________________

FIT REGION III
NUS CORPORATION
WORK PLAN FOR
Blosenski Landfill

TDD NO. F3- 8506-25
CHARGE NO. PAG3EF
EPA SITE NO. ________

Submitted by:	Reviewed and Approved by:	Reviewed and Approved by:
Atwood F. Davis, Chemist		
FIT NAME, TITLE	RPM	RQAR

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APPLICABILITY

The following portions of the Quality Assurance Manual are applicable to the performance of the specific elements defined in TDD No. F3-8506-25.

✓	QAP	2.5	Work Plans
		3.1	Control of Design Activities
✓		4.1	Field Data Collection
✓		4.2	Data Reduction, Validation, and Reporting
		5.1	Preparation of Procurement Documents
		5.2	Subcontractor QA Requirements
✓		6.1	Preparation of Instructions and Procedures
✓		7.1	Controlled Evidentiary Documents
✓		7.2	Issuance of Controlled Documents
		7.3	Development and Retention of Software Requirements
✓		7.4	Technical Reports
		8.1	Control of Procurement Activities
		8.2	Evaluation of Subcontractors
		9.1	Chain of Custody
✓		9.2	Sample Control
✓		10.1	Analysis Techniques
		11.1	Off Site Reconnaissance
		11.2	On Site Reconnaissance
		12.1	Measuring and Test Equipment Controls
		13.1	Marking, Labeling, and Shipping of Samples
✓		14.1	Nonconformance Reporting
✓		15.1	Implementation and Documentation of Corrective Actions
✓		16.1	Storage and Retrieval of Quality Assurance Records
		17.4	Preparation for Audit
		17.6	Quality Notices

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FIT Project Manager: Atwood Davis

Additional Personnel:	Project Assignment:
Thomas Fromm	Sampler
David Side	Hydrologist, sampler

Estimated Labor Hours: 250 **Priority:** H

Estimated Subcontract Cost: ________ **Estimated Date of Completion:** 8-31-85

Assignment Description: Perform soil gas testing in directional components (grid) from the landfill area of Well #2 & Well #3. Testing is to be accomplished by Portable Photo-Vac Gas Chromatograph. Purpose to evaluate & characterize the offsite migration of Volatile Organic Compounds & determine extent & direction of any plume from the landfill. Also take ~4 homewell samples for fecal coliform to rule out possibility of sewage system contamination.

Report/Final Product: Field trip report with Photo-Vac Chromatograms, photos, plume mapping (if found). Field notes will be taken according to WP-SI, Rev. 1, Sec. 6.0, 7.0. And report will follow format of WP-SI, Rev. 1, Sec. 11. Sources of techineal guidelines will be copied and included in report.

Report/Final Product Review:
Proj. Mgrs. - Tech & complete
ARPM - Tech & complete
RPM - Tech & complete
Report processing form used as per WP-SI, Rev. 1.

Technical Approach:

See attached papers on soil gas monitoring, specifically based on approach by Dr. Thomas Spittler and NUS Correspondence C-585-6-5-44 for sampling plan. Using Photo-VAC 10A10 per Photo-Vac Incorporated operating manual as referenced in WP-SI Rev. 1 Sec. 5.2. In addition ~4 homewell samples for fecal coliform analysis will be collected & analyzed by Region III CRL. - See workplan ammendment for procedure.

Summary of Background Information (Data Assessment Summary):

Blosenski L.F. located on Kings Highway (Route 340) in West Caln Twp., Chester County, PA. An inactive, privately owned landfill which accepted industrial waste, municipal wastes & demolition wastes. Specifically known to have received solvents & paints. TCE/Benzene have been identified in monitoring wells on-site and in several homewells adjacent to site. FIT III has conducted SI & Air monitoring of site, NUS Gaithersburg has conducted RI/FS with report due end of July 1985.

Background Data Available:

Soil GAS Monitoring papers by Dr. Thomas Spittler - EPA Reg. I CRL
and Dr. Glenn Thompson - Tracer Research Corp.
Photo-Vac 10-A-10 Operator's Manual

Required Resources: See attached Equipment List (or indicate if N/A) 2" Auger
- sampling syringes
- Soil gas sampling apparatus (replica of Spittler ap
- Photo-Vac Portable GC
- Personal Air Monitor pumps (Gillian or DuPont)
- TCE/Benzene Stds.
- Activated Charcoal Tubes

Field Procurement Procedures:

N/A

Training Requirements:

Team members have prior training and work experience in following areas: grid layout, auger sampling, hydrology, geology & chemistry. Each member trained in use of appropriate equipment. Specifically site: Chemist experienced in use of gas chromatography & trained in use of Photo-VAC. Review of training & experience and review of soil gas sampling methodology (See attached papers by Drs. Spittler & Thompson) conducted prior to present study.

Health and Safety Requirements: See attached Health and Safety Plan (or indicate if N/A) ______

Emergency Planning Considerations: See attached Health and Safety Plan (or indicate if N/A) ______

Access Planning and Requirements:

Site access unrestricted, access established thru Ed Schoener SIO-EPA And Tim Travers, Enforcement - EPA

Interface Requirements:

EPA - SIO Ed Schoener
EPA - Enforcement Tim Travers

Documents to be Generated (list):

Log Book
Telecons
Field Trip Report
Health & Safety Plan
Health & Safety Plan follow-up
Work Plan
Completion Document
TDD

Reports to Management:

Briefings prior to and thru field work

Quality Control Requirements:

Photo-Vac Portable Gas Chromatograph checked out & conditioned prior to field use by SITL A.Davis, calibrations/detection limits & sensitivity verified prior to field use.

Calibrations/sensitivity & detection limits verified on fresh stds. (daily) in field, calibration standard to be run every 10 sample runs, periodic blank analyses (at least every 10 runs after recalibration to be run. All Chromatograms to be labeled, dated & submitted in field trip report.

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Community Relations Assistance Requirements:

N/A

The following items are attached to this plan (indicate if appropriate):

	TDD
N/A	Equipment List
✓	Health and Safety Plans
N/A	Task Sampling Plans
N/A	Lab Analysis Costs
	Operating Guidelines
✓	Other (specify): NUS Correspondence C-585-6-5-44 Paper - Dr. Thomas Spittler Paper - Dr. Glenn Thompson

} Soil GA SAMPLING

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Pg. 1 of 2 **PROJECT NOTES**

TO: Work Plan Ammendment DATE: 7/16/85

FROM: A. Davis COPIES:

SUBJECT: Blosenski Landfill F3-8506-25 PAG3EF Technical Approach

Reference: WP-SI Rev. 1, Federal Register Vol. 44, No. 244, pp. 75050-52

Based upon soil gas trial results in stage 1 of this project and telephone conversations with Ed Schoener & Dr. Thomas Spittler the technical approach to sampling will be changed to headspace analysis.

The headspace analysis for benzene and trichloroethene will be accomplished using standard CLP 40ml water VOA vials with septum caps. A standard volume of sediment will be taken from the bottom of a 3-4' deep auger hole and placed in the VOA vial filling the vial approximately ½ full. A volume of distilled/deionized water will be added to the vial to bring the total volume in the vial to approximately ¾ full. The vial will then be capped with the teflon side of the septum facing down. The vials will be transported and stored until analysis inverted and on ice. Analysis will occur within standard CLP holding time requirements (5 days sample receipt / 7 days from sampling).

Fecal Coliform Sampling Procedure

Container: Polyethylene Sterile Sampling container, prepared and supplied by EPA Region III CRL

Preservation: Iced immediately & kept from direct light.

Holding time: 30 hrs. as specified by Annapolis CRL from Drinking Water Recommendations.

Faucets: If an aerator is in place, it will be removed. After removal of aerator & any attendant washers, the faucet fitting will be heated with a cigarette lighter. The faucet will then be flushed a minimum of 3 minutes before

Site Name: F3-8506-25 BLOSENSKI LF

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SAFETY PLAN

Site Name: Blosenski Landfill
Address: Route 340
West CAIN Township
Chester County, PA

Contact: T. TRAVERS, EPA
Phone Number: 215-597-3169
Other Contacts:

Purpose of Site Visit: ____PA ____SI Other (Specify) Special Enforcement SoilGas Ma

Proposed Date of Work: 7/12/85 and 7/15 through 7/19/85

Proposed Site Investigation Team:

NUS Personnel:	Responsibilities:
A. DAVIS	SITL, SAMPLER
T. FROMM	Safety Officer, SAMPLER
D. Side	Hydro-geo, SAMPLER

Other:	Purpose:
Ed Shoener, EPA	SIO
Tim TRAVERS, EPA	ENFORCEMENT Purposes
Jim Jerpe, EPA-Annapolis CRL	Accompany FIT personnel, consultan

Plan Preparation:

Prepared by: Atwood Davis (7/9/85)
Reviewed by: Marcia Lynn Irwin (7/12/85)
Regional Health Safety Coordinator

Approvals:
Regional Manager:

TDD No.: F3-8506-25
Site Name: Blosenski LF

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Emergency Information:

Local Resources:

Ambulance (Name): Dispatched thru Fire Dept Phone 215-436-47
Hospital (Name): Brandywine Hospital Phone 215-383-81
Police (Local or State): Local Phone 215-857-55
Fire Department (Name & Volunteer?): Phone 215-436-4
Radio Channel
Nearest Phone:

Office Resources:

Region III FIT Office	(215) 687-9510
EPA DPO Harold Byer	(215) 597-3437
Office Manger - Garth Glenn (home)	(215) 947-5806
Asst. Office Manager - Rich Cromer (home)	(215) 436-9135
Safety - Marcia Irwin (home)	(215) 692-8299
Zone, Tom Centi (office)	(703) 522-8802

Emergency Contacts: (Medical and Health)

- Dr. David K. Parkinson (NUS Consulting Physician - University of Pittsburgh)

  Office .... (412) 624-0127

  Please follow procedures as outlined on the following page.

- Gary Smith (NUS Zone Health and Safety Manager)

  Office .... (412) 788-1080
  Home .... (412) 695-3667

- Regional Health Maintenance Program
  (Thomas Jefferson Hospital)

  Cassie .... (215) 928-6918
  (215) 928-6914

- Poison Information Center .... (215) 922-5523

- National Response Center .... (800) 424-8802
  (FOR ENVIRONMENTAL EMERGENCY ONLY)

Directions to Hospital (Attach Map): Route 340 East, approx. 10 miles to Route 30 bypass, over bypass - first light make left, hospital on left.

University of Pittsburgh

SCHOOL OF MEDICINE
Department of Medicine
Program in Occupational Medicine

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Emergency Physician Access Plan

NUS Corporation, Superfund Division

December, 1983

A. MONDAY THROUGH FRIDAY, 9:00 A.M. - 5:00 P.M.

Dial the (412) 624-0127 number. When answered state that:
(1) you are calling from NUS Corporation;
(2) this is an emergency call.

Program staff will be alerted how to contact the physician designated to provide emergency coverage on that day. Collect calls will be accepted.

B. EVENINGS, WEEK-ENDS & HOLIDAYS:

Dial the (412) 624-0127 number. An operator from the answering service will answer the telephone. Do the following:

(1) tell the operator that you are calling from NUS Corporation
(2) tell the operator that this is an emergency call
(3) give her your name
(4) give her the telephone number where the physician is to call. Be certain that she has written the correct number (area code and seven digits)
(5) if you do not receive a call back within 15 minutes place a second call to (412) 624-0127

Collect calls will be accepted.

C. SITUATIONS WHERE EMPLOYEE REQUIRES IMMEDIATE TRANSPORT TO A HOSPITAL:

If the situation is life-threatening, ie., cardiac arrest or person not breathing call the emergency medical services system and transport the person to the nearest hospital with advanced life support capabilities.

After obtaining assistance as stated above, call the (412) 624-0127 number and follow the procedures in A or B as appropriate.

3601 FIFTH AVENUE PITTSBURGH PA 15213 (412) 624-0127

TDD No.: 8506-25
Site Name: Blosenski LF

ORIGINAL
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Background Information:

Site Status: ___ Active X Inactive ___ Unknown

Site Description (be specific): Inactive landfill approximately 10 acres in size.

Site History: Operated owned/ by Joe Blosenski for several years during the 1970's. Operating without a permit, received industrial waste including solvents, paints, other unknown industrial waste, municipal waste and demolition waste.

Waste Types: ✓ Liquid ___ Solid ___ Sludge ___ Gas

Characteristics:
✓ Volatile ___ Corrosive ___ Ignitable ___ Radioactive
___ Toxic ___ Reactive
___ Unknown
___ Other:

Hazard Evaluation:

Known or Suspected Hazardous/Toxic Materials: Past sampling results indicate the presen of benzene and trichloroethene (TCE) in monitoring wells. Most recent results indicate Benzene as high as 2ppm and TCE as high as 200 ppb.

(TCE TLV: 50ppm, Benzene TLV: 10PPM)

Toxic and Pharmacologic Effects: TCE - Suspect carcinogen, inhalation of high concentratio causes narcosis and anesthesia. Prolonged inhal. of mod. conc. causes headache/drowsines: Benzene - Suspect carcinogen, Recog. leukemogen; inhalation of high conc. causes narcosis/acute poisoning, anesthesia. Chronic exposure causes fatigue, headache, dizziness, nausea

Reactivity, Stability, Flammability: TCE: Reacts violently with Al, Ba, N_2O_4, Li, Mg, Liq. O_2, O_2, KOH, KNO_3, NO, NaOH, Ti. Stabile, low flamability. Benzene: Reacts vigorously with oxidizing materials such as BrF_5, Cl_2, CrO_3, O_2NClO_4, O O_3, perchlorates, ($AlCl_3$ + $FClO_4$) (H_2SO_4 + Permanganates), K_2O_2, ($AgClO_4$ + acetic acid), Na_2C
Moderate explosion hazard when exposed to flame. Highly flammable.

Overall Hazard: ___ Serious ___ Moderate
X Low ___ Unknown

Due to proposed on-site activity

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Site Name: Blosenski LF

Proposed On-site Activities: Soil gas monitoring & mapping using Photo-Vac GC. 4' depth auger, capping with soil gas collection apparatus, drawing soil gases wi Vac. pump and sampling with syringe. 40 holes 60' grid 600'x 24 Backfilling holes upon completion of inspection. Additionally, offsite collection of ~4 homewell samples for fecal coliform analyses.

Perimeter Establishment:

Map/Sketch attached? ✓

Perimeter identified? ✓

Zone(s) of contamination identified? To be established thru sampling/grid

Recommended Level(s) of Protection:

o Respiratory: Level D

Modifications: If ambient HNu readings exceed 5 ppm, upgrade to Level B.

o Field Dress: Coveralls, work boots, surgicals

Modifications:

Monitoring Procedures:

Site Monitoring Equipment:

✓ HNU

___ OVA

✓ Photovac

___ Drager Tube & Pump

___ Victoreen Radiation Detector

___ Other:

✓ TLD Badge

___ Radiation mini-alert

___ Explosimeter

___ O_2 meter

Methods for Surveillance: Continuous HNu readings will be made of ambient air.

Special Procedures: After capping auger hole with soil gas collection apparatus an activated carbon tube will be attached in-line between apparatus and vac. pump. The carbon tube will trap volatile organics prior to reaching pump and exhausting to atmosphere, lowering possibility of worker exposure.

Site Name: Blosenski LF

Decontamination and Disposal: If necessary according to photo-vac results

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Decontamination Procedure: (X) level to be utilized

____ Level A - Segregated equipment drop, boot cover and glove wash, boot cover and glove rinse, tape removal, boot cover removal, outer glove removal, suit and hard hat removal, SCBA backpack removal, inner glove wash, inner glove removal, inner clothing removal, field wash, redress.

____ Level B - Segregated equipment drop, boot cover and glove wash, boot cover and glove rinse, tape removal, boot cover removal, outer glove removal, suit/safety removal) SCBA backpack removal, inner glove wash, inner glove rinse, facepiece removal, inner glove removal, inner clothing removal, field wash, redress.

____ Level C - Segregated equipment drop, boot cover and glove wash, boot cover and glove rinse, tape removal, boot cover removal, outer glove removal, suit/safety boot wash, suit/safety boot rinse (Canister or Mask Change), safety boot removal, splash suit removal, inner glove wash, inner glove rinse, facepiece removal, inner glove removal, inner clothing removal, field wash, redress.

_X_ Level D - Segregated equipment drop, boot and glove wash, boot and glove rinse.

____ Modifications (specify): ____

Disposal Procedure for Investigation Derived Materials: Bag & dispose on-site

Emergency Procedures for Overt Personnel Exposure:

- Skin Contact: Wash immediately
- Inhalation: Fresh air, artificial respiration if necessary, transport to hospital.

Ionizing Radiation: Normal background 0.01 to 0.02 mR/hr

If less than 2 mR/hr, continue investigation with caution.

If greater than 2 mR/hr, evacuate site.

* Note: Background 10-20 CPM on mini-alert

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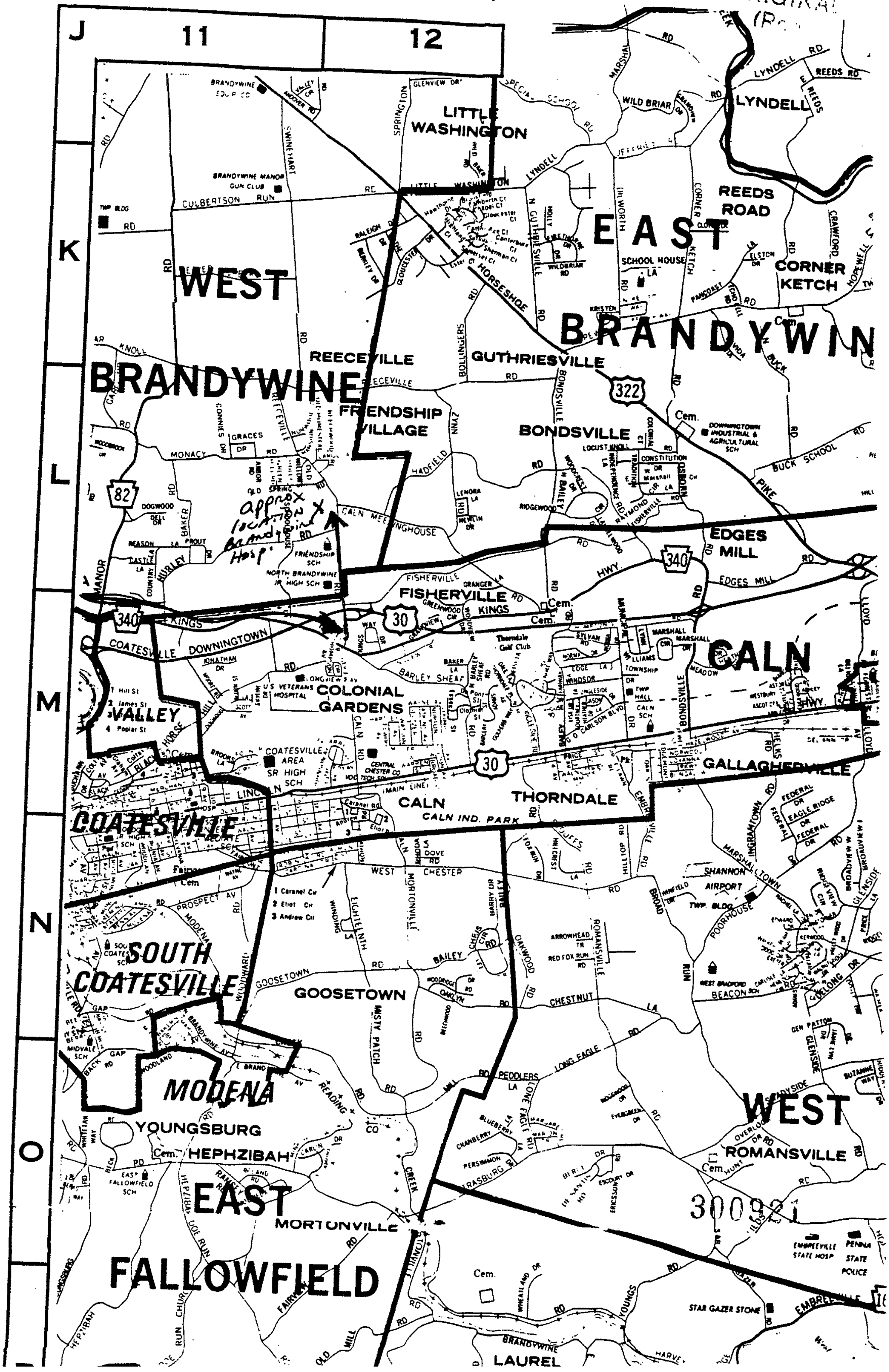

approx location X Brandywine Hosp.

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(Red)

NUS
CORPORATION
992 OLD EAGLE SCHOOL ROAD
SUITE 916
WAYNE, PENNSYLVANIA 19087
(215) 687-9510

June 28, 1985
C-585-6-5-44
68-01-6699

Mr. Harold Byer
U.S. Environmental Protection Agency
841 Chestnut Building
Ninth and Chestnut Streets
Philadelphia, PA 19107

Subject: Sampling/Work Plan
Blosenski Landfill
F3-8506-25

Dear Mr. Byer:

NUS FIT III has been tasked to perform soil gas testing at the Blosenski Landfill in West Caln Township, Pennsylvania, utilizing the portable photovac gas chromatograph. As stated in the request for assistance, the objective of this testing will be to characterize and evaluate the off-site migration of volatile organic compounds and to determine the extent and direction of movement of any plume of contamination from the landfill. As part of this task, 4 home well samples, the location of which will be determined by EPA, will be collected and analyzed for fecal coliform content.

Soil gas testing techniques and equipment needs have been discussed with experts from NUS Region II, EPA Region I, and EPA's Central Regional Lab. In addition, Kurt Sichelstiel of the NUS Remedial Investigation Team was contacted in order to obtain some specific information on the construction of recently installed monitoring well nos. 2 and 3. Based on these discussions as well as a meeting held at EPA Region III between NUS FIT III and Tim Travers and Ed Shoener of EPA, the following 3-stage course of action is proposed.

Stage 1: Before expending the time and effort needed to complete a grid and the resulting augering and sampling, it is suggested that several exploratory holes be augered in an area of known high concentration (near well nos. 2 and 3) in order that it may be determined that the method and apparatus to be used will in fact produce results which will meet EPA's needs. It is estimated that this stage will take less than 1 day to complete.

A Halliburton Company

Stage 2: A 600 by 240 foot grid will be laid out in the area of concern. Samples will be collected at 60-foot intervals. The result will be a total of 40 sample locations. Kurt Sichelstiel stated that well logs for well no.s 2 and 3 indicate that material was "slightly moist" at 12 to 15.5 feet in well no. 2 and "moist" at 3.5 to 4 feet in well no. 3 and that elevated OVA readings (up to 150 ppm during the reopening of well no. 2) were recorded in both wells. Based on this conversation, it is suggested that auger holes to a depth of 3.5 to 4 feet will be adequate to obtain the desired results. Sampling apparatus will consist of a replica of the device designed by Dr. Spittler of EPA Region I. A 1 to 1-1/2 inch borehole will be constructed at each grid interval (Dr. Spittler suggests approximately 1/10 the distance to the water level in the well, which is 3 to 4 feet in this case); the sampling device will be inserted and connected, as recommended by Dr. Spittler, to a constant flow air pump calibrated to pull approximately 150 milliliters per minute. After the pump operates for 5 minutes, the time needed to evacuate the probe, a sample will be collected using a pressure lock syringe through an in-line septum. As this is the only sample required for this task, the sampling apparatus will then be removed, the disposable plastic tubing disposed of, and the hole backfilled. The sampling apparatus will then be decontaminated in such a way as to ensure that all parts are free of organic vapors. The sample will then be injected into the photovac and run through the 1-foot GC column in order to obtain the desired identification of volatile organic compounds benzene and trichloroethene (TCE). No attempt will be made to generate a second column contamination nor will a longer column be used to achieve better elution. No samples will be sent to a lab for confirmation of possible results. Upon completion of the photovac analysis, the syringe will be decontaminated by applying heat from a portable electric hair dryer.

It is estimated that stage 2 will require between 3.5 and 4 days to complete.

Stage 3: Based on the results of stage 2, additional samples may be collected around the points, which revealed positive results. A tight grid, laid out around these points with 5- to 10-foot intervals, is suggested. This task would be contingent on the results of stage 2 and an estimation of the time required to complete it can not be made.

A possible fourth stage could be the preparation of a contamination isoplath if the results generated by stages 2 and 3 warranted such a task. A draft field trip report, including photos and photovac strip results, will be submitted as tasked.

If you have any further questions, please contact me.

Respectfully submitted,

for TF
Thomas Fromm
Assistant Manager

Approved by,

Garth Glenn
Manager, FIT III

TF/rmk

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A New Approach to Detecting Leaking Underground Storage Tanks

Dr. Spittler has been working on a field method for assessing leakage from buried solvent storage tanks, especially gasoline tanks. The technique involves use of a sensitive portable gas chromatograph to measure solvent vapors in the soil above such leaks. This method of detecting organic contamination has already been in use by the Regional Lab and the FIT team for several years to detect spilled and buried organic solvent wastes around Hazardous Waste Sites.

During June and July, three field studies are planned to evaluate this approach to finding leaking tanks at service stations. The first such exercise will be on June 29 or July 2 at a gasoline leak presently under investigation by the Regional Response Team. Health officers from the towns of Sudbury and Acton have requested similar work in their towns and will be working with Dr. Spittler and other lab personnel to conduct the studies.

Information gathered in these field exercises will be shared with other State and local government officials, as well as other EPA labs who have already expressed an interest in this problem.

The principal benefit of this technique will be to determine gas tank leakage before contamination of an aquifer leads to loss of water supplies. Where leaks are detected, more careful follow-up investigations can be pursued to determine appropriate actions which may be taken to protect existing supplies from the threat of future shutdown as contamination plumes advance toward the wells.

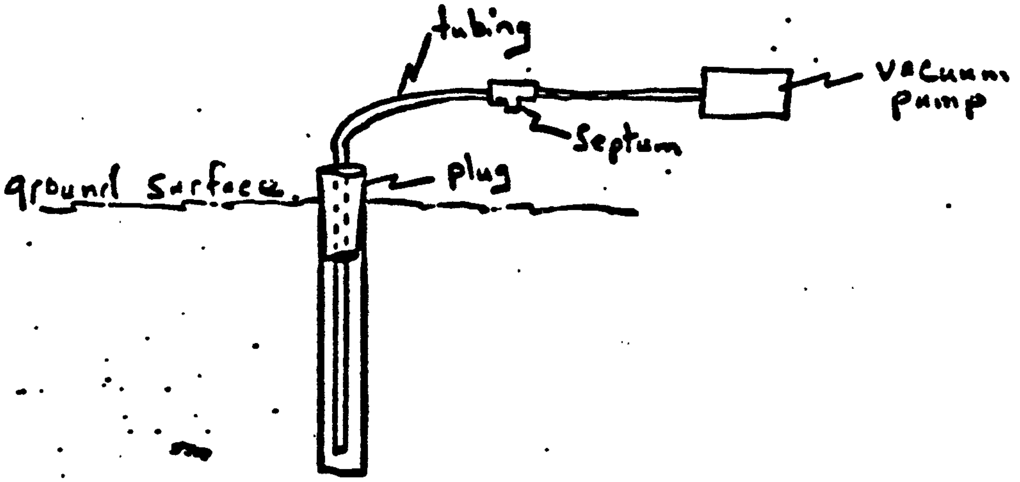
617-861-6700

Dr. Thomas M. Spittler
Director
U.S. EPA Region I Laboratory

U.S. Environmental Protection Agency
Environmental Services Division — Region I
60 Westview St., Lexington, MA 02173

The study at H-R Products provided an opportunity to utili the laboratory's capability to effect significant time and cost savings for the District. The basic question was raised whether there was any groundwater contamination at the H-R property and if so where was it located and what was (were) the probable source(s). The traditional approach to this type of problem is to drill a number of wells scattered across the property. Analysis of water samples from these wells would provide data for establishing concentration gradients. Because the Photovac is capable of extreme sensitivity and because of favorable hydrogeology of the site it was possible to eliminate the need for initial multiple well installations. When volatile organic chemicals are dissolved in groundwater which is at or near the top of the saturated zone, some volatilization of these compounds occurs into the air filling the pore volume of the soil in the unsaturated zone above the groundwater. Sampling and analysis of this soil atmosphere is then a measure of the composition of the underlying groundwater.

At the H-R site fifteen locations were sampled and analyzed in the following manner. A one-inch diameter hole was hand augered to a depth of 2.5 feet. One end of a quarter inch I.D. teflon tubing was placed to the bottom of the hole. It exited the hole through a tapered maple plug which was forced into the top of the augered hole, hence sealing the hole from the atmosphere above ground surface. The above-ground portion of the tubin was fixed with a septum adaptor and it terminated at a battery powered vacuum pump.



Sampling involved pumping the tubing for 30 seconds and then withdrawing a 250 microliter air sample through the septum. Analys by GC and comparison with reference standards revealed the composition of the soil atmosphere and relative concentration of the components.

The following figure indicates the locations of the fifteen sampling holes. Additionally the headspace in the cesspool was analyzed. 1,1,1 Trichloroethane (TCEA) and trichloroethylene (TCE) were found at all sixteen sampling points. Toluene (TOL) was found at three points. Relative concentrations are presented in the figure for each site as per the legend designation. Detector sensitivity difference between compounds has not been normalized; however comparison between sampling points for the same compound is meaningful. Locations 13, 14 and 15 indicated the highest concentrations of all three compounds. Inspection of the ground surface in the immediate vicinity of these holes revealed rusted containers (pint-size through gallon plus) and solidified resinous materials. Sampling location #12 appeared to be directly down gradient of this probable source and was chosen as the location for installation of observation well J-1.

Soil samples from J-1 were collected by split spoon sampling to a depth of 16 feet. Thereafter sampling was not possible. Analyses of these soil samples were conducted during drilling and indicated the presence of the same three compounds. The test results are as follows:

Depth (feet from surface)	Relative Concentration		
	TCEA	TCE	TOL
5-7	106	66	21,100
10-12	66	101	66
14.5-15	12	14	66
15-16	16	50	251

The raw data for these analyses were reduced in the same manner as earlier and similar conditions apply. Due to drilling complications only one sampling point (1.5 inch PVC screen) was installed at 5' to 10'.

Analysis of soil air and soil samples from drilling as described herein and undertaken in these studies is a powerful investigative tool in hydrologic studies. These techniques can enable the optimal siting of observation wells and they provide

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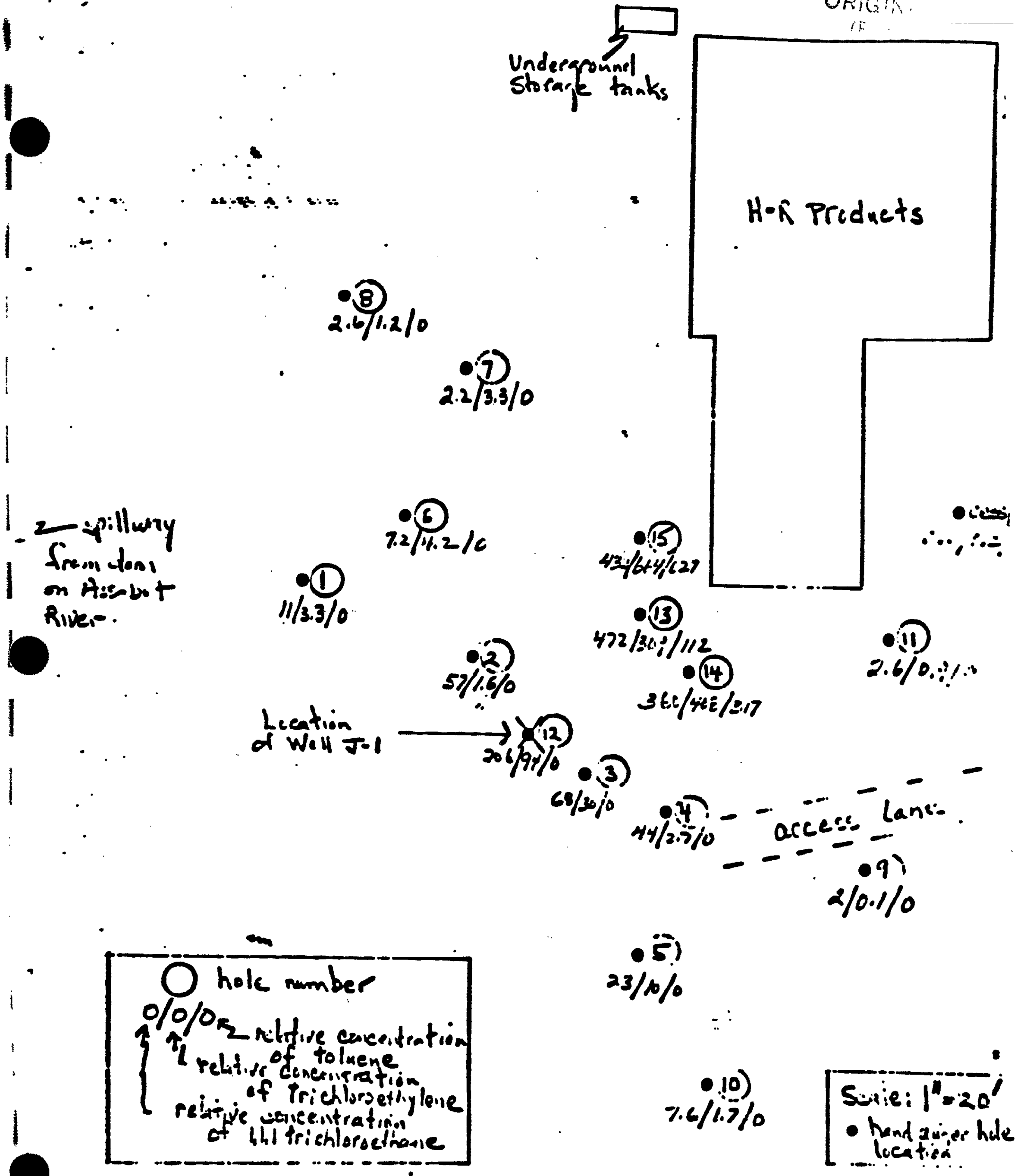

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J. C. Swallow

DELINEATION OF UNDERGROUND HYDROCARBON LEA BY ORGANIC VAPOR DETECTION

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(Red)

MOHSEN MEHRAN, Ph.D.
MICHAEL J. NIMMONS
EDWARD B. SIROTA
D'Appolonia Consulting Engineers, Inc.
Irvine, California

INTRODUCTION

The concern over leakage of petroleum products from underground tanks and pipes, stems from both economic and environmental considerations. Matis and Osgood[1] have reported gasoline leaks from less than 10 to more than 1000 gallons.[1,2] In 1976, the costs of cleanup operations have been reported to be in the range of $1 to $100/gal of product spilled.[3] Recent experience of the authors indicates costs can range to more than $1000/gal leaked with no recovery of any free product. A large percentage of this cost is incurred during the investigation phase in order to delineate the extent of product migration. For example, the cost of a drilling and abatement program for the product gasoline pipeline leak in Glendale, California, assumed by Western Oil and Gas Association was approximately $700,000. This is only part of the cost of the total recovery, most of which was assumed by other parties involved.[4]

In addition to high costs for product recovery, the environmental consequences resulting from migration of various phases (liquid, vapor and dissolved) of hydrocarbons can be serious. Soil contamination by the liquid phase (free product) can last for long periods of time. Removal of the contaminated soil is perhaps the most environmentally acceptable but most costly method of mitigation. Hydrocarbon vapor can migrate through the soil pore space into underground structures and cause undesirable odors and explosions. The hydrocarbons dissolved in groundwater can migrate, laterally and vertically, to large distances away from the source causing contamination of downgradient water supplies.

Efficient investigation of leaks is a key to cost-effective product recovery and the prevention of extensive areal contamination and associated economic consequences. The authors' purpose is to present a method by which the probably extent of a free product plume from underground hydrocarbon spills can be delineated by measuring the organic vapor concentration in the soil pore space. This method of delineation can reduce the extent and, thus, the cost of drilling programs that are required to map underground hydrocarbon contamination.

PETROLEUM PRODUCT MIGRATION IN SOIL-WATER SYSTEMS

As gasoline leaks from underground facilities into the soil, a certain amount adsorbs on the soil particles while the excess migrates under the influence of gravity and capillary forces. A continuous supply of gasoline for an extended period of time will result in the flow of liquid large distances away from the source. The vertical migration of free product, however, will be prevented if the water table is encountered. In this case, free material will migrate late on top of the water table and in the general direction of the grou water gradient. During this process a portion of free produc contact with the water table will dissolve in the water and su quently be transported downstream. The dissolved phase wil subject to mass flow of water, dispersion and physicochem phenomena such as adsorption and biodegradation.

The vertical migration of the free product generally produc wetting zone,[5] the shape of which depends on homogeneity isotropy of the medium. A portion of the free product in bot flowing and adsorbed phases is subject to evaporation. This cess is also dominant when free product reaches the water tabl any geologic barrier such as clay layers. The gaseous phas gasoline migrates through the pore space by the diffus convection process. Migration of gasoline in the vapor p depends on properties of the medium and thermal gradients.

PRODUCT MIGRATION IN THE VAPOR PHASE

Transport of gasoline vapor in the soil pore space is governe the processes of diffusion and convection. Diffusion is the resu thermal motion of the molecules subject to a concentration dient. Convection is the result of a pressure gradient causing flow in the gaseous phase. Although transport of the vapor p in soil is a three-dimensional phenomena, for illustrative purp only one dimension will be considered.

The governing equation describing the migration of the va phase can be written as:[4]

$$\frac{\partial C}{\partial t} = D_e \frac{\partial^2 C}{\partial y^2} - v_e \frac{\partial C}{\partial y}$$

where

C = concentration of gas
t = time
D_e = diffusion coefficient
y = distance
v_e = interstitial gas velocity

Neglecting the mass flow and assuming isothermal conditi the equation (1) will be reduced to:

$$\frac{\partial C}{\partial t} = D_e \frac{\partial^2 C}{\partial y^2}$$

which includes the effects of diffusion only.

Considering a two-dimensional contaminated space as shown in Figure 1, in which case the x dimension is infinitely long, the assumption of one-dimensional vertical migration can be valid.[7] For the conditions shown in Figure 1, the initial and boundary conditions are given as:

$$c = c_0 \qquad y > 0 \qquad t = 0 \tag{3a}$$

$$c = c_i \qquad y = h \qquad t > 0 \tag{3b}$$

$$\frac{\partial c}{\partial y} = 0 \qquad y = 0 \qquad t > 0 \tag{3c}$$

where

C_0 = initial concentration of gas in the pore space

C_i = concentration of gas at the soil-air interface

h = depth to the bottom of the contaminated zone

Solution of the equation (2) subject to initial and boundary conditions (equation 3) is given by:[8]

$$c = c_i + (c_0 - c_i)\,\frac{4}{\pi} \sum_{n=0}^{\infty} \frac{(-1)^n}{(2n+1)} \exp\left[-\frac{D_e(2n+1)^2\pi^2 t}{h^2}\right] \cdot \cos\frac{(2n+1)\pi y}{2h} \tag{4}$$

The concentration profiles for various values of $D_e t/h^2$ are given in Figure 2 to illustrate the decrease in concentration as the distance from the source increases.

Without describing the mathematical details of two-dimensional transport of vapor, from the above discussion it should be clear that concentration of vapor is expected to decrease both vertically and horizontally as a function of distance from the contaminated zone. This, of course, is based on the assumption that the medium is homogeneous and isotropic. Vapor detection methodology and interpretation presented herein are based on the above assumptions and mathematical descriptions of gas flow.

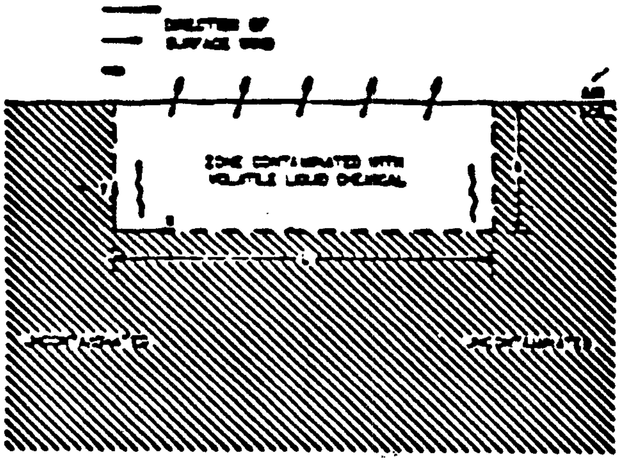

Figure 1
A two-dimensional representation of soil contaminated zone (After Thibodeaux[7])

ORGANIC VAPOR DETECTION

Detection of petroleum vapor from seeps and leaks dates back to nineteenth century oil explorations. Geophysical methods are among the most accepted methods used for exploratory purposes. These methods are generally costly, and other methods, such as gas geochemistry, are consequently becoming increasingly more attractive. A conventional method of measuring hydrocarbon gas uses a soil-gas sampler which extracts the sample to be used for subsequent analysis. This has the disadvantage of not taking into account the rapid changes due to meteorological factors. Also, a limited depth is attainable in this method. Another method is collecting the soil sample and sealing the sample into a gas-tight container for later analysis.

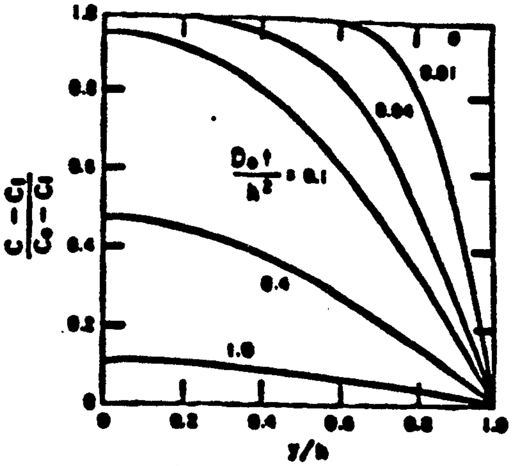

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Figure 2
Vapor concentration in the contaminated zone (After Thibodeaux[7])

However, a new method has recently been developed at the Colorado School of Mines[9] using an integrative device equipped with activated carbon. A shallow hole of 6 to 10 in. is drilled, and the instrument is kept in the hole for one week or two weeks prior to extraction and subsequent laboratory analysis.

The method of organic vapor detection presented uses the same concepts of gas geochemistry with one exception. Measurements are made of the instantaneous concentration of gas released from the pore space.

Instrumentation

The organic vapor detection surveys described utilized an Analytical Instruments Development Corporation (AID) Portable Organic Vapor Meter, Model 580. The AID 580 is a battery-powered, portable gas sampler with a photo-ionization detector. The instrument uses a small air pump to sample as much as 0.5 l/min. The gaseous sample is subjected to high intensity ultra-violet light from a krypton lamp with an ionizing energy of 10.0 eV. Water and low molecular weight hydrocarbons such as methane, ethane, propane, methyl alcohol and some freons will not ionize and, thus, will not be detected by the instrument. The ionized sample produces an ion current which is proportional to concentration and is measured by the instrument's picoammeter. The photo-ionization detector has a linear range from 0 to 2,000 ppm with a minimum resolution of 0.1 ppm.

The AID 580 is not species specific and will detect a variety of the hydrocarbons present in gasoline vapor. Instrument accuracy is dependent upon calibration with known concentrations of a known organic vapor. As employed in the surveys presented in this paper, each set of concentration measurements at a given location and on a given day is relative to a butadiene calibration standard and a constant instrument sensitivity setting.

Procedure

Each hydrocarbon vapor detection survey consists of drilling a predetermined, uniform pattern of 1 in. diameter, 15 to 18 in. deep holes with an electric roto-hammer. Immediately upon the roto-hammer bit removal, a 4 in. long casing is temporarily inserted into the borehole in order to minimize asphalt dust and surface atmospheric hydrocarbon sampling interference. A small diameter (less than 0.2 in. diameter) polyethylene tube is inserted through the temporary casing top to conduct the sampling.

As the sample is withdrawn, there is generally an increasing series of readings until a maximum reading is obtained, after which the readings decline. The peak instrument reading is the record of observation.

Following the reading, the casing and sampling tube are withdrawn, cleaned and purged before the next measurement. Depending on the site, 20 to 30 vapor detection holes are usually drilled. Before, during and following vapor hole measurement, background ambient hydrocarbon vapor concentrations are noted. The background concentrations are subtracted from the borehole readings to obtain net vapor concentration.

The vapor detection holes are placed in a predetermined pattern and sampled in a cartesian or radial grid system. Additional holes are drilled and sampled when gradients are measured. Holes are backfilled after the survey is completed.

Data Analysis

The relative concentration values obtained from the instrument are used as input to a computer code called "SURFACE II". This code is capable of interpolating and extrapolating the input data to arrive at isoconcentration lines. The plotting technique used in SURFACE II requires a minimum number of 10 data points. As the number of data points increases, the accuracy of data presentation by isoconcentration lines also increases.

Factors Affecting Measurement Reliability

Parameters affecting evaporation of gasoline through the soil pore space can be categorized into two groups, the environmental factors and the properties of the medium. The environmental factors include temperature, barometric pressure, relative humidity and wind velocity at the soil surface. The properties of the medium affecting gasoline evaporation consist of soil moisture, soil structure, organic carbon content and type, thickness and porosity of the pavement.

The authors' experience in organic vapor survey shows that cool, calm and cloudy days provide favorable environmental conditions for high reliability. Low moisture content and high porosity are among the most important media properties producing reliable measurements.

CASE STUDIES

The organic vapor detection method discussed has been used at a number of gasoline leaks to delineate the areal extent of free product contamination. The method has been successful in some cases and not so successful in others. The three cases presented here will provide a better understanding of the capability (Cases A and B) and limitation (Case C) of the method.

The characteristics of the sites, pertinent to the subject, are summarized in Table 1. It should be pointed out that most of the information given in Table 1 is obtained after performing the vapor probe survey.

Case A

This case involved a gasoline station underlain by a mixture of sand, silt and clay to a depth of 11 ft and decomposed granite below that. The decomposed granite is a confined aquifer under artesian head which raises the piezometric level to a depth of 9 ft.

As shown in Figure 3, the vapor survey indicated high concentrations coinciding with a borehole into the gasoline storage tank backfill where free gasoline was observed. Three other boreholes revealed no gasoline on the groundwater. No gasoline was detected in soil samples from the three boreholes. The relatively low organic vapor readings outside the immediate vicinity of the tank area corroborate the absence of gasoline in the surrounding soil.

The artesian head of the groundwater could contain the free gasoline plume in the relatively porous sand backfill of the tank pit. The low organic vapor measurements at the site periphery is consistent with the fact that no gasoline plume was detected off-site.

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Table 1
Site Characteristics

Case	Vol. of Leak (gal.)	Stratigraphy	Porosity (%)	Av. in situ Moisture Content (%)	Depth t Ground water (
A	< 1,000	Sandy Clay (0-11 ft) Decomposed Granite (11 ft and below)	25	10	11
B	1,130^2	Silt and Silty Sand	30$^{(1)}$	< 10$^{(1)}$	8
C	2,500	Silty Clay (0-5 ft) Silty Sand (5-13 ft) Clay (13-18 ft) Sandstone (18 ft and below)	varies	5	10

(1) Estimated from soil texture

(2) All hydrogeologic and geotechnical data indicate that less than 2,500 gal could have been los

Case B

The gasoline station is located on an alluvial plain, comprised o a complex stratigraphy of interfingering layers and lenses of gravel sand silt and clay. A surface layer of silt and sand lies on a deepe layer of silty clay encountered at depths varying from 10 to 20 ft The site is underlain by a moderately sloping semi-perched wate table sloping generally to the south. The shallow (8 ft), semi perched groundwater does not appear to be pumped in the vicinit of the site. As shown in Figure 4, the vapor survey indicate elevated concentrations immediately south of the storage tanks This was consistent with the presence of free product in borings immediately adjacent to and south of the east storage tank. Boring B-1 and B-2 contained 13 in. and 20 in. of free product, respectively, at the beginning of the investigation. Vapor probe readings a the station periphery indicated no evidence of elevated organi vapor concentrations off-site. Though petroleum hydrocarbo odors were noted in other boring during drilling, no free produc was detected at the other borings outside of the immediat underground tank area. The organic vapor survey in this case provided initial evidence of a localized plume and guidance fo borehole location.

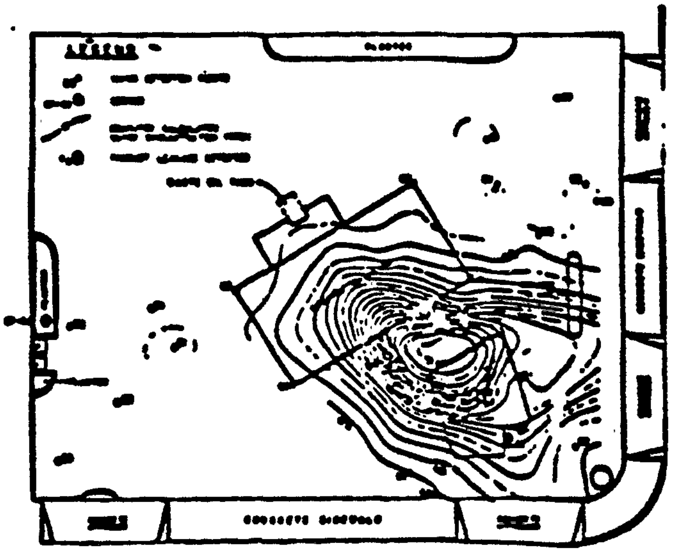

Figure 3
Isoconcentration lines obtained from organic vapor survey in Case A

essential criteria for positioning sampling points within the aquifer. Absolute concentration of contaminants is properly determined using water samples withdrawn from the sampling points after equilibrium occurs, usually in 2-4 weeks.

Very truly yours,

John C. Swallow

JCS/esm

cc: Mr. John MacLeod
Mr. Joe Lauzon
Mr. Ron Parenti
Mr. Basil Bonk
Mr. Paul Bartlett
Ms. Dorothy Karwin

J. C. Swallow

Soil-Gas Anal. Thompson

ORIGINAL

DEMONSTRATION OF SOIL-GAS SAMPLING AS A TOOL TO AID IN DEFINING THE DISTRIBUTION OF SUBSURFACE CONTAMINATION BY VOLATILE ORGANIC COMPOUNDS

BY

GLENN M. THOMPSON, PH.D.
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4934 VIA CARINA
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AUGUST 16, 1983

PHONE: 602-888-9523
602-621-7603

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ABSTRACT

A study was undertaken to demonstrate the value of soil-gas measureme as an aid to determining the overall distribution of volatile contaminants in the subsurface. The study entailed three soil borings from the land surface down to a depth of a few feet below the water table and one transect of shallow (3.5 ft deep) soil-gas samples collected across a know plume of TCE in the groundwater. In the borings, soil gas and soil sample were collected a various intervals down to the water. Water samples were collected at the top of the water table. Depth to water in all four areas ranged from 25 ft to 30 ft. Two borings were over areas of known contamin by CH_2Cl_2, F-113, TCA, TCE, and PCE. One boring was in a control area of known contamination. In both borings over the contaminated areas, contami from all the chemicals could be detected in the three ft to five ft depth range, and all concentrations increased down to the water table. At the c area, only traces of the contaminants were detected in the soil gas and wa and no trends or gradients were evident. The trace amounts may in part ha been due to equipment contamination from measurements at the previous two sites. Samples at the shallow soil-gas transect were collected through 1/ steel pipes driven into the ground by hand. TCE was detected in the soil at all sites above the plume and not detected in the uncontaminated areas both sides of the plume. All measurements were made in the field by gas chromatography. The equipment is capable of measuring two samples of air water every eight minutes. The detection limits for most contaminants is about 0.001 μg/L in air and 0.1 μL/L in water.

In conclusion the soil-gas sampling coupled with the rapid field ana appears to have good potential as a tool to aid in rapidly defining the distribution of subsurface contamination by volatile organic compounds.

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INTRODUCTION

The purpose of this work is to demonstrate the value of soil-gas measurements in studies of subsurface contamination by volatile organic contaminants. Virtually all industrial chemicals used as solvents that have become groundwater contaminants are present to varying degrees in the soil gas as well as in the groundwater by virtue of their high vapor pressure and low aqueous solubility. Measurement of the contaminants i the soil gas provides information about the overall subsurface distribut that is normally overlooked in most contaminant investigations. In addi the soil-gas sampling technique is normally faster than groundwater samp because soil gas is normally more accessable than the groundwater itself. Consequently, soil-gas sampling may function as a remote sensing techniq to delineate groundwater contamination.

In this work, four sites were investigated on the Plant property. A Sites 1 and 2 contaminant profiles were measured in the soil gas down thr the unsaturated zone to, and including, the groundwater. The purpose of study at these sites was to show the relationship or the distribution of contaminants between the soil gas and the groundwater in areas of known groundwater contamination. The third site at a location upgradient from the contamination was selected as a control to show soil-gas distribution at an uncontaminated site. The fourth site consisted of a transect of shallow (3.5 ft deep) soil-gas samples collected across a small plume of TCE contaminated groundwater. This site was selected to test the ability the method to locate contaminated groundwater by means of shallow soil-gas measurements. The results of the investigation at each site are discussed individually in the following sections. The investigation at Site 1 was

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performed on June 23, 1983. The investigations at Sites 2, 3, and 4 w performed on the following day, June 24, 1983.

SAMPLING PROCEDURE

Gas samples from Sites 1, 2, and 3 were collected through a drive- screen attached to 1-1/4 inch pipe. A bore hole was advanced to the de depth with a hollow flight auger. A soil sample was collected with a s spoon driven approximately 18 inches through the open end of the auger undisturbed soil. After withdrawing the split spoon, a hole approximat 1-1/2 inches in diameter remained. The drive point was inserted into t hole left by the split spoon and the auger was reversed to drop the cut above the top of the drive-point screen. The cuttings were tamped down making a seal of 6 to 12 inches of packed soil above the screen. A gla flow-through sample bottle having a valve at each end and a septum seal syringe access was placed in line between the 1-1/4 inch soil-gas pipe a vacuum pump used to withdraw soil gas. Soil gas was pumped for two m then the glass sample bottle was sealed and removed from the line for i analysis in the field.

Water samples were collected from the same bore holes by lowering through the hollow stem of the auger immediately after the auger interce water. The water samples were bottled, then analyzed in the field.

The shallow soil-gas samples collected in the transect along the pa lot at Building 10 were collected through small pipes (1/2 inch X 4 feet into the ground by hand. Soil gas was pumped from the pipe by means of peristaltic pump for a period of 30 seconds. The soil gas was sampled f the pump line directly with a glass syringe and injected into the gas ch in the field. The field analytical equipment was capable of measuring t

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of air or water every eight minutes. The detection limit for all of t compounds measured except CH_2Cl_2 were 0.001 μg/L in air and 0.1 μg/L i water. The detection limits for CH_2Cl_2 were 0.01 μg/L and 1.0 μg/L in and water, respectively.

RESULTS AND DISCUSSION

SITE 1

The results from all of the analyses at Site 1 are given in Table The confidence intervals shown represent one standard deviation. In t of the above-ground air samples, the large standard deviation is due t fact that some of the samples were collected in the morning and some i late afternoon. The large deviations represent changes in air quality probably attributable to chemical vapor releases in the surrounding ar The highest values were measured in the late afternoon.

The chemical concentrations in the above-ground air are higher th the soil gas of the top few feet. This suggests that the atmospheric concentrations presented here are not representative of the long-term because the atmospheric gases can permeate quite readily through the u few feet of soil given a time frame of a week or more.

All of the contaminants, without exception, increase in concentra downward in the soil This distribution demonstrates unequivocally tha there is a subsurface source of the chemicals. The depth to the water at this site was 25 ft. With the exception of TCE, all of the chemica concentrations (mass per unit volume of gas or liquid) are higher in t soil gas than in the groundwater. As an aide to understanding the int the field data, the behavior or distribution of each chemical in a sim gas-liquid system must be known. This parameter is known as the gas/l distribution coefficient. This coefficient is simply a measure of the

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TABLE 1. Chemical Data for Site 1.

SAMPLE	CH_2Cl_2	F-113	TC~~M~~A	TCE	
Air above Ground (5)[a]	0.7 ± 0.6[b]	0.08 ± 0.07	0.01 ± 0.01	(<0.001)[c]	0.00
Soil Gas 2 ft (1)	0.1	0.004	0.003	0.003	(
Soil Gas 3.5 ft (1)	3	0.3	0.03	0.01	(<
Soil Gas 11 ft (2)	340 ± 33	33 ± 3	0.6 ± 0.3	0.4 ± 0.3	
Soil Gas 14 ft (2)	11,000 ± 40	1700 ± 140	11 ± 4	2 ± 0.7	
Soil Gas 20 ft (2)	12,000 ± 1300	1800 ± 360	13 ± 2	3 ± 0.5	
Water (5) (Field Meas.)	1500 ± 150	81 ± 26	12 ± 2	16 ± 8	
Water (HLA Lab Analysis)		95	12	27	

[a] (5) number of samples analyzed.

[b] All analyses expressed as μg/L of gas or liquid, confidence limits ar one standard deviation.

[c] Parantheses indicate "none detected".

concentration ratio of the chemical at equilibrium in a closed system containing only water and air. These ratios were measured in this study for the compounds of interest, and are listed in Table 2. The distributi ratio varies with temperature but is independent of concentration at valu below the solubility limit for the chemical. This value is generally proportional to aqueous solubility for a nonpolar compound that does not react with water.

Several points can be noted with regard to the contaminant distribut at Site 1:

1) The relative proportions of compounds in the gas phase correspond roug to predictions based on the gas-liquid partitioning coefficients. The le soluble contaminant, F-113, shows the greatest proportion in the gas phase and the most soluble, TCE, has partitioned the least into the gas phase. Thus aqueous solubility is probably a major factor effecting the gas-liqui distribution of the chemicals observed at Site 1.

2) The soil-gas concentrations are not in equilibrium with the groundwate concentrations, and with the exception of TCE, the gradient favors more transfer from the soil gas to the groundwater.

3) Depending on the depth distribution of contamination below the water table, the proponderance of the CH_2Cl_2 and F-113 is likely to still exist in the soil gas. More groundwater measurements with depth are needed to v this point.

SITE 2

Soil-gas measurements at Site 2 (depth to water, 23 ft) also showed contaminant concentrations increasing downward into the soil (Table 3). An like at Site 1, indicate a subsurface source for the contaminants. Howeve unlike Site 1, the concentration gradient across the water table soil-gas

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TABLE 2. Concentration ratio for contaminants at equilibrium in an ai
system at 25°C.

COMPOUND	$C_{AIR} : C_{H_2O}$
CH_2Cl_2	2.7 : 1
F-113	4 : 1
TCA	1 : 2
TCE	1 : 3
PCE	1 : 2.3

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TABLE 3. Chemical Data for Site 2.

SAMPLE	CH_2CL_2	F-113	TCA	TCE	PCE
Air above Ground (1)	0.1	0.2	(<0.001)	(<0.001)	(<0.001
Soil Gas 5 ft (4)	1.5 ± 0.8	3.5 ± 0.1	0.14 ± 0.08	0.01 ± 0	0.45 ±
Soil Gas 15 ft (2)	170 ± 23	71 ± 6	2 ± 1	0.60 ± 0.14	5.0 ±
Soil Gas 20 ft (4)	190 ± 100	100 ± 32	4.0 ± 1.8	0.9 ± 0.1	6 ± 6
Water (Field Meas.)	29 ± 5	65 ± 13	120 ± 29	0.6 ± 0.3	0.1 ± 0
Water (HLA Lab Analysis)		70	100	0.50	

interface indicates that F-113 and TCA are moving from the water into soil gas whereas the remainder have the opposite gradient and thus are from the soil gas into the water.

The only speculation that might be appropriate from the data at S is that contaminants may have been introduced into the subsurface at d times or places. The distribution of compounds relative to each other clearly not directly a function of their solubility characteristics as to be the case at Site 1. If they had all been introduced at once in same system, the differences in their distribution should vary more pr as a function of their physical properties. However, at Site 2 the di cannot be so simply explained suggesting that other variables, both te or spatial, may be involved. More groundwater samples will have to be collected at depth to determine if the major mass of contamination is or below the water at Site 2.

SITE 3

Site 3 (depth to water, 24 ft) is located at a point upgradient f the contamination at the Plant. The purpose of the investigation at t site was to show what the soil-gas data looked like in an area where t was no contamination. The results are given in Table 4. Only two gas were analyzed from this site because one or two attempts to collect ga due to clogging of the drive-point screen in the soil.

The results show only traces of contaminants and no trends or gra are evident. In fact the trace levels of chemicals observed at this S probably represent carryover or equipment contamination from the sampl measured at the previous site where relatively high level contaminatio Only three gas bottles were on hand and each one had to be reused at e

TABLE 4. Chemical Data for Site 3.

SAMPLE	CH_2Cl_2	F-113	TCA	TCE	
Air above Ground (1)	0.1	0.004	0.003	(<0.001)	
Soil Gas 10 ft (1)	0.02	0.04	0.003	0.001	
Soil Gas 25 ft (2)	0.09 ± 0.01	0.01 ± 0.01	0.001 ± 0	0.001 ± 0.001	0.
Water (1) (Field Meas.)	(<1.0)	0.3	0.2	(<0.1)	
Water (HLA Lab Analysis)		ND	ND	ND	

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Because this site investigation was started at the end of the last day was no time to redo samples or make a special effort to clean the glass or the sampling equipment before making the measurements. However, mos the concentrations observed here are two or more orders of magnitude lo than were observed at the contaminated sites and thus are not likely to misleading results on a typical production-oriented day. In order to g positive results near the detection limits, a system employing analysis known blanks would have been used.

SITE 4

A transect of shallow soil-gas samples were collected at Site 4 acr a known TCE plume where the depth to water was 30 ft. The results of al gas analyses are presented in Table 5. A comparison of the TCE soil-gas data from this study with the groundwater TCE concentrations taken from previous study are shown in Figure 1. The results show that TCE was det every place over the plume, and was not detected over the noncontaminate on both sides of the plume. However, the high concentration observed in soil gas is not located exactly over the peak groundwater contamination The soil-gas peak and the groundwater high are separated laterally by ab 75 ft.

The fact that the soil-gas concentrations are not proportional to the groundwater concentrations is probably due to variations in the air permeability of the shallow soil. The soil at this site was particularl soft, requiring only two or three hammer blows (with a 10 lb sledge) per to drive the pipe. The soil at the point where the high concentration w measured was noticeably harder, thus contaminants at this point were probably better protected from dilution by atmospheric air.

TABLE 5. Shallow soil-gas transect across TCE plume at NE side of the parking lot.

Distance from North Corner of Parking Lot	CH_2Cl_2	F-113	TCA	TCE	PCE
#1 0 ft	0.06	0.006	0.001	(<0.001)	0.001
#2 65 ft*	0.02	0.05	1.0	0.01	0.004
#3 145 ft*	0.04	0.004	0.002	1.0	0.003
#4 236 ft*	0.04	0.01	0.003	0.3	(<0.001)
#5 325 ft*	0.02	0.3	2.0	0.03	0.002
#6 375 ft	(<0.01)	2.0	8.0	(<0.005)	0.04

* Sample location above previously determined TCE plume.

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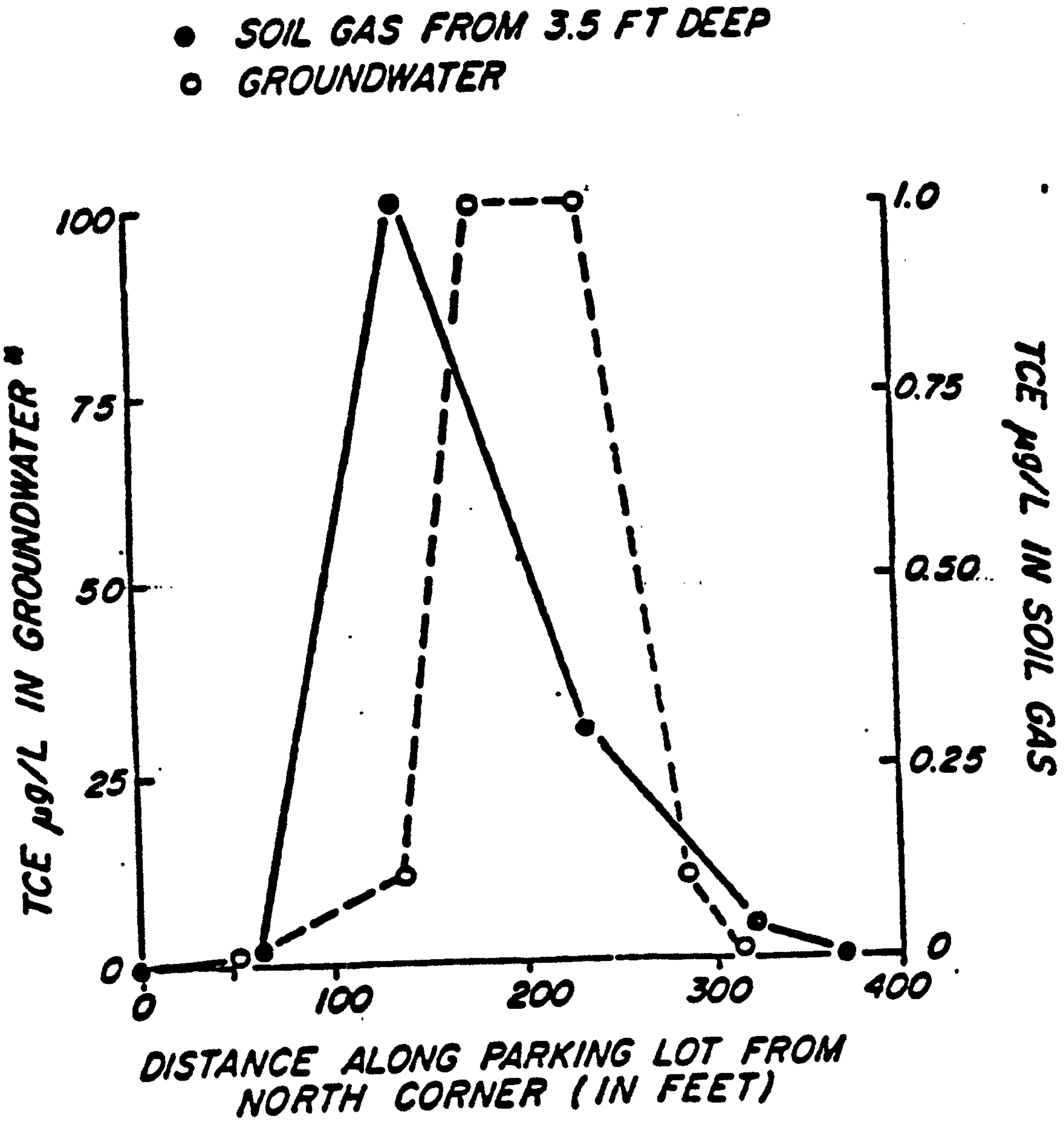

*PREVIOUS STUDY BY HLA

FIGURE 1. Soil-gas transect across TCE plume.

Soil-gas samples in this study were collected over a depth interv
3.0 to 3.5 ft. In view of the ease of pounding pipe into the ground i
area, any subsequent study should be performed using longer pipe that
more definitive results. Ten ft lengths of pipe could have been used
as easily as the four ft lengths, and probably would have given more ac
results. In this study, about 15 minutes was required at each transect
location to drive the pipe, collect and analyze two samples, and remove
pipe.

EFFECTS DUE TO SOIL TYPE

As noted previously, soil samples were collected as part of the ga
sampling process. The soil samples were examined in hand samples and t
observations for each boring are shown in Figure 2. No correlation cou
be made between the shape of the soil-gas contaminant profile and the p
of the soil.

CONCLUSIONS

The techniques employed in this study or demonstration showed the following points:

1) Subsurface contamination by volatile contaminants produces a concen
gradient in the soil gas that decreases in a direction away from the m
source or body of contamination.

2) All of the groundwater contaminants in this study were detectable a
distinguishable from atmospheric levels of the same contaminants at a s
depth of 3 to 5 ft.

3) A vertical profile of contaminant concentrations in the soil gas
down through the unsaturated zone and in groundwater through contaminate
portion of the aquifer is probably the most sensitive and rapid method

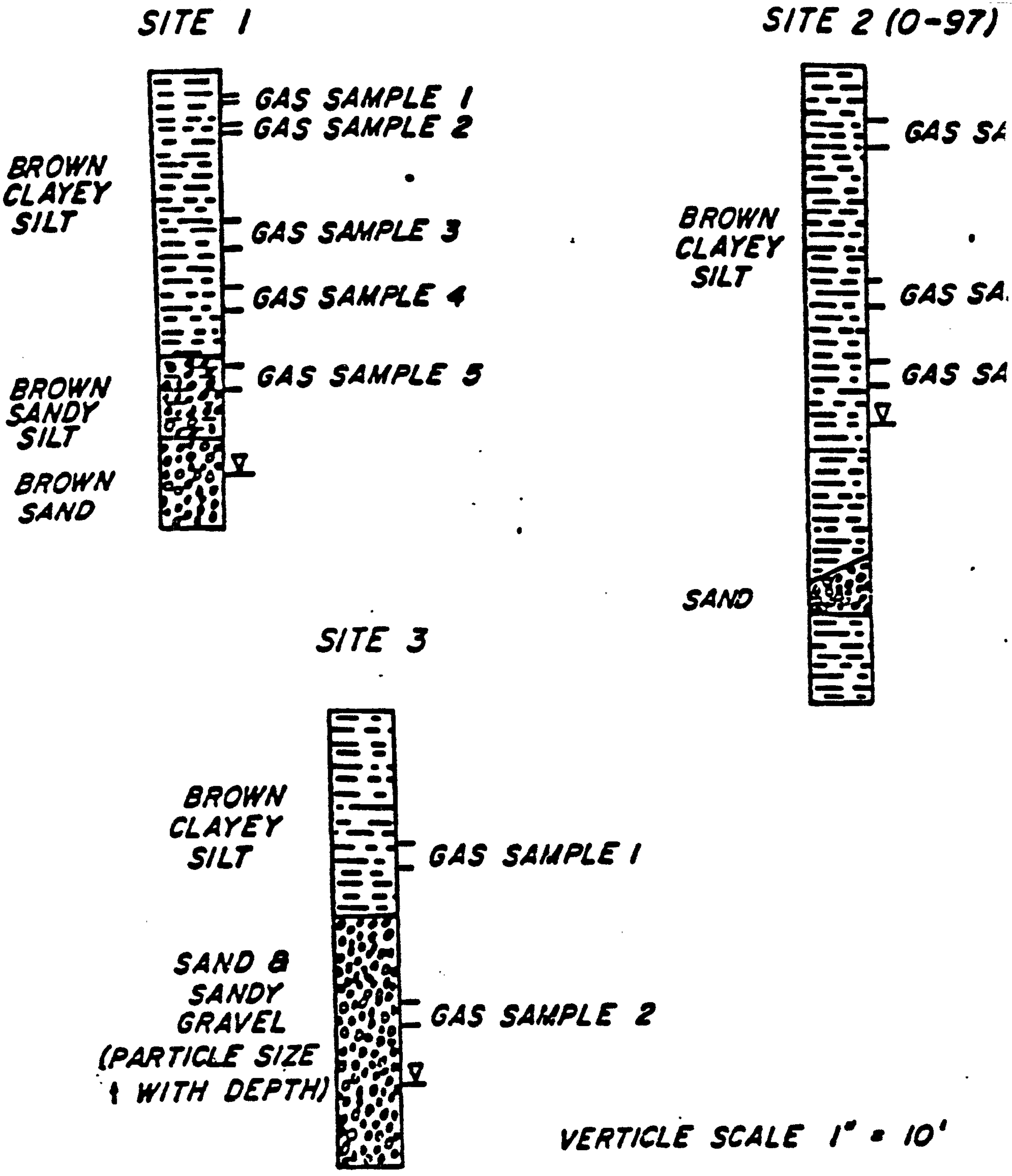

FIGURE 2. Soil Profiles at Sites 1, 2, and 3.

assessing the overall distribution of a contaminant in the subsurfac transect of such profiles would serve to obtain horizontal direction as well.

4) The vertical profiles measured on the second day of this study r 2.5 to 3.0 hrs to drill, collect samples, analyze the samples, and b the hole.

5) The shallow soil-gas transect which analyzed soil gas from a dep 3.0 to 3.5 ft appears to be a viable way of locating subsurface cont The technique is particularly useful for TCE because the ambient bac of TCE in the atmosphere is virtually not measurable, thus the trace concentration observed in the soil gas are significant. Soil-gas sa collected at a depth of 10 ft would probably give better correlation contamination levels with groundwater contamination levels.

APPENDIX 3

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
CENTRAL REGIONAL LABORATORY
839 BESTGATE ROAD
ANNAPOLIS, MARYLAND 21401

301-224-2740
FTS-922-3752

DATE : June 5, 1985

SUBJECT: Blosinski Superfund Site - Well Monitoring Head-Space Analysis

FROM : James Jerpe
Chemist

TO : Daniel K. Donnelly
Chief, Annapolis Lab

THRU : John Austin
Team Leader, Organic Analysis Section

Vapor head-space over well water samples taken from the Blosinski superfund site was subjected to gas chromtography analysis in the field. Techniques for preparation and injection were varied to determine the optimal manner for response to organics and the best replication.

Well water was first bailed and agitated then poured into a 40 ml clean glass vial leaving approximately 10 ml of vapor space above the solution. Vials were sealed with teflon screw caps and analyzed within one hour with a Photovac portable photoionization gas-chromatograph. Neither salt electrolytes nor internal standards were added to these solutions.

Standards were prepared the day previous in the laboratory by three distinct methods each of which was evaluated concurrently with testing procedures.

1. A multiple gas standard of methylene chloride, hexane, benzene, trichloroethylene, toluene was prepared by injecting microliter volume solutions of each component from its stabilized aqueous mixture into 30 ml organic free water. Concentration of the resultant head-space vapor was calculated from the equilibrium constant empirically determined for each compound.
2. Purgeable A and Purgeable B Supelco standards were injected (1 microliter of solution of each) into 30 ml water. This head-space was used primarily to determine relative retention times of response of each component.
3. A vol/vol standard of benzene, methylene chloride, trichloroethylene, toluene was prepared by classical gravimetric techniques and diluted 1 ml to 1 liter in a demonstrated clean glass gas bottle. Concentrations of components were calculated at standard temperature and pressure as parts per billion per component. A NBS traceable vinyl chloride gas tank was used for dilution into this multiple gas component standard at 50 ppb concentration.

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Identification of methyl ethyl ketone in Well #5-1 and trichlorofluoromethane in Well #9 was based on relative retention times from previous testing with the identical gas chromatograph columns. These compounds were not present in the standards prepared.

Samples were allowed to stand after agitating and adjust to room temperature before injecting.

To confirm the qualitative analyses, water samples from Well #3 and Well #8 were chosen for gas-chromatography/mass spectrometry. Samples had been refrigerated during transport to the laboratory; an unpunctured teflon septum replaced those used in the field.

One thousand microliter of vapor above the water was injected directly onto a narrow-bore fused-silica capillary column and cold-trapped with liquid nitrogen. The column was temperature programmed and eluting peaks were identified by computor stored library search.

Well #3 - GC/MS analysis confirmed chloro-ethene (vinyl chloride), benzene, toluene, ethyl benzene, chlorobenzene, and sulfur dioxide.

Well #8 - GC/MS analysis confirmed chloro-ethene, 1,2-dichloroethylene, 1,1-dichloroethane, trichloroethane, benzene, trichloroethylene, ethylbenzene.

Following is a list of purgeable reagents detectable by photoionization gas-chromatography previously demonstrated detectable on this equipment and testing conditions at a minimum limit of 2 parts per billion by volume of benzene.

Dichlorofluoromethane
Bromomethane
Trichlorofluoromethane
Vinyl chloride
Methylene chloride
Trans-1,2-dichloroethylene
1,1-dichloroethane
Methyl ethyl ketone
Chloroform
1,2-dichloroethane
1,1,1-trichloroethane
Benzene
1,2-dichloropropane
Trichloroethylene
Bromodichloromethane
cis-1,3-Dichloropropene
trans-1,3-Dichloropropene
1,1,2-trichloroethane
Toluene
Dibromochloromethane
Tetrachloroethylene
Chlorobenzene
Ethylbenzene
Bromoform
Tetrachloroethane

JJ:ad

cc: Atwood Davis,
NUS Corp.

	Well #2 (Vent)	Well #2	Well #3	Well #2 (Before Bailing)	Surface Water	Well #5-1	Well #8-1	Well #9	Room Air
Trichlorofluoromethane	--	--	--	--	--	--	--	Present	--
Vinyl Chloride	--	--	>50	--	--	--	--	--	--
Methylene Chloride	--	14	--	160	--	5	Present	--	--
Trans-1,2-Dichloroethylene	--	--	--	--	--	Present	Present	--	--
1,1-Dichloroethane	--	--	--	--	--	--	Present	Present	--
Methyl Ethyl Ketone	--	--	--	--	--	>100	--	--	--
1,2-Dichloroethane	--	--	--	--	--	Present	--	--	--
1,1,1-Trichloroethane	--	--	--	--	--	--	Present	--	--
Benzene	6	--	>>500 (23,260)	--	--	--	>500 (286)	Present	--
Carbon Tetrachloride	--	--	Present	--	--	Present	Present	--	--
1,2-Dichloropropane	--	--	--	--	--	Present	Present	--	--
Trichloroethylene	--	25	--	215	--	Present	Present	Present	--
Trans-1,3-Dichloropropene	--	--	Present	--	--	Present	Present	--	--
Toluene	--	50	>500	--	--	--	--	--	--
Dibromochloromethane	--	--	--	--	--	--	Present	--	--
Tetrachloroethylene	--	<20	--	--	--	--	Present	--	--
Chlorobenzene	--	Present	--	--	--	--	--	--	--
Ethylbenzene	--	Present	Present (91)	--	--	--	>100	--	--

ppb; ng/L
( ) = Values are calculated from ion current of mass-spectrometer reconstructed total ion current chromatograms.
Standard solution vapor head-space is identical solution used for photoionization GC.

APPENDIX 4

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SAMPLE RECEIPT

On July 23, 1985, NUS CORPORATION representative Atwood F. Davis received permission from Donald L Canull to remove material from his/her property, contained in ________ 2-quart glass organic sample bottle(s), 1 40-ml glass volatile organic sample bottle(s), ________ 8-oz. glass sample jar(s), 1 inorganic 1-quart polyethylene sample bottle(s), and ________ inorganic 1-liter glass sample bottle(s).

Donald L. Canull 7/23/85
Property Owner, Signature & Date

Atwood F. Davis
NUS CORPORATION
Representative Signature & Date

SAMPLE RECEIPT

On July 23, 1985, NUS CORPORATION representative Atwood F. Davis received permission from Holly Hartmetz to remove material from his/her property, contained in — 2-quart glass organic sample bottle(s), / 40-ml glass volatile organic sample bottle(s), — 8-oz. glass sample jar(s), / inorganic ~~[illegible]~~ 1 quart polyethylene sample bottle(s), and — inorganic 1-liter glass sample bottle(s).

Holly Hartmetz 7/23/85
Property Owner, Signature & Date

Atwood F. Davis
NUS CORPORATION
Representative Signature & Date

300956A

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SAMPLE RECEIPT

On July 23, 1985, NUS CORPORATION representative Atwood F. Davis received permission from Renee Bardsley to remove material from his/her property, contained in — 2-quart glass organic sample bottle(s), 1 40-ml glass volatile organic sample bottle(s), — 8-oz. glass sample jar(s), 2 inorganic ~~4~~ 1-quart polyethylene sample bottle(s), and — inorganic 1-liter glass sample bottle(s).

Renee Bardsley 7/23/85
Property Owner, Signature & Date

Atwood F. Davis 7/23/85
NUS CORPORATION
Representative Signature & Date

ENVIRONM…TAL PROTECTION AGENCY
Office of Enforcement

REG…N 3
Curtis Bldg., 6th & Walnut Sts.
Philadelphia, Pennsylvania 19106

CHAIN OF CUSTODY RECORD

PROJ. NO.
PROJECT NAME Blosenski LF.

SAMPLERS: *(Signature)* Atwood F. Davis

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	Coliform bottles*						REMARKS * Supplied by Annapolis USEPA Region III CRL
1	7/27/85	1:45P		X	CANALL House	1	1						
2	″	2:00P		X	Hartmetz House	1	1						
3	|	2:10P		X	Bardsley House	1	1						
4	|	2:10P		X	Bardsley House Dup	1	1						
5	|	2:15P		X	AIR BLANK	1	1						
6	V	2:20P		X	FIELD BLANK	1	1						

Relinquished by: *(Signature)* Atwood F. Davis	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time	Remarks	

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

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SEE BACK OF FORM SET FOR COMPLETE PREPARATION INSTRUCTIONS.

[redacted]0153[redacted]

00194

YOUR FEDERAL EXPRESS ACCOUNT NUMBER 1059-6338-6

DATE 7/23/85

OM (Your Name) Atwood F. Davis

DEPARTMENT/FLOOR NO.

CORPORATION

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CITY WAYNE STATE PA

ZIP ACCURATE ZIP CODE REQUIRED FOR CORRECT INVOICING 1 9 0 8 7

AIRBILL NO. 180153691

TO (Recipient's Name) BETTINA Fletcher

If Hold For Pick-Up or Saturday Delivery, Recipient's Phone Number

COMPANY CENTRAL REGIONAL LAB
US EPA REGION III

DEPARTMENT/FLOOR NO.

STREET ADDRESS (P.O. BOX NUMBERS ARE NOT DELIVERABLE) 839 BESTGATE Rd

CITY ANNAPOLIS STATE MD

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☐ Cash in Advance Account Number/Credit Card Number

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CHECK ONLY ONE BOX

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COURIER PAK
☐ OVERNIGHT ENVELOPE (Up to 2 LBS.)
3 ☐ OVERNIGHT BOX (Up to 5 LBS.)
☐ OVERNIGHT TUBE (Up to 5 LBS.)
STANDARD AIR
5 ☐ DELIVERY 2ND BUSINESS DAY FOLLOWING PICK-UP (Up to 70 LBS.)

OVERNIGHT LETTER
6 ☐ (Up to 2 OZ.)
7 ☐
8 ☐
9 ☐

"VERNIGHT" IS NEXT BUSINESS DAY ONDAY THROUGH FRIDAY); TWO DAYS OM ALASKA/HAWAII. SATURDAY DELIVY AVAILABLE IN CONTINENTAL U.S. SEE "SPECIAL HANDLING."

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5 ☐ SSS (Signature Security Service required, extra charge applies)
6 ☐ DRY ICE ____________ LBS
7 ☐ OTHER SPECIAL SERVICE ____________
8 ☐ ____________
9 ☐

PACKAGES	WEIGHT	DECLARED VALUE	O/S
1			
TOTAL 1	TOTAL	TOTAL	

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TOTAL CHARGES

PART #2041730751
FEC-S-0751 D/O/B
REVISION DATE 2/83 S
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ORIGINAL
(Red)

APPENDIX 5

ORIGINAL
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NUS CORPORATION **TELECON NOTE**

CONTROL NO:

DATE: 6/26/85

TIME: 2:10 P

DISTRIBUTION:
T. Fromm
G. Glenn
D. Side

pg. 1 of 2

BETWEEN: Dr. T. Spittler

OF: EPA Reg. I CRL

PHONE: (617) 861-6700

AND: A. Davis (NUS)

DISCUSSION:

Blosenski Soil Gases analysis techniques:
Discussed following ideas
① Sample size - He recommends smallest possible to avoid saturating instrument. Suggested that it is possible to use non-pressure lock syringes as they will hold sample for ≈ ½ hour - this may be possible with minimal handling but I'm not too sure about sample integrity / volatilization/loss. I suggested sampling several sample volumes in series at each test hole (ie. a non-pressure-loc 10 ul syringe, a 25 ul pressure-loc & a 250 ul pressure-loc) in this way I could inject smallest volumes first to "zero" in on the optimal injection size without saturating the instrument. Spittler felt this was a good way to go if inconvenient to keep re-sampling the hole.
② Column selection - we both felt 1 foot column would be adequate as a screen? at least prior to injection on 4 foot column. However depending upon con-

~~ACTION ITEMS:~~

centrations encountered, separation of the Benzene from toluene could be a problem - if necessary to tell one compound from the other or relative proportions of the compounds to each other if both are present, it may be necessary to go to the 4 foot column. I should be able to determine the separation efficiency before we go out to see if the 1 foot column is adequate

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NUS CORPORATION — TELECON NOTE

CONTROL NO:

DATE:

TIME:

DISTRIBUTION:

BETWEEN:

OF:

PHONE: (   )

AND:

(NUS)

DISCUSSION:

However, conditions encountered on site may still make it necessary to use the 4 foot column. In either case, I'll have both columns conditioned & ready to go.

③ Set-up area – Ideally enclosed area with some degree of temperature control with electricity available. Spittler seemed to feel as long as there is an area contamination free, upwind of site & any gas generator etc, should be sufficient – we'll just have to play it by ear & go with whatever is available.

ACTION ITEMS:

ORIGINAL

NUS CORPORATION | **TELECON NOTE**

CONTROL NO:	DATE: 6/26/85	TIME: 2:10 P

DISTRIBUTION: T. Fromm
G. Glenn
D. Side

pg. 1 of 2

BETWEEN: Dr. T. Spittler	OF: EPA Reg. I CRL	PHONE: (617) 861-6700

AND: A. Davis , (NUS)

DISCUSSION:

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NUS CORPORATION **TELECON NOTE**

CONTROL NO:	DATE:	TIME:

DISTRIBUTION:

BETWEEN:	OF:	PHONE: ( )

AND: (NUS)

DISCUSSION:

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ACTION ITEMS:

NUS CORPORATION **TELECON NOTE**

CONTROL NO:	DATE: 7/16/85	TIME: 10:00 AM

DISTRIBUTION:
Froma
Glenn
Side

ORIGINAL
(Red)

BETWEEN: Ed Schoener / T. Spittler	OF: EPA III / EPA I	PHONE: 215 (597) 2193

AND: A. Davis (NUS)

DISCUSSION:

Blosenski Soil Gases / Headspace Sampling Techniques – Dr. Spittler agreed that under the circumstances noted (ie. damp soils, rainfall over past week, samples to be taken in a wooded area) that soil gas technique may be difficult. He feels that the decision to analyze by headspace analysis is probably the proper decision. His feelings on why the soil gas sampler didn't work is only a theory – but he believes that the rainfall "washes down" the volatile gases out of the vadose layer and that given enough dry days it starts to build up again. Given the fact that we keep having thundershowers frequently these past 2 weeks, it appears that the gas concentration has not had enough time to build back up. He has never used the soil gas sampler in a wooded area, so he is not sure how it would react in that particular moist environment.

ACTION ITEMS: Dr. Spittler Recommended that the headspace sampling be done in a VOA vial, filling it ~ 1/3 to 1/2 full with soil and adding water (ie. Dist, deionized) to a level approximately 3/4 full in the vial. The volatile compounds in the soil partition into the water (in effect a water extraction) and the further partition between the water / gas phases at sample equilibration, giving a more efficient / more sensitive headspace analysis.

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pg. 2 of 2

NUS CORPORATION TELECON NOTE

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BETWEEN:	OF:	PHONE: ( )

AND:

(NUS)

DISCUSSION:

Dr. Spittler's suggestions on the headspace analysis turns out to be the basic methodolgy I used for solid headspace in the past, the water addition does give a much better, more efficient partitioning of the volatile compounds.

After talking with Dr. Spittler, Ed Schoener and I felt that headspace analysis should be the best approach to this site given these particular circumstances. Sampling will be conducted the week of 7/22 for Phase II 600' x 240' grid @ 60' intervals. The samples will be transported and held on ice prior to analysis (within CLP holding times for VOA's) in the FIT III office.

ACTION ITEMS:

NUS CORPORATION TELECON NOTE

CONTROL NO:

DATE: 8/26/85

TIME: 8:25 A

DISTRIBUTION:

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BETWEEN: Jim Jerpe

OF: EPA Region III CRL

PHONE: 301 (224) 2740

AND: Atwood Davis (NUS)

DISCUSSION: VOA Relative Retention Times PACKED COLUMN RRT to Benzene.

	Vinyl Chloride	.31
	Methanol	.36
	Methylene Chloride	.46
	trans-1,2-dichloroethene	.59
	methyl ethyl ketone	.64
	1,1-dichloroethane	.74
	chloroform	.80
	1,2-dichloroethane	.86
	1,1,1-trichloroethane	.902
	benzene	1.00
	1,2-dichloropropane	1.24
*	trichloroethene	1.32
	trans-1,3-dichloropropene	1.72
	1,1,2-thrichloroethane	2.07
	toluene	2.28

* Note Jerpe's RRT 1.32 TCE closely agrees with my RRT averages of 1.36-1.34 over the three analysis days.

APPENDIX 6

pg. 1 of 5

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Blosenski LF 8506-25

NUS CORPORATION
SUPERFUND DIVISION Sample Run Chronicles Photo-VAC **PROJECT NOTES**

Run #	Sample Description	ul injected	Date Sampled	Date Analyzed	Comments
1	Std 1	10		7/26/85	
2	Std 2	2			
3	Std 1	10			
4	Std 1	5			
5	Std 1	10			
6	Air Blank	10			
7	Headspace trial Sed near MW 2	250	7/15		Hypovial/minivent valve w/o water added (Benz., TCE) TCE offscale
8	Headspace trial Sed near MW2	100	7/15		Re-inject, smaller volume, still shows benzene, tCE but both onscale
9	Air Blank	100			Some column loading evident
10	Air Blank	100			Reinject, some column loading, but negligable amount
11	Field Blank II 7/22	100	7/22		
12	Field Blank II 7/22	100	7/22		Re-inject
13	Field Blank II 7/22	100	7/22		Re-inject
14	A3	100	7/22		
15	A5	100	7/22		Large offscale column bleed; neglig. effect since after TCE RT
16	Std. 1	10			After 1 hour w/o injection
17	A5	100	7/22		Reinject, no loading evident
18	A1	100	7/22		
19	A2	100	7/22		
20	A2-Dup	100	7/22		Field Duplicate
21	Field Blank I 7/22	100	7/22		
22	A4	100	7/22		Syringe plugged, will reinject sample
23	A6	100	7/22		
24	A4	100	7/22		Reinject
25	A4	100	7/22		Reinject
26	A7	100	7/22		
27	A8	100	7/22		
28	A9	100	7/22		

ORIGINAL

pg. 2 of 5

Blosenski LF 8506-25

NUS CORPORATION
SUPERFUND DIVISION Sample Run Chronicles Photo-Vac **PROJECT NOTE**

Run #	Sample Description	ul injected	Date Sampled	Date Analyzed	Comments
29	Std 1	10		7/26	
30	A10	100		7/26	
31	Headspace trial sed Near MW 2	100	7/17	7/29/85	Reinject
32	Field Blank I 7/22	100	7/22	↓	Reinject
33	Std 1	10			} Fresh daily standards
34	Std 2	10			
35	A11	100	7/22		Benzene peak, high level offscale & other substantial peaks
36	A11	50	7/22		Attenuation 1x20 & smaller injection size - benzene still offscale
37	A11	10	7/22		Attenuation 1x2 & smaller injection siz Benzene onscale.
38	A11	10	7/22		Reinject of Run 37
39	A11-Dup	100	7/22		Field duplicate, benzene offscale Some column bleed evident
40	A11-Dup	10	7/22		Attenuation 1x20, benzene peak ht. identical to Run: 37 & 38
41	AA11	100	7/22		Possible small benzene peak
42	B11	100	7/22		Benzene peak ≃ 40% scale.
43	Std 1	10			
44	Field Blank I 7/23	100	7/23		
45	B11	100	7/22		Re-inject verify benzene Run 42
46	BB1	100	7/23		
47	BB5	100	7/23		Some late column bleed
48	Std 2	10			
49	Std 1	10			
50	Std 1	2.5			
51	Std 1	5			
52	BB6	100	7/23		
53	BB5	100	7/23		Reinject of Run 47
54	Field Blank II 7/23	100	7/23		
55	Field Blank II 7/23	100	7/23		Reinject
56	BB7	100	7/23		Slight column bleed @ end of run

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Blosenski LF. 8506-25

NUS CORPORATION
SUPERFUND DIVISION SAMPLE RUN Chronicles Photo-VAC **PROJECT NOTES**

Run #	SAMPLE DESCRIPTION	ul injected	DATE SAMPLED	DATE Analyzed	Comments
57	AA5	100	7/23	7/29	Slight column loading @ end run
58	AA6	100	7/23		
59	AA7	100	7/23		
60	Std. 1	10			
61	B5	100	7/23		
62	B6	100	7/23		
63	B7	100	7/23		
64	B7-Dup	100	7/23		Field duplicate, slight col. load @ end
65	AA3	100	7/23		Column loading
66	AA3	100	7/23		
67	AA3-Dup	100	7/23		Field duplicate
68	B3	100	7/23		
69	Std. 1	10			Some electronic noise evident
70	Std. 1	10		7/30	
71	Std 1	10			
72	Field Blank II 7/23	100	7/23		Column loading @ end run
73	AA1	100	7/23		Column loading @ end RUN
74	AA2	100	7/23		Some electronic noise Slight col. loading @ end run
75	AA4	100	7/23		
76	BB4	100	7/23		
77	BB2	100	7/23		Column loading @ end run
78	BB3	100	7/23		Column loading @ end run
79	B1	100	7/23		
80	B2	100	7/23		Sample vial broken in oven, sampl transferred to new vial, equil. & ru
81	~~B3~~ B4	100	7/23		
82	Std 1	10			
83	Field Blank I 7/24	100	7/24		
84	B4	100	7/23		Reinject

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Blosenski LF 8506-25

NUS CORPORATION
SUPERFUND DIVISION

Sample Run Chronicles Photo-VAC

PROJECT NOTE

Run #	Sample Description	ul injected	Date Sampled	Date Analyzed	Comments
85	B8	100	7/24	7/30	
86	B10	100	7/24		Some electronic noise
87	B10	100	7/24		Reinject run 86
88	Std. 1	10			
89	AA8	100	7/24		
90	AA9	100	7/24		
91	AA9	100	7/24		Reinject of 90
92	AA10	100	7/24		
93	Field Blank II 7/24	100	7/24		Slight column loading @ end run
94	BB8	100	7/24		
95	BB8	100	7/24		Reinject, showed loading @ end ru
96	BB8-Dup	100	7/24		Field duplicate, some elect. noi.
97	B8	100	7/24		Slight loading & electronic noise @ en
98	Std. 1	10			New septum, tried to control Noisy baselin
99	BB 11	100	7/24		Still showed some noise
100	BB11-Dup	100	7/24		Field duplicate, noise less
101	BB11	100	7/24		Reinject of 99
102	BB10	100	7/24		
103	Std. 1	10	7/24		
104	BB10-Dup	100	7/24		Field-Duplicate, electronic noi and column loading evident
105	BB10-Dup	100	7/24		Reinject, still low noise & end run loa
106	Field Blank I 7/24	100	7/24		
107	Headspace Trial Sed near MW2	100	7/17		Some electronic noise, but still shows benzene/TCE.
108	Std. 1	10			
109	Std. 1	10			Some electronic noise
110	Std. 1	5			Some electronic noise
111	Field Blank I 7/24	100	7/24		Reinject
112	Headspace trial Sed near MW 2				10ml water added, equil. No ch. From

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Pg. 5 of 5

Blosenski LF 8506-25

NUS CORPORATION
SUPERFUND DIVISION

Sample Run Chronicles Photo-VAC

PROJECT NOTES

Run #	Sample Description	ul injected	Date Sampled	Date Analyzed	Comments
113	Canull Well	100	7/23	7/30	Aqueous TCE some loading @ en. & electronic noise
114	Canull Well	100	7/23	↓	Reinject late loading & noise but still TCE
115	Bardsley Well	100	7/23	↓	Low Benzene, Offscale TCE AQ.
116	Bardsley Well	5	7/23	↓	Reinject smaller volume Benzene not detectable, TCE onscale
117	Field Blank I 7/24	100	7/23	↓	
118	Hartmetz Well	100	7/23	↓	AQ Clean all peaks less than blank
119	Hartmetz Well	100	7/23	↓	Reinject Clean all peaks less than blank
120	Canull Well	100	7/23	↓	TCE present
121	Std. 1	10		↓	adj. baseline between peaks to keep TCE onscale.

NUS CORPORATION
SUPERFUND DIVISION Benzene/TCE Retention Times **PROJECT NOTES**

Run #	Benzene	TCE	TCE RRT to Benzene	Daily Ave. RT	
1	11.0	15.0	1.36	Benzene	TCE
2	11.0	15.0	1.36	$\frac{84.5}{7} = 12.1$	$\frac{115}{7} = 16.4$
3	11.5	16.0	1.39		
4	12.0	16.5	1.38		$\overline{RRT} = 1.36$
5	12.5	17.0	1.36		
16	13.0	17.5	1.35		
29	13.5	18.0	1.33		
33	13.5	18.0	1.33	Benzene	TCE
34	13.5	18.0	1.33	$\frac{119.5}{9} = 13.3$	$\frac{160.5}{9} = 17.8$
43	13.5	17.5	1.30		$\overline{RRT} = 1.34$
48	13.0	17.5	1.35		
49	13.0	17.5	1.35		
50	13.0	17.5	1.35		
51	13.0	18.0	1.38		
60	13.5	18.5	1.37		
69	13.5	18.0	1.37		
70	12.5	16.5	1.32	Benzene	TCE
71	12.0	16.5	1.38	$\frac{113.8}{10} = 11.4$	$\frac{154.6}{10} = 15.5$
82	11.0	15.0	1.36		$\overline{RRT} = 1.36$
88	11.0	15.0	1.36		
98	11.0	15.3	1.39		
103	11.3	15.3	1.35		
108	11.5	15.5	1.35		
109	11.0	15.0	1.36		
110	11.0	15.0	1.36		
121	11.5	15.5	1.35		

* Chart units in .2 cm @ .5 cm/min chart speed

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NUS CORPORATION
SUPERFUND DIVISION Unknown Peak Relative Retention Times **PROJECT NOTES**

	$\bar{x}$ RRT	n	Std. Deviation	Possible ID
Peak I	.352	44	.026	Methanol
Peak II	.488	41	.027	Methylene Chloride
Peak III	.530	42	.027	Unknown
Peak IV	.609	47	.031	TRAN-1,2-dichloroethene
Peak V	.675	43	.032	≈ 1,2-dichloroethane

APPENDIX 7

ORIGINAL
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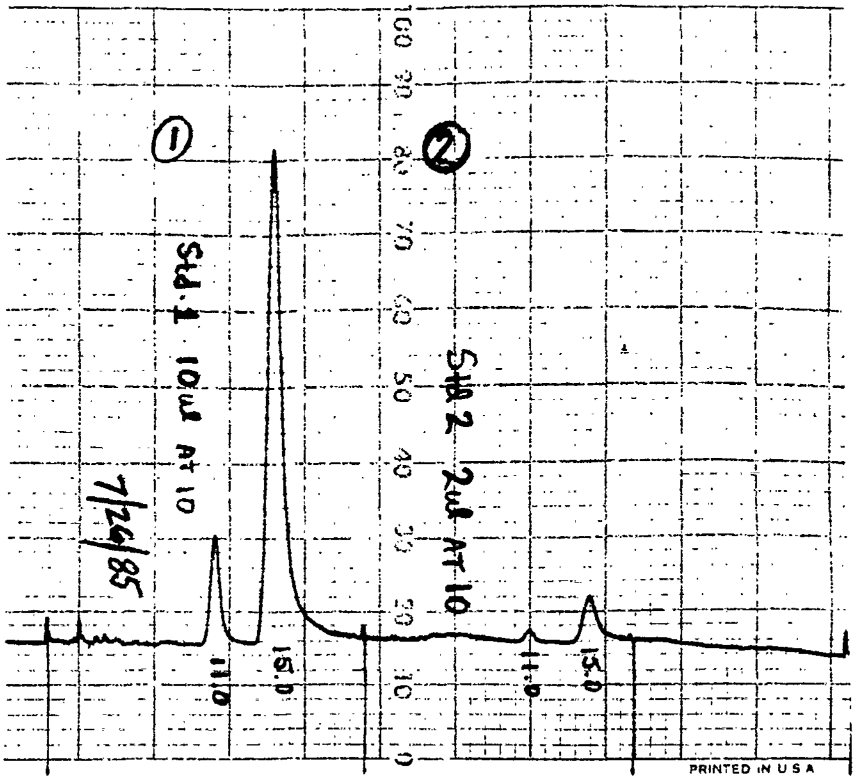

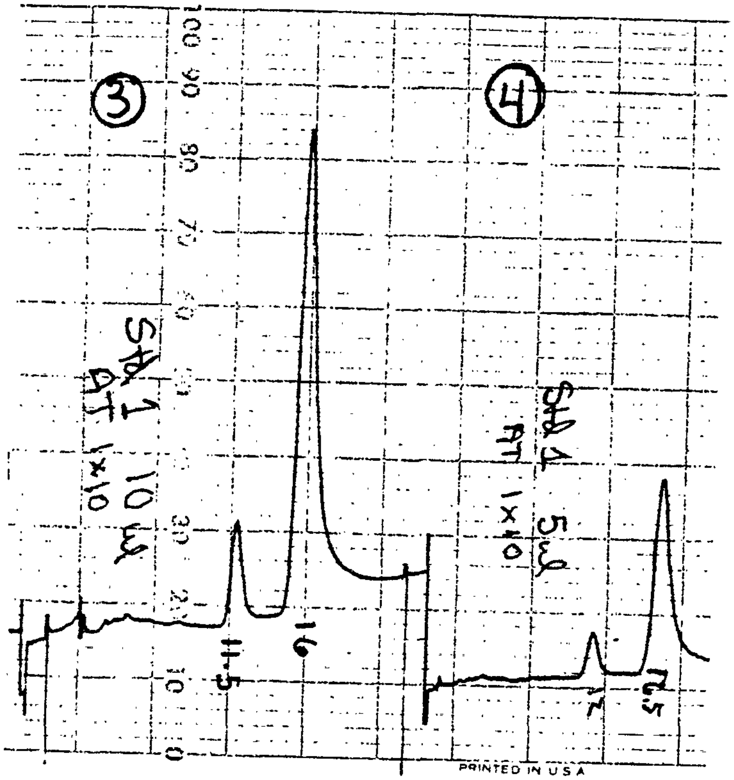

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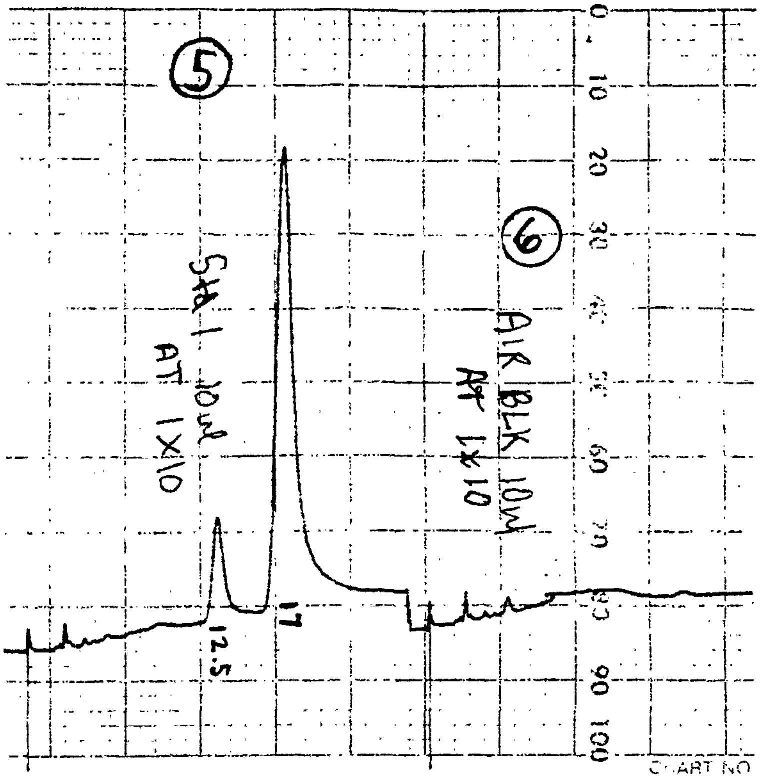
5
Std 1 10ul
AT 1x10
12.5
17
6
AIR BLK 10ul
AT 1x10
0
10
20
30
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80
90
100
CHART NO

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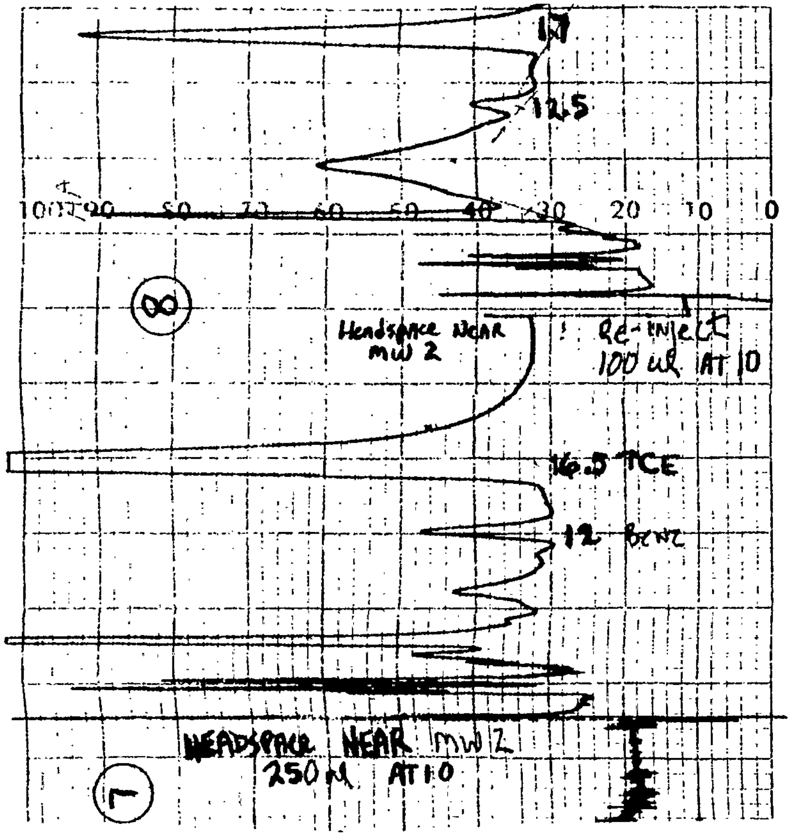

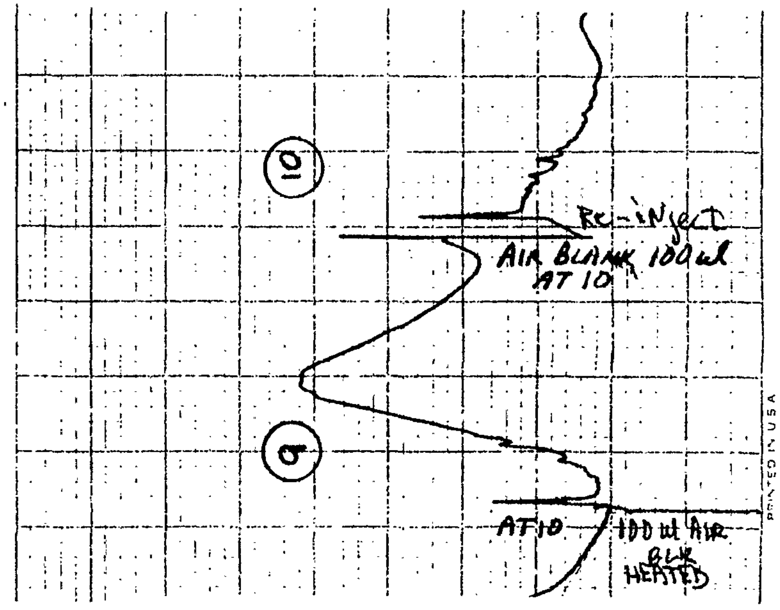

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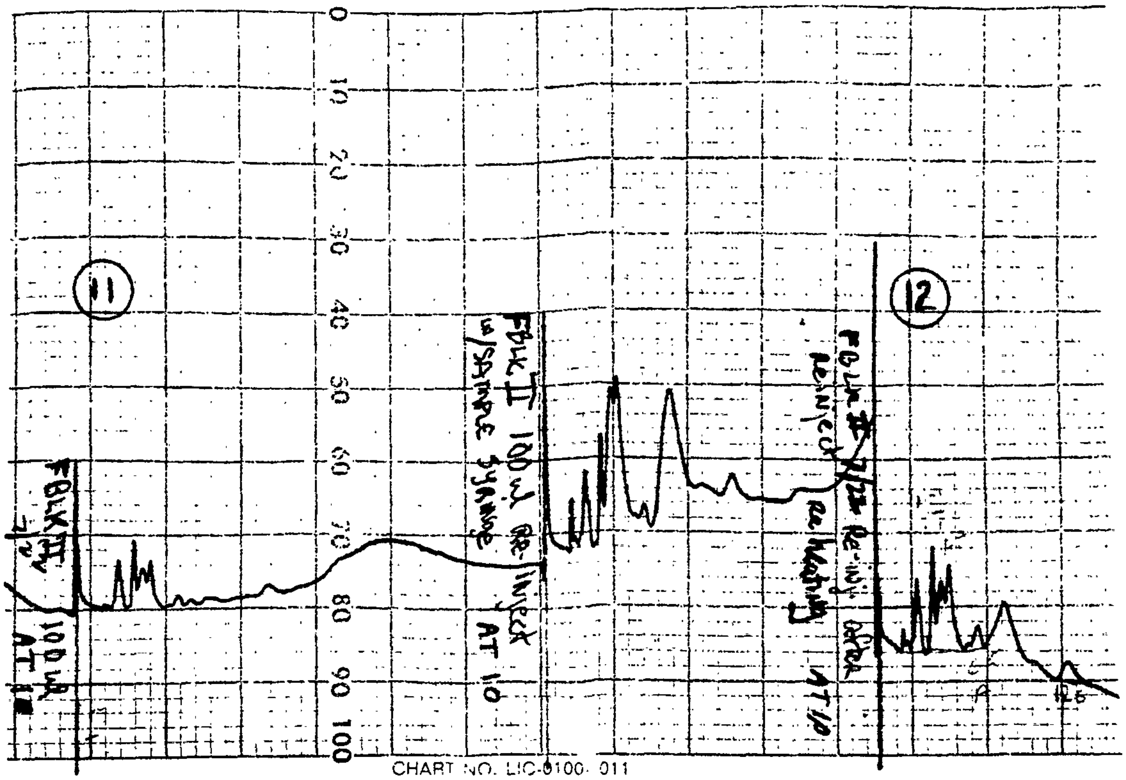

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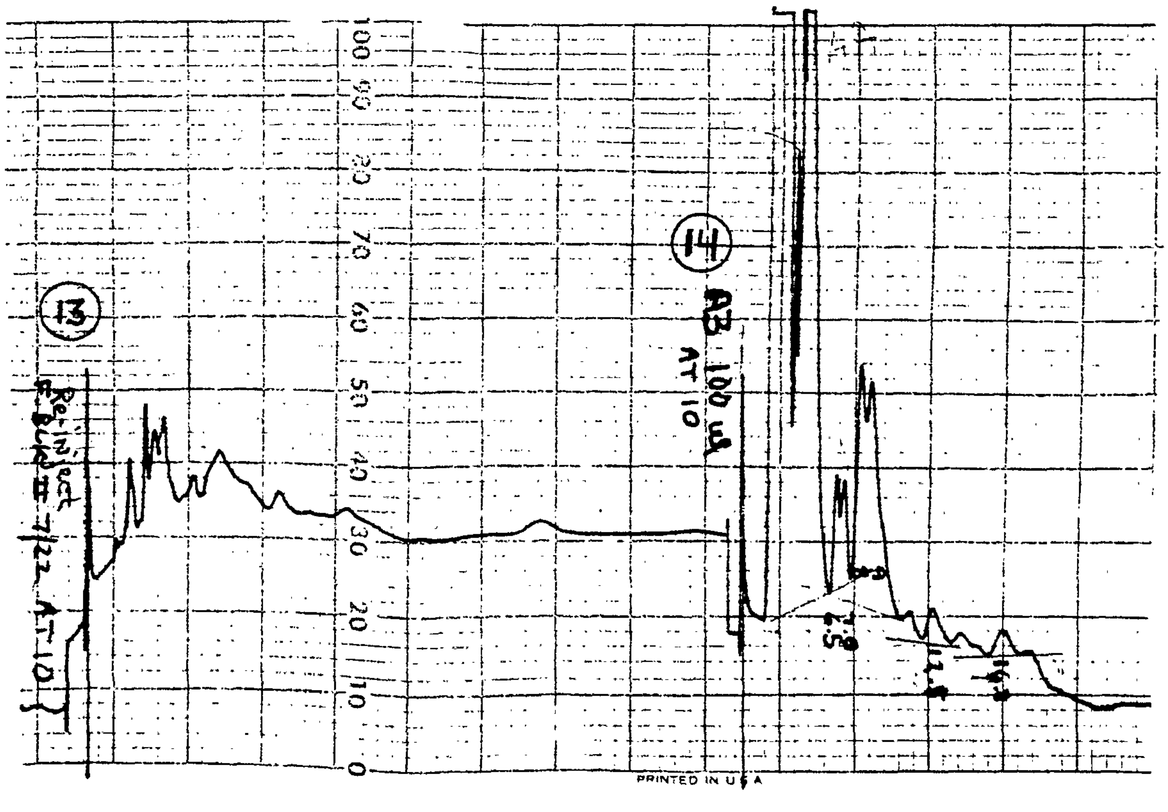

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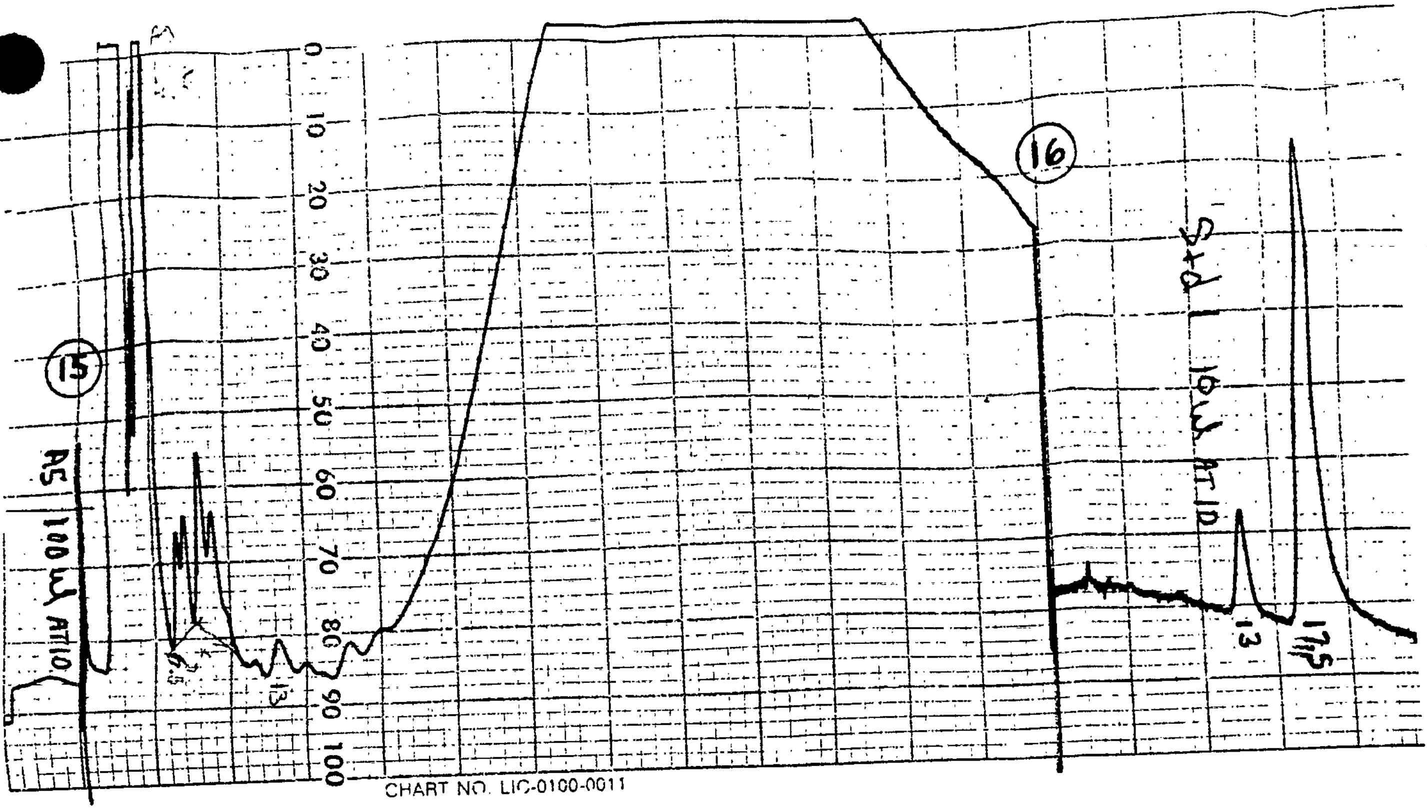

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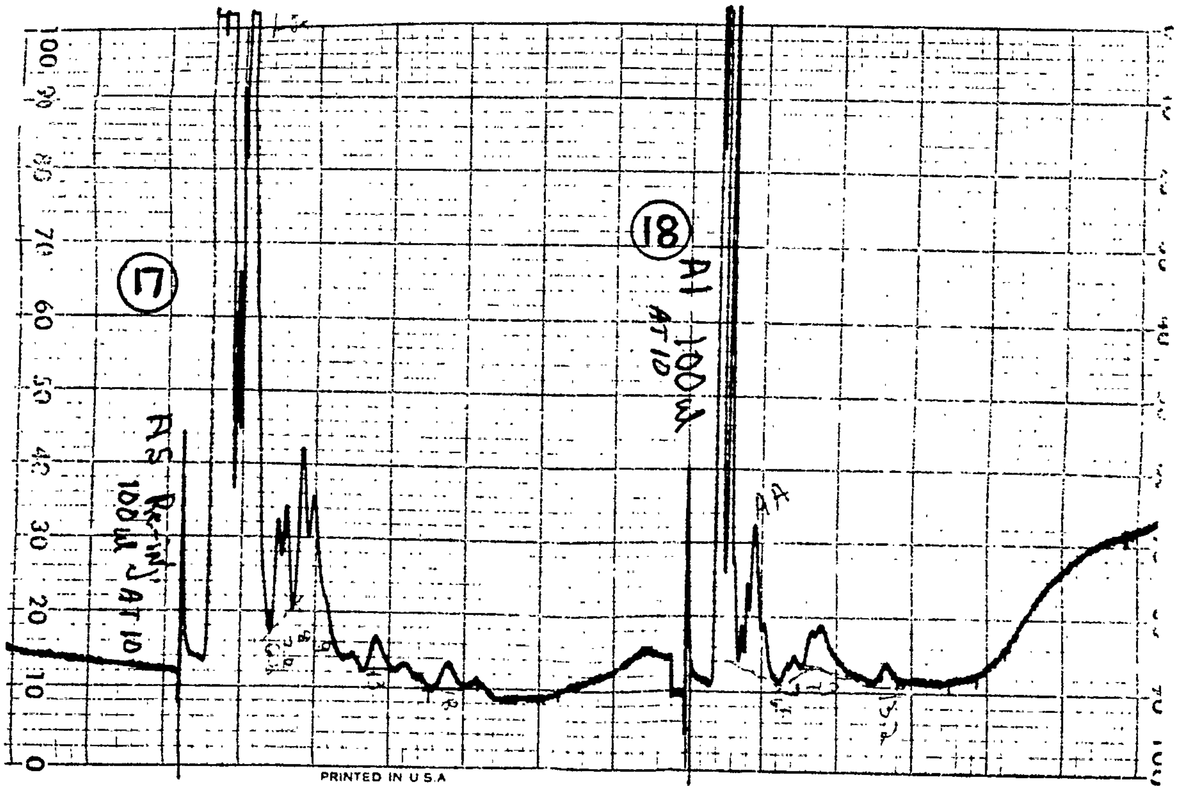

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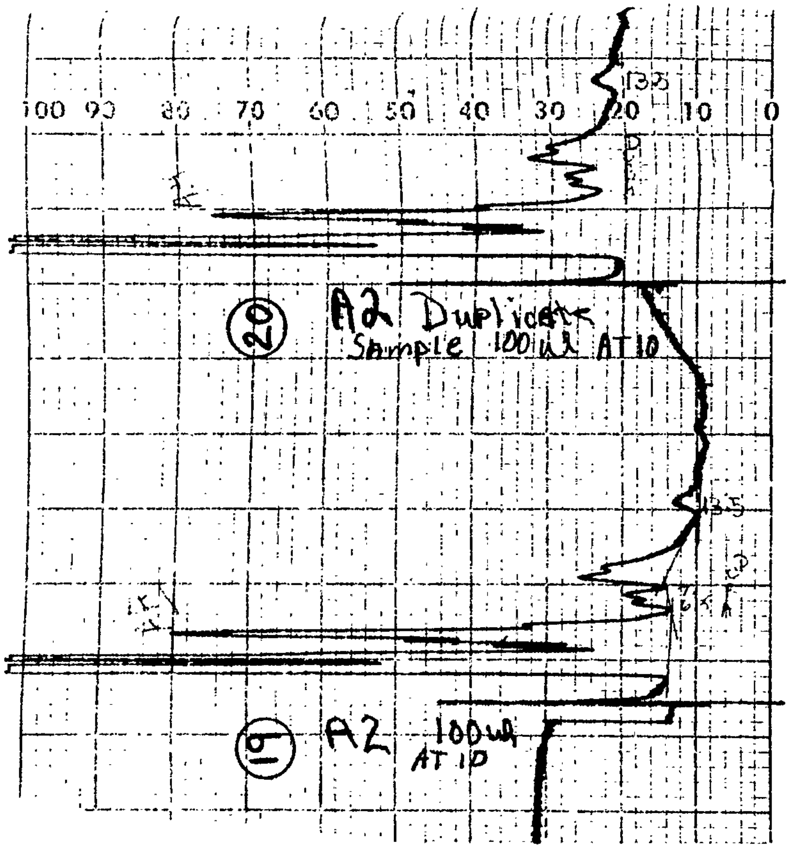
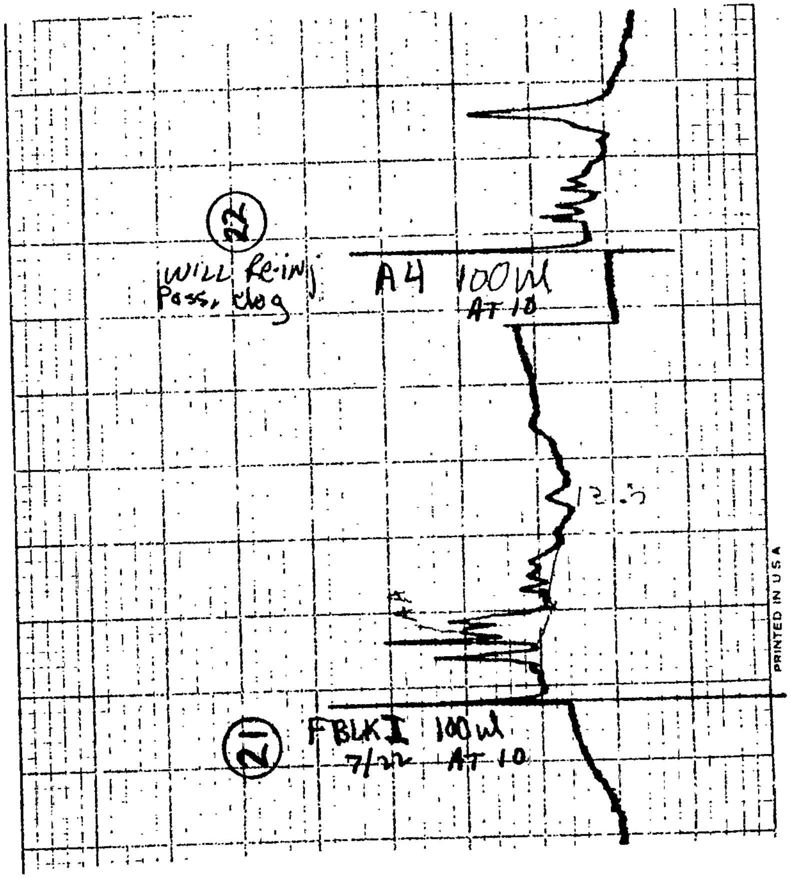

100 90 80 70 60 50 40 30 20 10 0
133
13.5
⑳ A2 Duplicate Sample 100 ul AT 10
⑲ A2 100 ul AT 10


㉒ Will Re-inj Poss. clog
A4 100 ul AT 10
12.5
㉑ FBLK I 100 ul 7/22 AT 10
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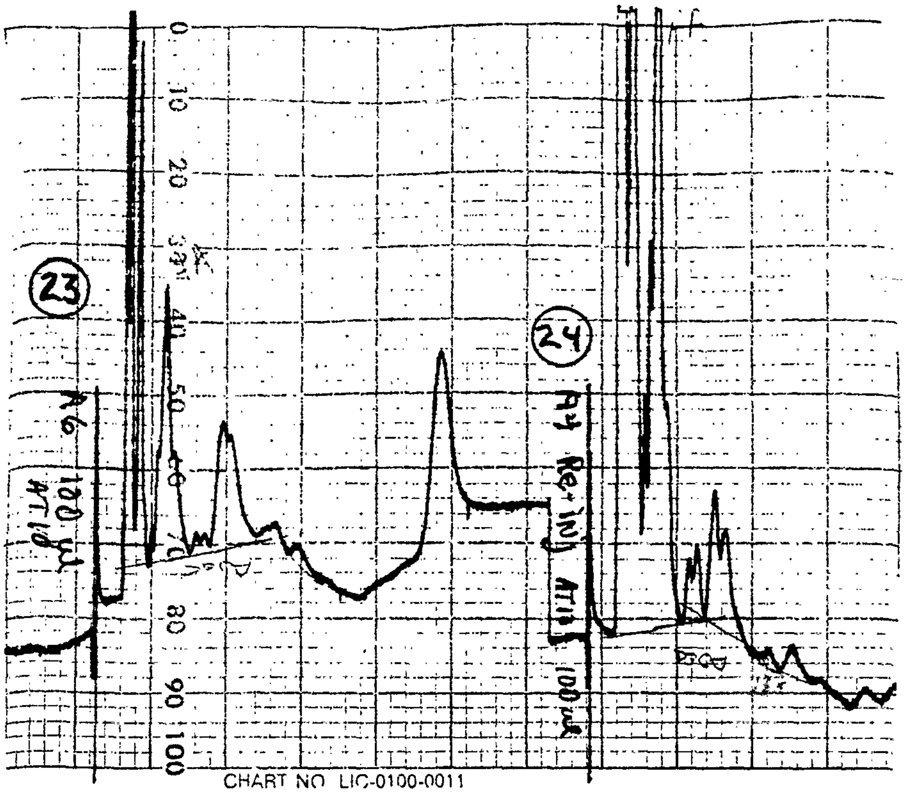

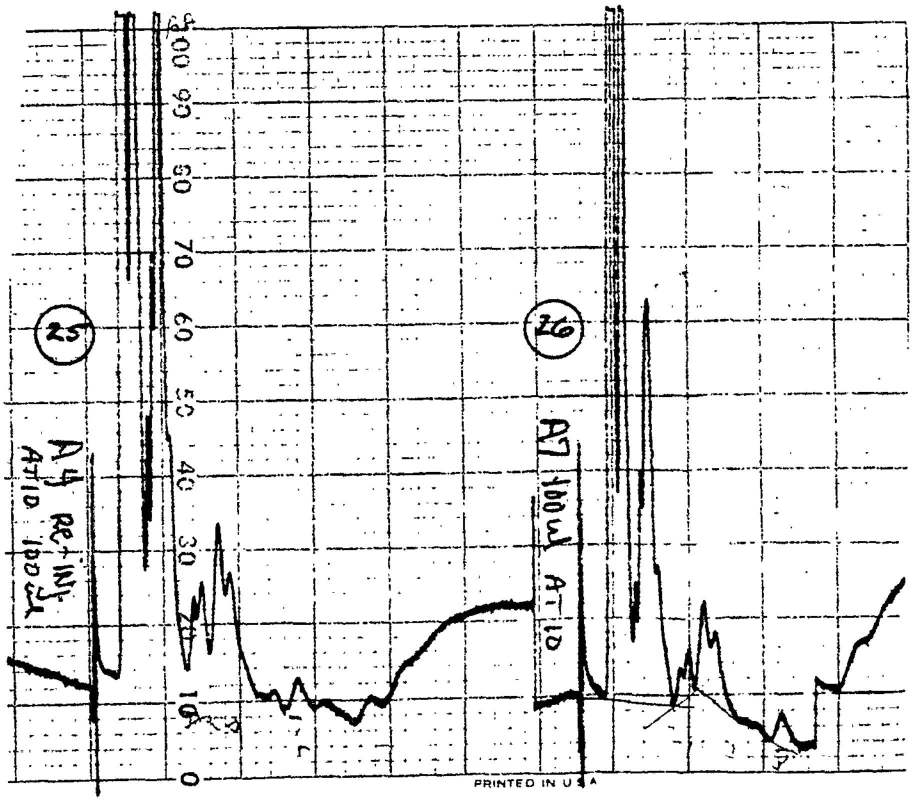

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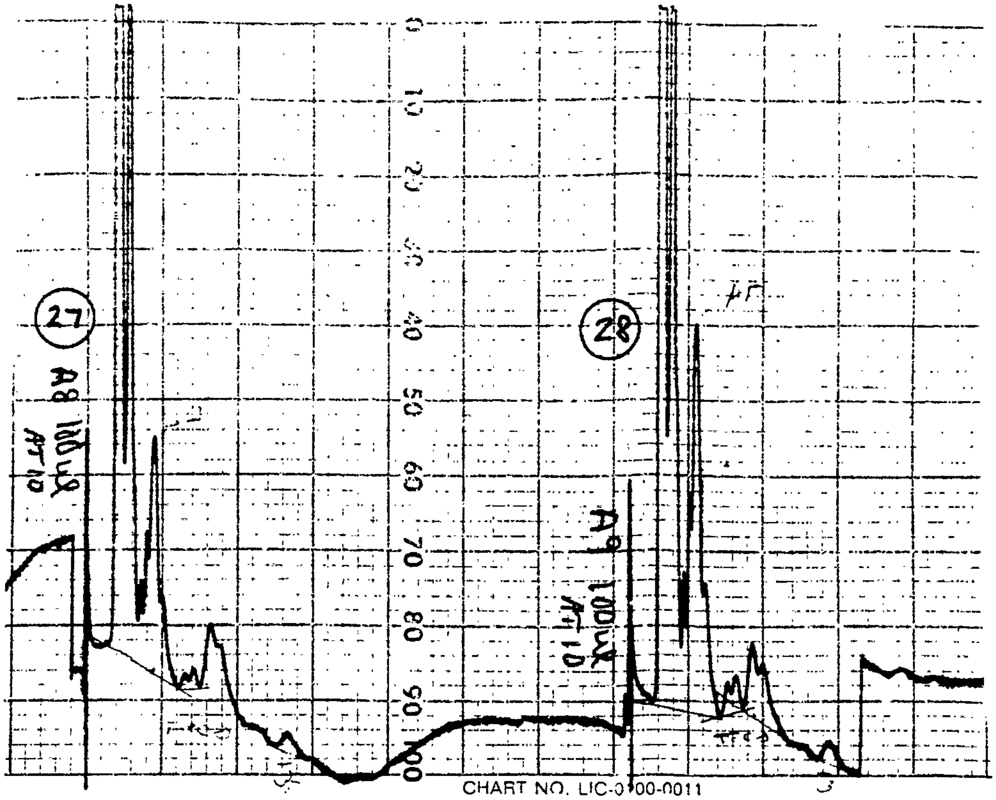
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A8 100μl
AT10
28
A9 100μl
AT10
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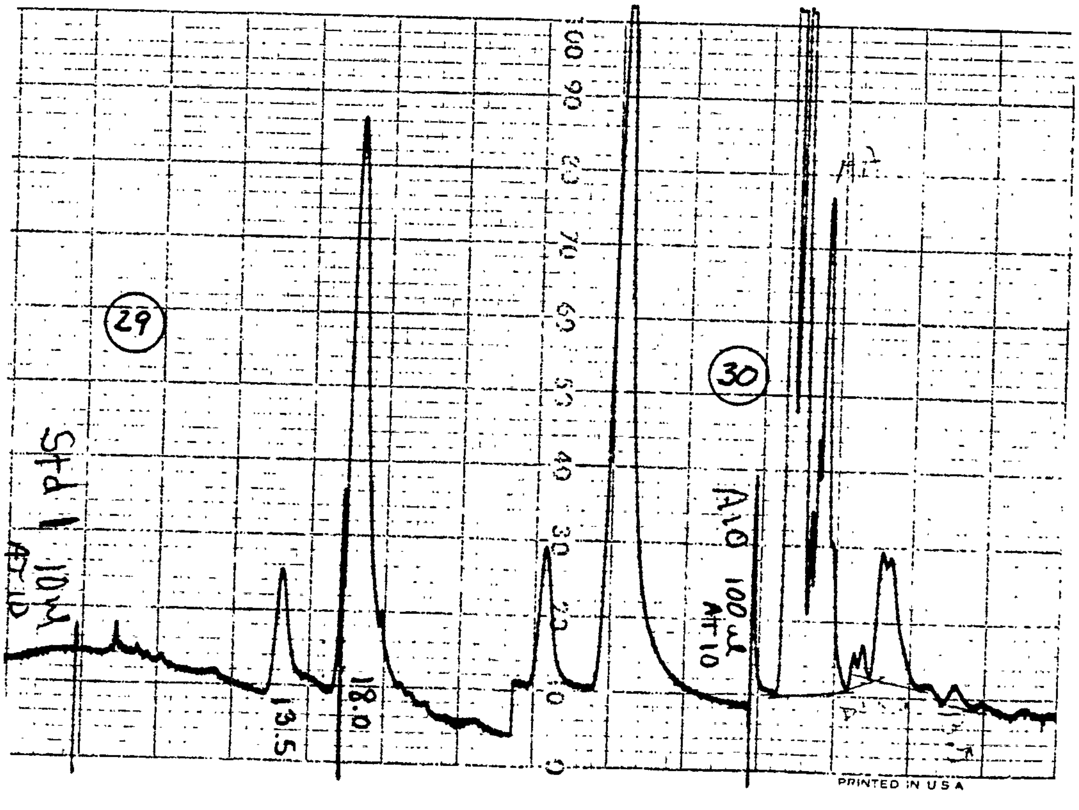
CHART NO. LIC-0900-0011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Std 10μl
AT10
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18.0
30
A10 100μl
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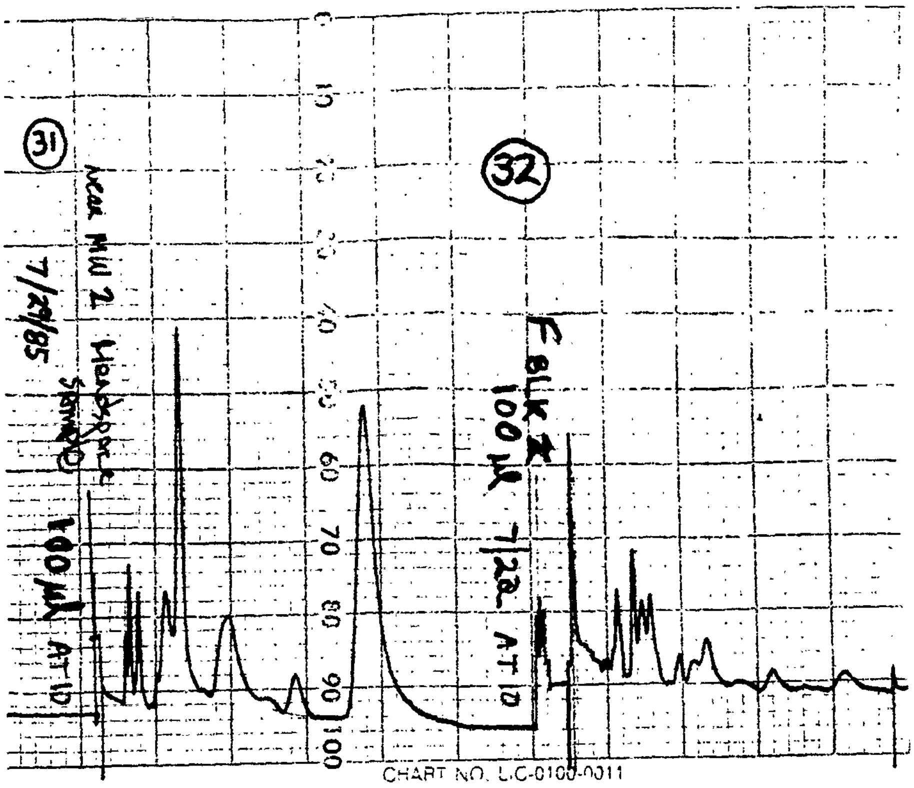

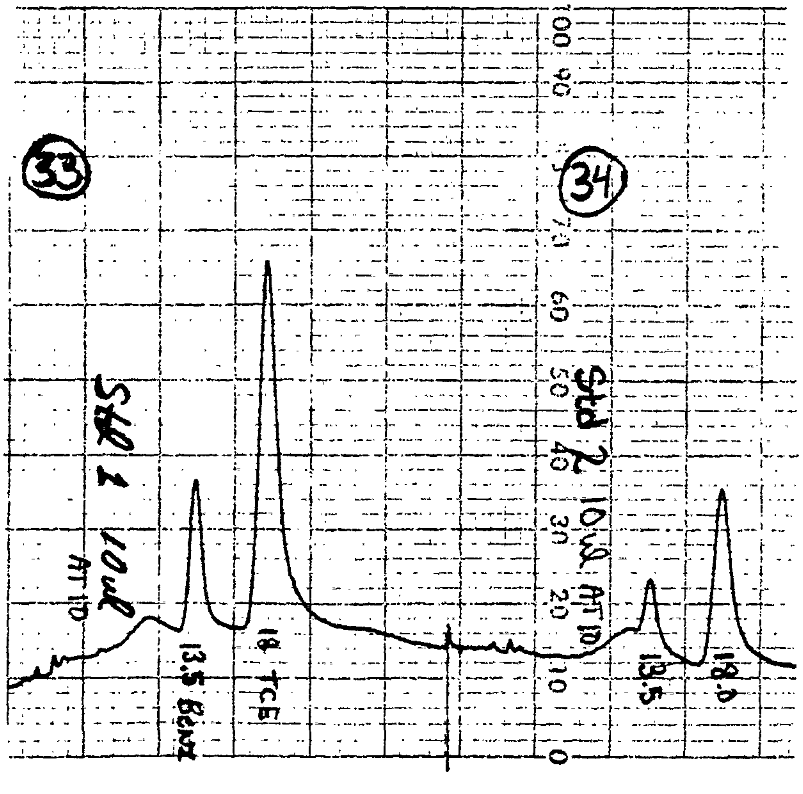

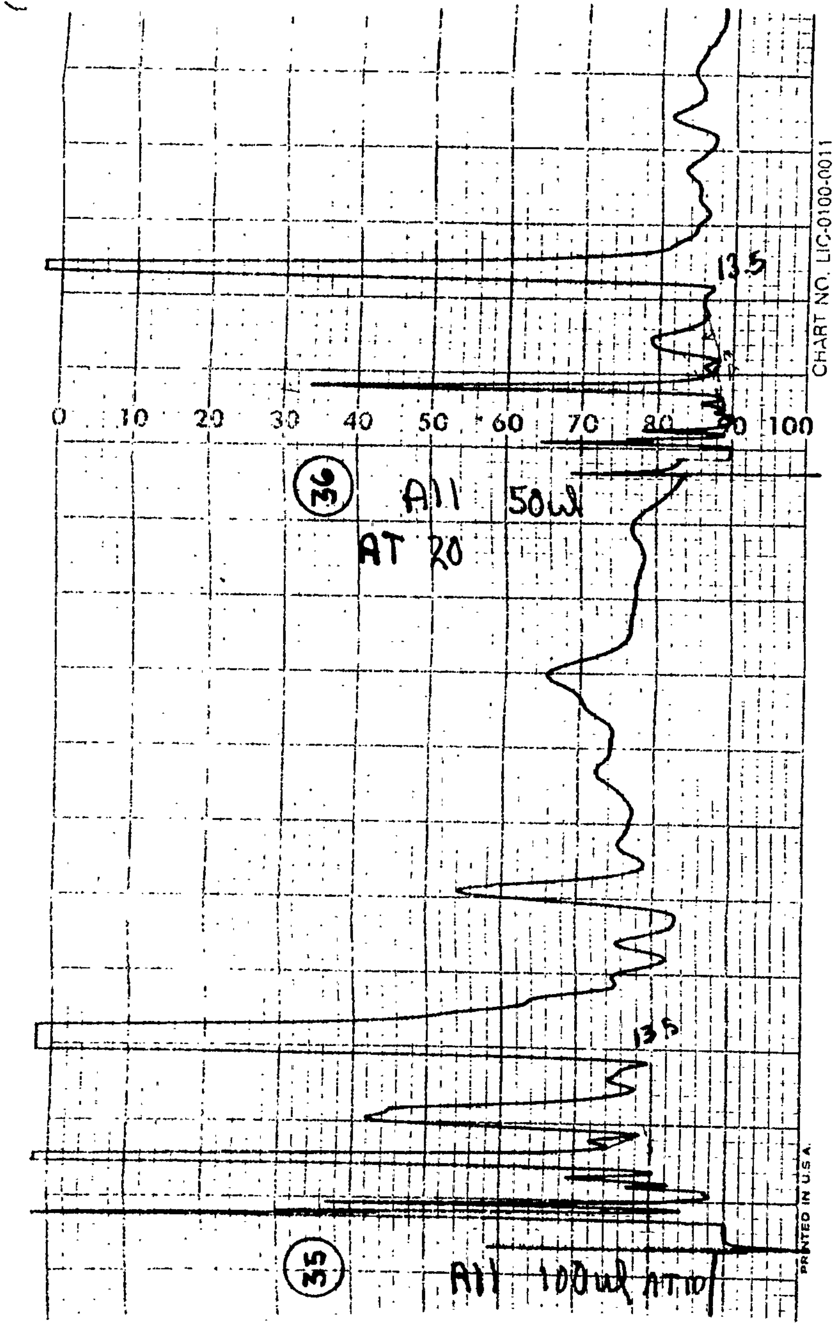
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CHART NO. LIC-0100-0011
PRINTED IN U.S.A.
13.5
36
All 50ul
AT 20
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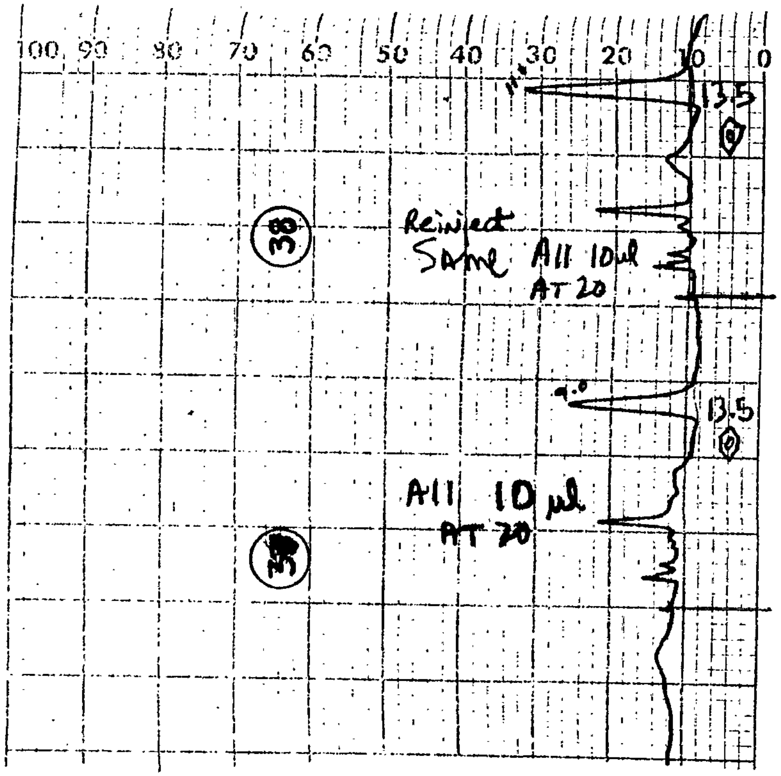
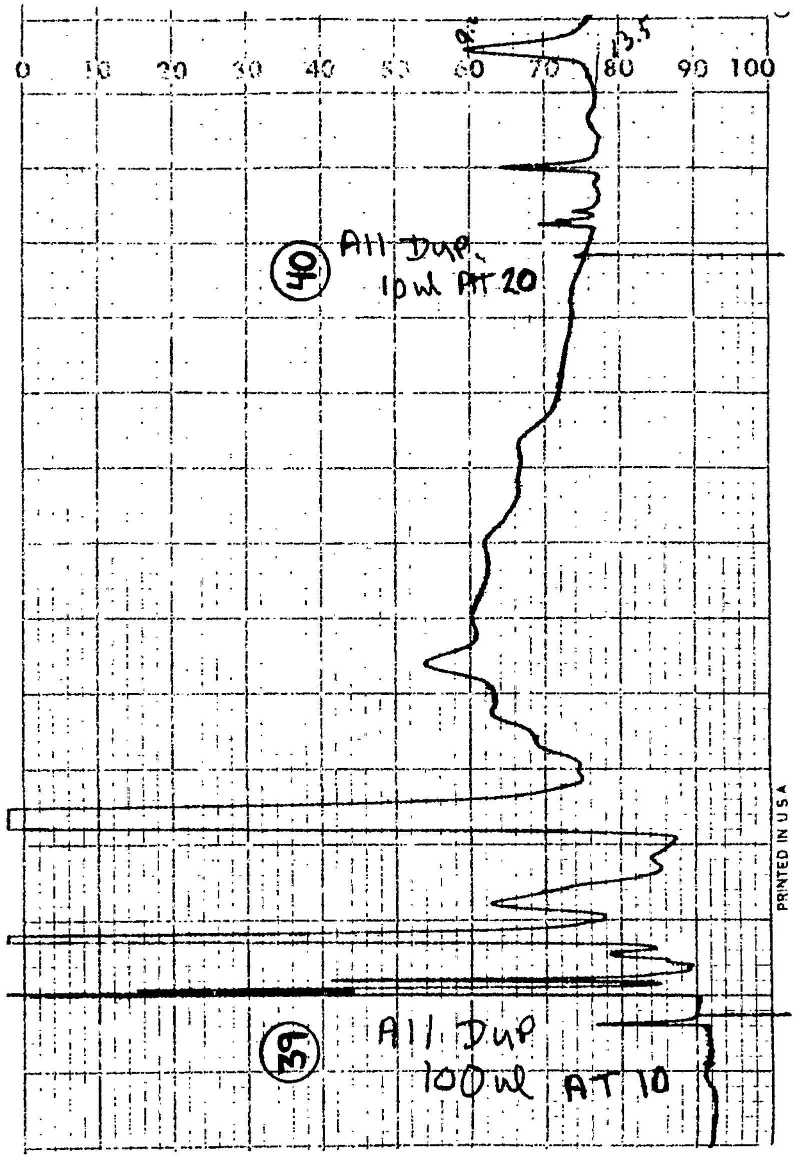
35
All 100ul AT10



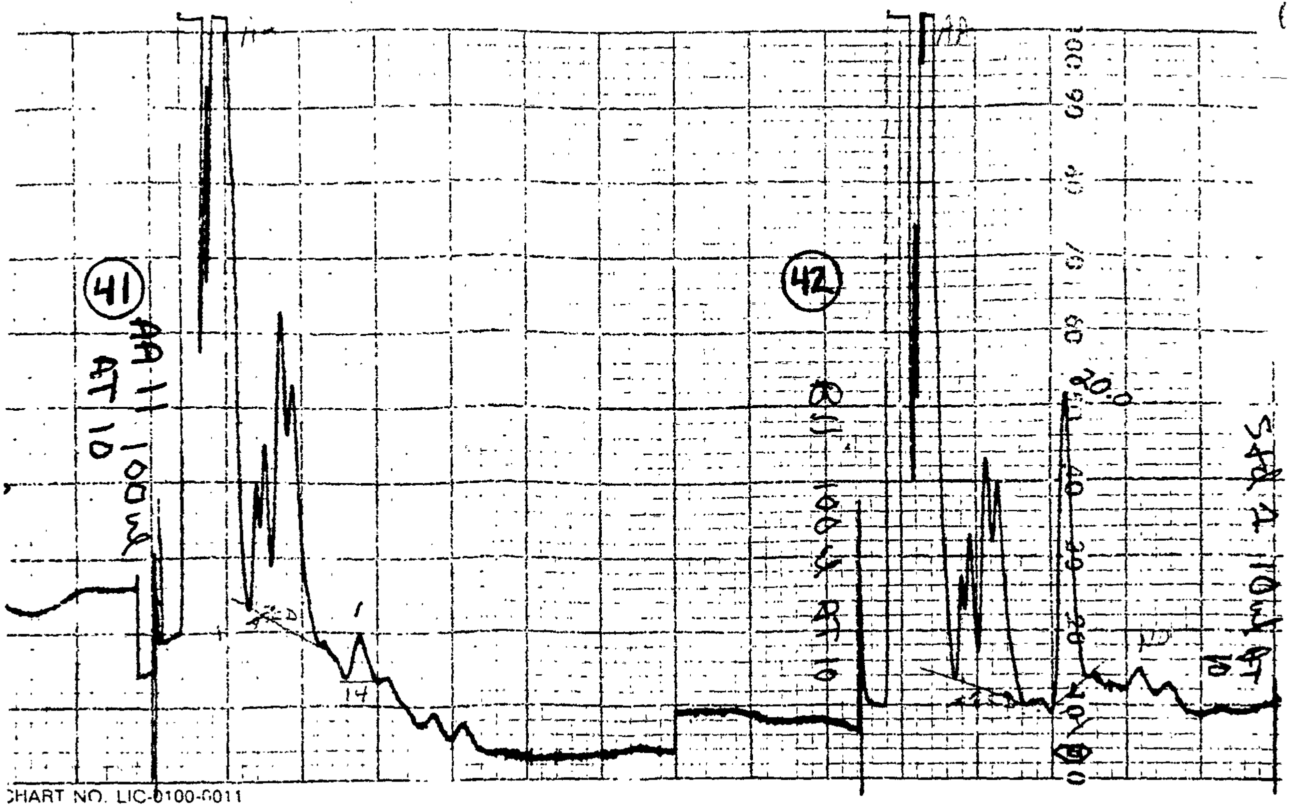
100 90 80 70 60 50 40 30 20 10 0
38
Reinject Same All 10µl AT 20
11.0
13.5
37
All 10 µl AT 20
9.0
13.5



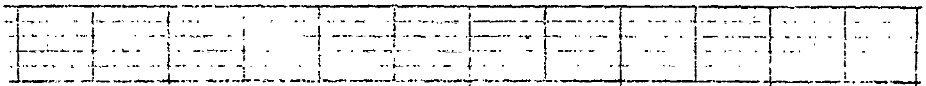
0 10 20 30 40 50 60 70 80 90 100
9.0
13.5
40
All Dup. 10µl AT 20
39
All Dup 100µl AT 10
PRINTED IN U S A

300987

(Red)



41
AA 11 100ul
AT 10
14
AP
42
R-1 100ul AT 10
20.0
Std II 10ul AT 10
CHART NO. LIC-0100-0011



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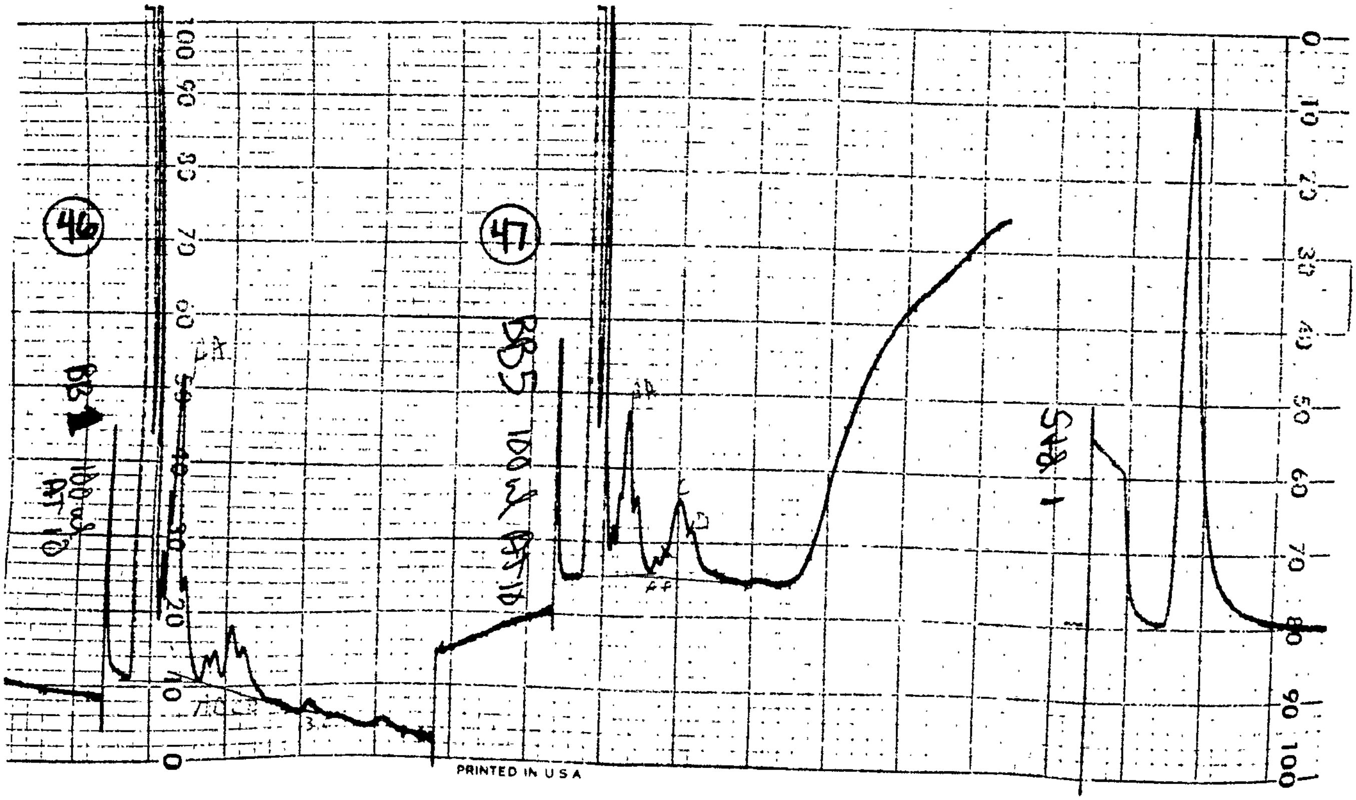

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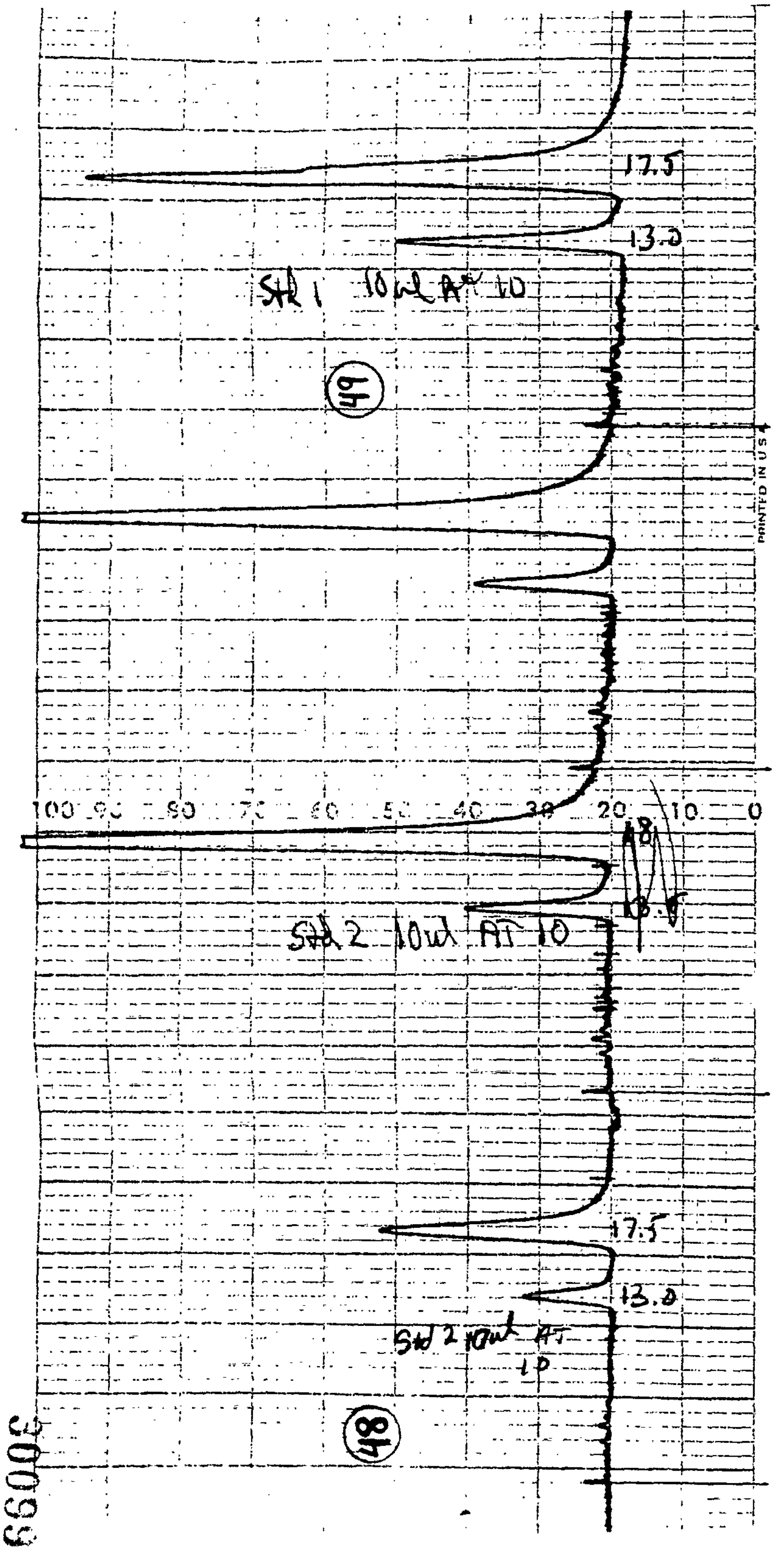

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(Red)

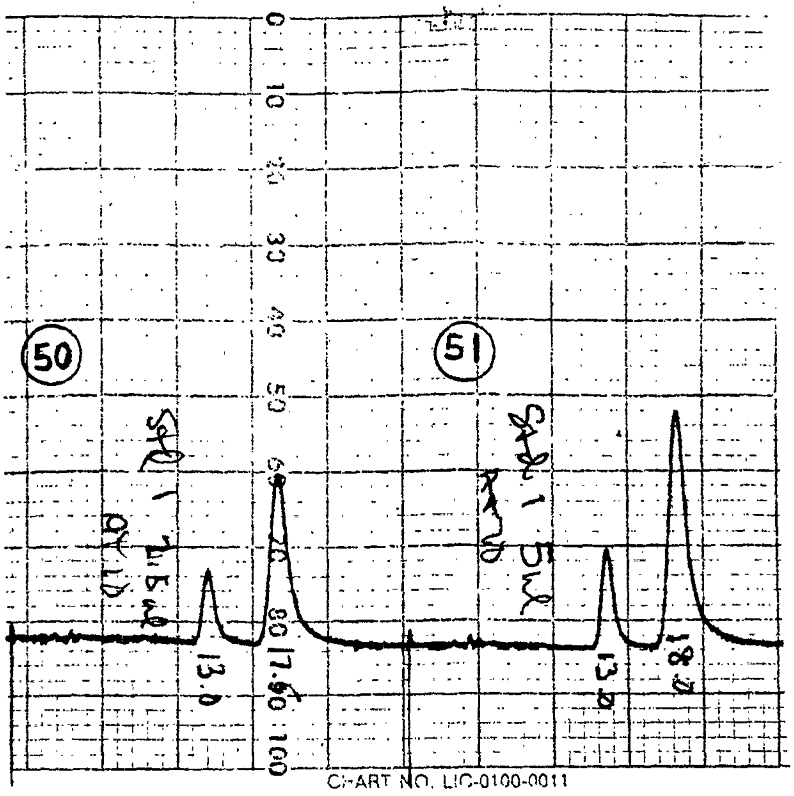

CHART NO. LIC-0100-0011

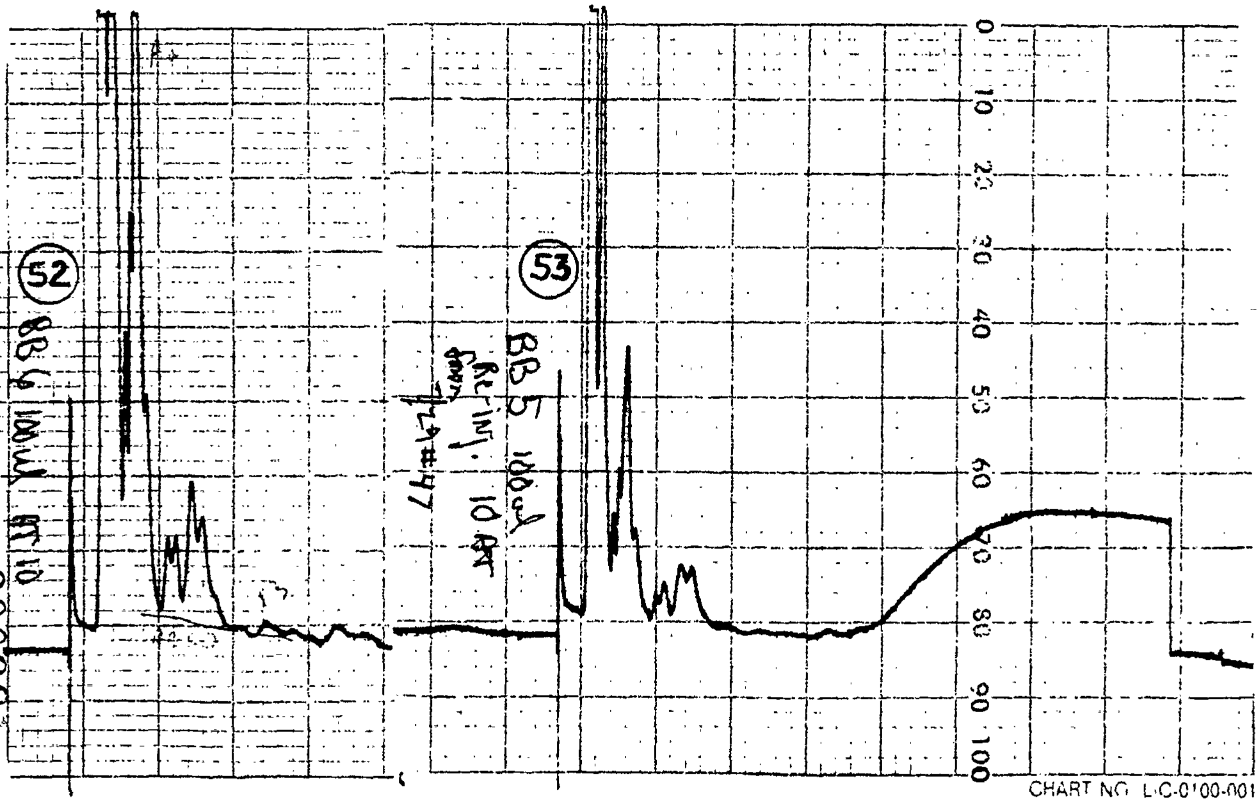

CHART NO. LIC-0100-001

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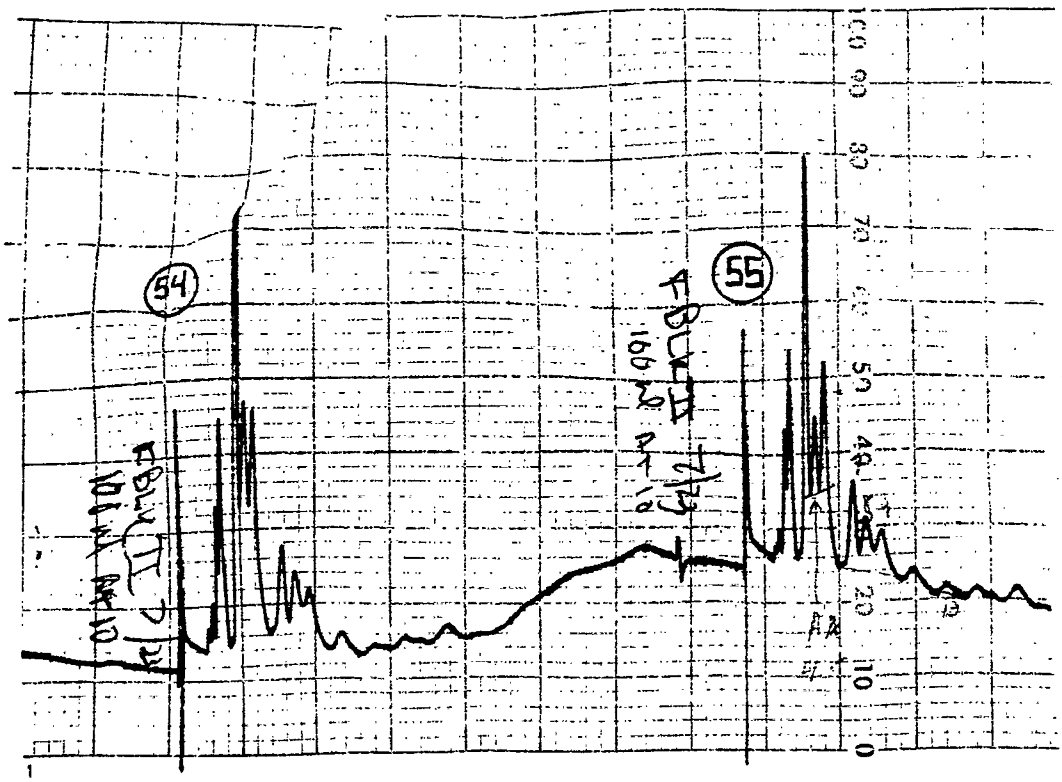
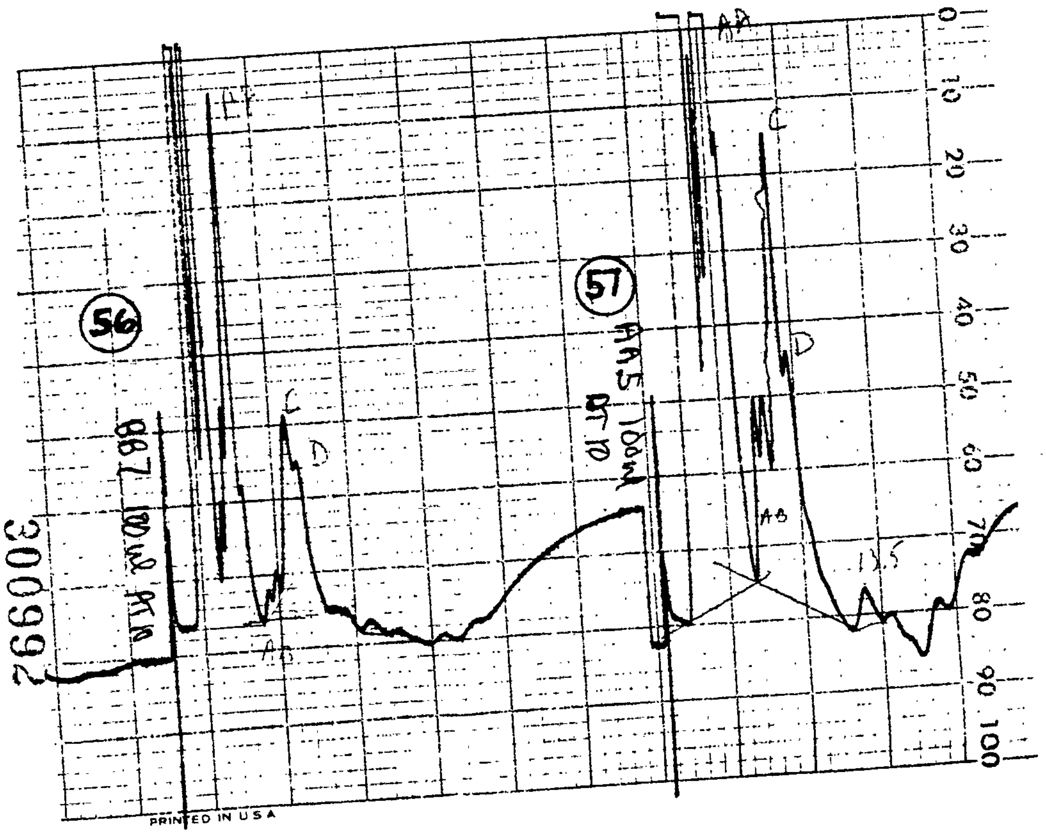
(Red)

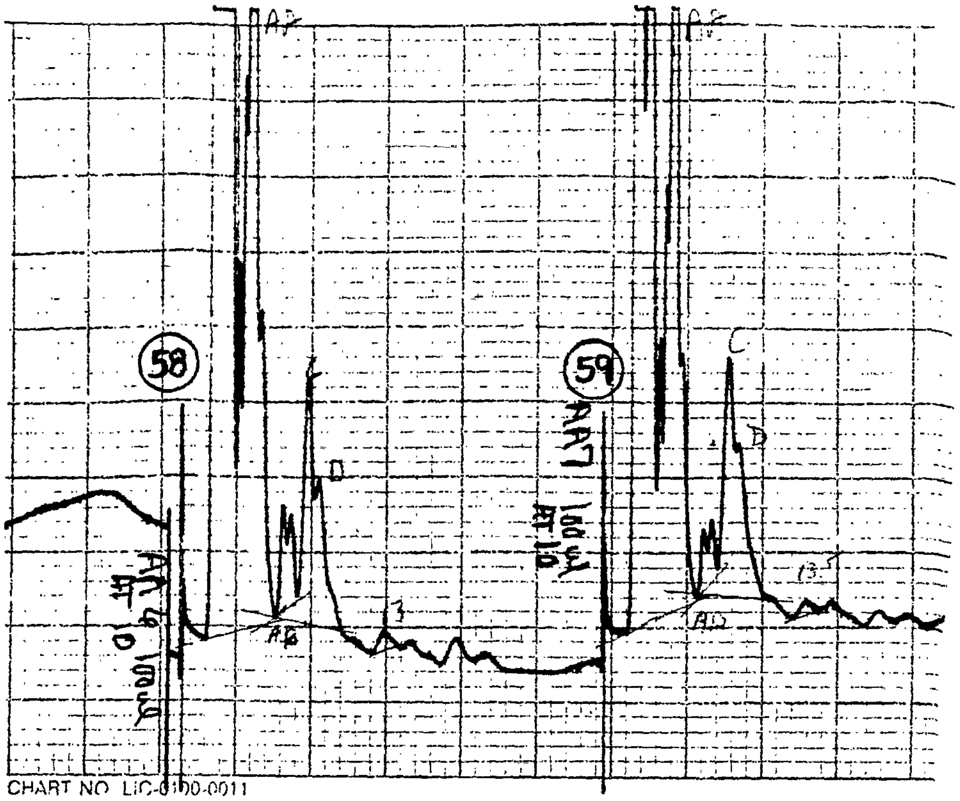


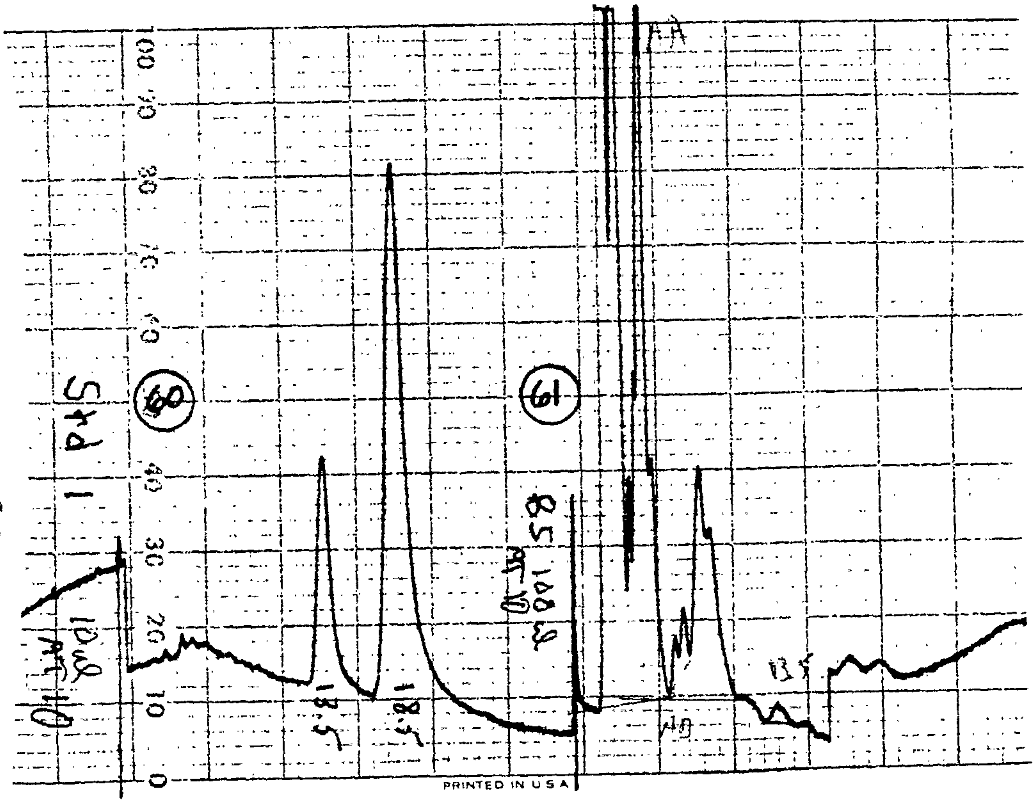
54
FBLK II 7/13
100 ul Atn 10
55
FBLK II 7/13
100 ul At 10
AA
0
10
20
40
50
60
70
80
90
100



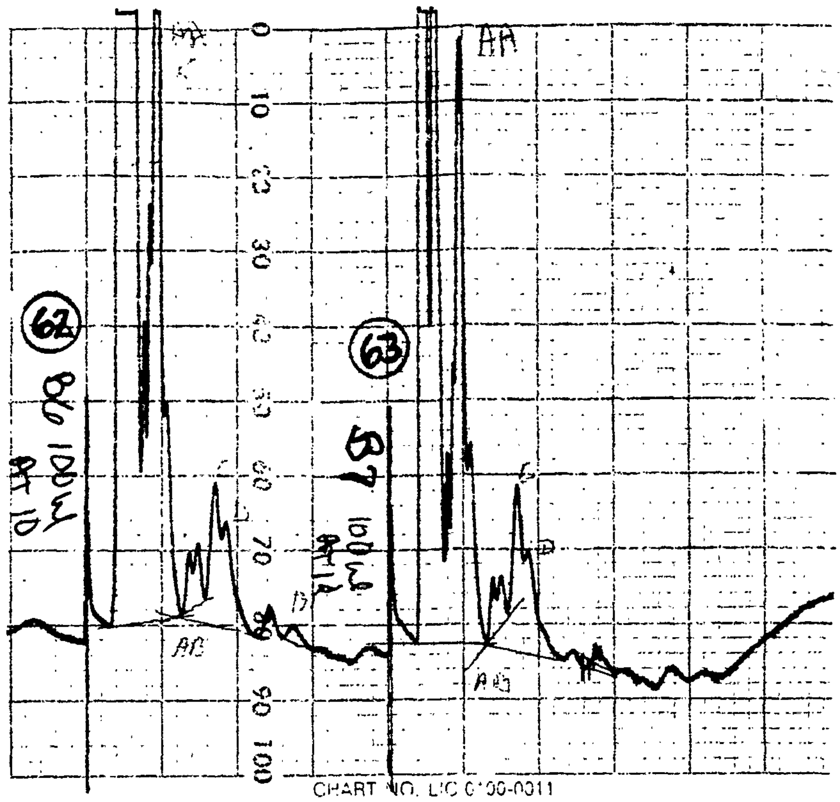
56
887 100ul Atn
A
C
D
AA
57
AAS 100ul At 10
AA
C
D
AB
13.5
0
10
20
30
40
50
60
70
80
90
100
PRINTED IN U.S.A.

ORIGINAL
(Red)

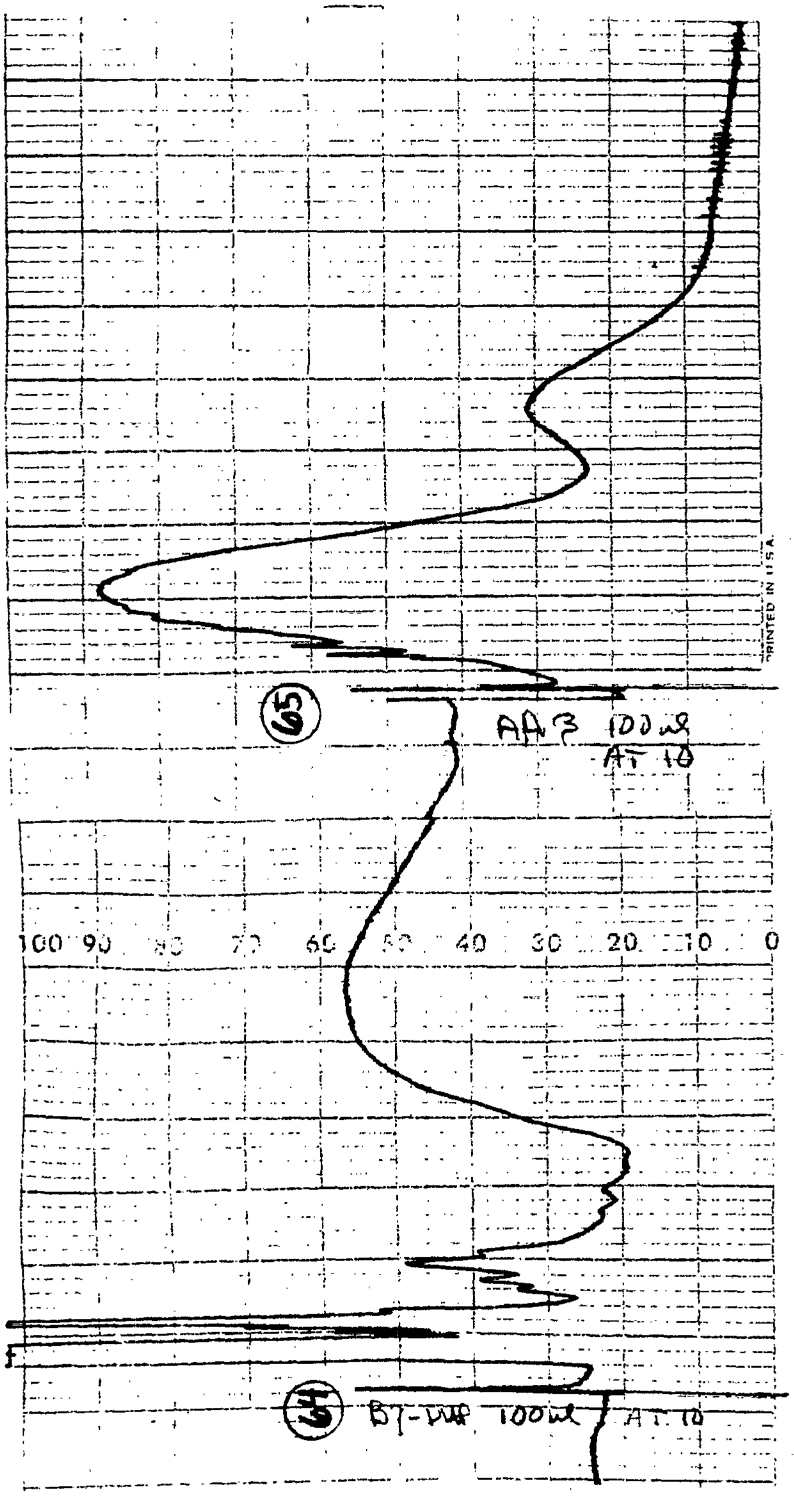




ORIG
(Red


62
86 100ul
AT 10
63
87 100ul
AT 12
AA
C
D
AB
0
10
20
30
40
50
60
70
80
90
100
CHART NO. LIC 0100-0011

ORIGINAL
(Red)



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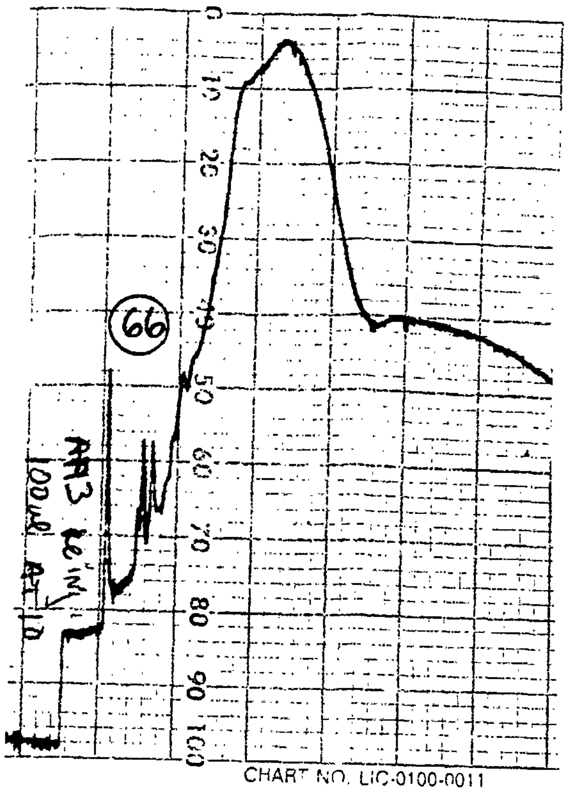
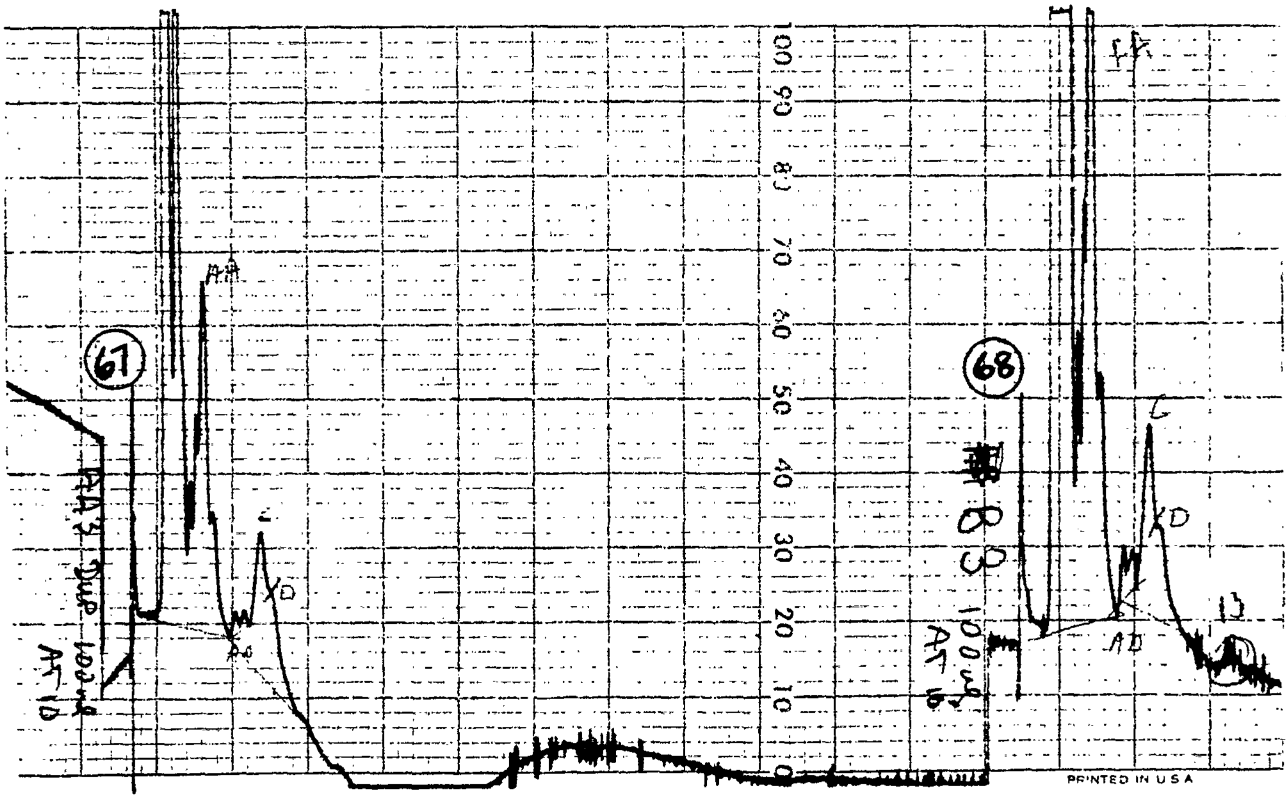
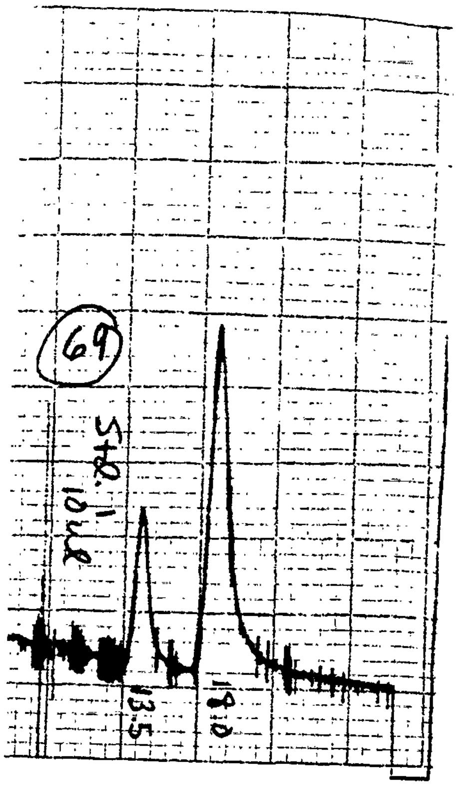
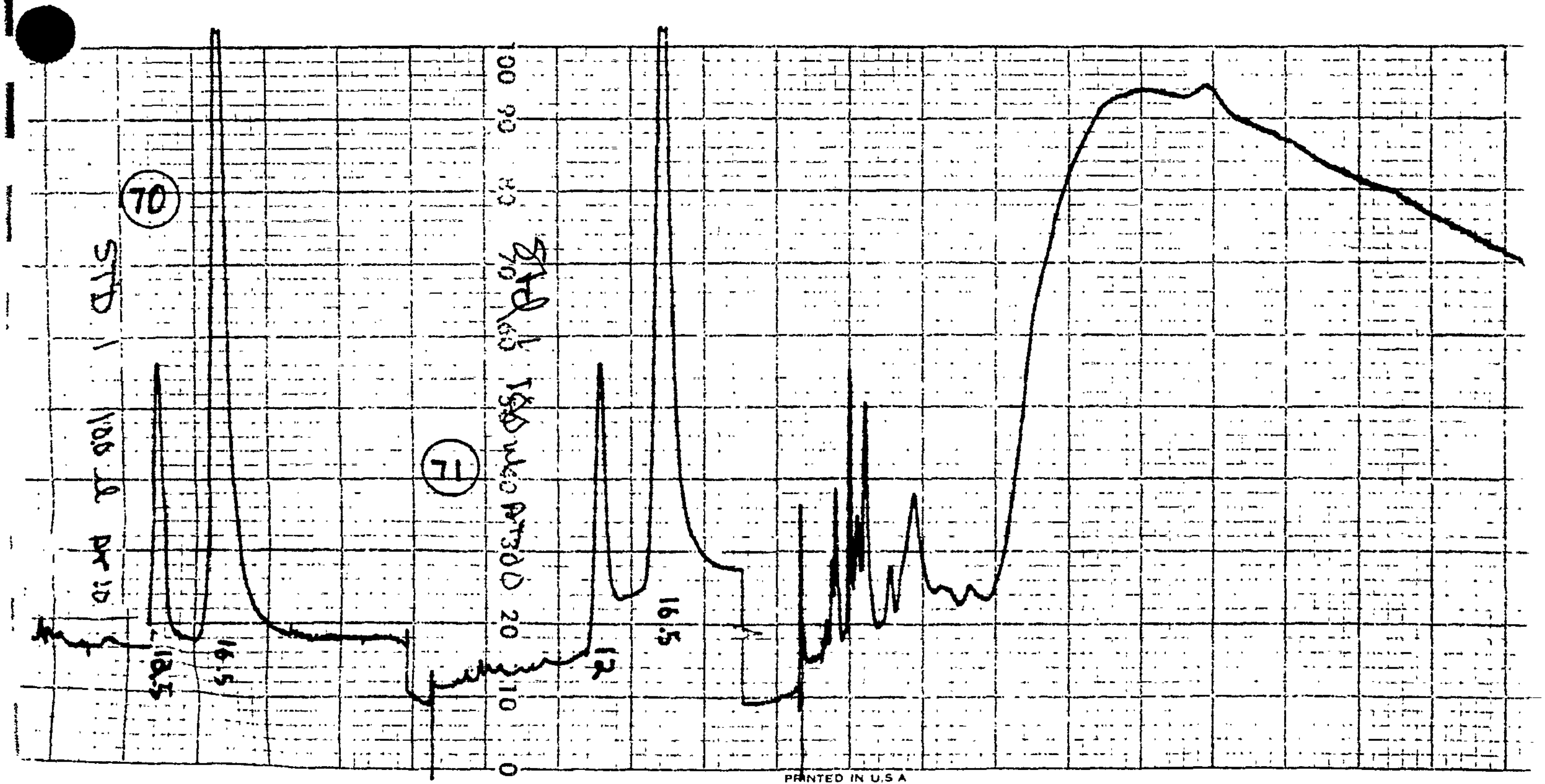
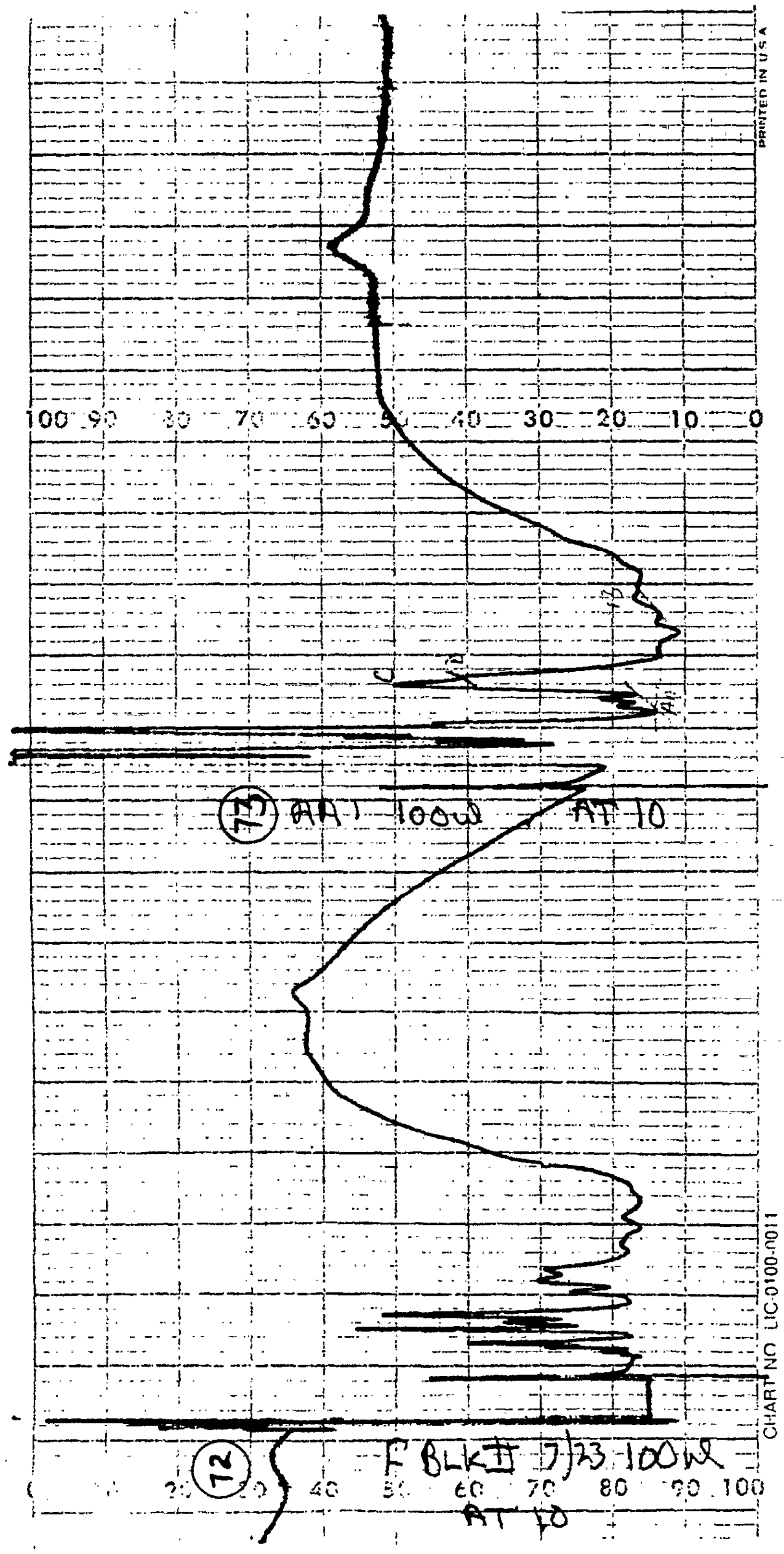





69
Std. 1
10 µl
13.5
19.0


70
STD 1
100 µl Ar 10
12.5
16.5
71
Std 1
150 µl AT 300
12
16.5
100
90
80
70
60
20
10
0
PRINTED IN U.S.A

ORIGINAL
(Red)



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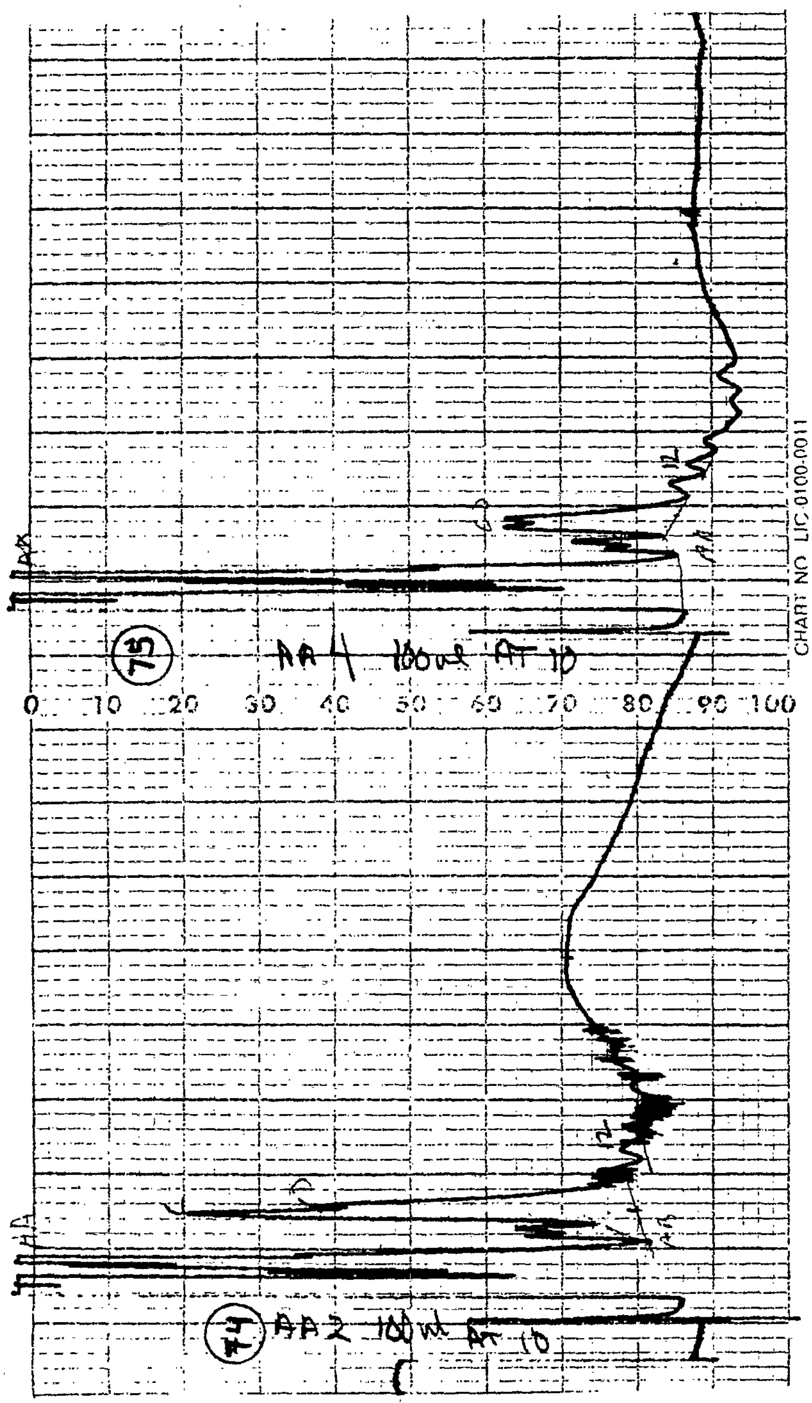

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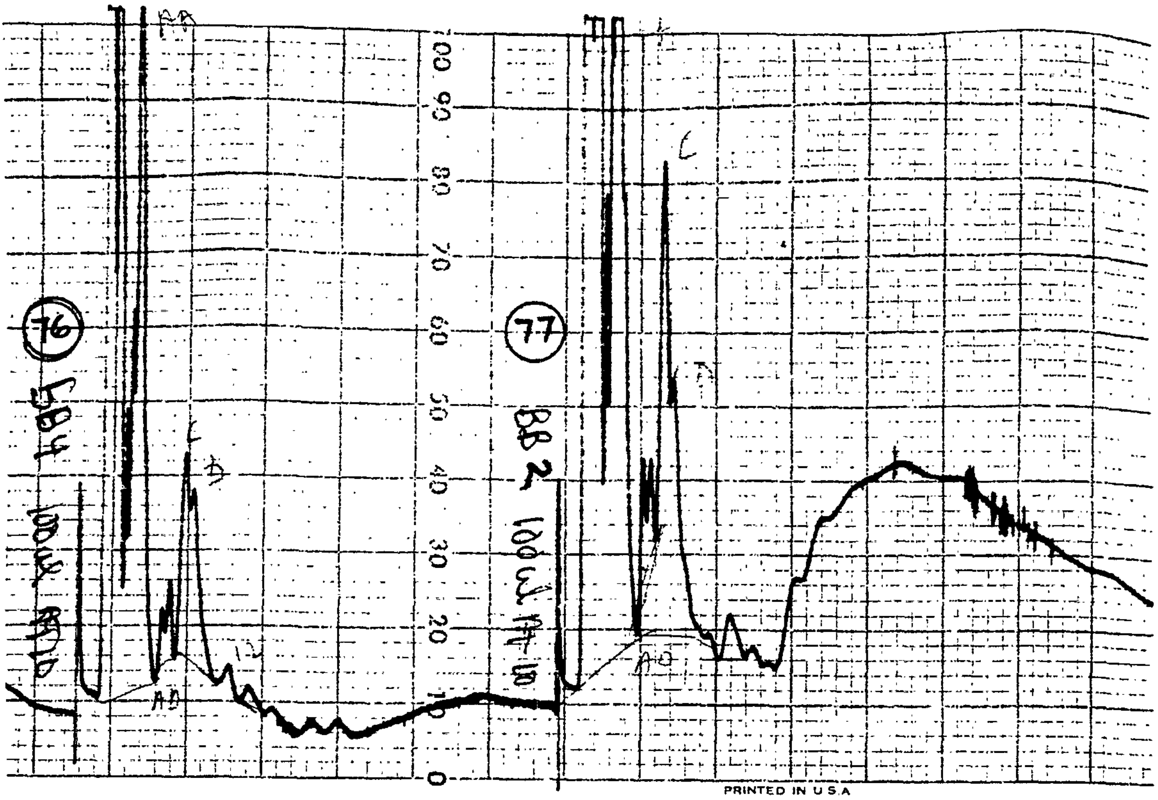

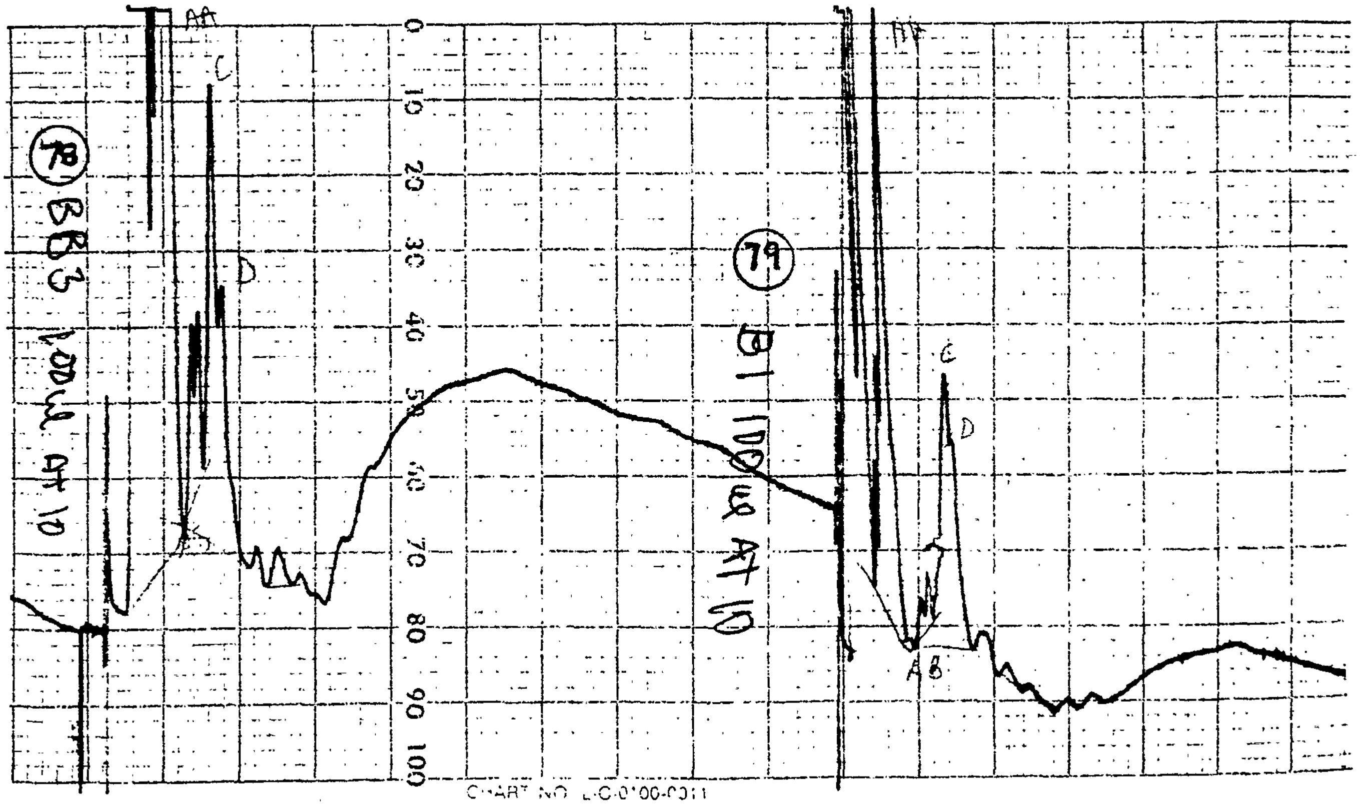

301000

CHART NO. LIC-0100-0011

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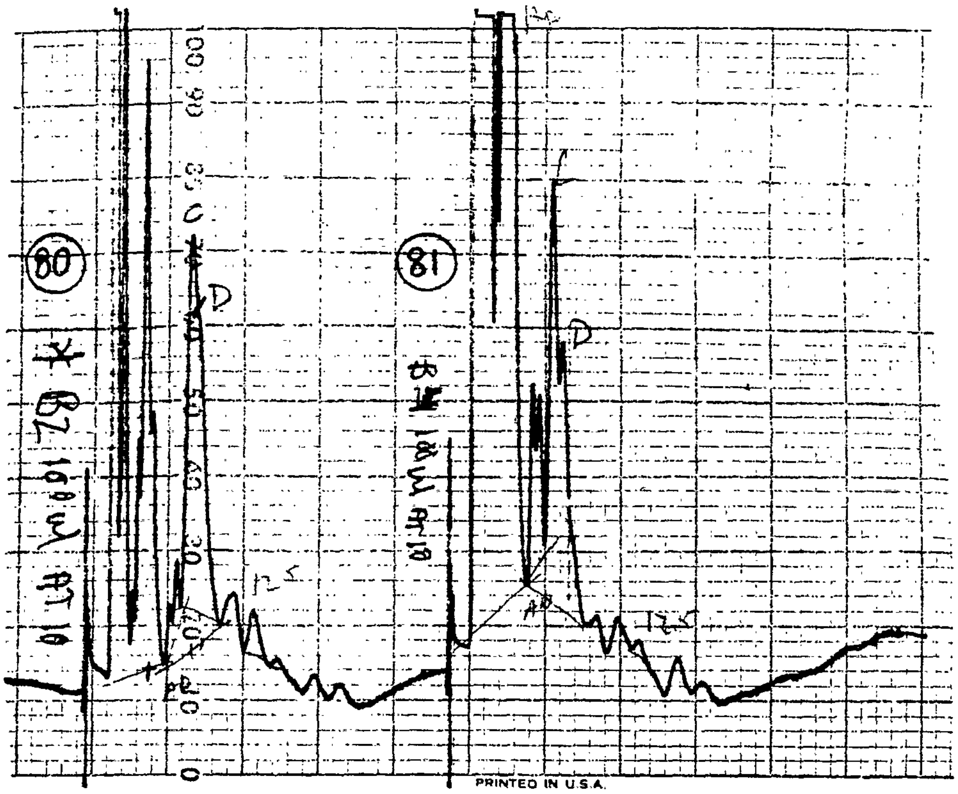

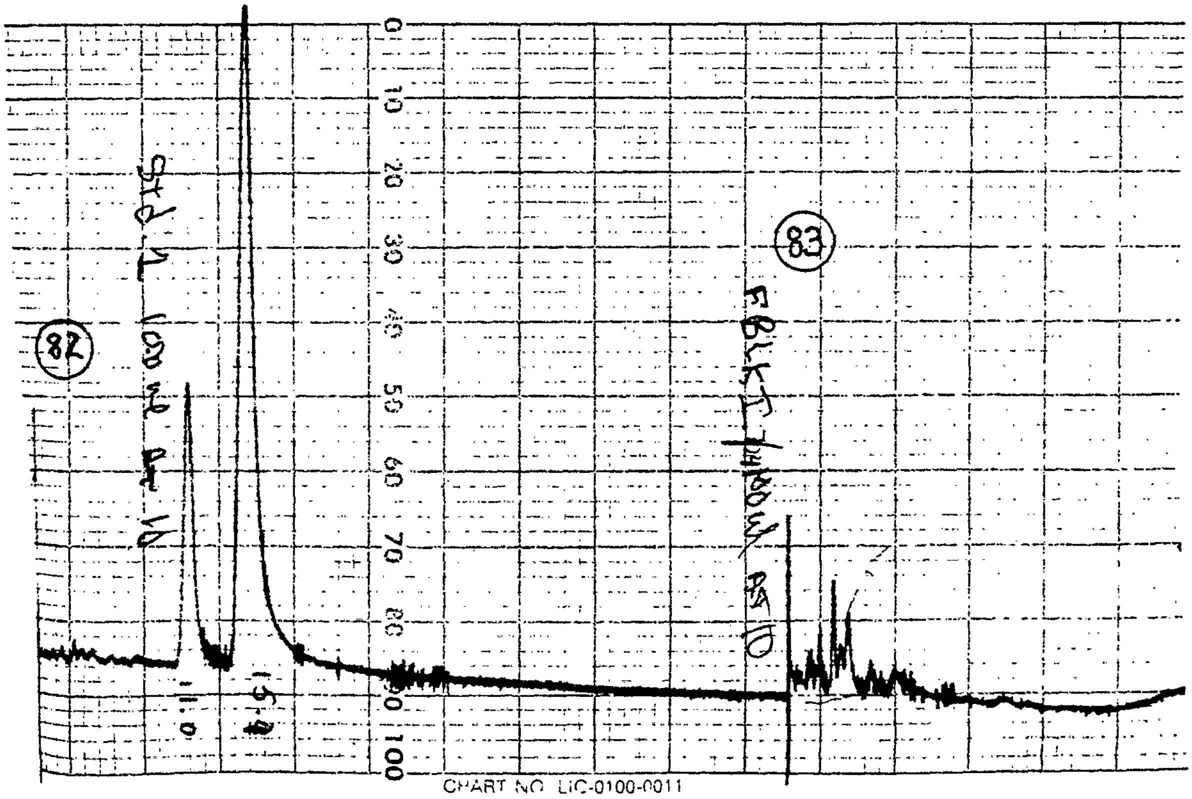

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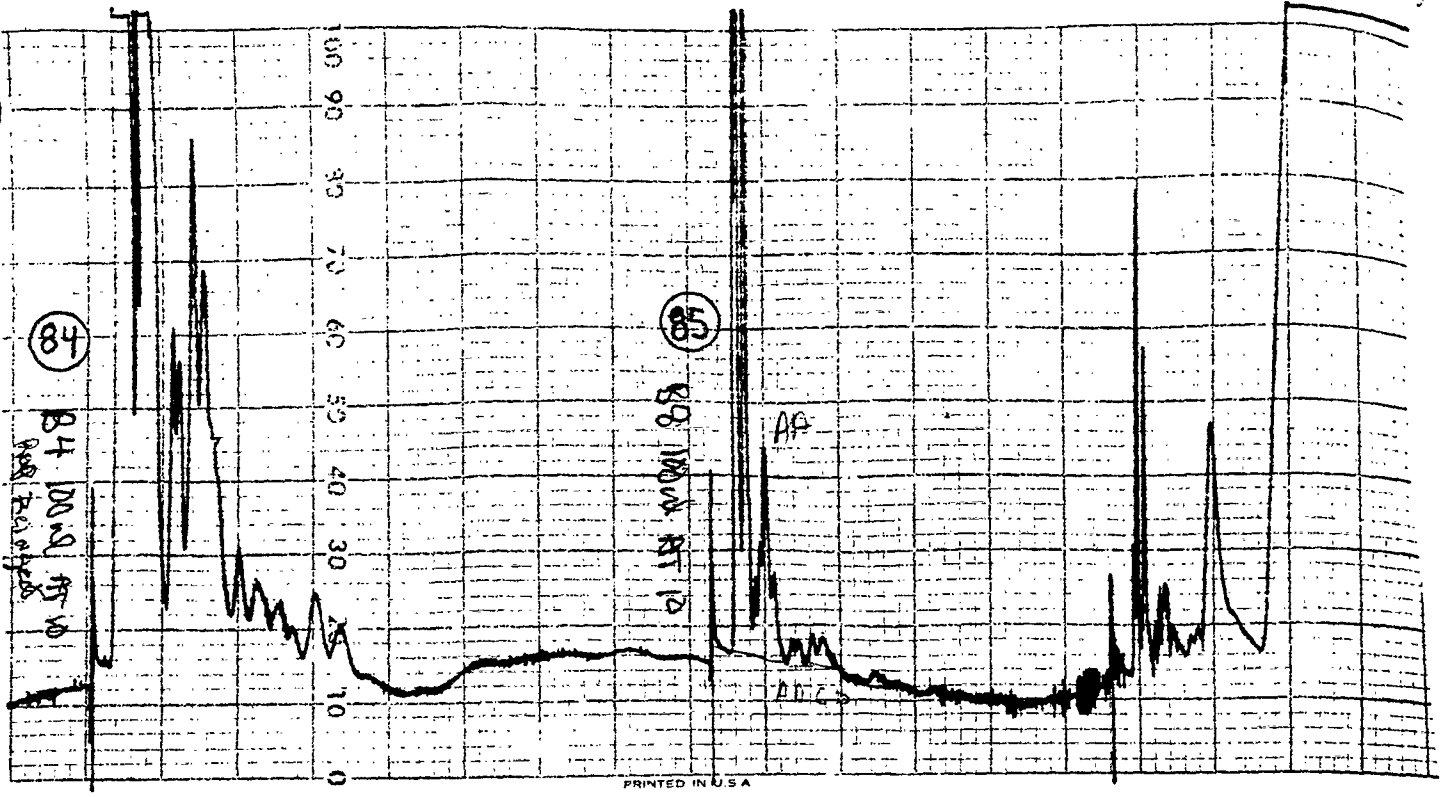

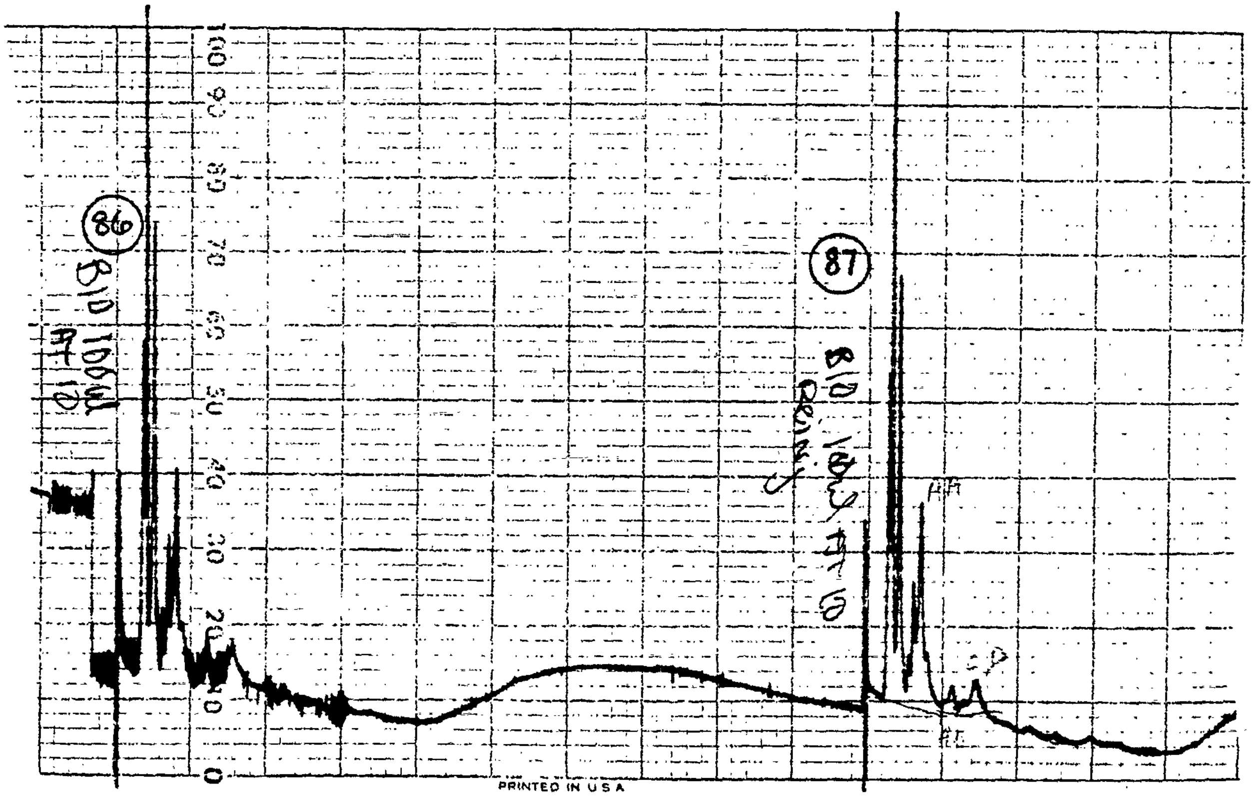

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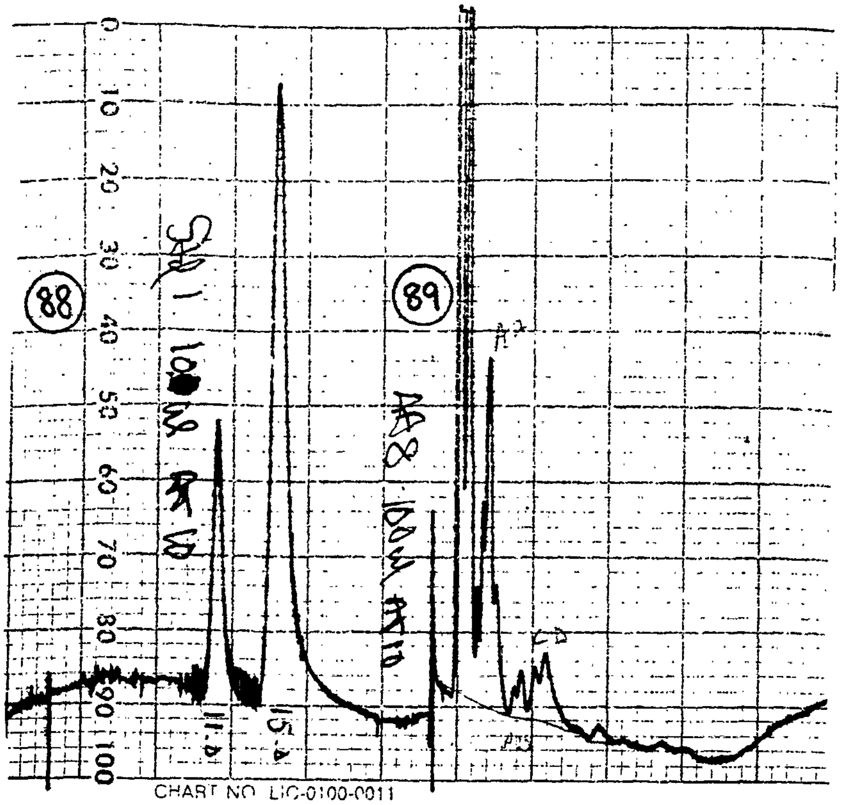

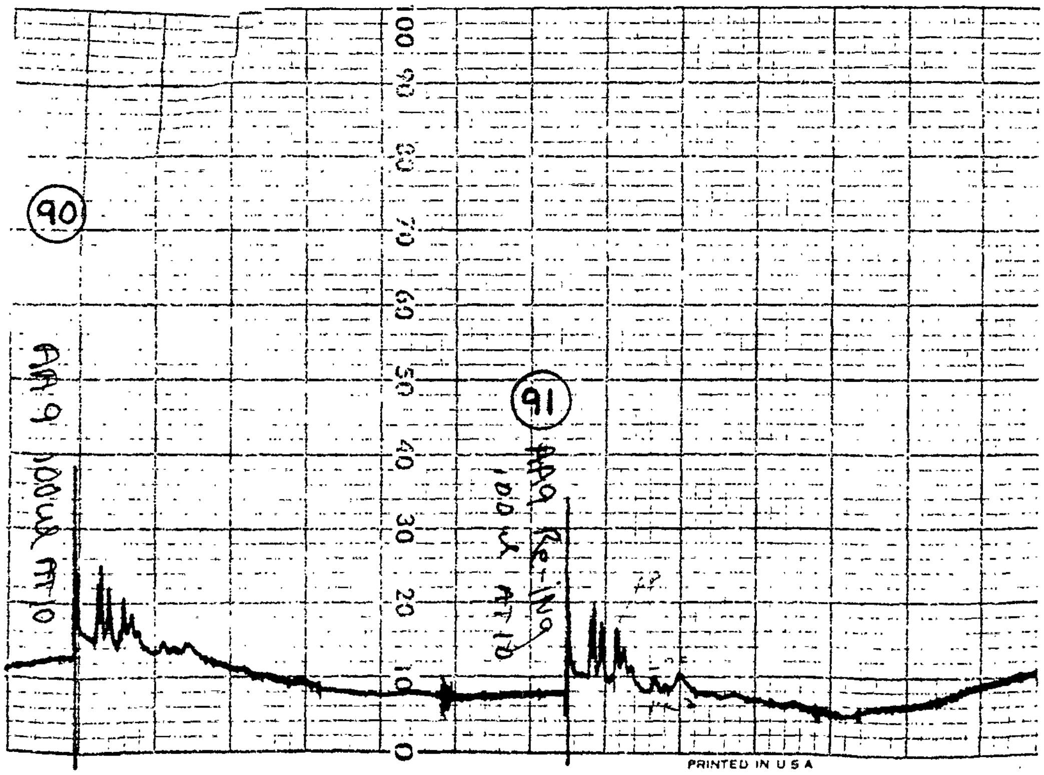

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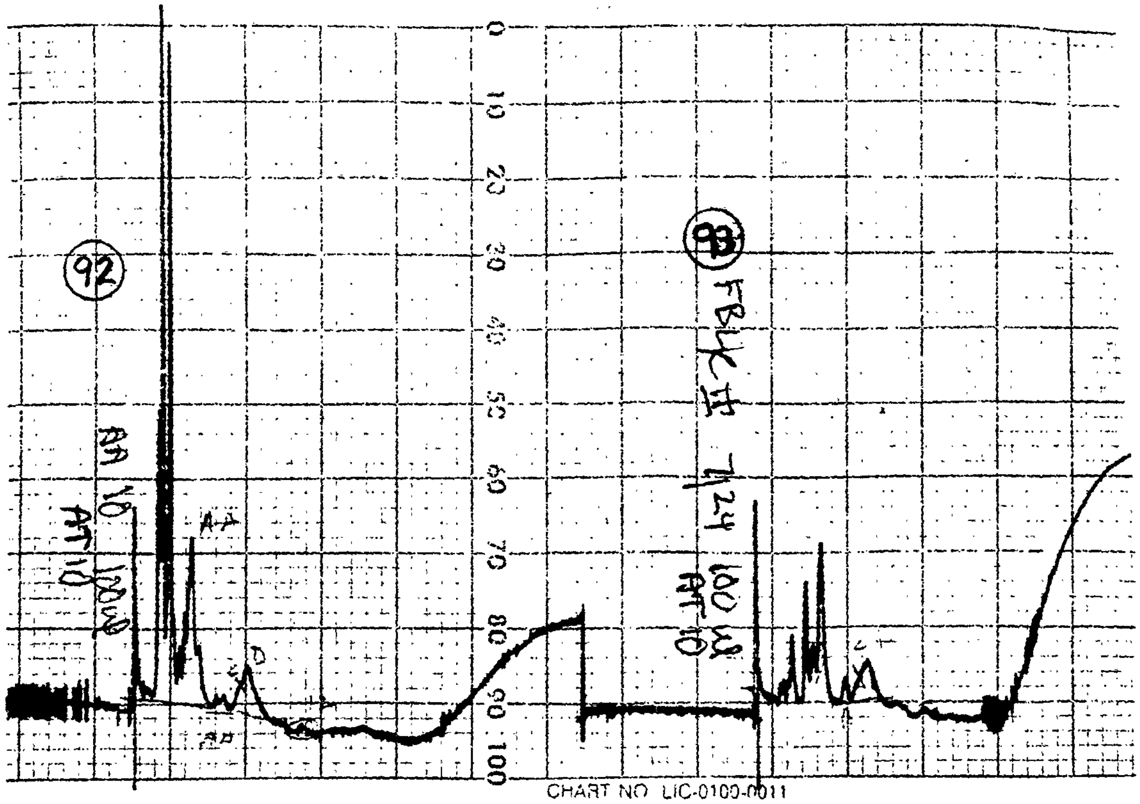

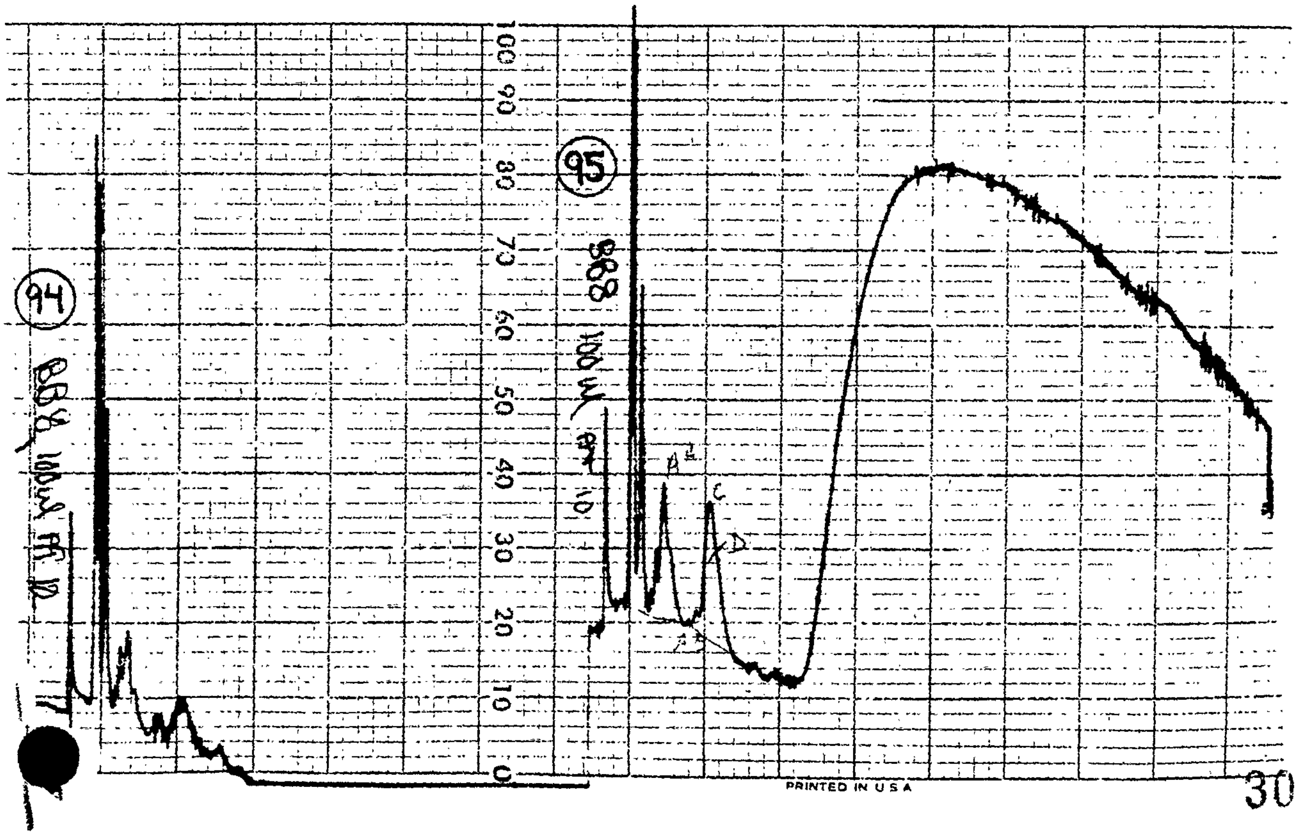

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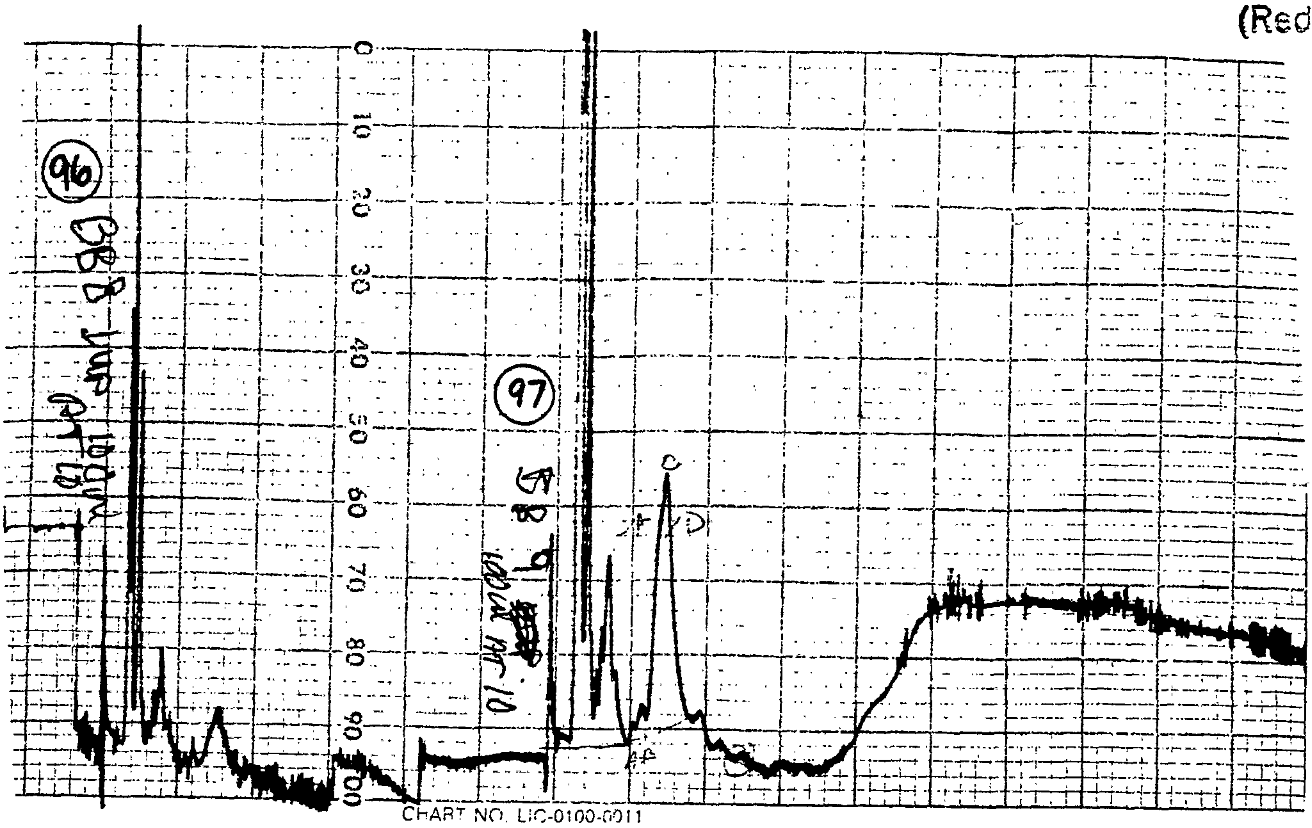
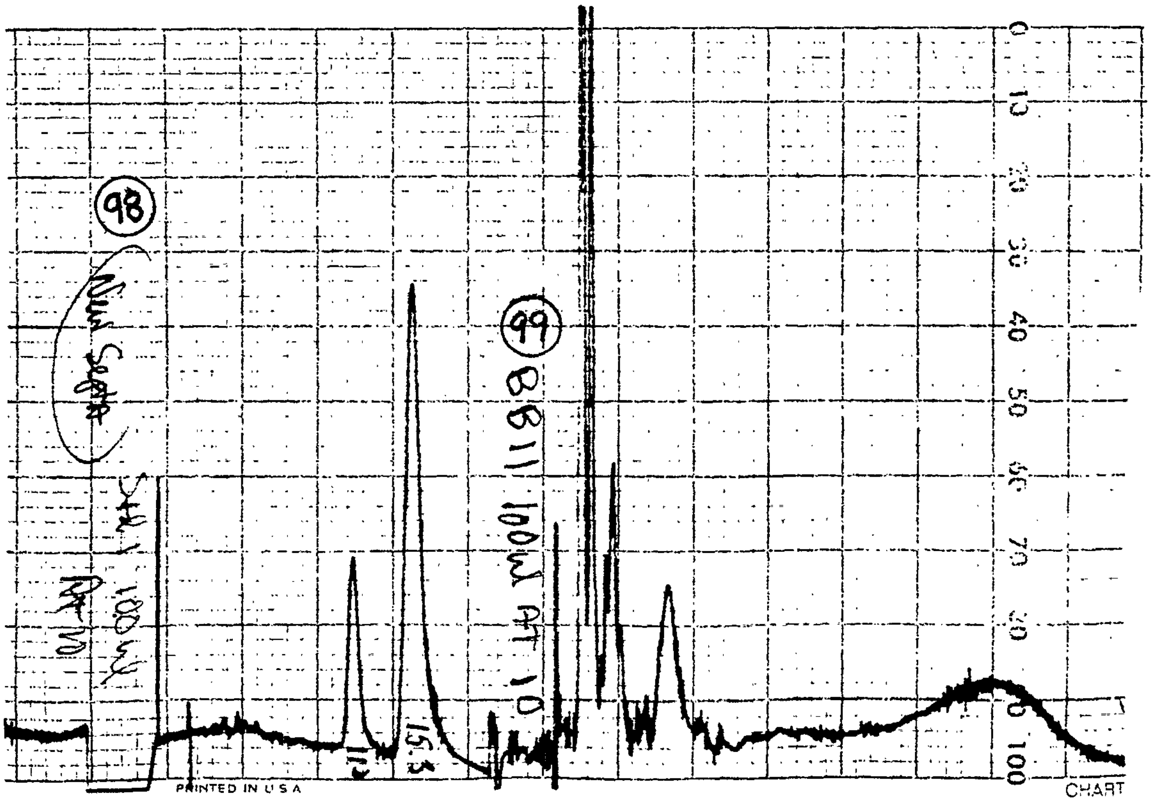
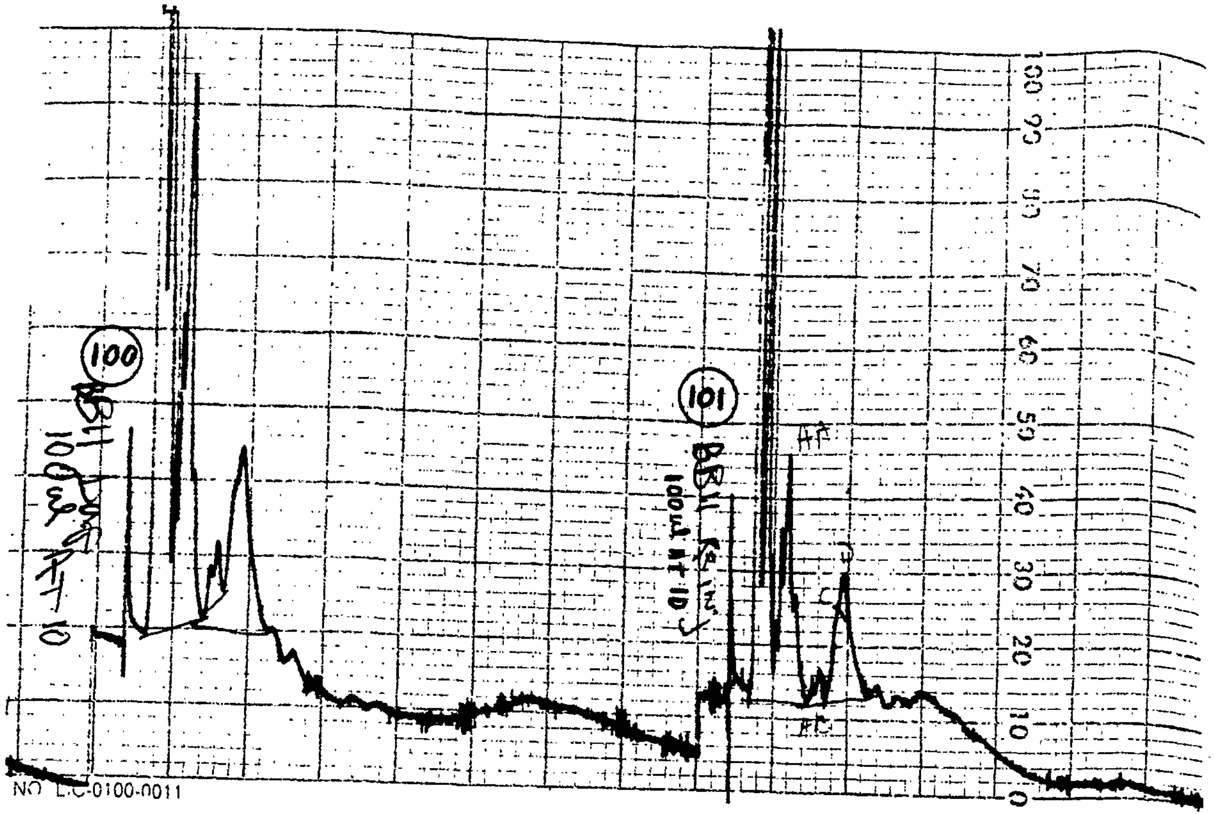
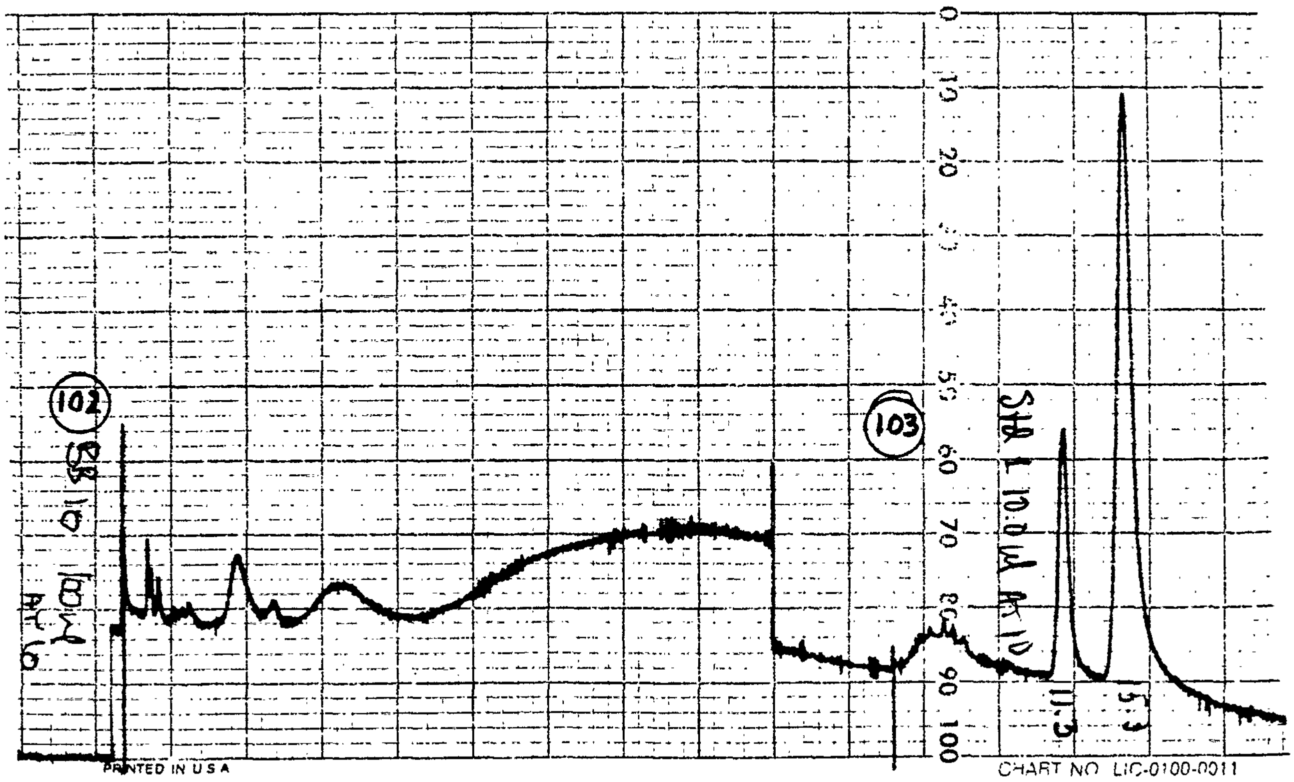


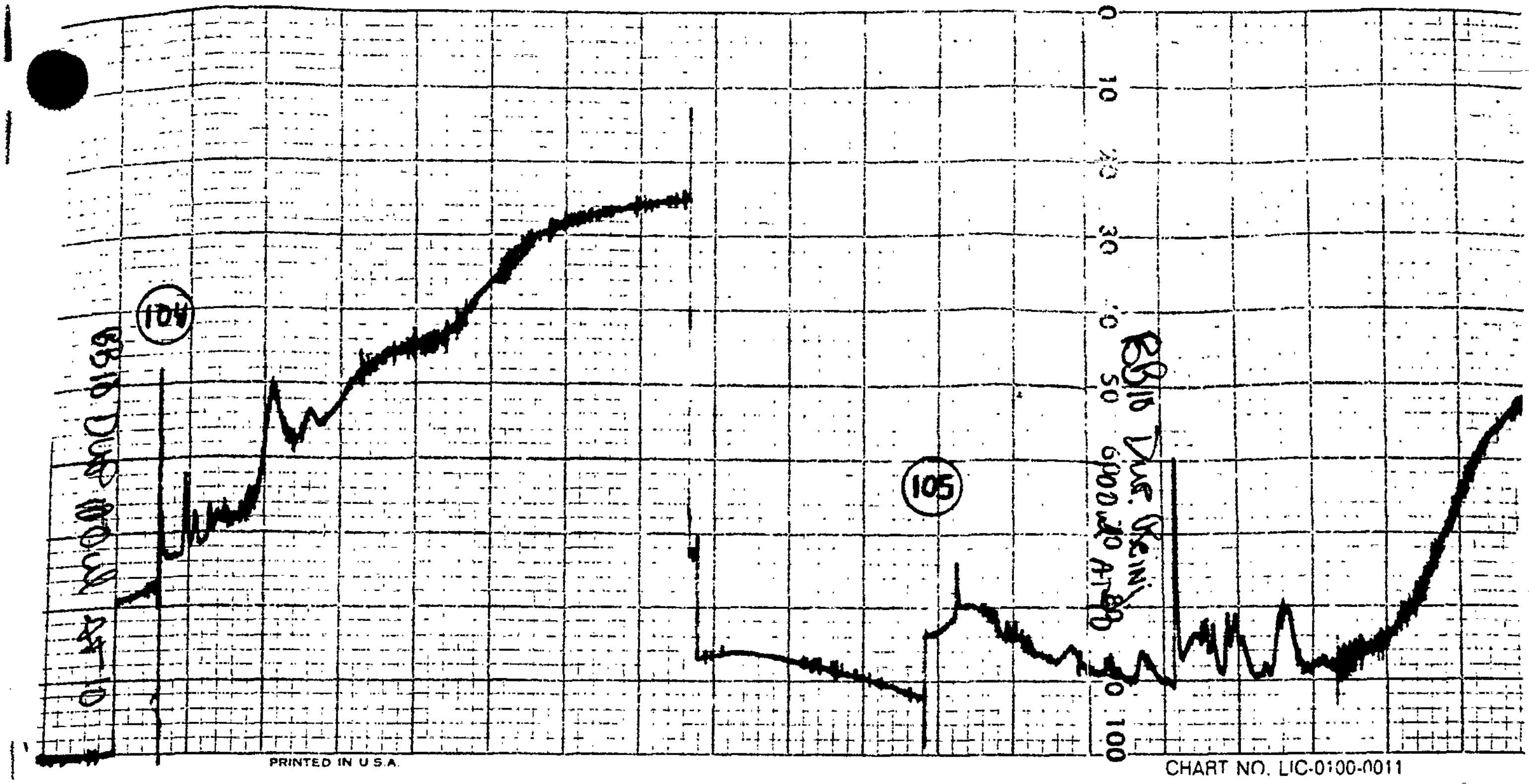


ORIGIN

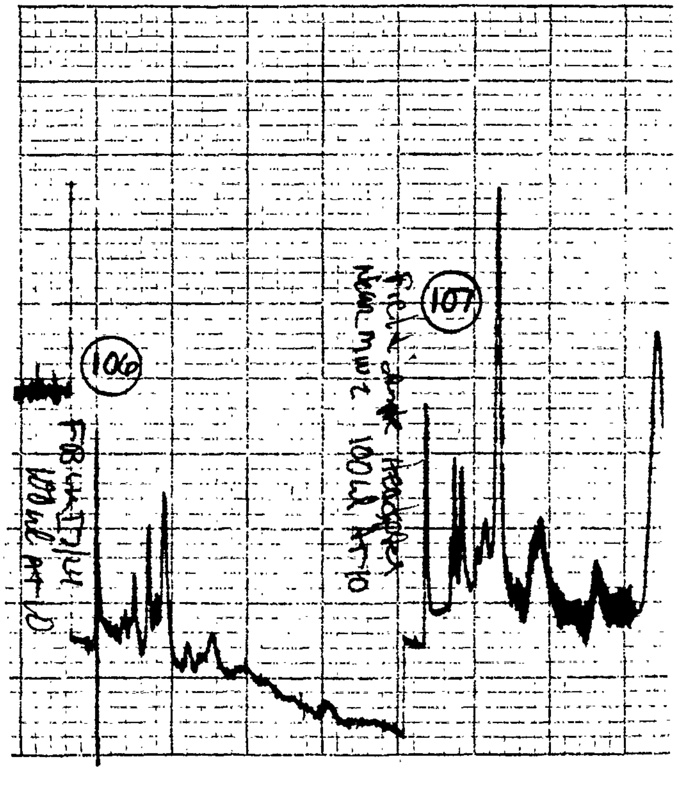

100
BB11 Dup
100µl AT 10
101
BB11 (Re-inj)
100µl AT 10
AF
AF
C
0
10
20
30
40
50
60
70
80
90
100
NO LIC-0100-0011


102
SB 10 100µl
AT 10
103
STD 1 10.0µl AT 10
11.3
5.3
0
10
20
30
40
50
60
70
80
90
100
PRINTED IN U S A
CHART NO LIC-0100-0011

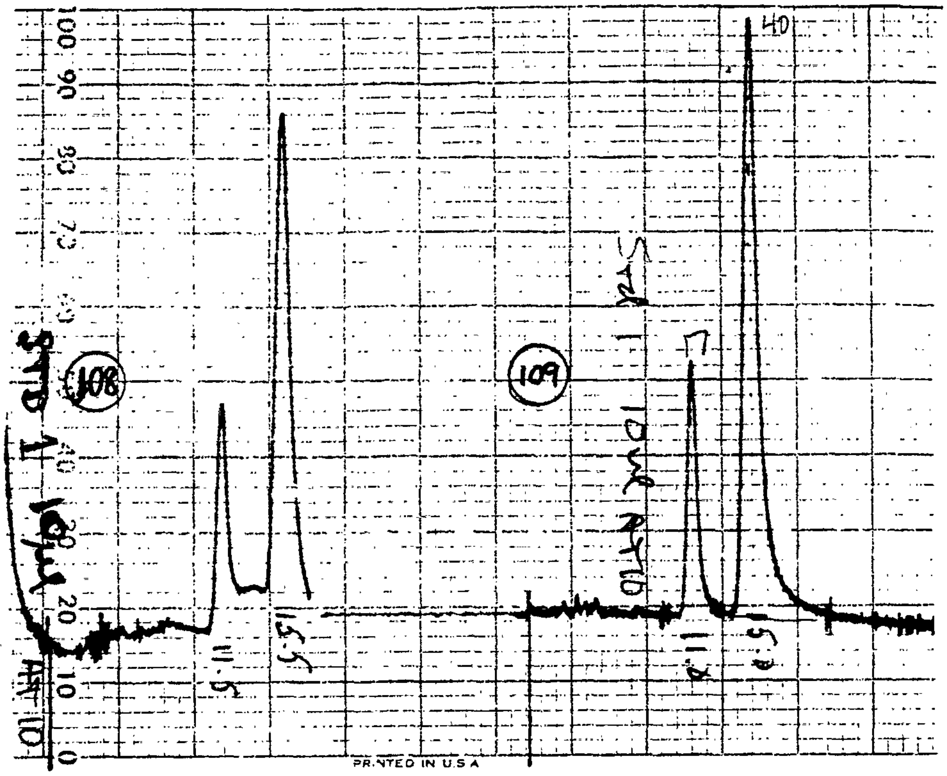
ORIG...
(Red)



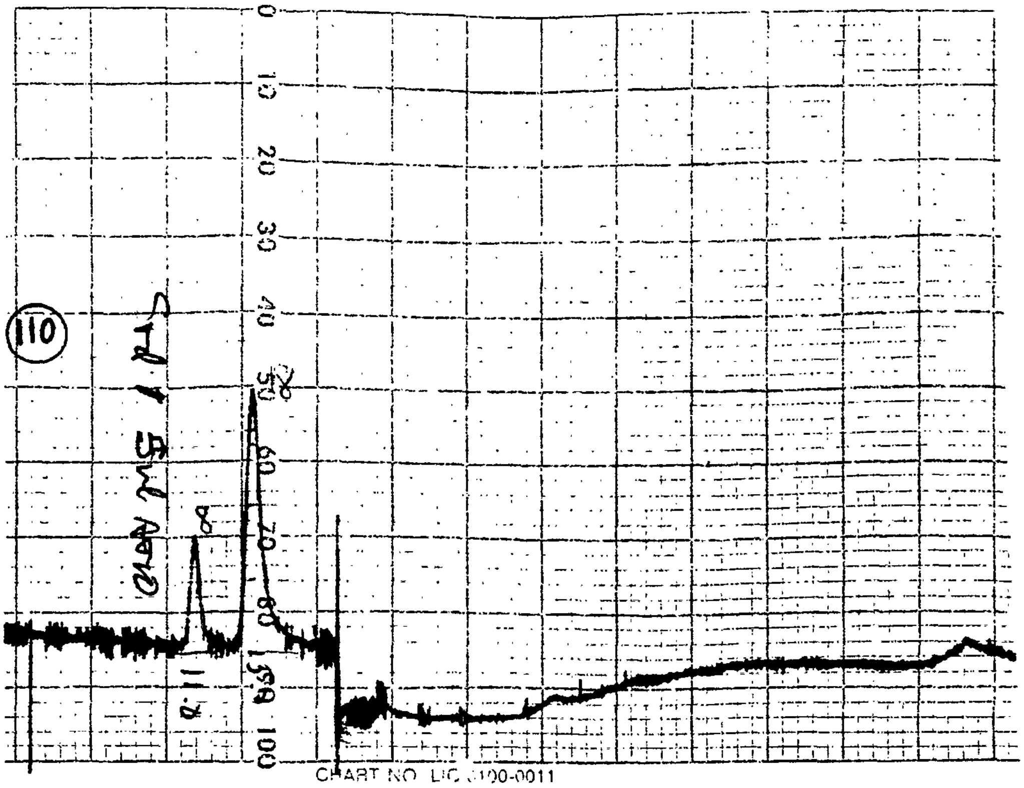
0
10
20
30
40
50
60
70
80
90
100
104
BB10 DUP 100ul AT 10
105
BB10 Dup. Reinj 600ul AT 10
PRINTED IN U.S.A.
CHART NO. LIC-0100-0011

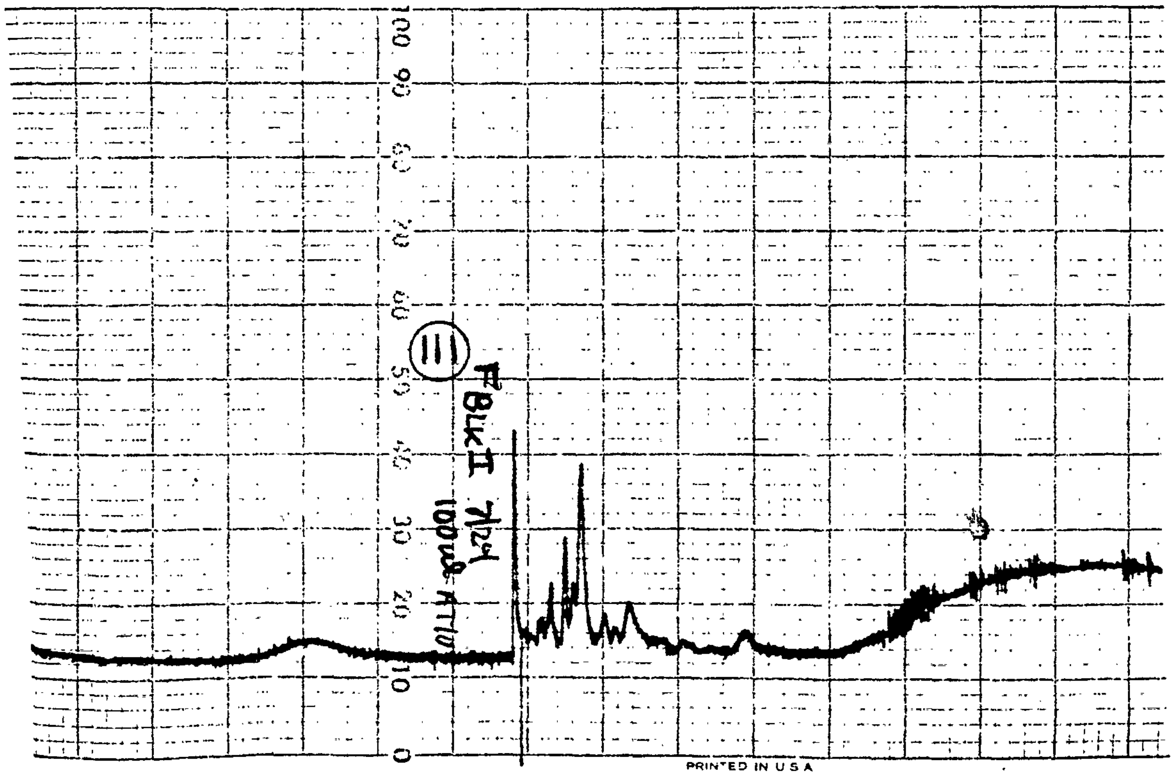


106
FB44 I7/24
100ul AT 10
107
Field blank Headspace
Near MW2 100ul AT 10


100
90
80
70
60
40
30
20
10
0
STD 1 10μl
ATT 10
108
11.5
15.5
109
Std 1 10μl ATT 10
17
11.8
40
15.0
PRINTED IN U.S.A

ORIGINAL
(Red)





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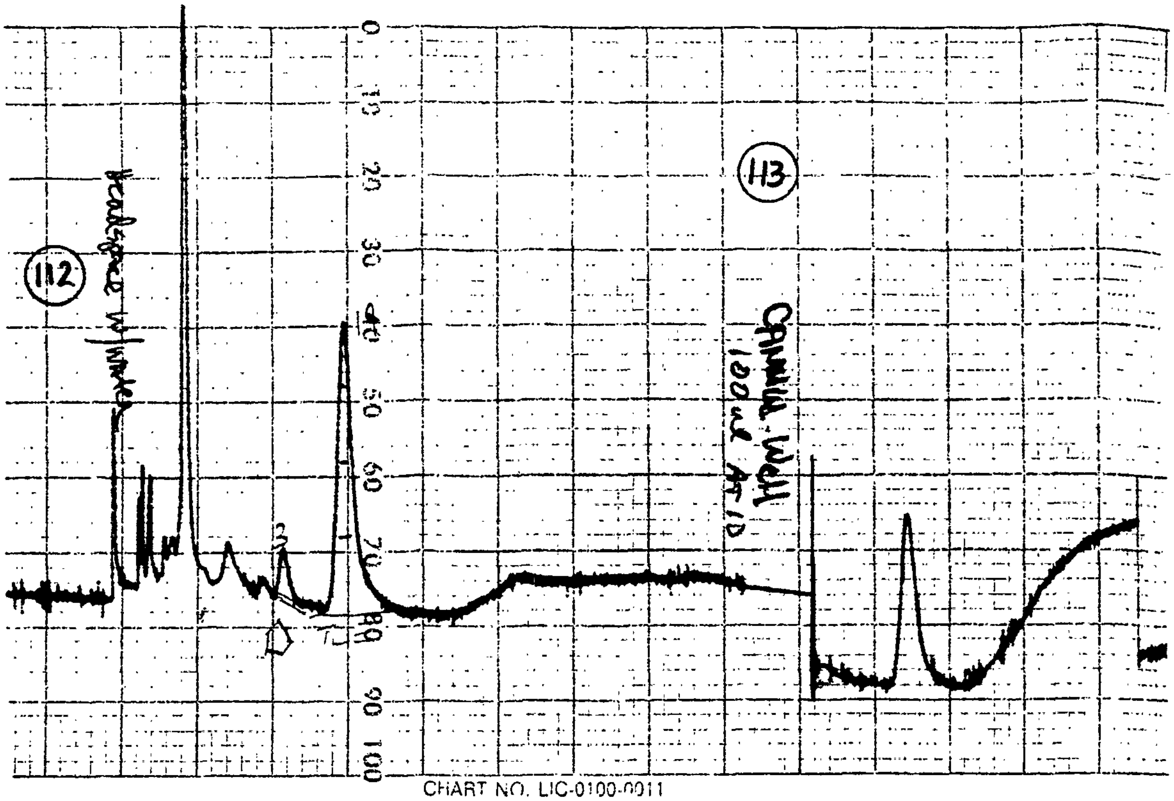

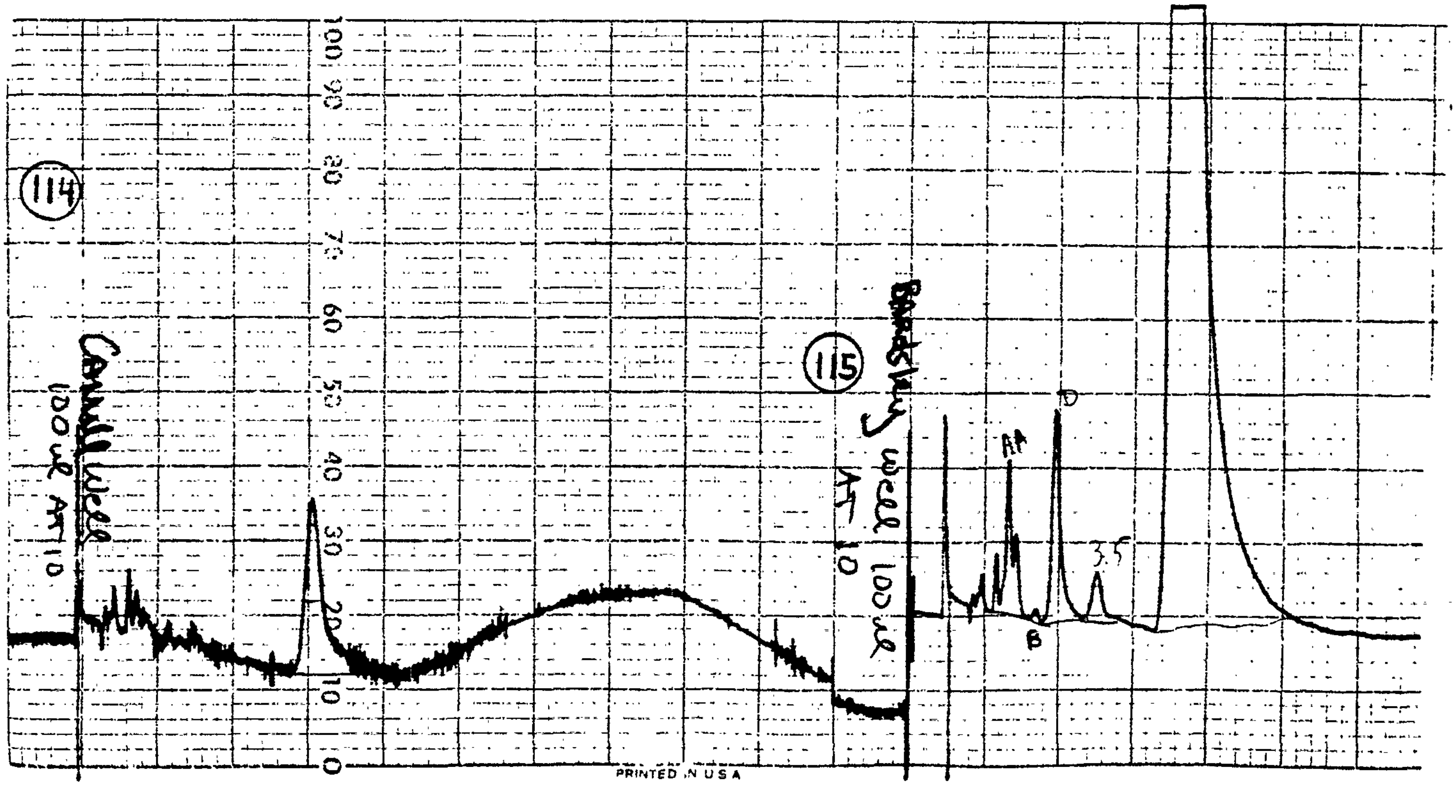

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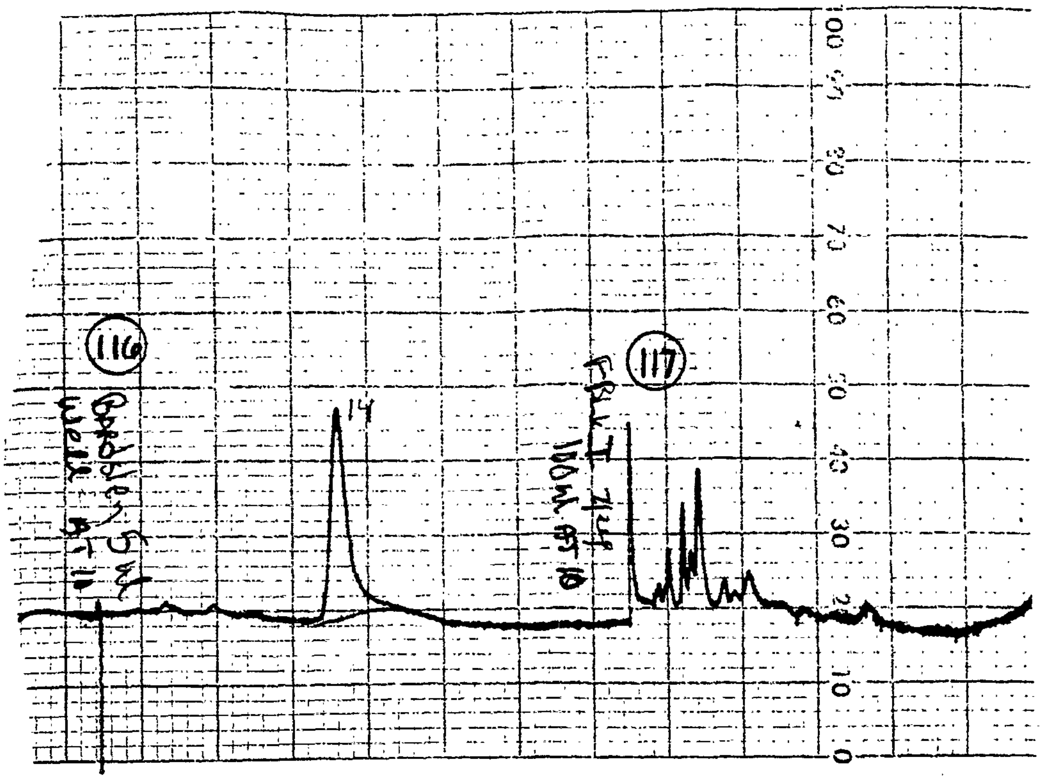

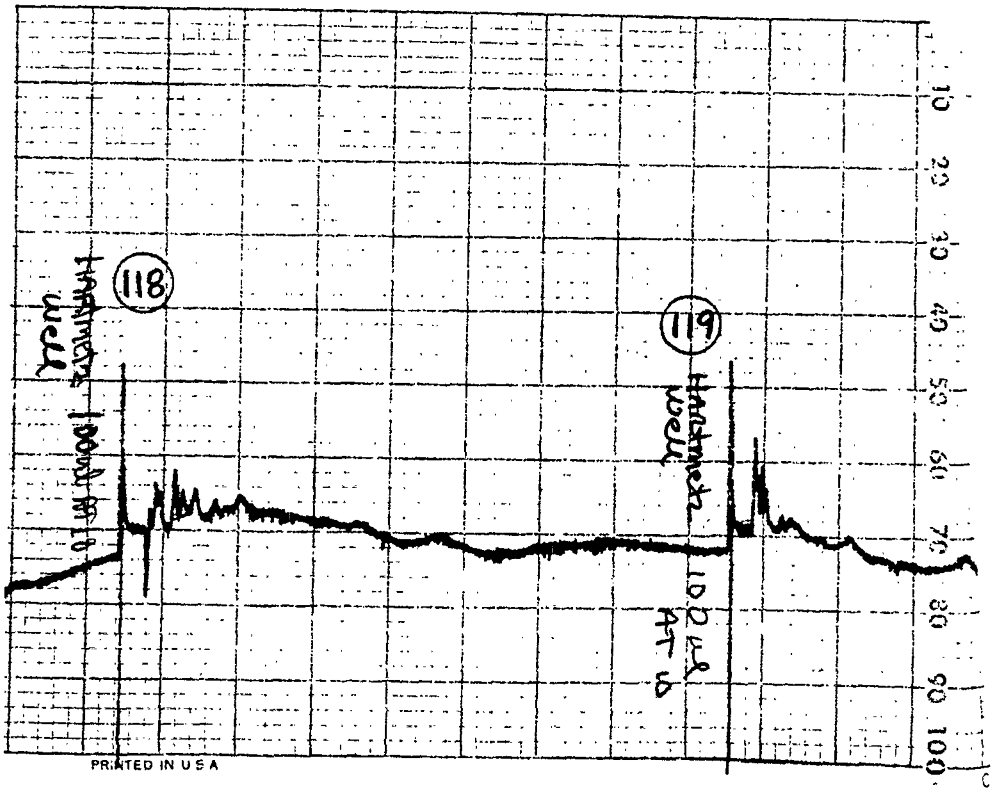

ORIGINAL
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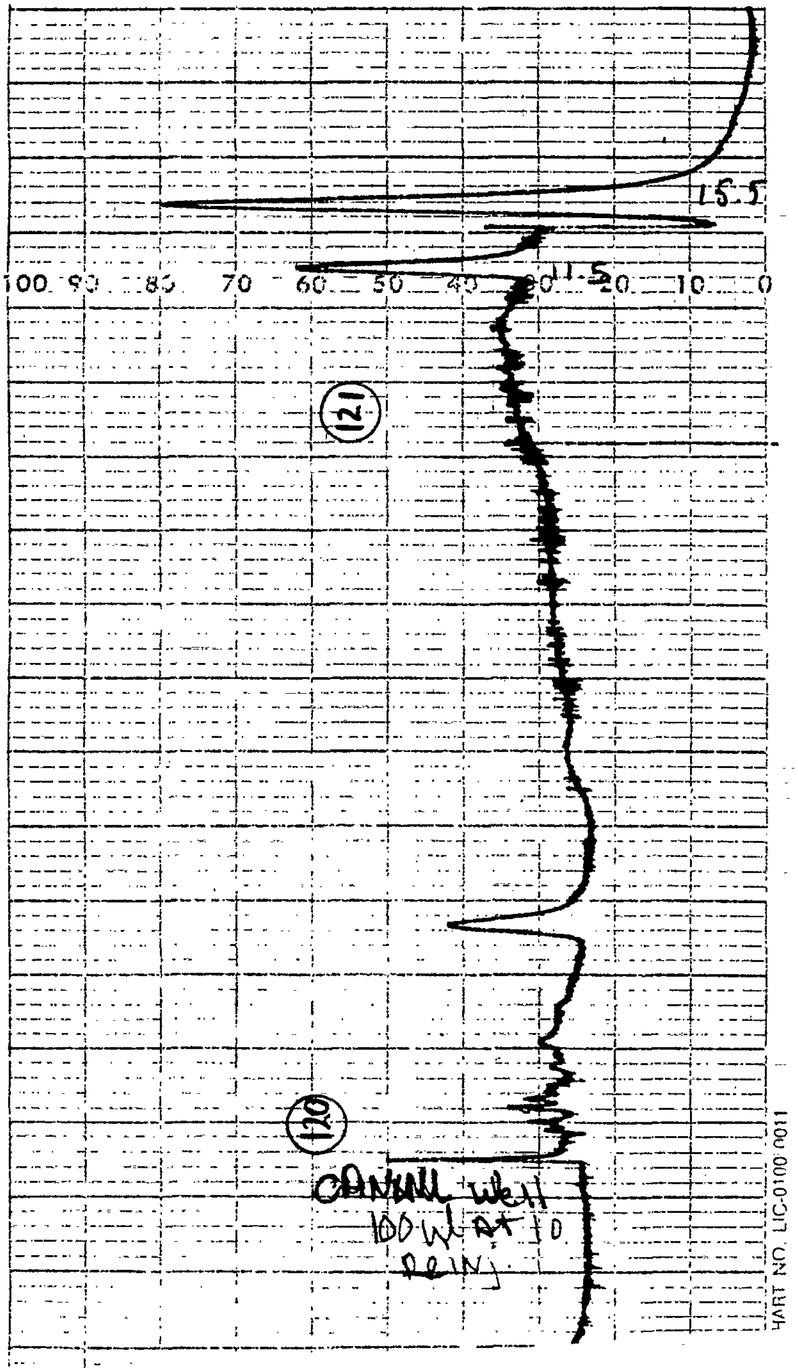

APPENDIX 8