SDMS Document
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Volume II

Appendices for Draft Feasibility Study for the First Operable Unit of the SCP/Carlstadt Site

12 April 1989

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APPENDICES FOR PRELIMINARY FEASIBILITY STUDY FOR THE FIRST OPERABLE UNIT

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APPENDIX A
FEASIBILITY STUDY WORK PLAN

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Appendix A
FS Work Plan

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APPENDIX A

On 14 December 1988 a Work Plan for the Feasibility Study/First Operable Unit was submitted to USEPA Region II. Following a review of the Work Plan EPA transmitted on 12 January 1989, comments to be incorporated into the Work Plan. The comments were resolved and a Work Plan for the FS/FOU dated 15 February 1989 was transmitted to EPA.

During a meeting with EPA in Edison, New Jersey on 21 February 1989, EPA suggested a few minor changes be made to the Work Plan dated 15 February 1989 and that the changes would be requested in a letter to the Facility Coordinator of the PRP Committee.

The current Work Plan is that of 15 February 1989.

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FEASIBILITY STUDY WORK PLAN
FOR THE FIRST OPERABLE UNIT
SCIENTIFIC CHEMICAL PROCESSING SITE
CARLSTADT, NEW JERSY

15 February 1989

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FILE NO. 802-01-00-01

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SECTION 1

INTRODUCTION

1.1 Scope and Objectives of This Feasibility Study for the First Operable Unit

This document is a Work Plan for the Feasibility Study (FS) to be conducted for the remediation of on-site sources at the Scientific Chemical Processing Site in Carlstadt, New Jersey (SCP/Carlstadt site). It is designed to identify and evaluate source control alternatives for the remediation of the first operable unit (on-site sludges, surface soils above the clay, and shallow ground water).

A number of information sources including journal articles and vendor literature will be used to evaluate remedial technologies. Sufficient information is available to evaluate a number of remedial technologies; however, there are certain innovative, emerging, or highly site-dependent technologies for which available information is not adequate to complete these evaluations without treatability testing. Part of the Feasibility Study/First Operable Unit (FS/FOU) will include treatability studies of limited scope on at least three remediation technologies. These treatability studies will be performed to help assess the feasibility, practicality and effectiveness of various source control remedial technologies. The technologies investigated in these studies may or may not become part of the remedial alternative(s) recommended at the conclusion of the FS/FOU. The remedial alternatives evaluated in the FS/FOU may consist of more than one remedial technology. The scope of these treatability studies is provided in Section 4.

1.2 Work Plan Format

The Superfund Amendment and Reauthorization Act (SARA) was enacted in October 1986. The current SARA guidance (Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final, September 1988) is being followed in the development of the format of this FS/FOU report.

In accordance with SARA, this FS/FOU Work Plan is divided into three phases:

- Phase I: Development of Source Control Alternatives

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- Phase II: Initial Screening of Source Control Alternatives

- Phase III: Detailed Analysis of Source Control Alternatives

Also included with this Work Plan is a section defining the schedule for completion of the various tasks in the FS/FOU.

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SECTION 2

PHASE I

DEVELOPMENT OF SOURCE CONTROL ALTERNATIVES

2.1 Description of Proposed Response

The first section of the FS/FOU will define and describe the portion of the site which is being addressed. This determination will be based upon data provided in the on-site Remedial Investigation (RI) draft report and evaluations from the Alternatives Array document. Utilizing these data, a site-specific statement of purpose for remedial response will be developed. This response will address the human health risk, environmental impacts, and exposure pathways of concern to the EPA. Additionally, a statement of response will be developed to ensure compliance with the most recent regulatory requirements and guidelines for the Superfund Amendments and Reauthorization Act of 1986 (SARA).

2.2 Identification of Preliminary Remedial Technologies (Task 1)

Following a description of the current situation and the purpose of the response, the FS/FOU will develop a rational screening process that will lead to selection of appropriate remedial action(s) for source control of the Scientific Chemical Processing site. Based upon the known site problems, pathways of exposure, and statement of purpose, the potentially feasible technologies appropriate as source control will be identified. The first step in this process is to identify appropriate general response actions that present a coordinated remedy for source control at the site. Table 2-1 presents a matrix of general response actions that may be considered. A final determination on those actions will be based upon data developed in the RI and the Public Health Assessment (PHA) regarding site conditions, waste characteristics and migration pathways.

Based upon the determination of the potentially applicable general response actions, the next step in the FS/FOU process will be to identify feasible technologies associated with each of these general response actions. Potential remedial technologies that may be associated with each of the applicable general response actions may include, but are not limited to those listed on Table 2-2.

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TABLE 2-1

REMEDIAL RESPONSE ACTIONS FOR SOURCE CONTROL
AT THE SCP/CARLSTADT SITE

Response Actions	Sludges	Surface Soils	Shallow Ground Water	Surface Water
No Action	X	X	X	
Containment	X	X	X	X
Lowering Shallow Ground Water Table/ Ground Water Recovery			X	
Complete Removal	X	X		
Partial Removal	X	X		
On-Site Treatment	X	X	X	
Off-Site Treatment	X	X	X	
On-Site Disposal	X	X	X	
Off-Site Disposal	X	X	X	

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TABLE 2-2

POSSIBLE REMEDIAL TECHNOLOGIES ASSOCIATED WITH GENERAL RESPONSE ACTIONS FOR SOURCE CONTROL[1] AT THE SCP/CARLSTADT SITE

- No Action or Limited No Action
- Containment
  - a) Capping
  - b) Slurry Walls
- Lowering of Shallow Aquifer Water Table/Ground Water Recovery
  - a) Pumping Wells
  - b) Interceptor Trenches
  - c) Subsurface Drains
- Diversion of Run-On and Run-Off
  - a) Diversion Channels
  - b) Dikes/Berms
- Complete Removal
  - a) Excavation
- Partial Removal
  - a) Excavation
- On-Site Treatment of Shallow Ground Water
  - a) Air Stripping[2]
  - b) Liquid Phase Carbon Adsorption
  - c) Chemical Treatment (e.g., UV/Hydrogen Peroxide)
- On-Site Treatment of Sludges and Soils
  - a) Volatiles Stripping
  - b) Stabilization/Solidification
  - c) Thermal Treatment/Incineration
  - d) Contaminant Removal via Solvent Extraction
  - e) Vitrification

TABLE 2-2 (continued)

- Off-Site Treatment of Shallow Ground Water via Treatment by a Publicly-Owned Treatment Works (POTW)

- Off-Site Treatment of Sludges and Soils

  a) Thermal Treatment (e.g., incineration)
  b) Contaminant Removal via Solvent Extraction
  c) Chemical Detoxification

- On-Site Disposal of Sludges and Soils

  a) RCRA Vault
  b) RCRA Landfill

- Off-Site Disposal of Sludges and Soils

  a) RCRA Landfill
  b) Pretreatment and Disposal in a RCRA Landfill

- Off-Gas Treatment

  a) Vapor-Phase Carbon Adsorption
  b) Fume Incineration

FOOTNOTES:

(1) Sludges mentioned in this table refer potentially to sludges present in both the pit and the tank located on site.

(2) Air stripping typically must be followed by treatment of the air stripper exhaust (or off-gas treatment), which is listed separately on this table.

Next in the evaluation of source control remedial technologies will be the screening of the initial list of the remedial technologies. The screening will eliminate those technologies that are clearly inapplicable or not feasible as a component for a source control remedy. This screening will be based on site conditions, waste characteristics and technical criteria for remediation. Characterization of site conditions will be based on RI data, ground water and soil characteristics. Technical criteria will include performance, constructability, operation and maintenance, and the status of the technical development of the remedial technologies. Where appropriate, innovative technologies will not be screened out because of a limited record of performance.

To aid in the evaluation and selection of technologies for the remediation of soils, sludge and ground water, a limited scope of treatability studies will be conducted as part of the FS/FOU. A statement of work for these studies has been prepared and is included as Section 4 of this Work Plan.

2.3 Development of Source Control Alternatives (Task 2)

Remedial source control technologies that have passed through the previous screening process will be combined, as necessary, into remedial source control alternatives. Because of the host of chemical compounds present at the site, it is expected that multiple technologies will be required to achieve the desired level of remediation. Therefore, combinations of different treatment technologies and combinations of treatment and containment technologies will be developed in this Task.

In the development of the remedial source control alternatives, the following types of alternatives should be developed to the extent practicable:

- A number of treatment alternatives ranging from one that would eliminate or minimize to the extent feasible the need for long-term management (including monitoring) at a site to one that would use treatment as a primary component of an alternative to address the principal threats at the SCP site. Alternatives within this range typically will differ in the type and extent of treatment used and the management requirements of treatment residuals or untreated wastes.

- One or more alternatives that involve containment of waste with little or no treatment but protect human health and the environment by preventing potential exposure and/or reducing the mobility of contaminants.

- A no-action alternative or a limited no-action alternative, which may include some minimal actions such as fencing,

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using institutional controls, or monitoring, if no action at all is clearly not viable.

Based upon the data and information developed, as well as the preliminary technology screening, remedial source control alternatives will be developed for further evaluation. Examples of remedial alternatives for each medium are provided in Table 2-3. These alternatives will be further described in Phase II of the FS/FOU. For the final evaluation of alternatives, remedial source control technologies for each of the various media requiring remediation will be combined so that all media identified to be addressed in this FS/FOU are evaluated in the Phase III analysis. If no technologies can be identified which are feasible for remediating one of the types of media, the FS/FOU could conceivably result in the recommendation of an alternative which remediates most but not all of the media.

TABLE 2-3

EXAMPLES OF POTENTIAL SOURCE CONTROL ALTERNATIVES
FOR THE SCP/CARLSTADT SITE

CONTAMINATED SLUDGES AND SOILS: (1)

- No Action or Limited No Action Alternative

- Containment Alternatives

  a) Capping
  b) Barrier Walls
  c) Capping/Barrier Walls

- Off-Site Treatment Alternatives

  a) Excavation/Stabilization or Solidification
  b) Excavation/Thermal Treatment
  c) Excavation/Above-Ground Solvent Extraction
  d) Excavation/Above-Ground Chemical Treatment

- Off-Site Disposal Alternatives

  a) Excavation/RCRA Vault
  b) Excavation/RCRA Landfill

- On-Site Disposal Alternative

  a) Excavation/RCRA Vault
  b) Excavation/RCRA Landfill

- On-Site Treatment/On-Site Disposal Alternatives

  a) Above-Ground Solvent Extraction/RCRA Vault

  b) Excavation/Thermal Treatment/Stabilization or Solidification/RCRA Landfill

  c) Above-Ground Solvent Extraction/Stabilization or Solidification/RCRA Vault

  d) Excavation/Stabilization or Solidification/RCRA Landfill

  e) Excavation/Stabilization or Solidification/RCRA Vault

  f) In Situ Vacuum Extraction/Stabilization or Solidification/RCRA Vault

TABLE 2-3 (continued)

- On-Site Treatment/Off-Site Disposal Alternatives

  a) Above-Ground Solvent Extraction/Disposal in Off-Site Landfill

  b) Excavation/Thermal Treatment/Disposal of Ash in Off-Site Landfill

  c) Excavation/Thermal Treatment/Stabilization or Solidification of Ash/Disposal in Off-Site Landfill

  d) Excavation/On-Site Stabilization or Solidification/ Disposal in RCRA Landfill

SHALLOW GROUND WATER ("WATER TABLE AQUIFER")

- Water Table Control and Ground Water Recovery and Treatment (Via any combination of technologies).

Water Table Control	Ground Water Recovery	Treatment
a) Pumping Wells	a) Pumping to Treatment Unit	a) Air Stripping
b) Well Points	b) Gravity Flow to Treatment Unit	b) Air Stripping/ Off-Gas Treatment(2)
c) Interceptor Trenches	c) Induced Flow to Treatment Unit	c) Liquid-Phase Carbon Adsorption
d) Subsurface Drains		d) Chemical Treatment
		e) Treatment at the Local POTW

FOOTNOTES:

(1) Sludges mentioned on this table refer to sludges present in both the pit and the tank on site.

(2) Off-gas treatment may consist of Vapor-Phase Carbon Adsorption, Fume Incineration, or other treatment technology.

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SECTION 3

PHASE II

INITIAL SCREENING OF SOURCE CONTROL ALTERNATIVES

3.1 Alternatives Screening Process (Task 3)

Phase II will initially evaluate the remedial source control alternatives previously developed. This phase is an interim screening process prior to the detailed evaluation of the alternatives which will be conducted in Phase III.

The screening to be performed during this phase will evaluate effectiveness in protecting human health and the environment, technical and administrative feasibility, and costs of the remedial alternatives.

The evaluation of effectiveness in protecting human health and the environment offered by each alternative will consider the protectiveness that the alternative will provide, and the reductions in toxicity, mobility or volume that the alternative will achieve. A qualitative assessment of protectiveness may be performed for each of the alternatives as part of this evaluation. Those alternatives which are unacceptable in providing effective protection of human health and the environment, will be eliminated from further consideration.

Those alternatives that do satisfy the environmental objectives without causing unacceptable effects will then be evaluated with regard to their technical feasibility. This evaluation may rely upon the results of treatability testing, technology evaluation as reported in engineering and scientific literature, engineering calculations, past experience and other acceptable means. Those alternatives which rely upon a technology that is difficult to implement, which take a relatively long time to achieve the remedial objective, which have a high probability of failure or which pose an unacceptable risk to human health and/or the environment, will be eliminated.

Only those alternatives that satisfy the environmental and technical criteria will be subjected to a cost analysis. The purpose of considering costs at this time will be to eliminate those alternatives whose costs are significantly higher than others, unless significant environmental, public health, or reliability benefits are realized by this additional cost.

Preliminary cost estimates will be developed with an accuracy range of -30% to +50%. The cost estimates will be based upon

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block flow diagrams, treatment volumes or flow rates, and other appropriate information developed for each alternative. From this information, cost estimates that rely upon standard cost indices, cost estimates from similar projects, and other readily available information will be developed. Where such information is not readily available for an alternative, as may be the case for an innovative technology, costs will be conservatively developed using best engineering judgment.

Estimates will be developed for capital and operating and maintenance costs of each alternative. These estimates will then be utilized to develop the present worth of the competing alternatives. The costs will then be compared. Alternatives that are an order of magnitude more expensive than their competing alternatives will be eliminated if they offer similar or fewer environmental, public health, or reliability benefits. Competing alternatives that are significantly more expensive but offer substantially greater environmental, public health, or reliability benefits will not be eliminated.

Those alternative remedial actions which remain will then be subjected to a more comprehensive comparative analysis in Phase III.

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SECTION 4

TREATABILITY STUDIES

A number of information sources, including journal articles and vendor literature, will be used to evaluate remedial technologies. While sufficient information is available to evaluate a number of remedial technologies, there are certain technologies for which available information may not be adequate to complete their evaluation without treatability testing. In Task 4, Preliminary Treatability Study, three technologies will be evaluated by conducting a limited scope of treatability testing. The studies must be limited due to the short time period available to complete the FS/FOU. They will be performed concurrently with Phases I and II of this FS/FOU.

The studies will assist in evaluating the recommended process options for treatment of soils, sludges (i.e., sludge in both the pit and the tank located on site), and ground water from the shallow aquifer. The technologies investigated in these studies may or may not become part of the remedial alternative(s) recommended at the conclusion of the FS/FOU.

This section lists the objectives of the proposed treatability work, the methods to be used, and the rationale for the testing approach.

4.0 Treatability of Surficial Soils and Sludge

The treatability study for surficial soils and sludge will be conducted in two phases. Part I will consist of the actual treatability tests, while Part II will consist of the comparative analysis, selection, and conceptual design of those technologies (or remedies) evaluated in the study. Part II will also include preparation of cost estimates for completing detailed evaluation of soil and sludge remediation alternatives.

4.1 Program - Part I

4.1.1 Solidification/Stabilization Testing

a. Carry out solidification tests on surficial soils and sludge at the site.

b. Assemble and tabulate the test results.

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c. Evaluate the test data to determine the potential for immobilizing the soil/sludge utilizing a solidification/stabilization technology.

d. Select the optimum solidification design mix and processing procedures.

e. Prepare the solidification/stabilization section of the overall treatability study report.

4.1.2 Ex-Situ[1] Extraction Testing

a. Carry out treatability tests for extraction from the soil via an above-ground batch process utilizing water, inorganic solvents, organic solvents and/or surfactants.

b. Assemble and tabulate the test results.

c. Evaluate the test data to determine the potential for remediation via excavation and above-ground batch processing.

d. Select the superior extraction fluids for removal of site-specific soil constituents, and develop the extraction sequence and procedures.

e. Select the superior process for interim and final treatment of extraction fluid.

f. Prepare the extraction section of the overall Treatability Study Report.

4.1.3 Thermal Treatment-Incineration Testing

The scope of this work is laboratory bench scale testing to determine the feasibility of incineration in general, as outlined below:

a. Carry out test burn on surficial soils and sludges from the site.

b. Assemble and tabulate the test results.

(1) Ex-Situ Extraction will involve excavation of materials (soils and/or sludges) and performance of an above-ground extraction treatment remedy on site with redeposition or consolidation of treated materials back to the site.

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c. Evaluate the test data to determine the potential for adequate thermal treatment-incineration.

d. Prepare the thermal treatment-incineration section of the overall treatability study report.

4.2 Program - Part II

4.2.1 Compare the relative potential for remediating the surficial soils and site sludges via the three different technologies investigated in Part I.

4.2.2 Select for further evaluation the technology (or technologies) determined to be effective for surficial soils and site sludges treatment.

4.2.3 Develop the conceptual design for the site soil and site sludge treatment technology (or technologies) selected for further evaluation.

4.2.4 Prepare a budget cost estimate for use in conducting the detailed evaluation of soil and sludges remediation alternatives.

4.3 Treatability Study Methods

4.3.1 Solidification/Stabilization Remedy

These treatability studies on chemical solidification/stabilization (CSS) of the surficial soils/sludge will be designed to simulate the chemical reactions that would take place with a CSS process. The studies will consist of sample collection, sample processing, CSS process sample analyses, study data evaluation, and report preparation work elements, as described below.

Sample Collection

After a complete review of the available data on site soil and sludge contamination, sampling locations will be selected to provide representative soil and sludge samples for CSS testing. Locations and depths shown by site data to contain the highest concentrations (i.e., hot spots) will be sampled, as well as a sufficient number of locations to allow the development of one or more composite samples. Soil samples will remain separate from sludge samples, because the optimum CSS design for these two media is likely to be different. Samples obtained from each hot spot will generally remain separate; different hot spot samples will be composited only if site data show that they contain similar types and levels of materials. For soils from areas likely to require a similar design mix, a composite sample will

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be prepared by mixing samples in proportion to the portion of the total soil volume represented by the individual sample. A composite sample of sludges will be prepared in a similar fashion. The actual soil samples used for the treatability work will be selected jointly by the PRP's consultant and solidification contractors.

Sample Processing

Individual samples of soils and individual samples of sludge will be processed by cementitious, pozzolanic or proprietary chemical processes to determine the feasibility of this remedy. The pozzolanic process is the mixing of alumina and silica-containing materials (pozzolans) and alkaline earth materials (reaction initiators) with waste so that the waste becomes immobilized in a monolithic or soil-like crystalline material. The cementitious process involves the mixing of an alkaline material with a waste to obtain similar results. The study contractors may also test one or more proprietary processes already developed by commercial CSS firms for processing certain types of constituents.

For each process evaluated, a range of chemical additives, and additive ratios (i.e., pounds of each additive per cubic yard of waste) will be employed; one additive mixture and ratio for each performance trial. Separate CSS plugs, or molds, will be made for each additive mixture at each ratio (i.e, each mix design) and subsequently tested for process performance and moisture content. For each ratio, three replicate plugs will be made to facilitate simultaneous testing of potential performance parameters: one for strength testing, one for permeability testing, and one for extraction leachate testing. Each plug will be cured prior to testing. All curing will be done in a sealed environment (i.e., individually wrapped) to prevent drying of CSS plugs or the additional intake of water for hydration. Curing temperatures will be in the range of expected field conditions (10-20°C).

Solidified Waste Sample Analyses

Each design mix that results in a self-supporting mass will be tested for structural strength. A preliminary screening program for a chemical solidification/stabilization (CSS) process would include strength testing, leachate tests, and permeability testing. The interpretation of the results from the above testing will allow a preliminary evaluation of the feasibility for the remedial technology of CSS.

The strength evaluation will be accomplished through the use of one of two tests for unconfined compressive strength (UCS) depending on material type. These tests are:

Cohesive soil-like materials: ASTM-2166
Monolithic materials: ASTM-1633

A testing procedure that will gather data in the most effective method will involve UCS testing of three replicate samples at each of 0, 1, 3, 7, 14, 28 days after mixing. Water content and density will also be determined throughout the testing procedure. This type of sample run will allow the interpretation of mix variability, strength gain over time, and general workability.

Design mixes that require a lower additive ratio to achieve the performance criteria of 50 psi compressive strength will be considered the better designs, and will be selected for permeability and extraction analyses. The selection of the 50 psi strength criteria is recommended because it provides a measure of safety above the 10 psi value that has been demonstrated in field operations to support the heavy construction equipment likely to be used for the in situ CSS process. The solidified mass is not expected to be subjected to loads greater than 15 psi during or after successful solidification.

Permeability values will be generated via triaxial permeability tests, which provide measures of both lateral and vertical permeability, rather than by falling head permeability tests, which only provide a measure of vertical permeability. Lateral permeability is important, because the site contains a shallow ground water aquifer which would be present at the elevations where the solidified mass would be present after processing. Permeability testing will produce an estimate of the potential for water to move through the stabilized material. If the material is relatively impermeable the material would generally not conduct water and therefore would not be affected by leaching. The tests will be run in a triaxial permeameter (flex-wall perameter) and be performed on a three sample replicate after substantial curing has been completed.

EPA will require leachate analysis of design mixes. Analysis of extraction leachate will be conducted on certain selected design mixes that pass the strength and permeability performance criteria to evaluate the reduction in constituent mobility in the CSS matrix. Leachate development will be conducted according to the analytical procedure promulgated by the EPA. Three replicate samples will be tested after substantial curing to evaluate the variability of the mixes.

Study Data Evaluation

Performance data for the design mixes will be compared, and these mixes ranked according to their ability to meet the strength, permeability and leachability criteria. The definition for

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passage of the leachate test, as applied to potential CSS processing of affected soils and sludges at the SCP/Carlstadt site, will be finalized during this portion of the treatability study, since EPA has not yet promulgated standards (i.e., maximum levels) for extraction leachates. The final definition for passage will be established on the basis of a number of factors including, but not limited to, known characteristics of the site waste, site hydrogeology, potential human receptors and current regulations affecting site remediation and land disposal. Those samples that require a lower additive ratio, reduce soil permeability, and pass the extraction leachate tests according to the definition provided above, will be selected for treatment remedy evaluation.

Report Preparation

The written results of the CSS treatability study will be incorporated into the FS/FOU. The study will include the following:

1. Summary of the basic procedures used to develop the test plugs.

2. Summary of the CSS process performance data, including strength, permeability, and extraction leachate quality for the range of preliminary mix designs, including all designs selected for the treatment remedy evaluation (Section 4.4).

3. Identification of the chemical process (i.e., pozzolanic, cementitious or other) used to develop each of the mix designs for which performance data are reported.

4. Identification of the preferred additive ratio to achieve the performance criteria, including any necessary water additions, as well as the estimated additive ratio for full-scale CSS processing of the waste, as projected on the basis of known waste characteristics.

5. A concise evaluation of the ability of alternative CSS process implementation methods to accommodate the physical and constituent characteristics of the site.

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6. Methods to control potential emissions of dust and volatile organics during the CSS process, which is an exothermic process.

7. Recommendations.

4.3.2 Ex-Situ[1] Extraction Testing

a. Bench-Scale Treatability Study (Continuous-Stir Test)

The bench-scale treatability study will consist of soil characterization, soil sample preparation and extraction process performance trials via continuous-stir tests, and extraction fluid treatability tests. The study will be completed by assembling and evaluating the test data, and selecting the optimum processes for extraction and extraction fluid treatment.

Soil characterization will include analyzing a representative number of soil samples for maximum particle size, particle size distribution, pH, humus content and concentrations of specific substances. Soil samples will be prepared as a weight-based composite of all individual soil samples and this composite sample will be analyzed to determine average soil characteristics.

Site soil and control soil samples will be subjected to performance trials for investigating the extraction process. The performance trials will be designed to simulate above-ground extraction via a batch process. Soils will be filtered prior to transfer to the next stage, due to the anticipated effect that a process step has on extraction efficiency.

The performance trials will assist in determining potential extraction fluid or fluids, number of extraction stages, and contact time of each stage.

(1) Ex-Situ Extraction will involve excavation of materials (soils and/or sludges) and performance of an above-ground extraction treatment remedy on site with redeposition or consolidation of treated materials back to the site.

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Performance trials will consist of a series of continuous-stir tests designed to determine the effect of the following process variables on the efficiency of extraction: type of extraction fluid, the fluid to soil volume ratio, the number of successive extractions, the sequence for using various extraction fluids (if more than one fluid is used), and the contact time in each extraction stage. Performance trials will be preceded by a chemical analysis of the raw soils and sludge. The procedure for each continuous-stir test is as follows:

1. Fill a flat-bottomed flask with a known weight of prepared soil sample (after grinding and homogenization).

2. Add a known volume of a single extraction fluid of known composition to the flask;

3. Stir the soil/fluid mixture to make a slurry, using a stirring bar/rotating magnet stirrer (or the equivalent);

4. Extract by continuously stirring the slurry for a preselected contact time;

5. Allow the slurry to settle into its soil and extraction fluid phases, and vacuum-filter the soil through filter paper;

6. As a specified volume of spent extraction fluid is transferred out of a selected extraction stage, analyze the fluid and record results in grams removed per kilogram of test material on a dry weight basis;

7. Conduct a number of continuous-stir tests simultaneously in order to compare treatment efficiency as a result of varying a single process variable. Conduct additional stir tests to assist in refining the processing conditions.

b. Treatability Data Evaluation

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Data derived from the extraction treatability study will include concentrations in untreated soils/sludge, and in samples treated under varying process conditions. Also, for each performance trial a record will be maintained for the type of extraction fluid or fluids, the fluid volume:soil weight ratio, the number of extraction stages, the sequence for using different fluids, and the stage-specific and total contact time for soils/sludge extraction. Data analysis will consist of determining the concentration of each compound removed and percent removals, comparing the efficiencies of various extraction fluids and extraction sequences, and identifying the minimum required fluid sample ratio.

4.4 Feasibility Evaluation

The results of the treatability studies on the in situ CSS process, the above-ground extraction, and the thermal treatment-incineration will be evaluated to determine the potential for three technologies to remediate the surficial soils and sludges. Remediation potential will be defined as a weighted consideration of several factors: percent removals of chemicals (for the extraction process and for the thermal treatment-incineration) or percent reduction in mobility (for the in situ CSS process), required processing time, and number of required process stages. If these technologies are selected for the development of source control alternatives, they will be further evaluated via detailed analyses, cost and regulatory compliance analyses in accordance with Section 5 of this Work Plan.

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SECTION 5

PHASE III

DETAILED ANALYSIS OF SOURCE CONTROL ALTERNATIVES

5.1 Alternatives Evaluation Process

Each source control alternative that passed the initial screening conducted in Phase II will be given further definition and individually analyzed for the complete remediation of on-site soils (above the clay layer), sludges, and shallow ground water. The sludges to be addressed include the pit sludge (estimated to be approximately 2,000 to 3,000 cubic yards) and the tank sludge (estimated to be approximately 10 cubic yards). The definition for each alternative will identify which specific technologies will be considered for the remediation of each type of media, and will describe how these technologies will be combined to produce the full alternative.

Source control alternatives will be individually evaluated based on a number of information sources including, but not limited to, journal articles, vendor literature, and professional experience. Evaluation criteria will include those identified by EPA in the Interim Final Guidance Document dated September, 1988, as important to the selection of a site cleanup remedy.

The EPA criteria for this detailed analysis of source control alternatives, pursuant to the latest RI/FS guidance, are as follows:

- Short-term effectiveness
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, and volume
- Implementability
- Cost
- Compliance with ARARs
- Overall protection of human health and the environment
- State Acceptance
- Community Acceptance

Note that the criteria of State Acceptance and Community Acceptance will not be considered in detail in the evaluation of alternatives. A detailed evaluation of the last two criteria, State Acceptance and Community Acceptance, will be postponed until the solicitation of formal public comment.

The above evaluation criteria are defined in terms of specific factors and effects which allow for comparisons between source control alternatives and identify the relative strengths and weaknesses of each by comparison. The nine EPA evaluation criteria are defined and presented below for this feasibility study.

5.1.1 Short-Term Evaluation

Each source control alternative will be addressed in terms of the extent to which it can mitigate short-term exposures to on-site chemicals during remedial actions and until cleanup goals are achieved. This evaluation will focus on:

- the degree to which existing site risks are reduced;
- possible short-duration risks borne by the cleanup workers and the nearby community, or possible adverse effects on segments of the environment (such as Peach Island Creek) during implementation of a remedial alternative, including potential risks associated with excavation, transport, storage, and treatment/disposal of site media;
- the duration of the remedial action required to reduce site risks to human health and the environment to acceptable levels.

5.1.2 Long-term Effectiveness and Permanence

Each source control alternative will be assessed on its effectiveness in minimizing or reducing long-term exposure to any residual material associated with the site. This evaluation will focus on:

- the magnitude of risk posed by residual material remaining after implementation and completion of a remedial action;
- the compatibility with remedial alternatives potentially implemented for other portions of the site;

- the type and degree of long-term site management required, including monitoring, operation and maintenance, and site security;

- the long-term reliability of proposed technical and institutional controls on the movement and migration of waste residuals, and on the potential for recontamination of remediated site media from off-site sources and phased cleanup efforts.

5.1.3 Reduction of Toxicity, Mobility and Volume

Each source control alternative will be evaluated to determine the extent to which it can reduce the volume or area, minimize or prevent migration, and reduce the toxicity of site materials. This evaluation will focus on:

- the treatment processes to be employed and the wastes/ media that are to be treated;

- the degree of treatment provided in terms of amounts destroyed and/or permanently altered;

- the permanence of a treatment process, considering the potential for future mobility or toxicity effects of treated materials;

- the residuals remaining after treatment, considering their persistence, toxicity, mobility, volume and tendency to bioaccumulate.

5.1.4 Implementability

This evaluation will focus on the possibilities of off-site treatment/disposal, the constructability and installation of focused source control alternatives on-site, and the time required to remediate or complete the cleanup action. It will address issues concerning on-site/off-site placement, equipment availability and limitations, time to complete performance tests, construction duration, and time to operate. The following factors will be considered:

- degree of difficulty associated with constructing and/or installing/arranging the remedy;

- expected operational reliability and control of the remedy;

- need to coordinate and obtain necessary regulatory approvals and permits to design, conduct/construct and operate a proposed remedy;

- availability of necessary facilities, equipment, chemicals and specialists for a particular treatment measure;

- the relative ease for undertaking additional remedial actions for achieving a cleanup objective or for remediation of site media beyond the source areas;

- ability to monitor the effectiveness of a remedy in operation and the residual content following completion of a remedial action.

5.1.5 Detailed Cost Analysis

The evaluation of costs for the source control alternatives will focus on the following:

- capital costs;
- operation and maintenance (O&M) costs;
- net present worth of capital and O&M costs; and
- potential future remedial action costs.

These estimates will have a target accuracy of -30 to +50 percent.

Consistent with conventional cost estimating practices, separate estimates will be prepared for capital, and operation and maintenance costs. Capital costs include direct costs associated with the following:

- construction labor, equipment and materials,
- process equipment,
- site development,
- control building, utilities, and services,
- relocation/evacuation, and
- disposal of wastes, including transportation.

Capital costs also include indirect costs associated with the following:

- engineering expenses for administration, design, construction supervision, drafting, and testing of remedial alternatives;
- legal fees, licensing, and permit costs;
- start-up costs; and
- contingency allowances to account for unforeseen circumstances such as adverse weather conditions, labor problems, or new site information that affects the schedule for implementation.

Operation and maintenance costs are the costs that ensue after construction to carry out the remedial action. These costs include the following:

- operating labor costs, including wages, salaries, training, overhead and fringe benefits;
- maintenance materials, labor, and equipment;
- auxiliary materials and energy such as chemicals, fuel, water and sewer service, etc.;
- purchased services for sampling and analytical requirements and professional service;
- administrative costs;
- insurance, taxes, and licensing costs such as permit renewal and reporting costs;
- rehabilitation costs for maintenance equipment and/or structures; and
- other costs.

Cost information will be obtained from vendor estimates, from costs calculated for similar alternatives considered for other sites, from EPA costing documents, and from standard cost estimating guides such as the "Means Guide" and "Dodge Guide". Costs for innovative technologies will be based on best engineering judgment when other cost information is not available.

The present-worth analysis will be developed using the current EPA-based discount rate of 5 percent. The period of performance used in the analysis will not exceed 30 years, although some of the anticipated remedial alternatives for this site may have an operating requirement that is longer than 30 years.

Where applicable, the necessity of replacing the selected remedial alternative will be evaluated.

5.1.6 Compliance with ARARs

An evaluation will be conducted to determine the potential for each source control alternative to attain legally applicable or relevant and appropriate requirements (ARARs) of Federal and State environmental and public health laws. The basis of the evaluation will include whether chemical-, location- or action-specific ARARs can be met or closely met by the alternative under consideration.

Although ARARs will be used as a goal for remediation of the site, consideration will be given to the circumstances in which ARARs may be waived. The waivers provided by CERCLA (121) (d) (4) (A) are:

i. The remedial action selected is only part of a total remedial action that will attain such levels or standard of control when completed.

ii. Compliance with such requirement at the facility will result in greater risk to human health and the environment than alternative options.

iii. Compliance with such requirements is technically impracticable from an engineering perspective.

iv. The remedial action selected will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, criteria or limitation through use of another method or approach.

v. With respect to a State standard, requirement, criteria or limitation, the State has not consistently applied (or demonstrated the intention to consistently apply) the standard requirement, criteria, or limitation in similar circumstances at other remedial actions.

5.1.7 Overall Protection of Human Health and the Environment

Source control alternatives for remediation of sludges, surface soils, and the shallow ground water that have been retained through Phase II screening process will be assessed as to whether they will provide adequate protection of human health and the environment. Exposure to remediated site soils and sludges as well as the potential for migration of residual contaminants from the remediated soils will be considered in this assessment. A risk assessment will be performed to determine the residual risk associated with exposure to site soils and sludges.

5.1.8 State Acceptance

The assessment will evaluate the technical and administrative issues and concerns which the state of New Jersey may have regarding each of the alternatives.

5.1.9 Community Acceptance

The assessment will incorporate public input into the analysis of alternatives.

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The ERM Group

5.2 Preliminary Report

A Preliminary FS/FOU that encompasses the three SARA phases of the FS and recommends appropriate source control measure(s), will be provided to EPA and other regulatory agencies for review.

This report will be formatted as follows. Technologies to be evaluated for use at the site will each be evaluated individually against the requirements described in Section 2.2 of this Work Plan. An end-of-section summary indicating which technologies have been retained or discarded will be provided. Preliminary screening of source control alternatives and/or combinations of the alternatives derived from the retained technologies, will be performed using the criteria given in Section 3 of this Plan. An end-of-section summary for this evaluation will also be provided. An evaluation of the retained source control alternatives in combinations will be conducted against the nine evaluation criteria discussed in Section 5.1 of this Plan. A summary of this evaluation will be provided in a separate subsection following the detailed evaluation of alternatives. This summary would include tabulated results of the detailed evaluation and would also contain, if appropriate, a discussion of trade-offs among similar alternatives. This summary section would be organized to permit comparison of each alternative against others for all nine criteria described in Section 5.1.

5.3 Final Report

A Preliminary FS/FOU Report including a recommended remedial alternative, will be submitted to EPA. EPA will review and comment on the Preliminary FS/FOU Report. Within 15 days of receipt of written final EPA comments on the Preliminary FS/FOU Report, the Report will be modified as may be necessary to conform with such comments and submitted to EPA for approval, and/or additional engineering evaluations as EPA finds necessary will be initiated.

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SECTION 6

PROJECT SCHEDULE

The duration for this focused approach to the FS/FOU for remediating surficial soils, sludges and shallow ground water is four months. It is anticipated that the FS/FOU effort will be initiated on 5 December 1988 and be completed by submission of a Preliminary FS/FOU Report on 1 April 1989 to USEPA Region II.

The proposed schedule includes performance of necessary tasks: to evaluate and screen technologies and process options, to develop alternatives which typically combine one or more feasible treatment technologies, to conduct limited but appropriate treatability tests, to screen the feasible field of alternatives to select the most effective and protective remedial alternatives, and to analyze these selected alternatives in detail to provide a basis for comparison and decision making. The remaining task is to generate a report to document the above sequence of feasibility study evaluations and analyses, and to present the most appropriate alternatives in terms of the degree or extent that they satisfy the evaluation criteria.

The development of alternatives will follow the evaluation and screening of technologies in Phase I. At the completion of Phase I, an Interim Status Report for the FS/FOU will be issued to the EPA. At this time, drafting of the FS/FOU report will be initiated to document and highlight the Phase I activities.

The Phase II effort will follow immediately and cover a minimum time period to accomplish the evaluation and screening of source control alternatives and/or combinations to select a limited number of alternatives for the detailed analysis. Again, appropriate FS/FOU report sections will be drafted to cover the Phase II evaluation. At the completion of Phase II, a second Interim Status Report for the FS/FOU will be issued to the EPA. The results of the treatability studies will be incorporated for review as the results become available.

Finally, Phase III will involve detailed analyses to complete the FS/FOU process and assembly/critique of a draft of the Preliminary FS/FOU Report beginning after the treatability and Phase II efforts are completed. Interim Status Reports submitted to EPA at the conclusion of Phase I, II and III will contain a detailed description of all work performed during each phase, and the written results of all work performed during each phase.

The Preliminary FS/FOU Report will be delivered on schedule to the USEPA by 1 April 1989.

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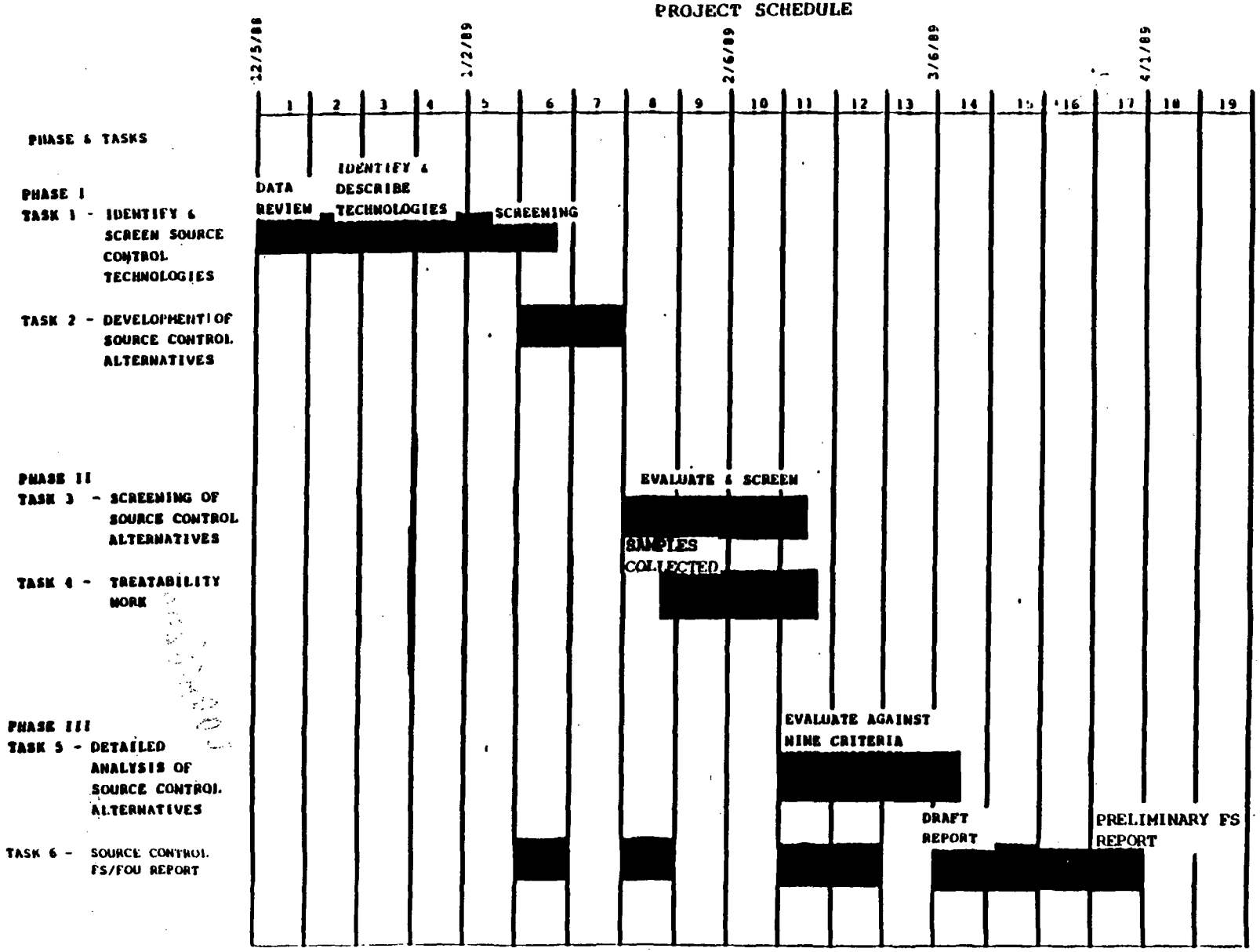
FIGURE 6-1
SCP CARLSTADT
FEASIBILITY STUDY/FIRST OPERABLE UNIT
PROJECT SCHEDULE



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Appendix B
Resolution to U.S. EPA
ISR Correspondence

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APPENDIX B
RESOLUTION TO USEPA CORRESPONDENCE CONCERNING INTERIM STATUS REPORT PHASES I AND II

Table of Contents

- USEPA Correspondence dated 28 February 1989 to Mr. G. Weil, Facility Coordinator for the SCP PRP Committee

- Resolution to USEPA correspondence concerning Interim Status Report, Phase I

- USEPA Correspondence dated 24 March 1989 to Mr. G. Weil, Facility Coordinator for the SCP PRP Committee

- Resolution to USEPA correspondence concerning Interim Status Report, Phase II

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

FEB 28 1989

REGION II
JACOB K. JAVITS FEDERAL BUILDING
NEW YORK, NEW YORK 10278

CERTIFIED MAIL--P545 546 732
RETURN RECEIPT REQUESTED

H. Gilbert Weil
Union Carbide Corporation
P.O. Box 670
Bound Brook, New Jersey

Re: SCP-Carlstadt Site, Administrative Orders Index No. II-CERCLA-80114 and II-CERCLA-60102

Dear Mr. Weil:

This is to transmit EPA's comments on ERM's "Interim Status Report for Phase I" of the Feasibility Study ("FS") being conducted by Respondents to the above-referenced Administrative Orders. These comments were verbally transmitted to ERM and Respondents' representatives at a meeting on February 9, 1989.

One general comment made was that, although ERM presented separate alternatives for each media in the Status Report, these individual alternatives must ultimately be combined into alternatives which address the entire site. These media-specific alternatives can be screened separately, but should be combined into site alternatives before commencement of the detailed evaluation, since it is likely that soil and groundwater treatment will be combined. Some examples of this are:

-soil stabilization could utilize groundwater in the treatment process, and thus reduce, or eliminate, the need for groundwater treatment;

-dewatering during excavation might eliminate the need for a separate wellpoint system for pumping and treatment of groundwater; and

-the application of in-situ technologies (such as stabilization and vitrification) around the site perimeter initially to isolate the site groundwater may reduce the volume of groundwater, and thus the treatment time and cost.

These and other considerations should be taken into account by evaluating the soil and groundwater alternatives together as alternatives for the entire site.

Another general comment is that ERM should determine whether the removal/treatment soil alternatives described apply to the entire fill layer, or partial hot spots. This determination will affect the remaining portions of the alternatives, as well as the alternative screening. For example, if the entire site is treated by in-situ vitrification, a multi-media cap might not be required - a clean soil backfill might suffice. If only hot spots are treated, then a multi-media cap may be appropriate, since some contaminated soil is left on site. In addition, it might be more cost-effective to excavate and treat soil hot spots by one process and then treat the remaining fill layer by another process, rather than looking only at excavation and treatment of the entire fill layer.

More specific comments discussed at the February 9, 1989 meeting are as follows:

page	section	comment
1-1	1.3	The applicable sections of EPA's Endangerment Assessment will be used in the FS, not TERRA's Public Health Assessment.
2-2	2.2	EPA has provided ARARs and TO BE Considered Criteria for cleanup, which constitute the Remedial Action Objectives. The material provided by EPA must be used in the FS.
2-2	2.3	Disposal/discharge is a general response action which is potentially applicable to shallow groundwater. Potential disposal options for treated groundwater include discharge to POTW, storm sewer, Beach Island Creek, or re-injection.
2-5	2.5	Any off-site disposal of the soil/sludge would definitely require prior treatment (not "possibly"), due to land disposal restrictions.
2-5,6	2.6	Why wasn't metals removal included in Alternatives GW-2 and GW-4? Are both chemical oxidation and bio-treatment with GAC necessary?
2-7,8	2.6	In-situ volatilization, or some type of VOC removal/collection may be required for protection of public health during or prior to excavation, or as a pre-treatment for another technology not as effective for VOC's, such as stabilization.

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page	section	comment
2-7,8	2.6	In alternative S/S 8, the slurry wall depth should be estimated, based on availalbe data. It is unlikely that the wall could be keyed into the clay layer, which is quite thin in some areas. As stated previously, a multimedia cap might not be necessary for all of the S/S Alternatives.
2-8,9	2.6	Does "remove PCB-containing sludges for treatment" in Alternatives S/S 9 and 10 refer to off-site treatment?
1	Table 1	Land use, fencing, deed restrictions could be added to the "No-Action" Alternative here and on the other Tables.
	Table 1	Several other technologies could be added to Table 1 (and the other Tables), e.g. silicate based stabilization (which may be more effective for organics) and high temperature incineration (such as the Westinghouse pyrolyzer or Retech's Plasma system, which may be more effective in binding metals with the ash). In addition, a distinction should be made between in-situ and ex-situ fixation. Options for disposal of groundwater, discussed above, should be added to all Tables, as well as in-situ volatilization.
	Table 4	Screening comments should be expanded with more specific reasons for screening out a particular process option.
4	Table 2	Air stripping should be retained since VOCs are the primary groundwater contaminants, and activated carbon could be used as a polishing step to remove non-VOCs, if necessary. The trade-off between the use of air stripping and a greater amount of carbon versus the added cost of steam stripping and a lesser amount of carbon can be evaluated in the alternative evaluation. If this comparison has already been made, then air stripping could be screened out in Table 3. The option of regenerating the spent carbon on-site could also be evaluated.

page	section	comment
5	Table 2	For reverse osmosis, NJDEP recommends a literature search; the technology may not be feasible due to the diversity of contaminants (as opposed to low concentrations).
5	Table 2	Thermal destruction for groundwater could be screened out here, instead of in Table 2, since the basis for screening is implementability. In addition, the groundwater concentrations appear to be too low on the average to warrant incineration of water alone, but it may be feasible to incinerate some groundwater together with soil (i.e., without dewatering). The comments provided for biological treatment of soil do not justify screening out this technology at this point, since it is applicable to organics treatment, and might be followed by an inorganics treatment, such as stabilization.
6	Table 2	Both in-situ and ex-situ stabilization should be considered separately in this Table and in Table 3, since the processes differ so greatly. In-situ volatilization should be added after air stripping, as discussed above, to include processes similar to Toxic Treatment, Geo-Con, etc. (as opposed to surface aeration methods only).
7	Table 2	The screening comment provided for low temperature thermal stripping is not adequate. This technology should not be screened out at this point. Explain the process problems expected with fluidized bed incineration. Many processes are available, and pre-treatment to screen out debris and reduce particle size can eliminate any problems. Fluid bed systems, where lime is added, may be effective for fixing metals in the ash as well as removing and destroying organics. This process should not be eliminated here, but rather, after a comparison with other processes, might be eliminated later.

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page	section	comment
	Table 3	The purpose of Table 3 is to screen the process options within each technology type in order to choose a representative process(es) for use in the alternatives development. This was not done in all cases, thus it is unclear why certain processes were eliminated. The following examples illustrate this confusion:
2		Implementation criteria listed under removal are related to ultimate disposal; criteria here should be related to excavation.
3		Why was dehalogenation eliminated if it is effective and readily implemented? (A better comment may have been that chemical oxidation or critical fluid extraction are more effective in treating a wide range of contaminants, where dehalogenation is more specific to halogenated compounds.)
3		Why is fixed film growth eliminated? Is it because suspended growth is more effective? Explain.
4		The effectiveness of dehalogenation versus the other physical/chemical processes should be discussed, as noted above. The comments provided do not justify elimination.
4,5		In-situ and ex situ fixation should be discussed separately, since effectiveness and implementation criteria will differ.
5		The effectiveness of the thermal destruction processes should be discussed in relation to each other. Include fluidized bed, as discussed above. Permits would not be required for remedial activities conducted entirely on-site, but substantive requirements must be met
6		It is unlikely that a pilot test is necessary for off-site landfilling, though pretreatment would probably be required. Also, no permits required for on-site work.

At the February 3, 1989 meeting, some other general comments were made. EPA suggested that, if they had not done so already, ERM should immediately contact local POTWs to inquire about the potential for accepting treated groundwater from the site. In addition, EPA recommended that ERM think about methods for dewatering - would they use some sort of barrier? EPA also raised the issue of future land use as it relates to the stabilization alternatives - would the increased volume of material (five to six foot mound) be conducive to any future use scenarios, and if not, would it be feasible to remove some of the stabilized material off-site?

Enclosed is a copy of the "Interim Status Report" which has been marked up to highlight additional general/editorial comments.

Please ensure that all of the comments outlined herein and in the attachment are addressed by ERM as they proceed with the FS, and in the Preliminary FS Report which will be submitted to EPA by no later than April 1, 1989.

If you have any questions regarding these comments, please contact Janet Feldstein of my staff, at (212) 264-0613.

Sincerely yours,

Raymond Basso

Raymond Basso, Chief
New Jersey Compliance Branch

Enclosure

cc: William Warren, Esq.
Thomas Armstrong, General Electric
Pamela Lange, NJDEP
Harry Yeh, EBASCO

002571A

RESOLUTION TO USEPA CORRESPONDENCE CONCERNING INTERIM STATUS REPORT, PHASE I

Item: General Comment (Page 1)

Response: As noted in this FS submittal, site alternatives are created at the end of Phase II.

Item: General Comment (Page 2)

Response: PCB "Hot Spots" have been addressed throughout this FS.

Item: ISR Page 1-1, Section 1.3

Response: As of 4 April, 1989, ERM has received only summary Table E-2 from USEPA; no supporting text from the Endangerment Assessment has been provided. Therefore, the USEPA Endangerment Assessment is not discussed in this Feasibility Study text.

Item: ISR Page 2-2, Section 2.2

Response: The ARARs and TBCs have been considered in this Feasibility Study.

Item: ISR Page 2-2, Section 2.3

Response: Shallow ground water disposal to Peach Island Creek, BCUA POTW, off-site TSD, or reinjection are all addressed in this FS.

Item: ISR Page 2-5, Section 2.5

Response: Treatment required is unknown until TCLP leachate is analyzed. Untreated soil/sludge could possibly meet treatment standards.

Item: ISR Page 2-5, 6, Section 2.6

Response: Former GW-2 (now GW-3) and GW-4 (now GW-8) had neglected metals removal; both of these now incorporate chemical precipitation to remove metals. GAC is included as a potential polish prior to discharge.

Item: ISR Pages 2-7, 8, Section 2.6

Response: In situ soil vacuuming (vacuum extraction) has been included prior to excavation.

Item: ISR Pages 2-7, 8, Section 2.6 (Paragraph 1)

Response: According to the Dames & Moore RI (1988), the varved clay (hydraulic conductivity of ~1 x 10^{-8} cm/sec) and red clay (hydraulic conductivity of ~1 x 10^{-7} cm/sec) together as a unit range from 8 to 10 feet in thickness.

The slurry wall depth will be an average of 17 feet deep, keying into the clay a minimum of 3 feet.

Item: ISR Pages 2-7, 8 Section 2.6 (Paragraph 2)

Response: A multimedia cap is not proposed for all S/S alternatives in this FS.

Item: ISR Pages 2-8, 9 Section 2.6

Response: S/S-9 and S/S-10 had originally proposed to remove PCB-containing sludges for off-site treatment. Please

note that this FS has changed alternative number designations since submission of the Interim Report.

Item: Table 1 (Paragraph 1)

Response: Institutional actions such as deed restrictions and fencing have been added to this FS in accordance with USEPA RI/FS Guidance (October 1988) for a "Limited Action" Alternative (page 4-8 of the guidance).

Item: Table 1 (Paragraph 2)

Response: Pozzolan-based stabilization/solidification is the mixing of finely-divided alumina and silica-based materials (i.e., pozzolans) and alkaline earth materials with waste. Thus, "silicate-based stabilization" has already been included (as pozzolan-based stabilization/solidification).

In situ vacuuming, pyrolysis, plasma arc incineration, ground water disposal options, etc. have been added (see Table 2-3).

In situ and on-site stabilization/solidification are addressed as separate technology process options.

Item: Table 2 (Paragraph 1)

Response: Technologies are now described in text format, with an initial screening discussion. The table (Table 2-3) now stands as a summary of these discussions.

Item: Table 2 (Paragraph 2)

Response: Air stripping was evaluated as a primary treatment option for shallow ground water. Levels of organics (thousands ppm) make air stripping viability questionable, however; air stripping is thus retained initially for polishing only.

Item: Table 2 (Paragraph 3)

Response: As noted in the FS, some membranes may be dissolved by some wastes, suspended solids and some organics will clog the membrane material, and low-solubility salts may precipitate onto the membrane surface. For these reasons, the technology was initially screened out.

Item: Table 2 (Paragraph 4)

Response: As noted in the FS, ground water has a low caloric value and a high specific heat and requires/large quantities of fuel for combustion. Incineration of large volumes of water is thus generally not practical. In addition, the rate of thermal destruction of contaminated ground water is limited by the Btu capacity of the off-site and mobile units. Thus incineration of ground water is not feasible.

It is not feasible to incinerate ground water with soil/sludge, as dewatering is required prior to excavation and processing, and ground water has near-zero Btu value.

Item: Table 2 (Paragraph 5)

Response: This FS addresses biological treatment of soils.

Item: Table 2 (Paragraph 6)

Response: As noted above, in situ and on-site stabilization are considered separately throughout the FS.

Item: Table 2 (Paragraph 7)

Response: In situ vacuuming to remove volatile organics from soil/sludge, has been considered in the FS.

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Item: Table 2 (Paragraph 8)

Response: As discussed in the FS, low temperature thermal stripping is applicable to some soil/sludge contaminants. Thus, it was retained for further review and not screened out initially.

Item: Table 2 (Paragraph 9)

Response: The process problems noted in the Interim Report dealt with the debris, etc. which would foul the system. As discussed in the FS, waste material would be shredded prior to injection into the incinerator to avoid these problems. The technology was retained initially and eliminated later after a comparison with other processes.

Item: Table 3 (Paragraph 1)

Response: As discussed in the FS, the objective in this screening step is to select one representative process option, if possible, for each technology type to simplify the subsequent development and evaluation of alternatives without limiting flexibility during remedial design. However, due to the variety of constituents present in both the shallow ground water and soil/sludge, some of the technology types may retain more than one process option for further evaluation.

Item: Table 3 (Paragraph 2)

Response: Implementation criteria (Table 2-4) as well as the entire FS relates removal to excavation.

Item: Table 3 (Paragraph 3)

Response: As discussed in the initial screening section of the FS, dehalogenation processes are not effective on compounds in non-aqueous solutions. This

technology process option, therefore, is not technically implementable and was not considered further.

Item: Table 3 (Paragraph 4)

Response: As discussed in the FS (Table 2-4), fixed-film growth is susceptible to upsets and overloading. The high-level BOD organics will overload the system.

Item: Table 3 (Paragraph 5)

Response: [See the response to Table 3 (Paragraph 3) above.]

Item: Table 3 (Paragraph 6)

Response: As discussed above, in situ and on-site stabilization/solidification is discussed separately throughout this FS.

Item: Table 3 (Paragraph 7)

Response: The FS discusses in (Table 2-4) mobile incinerators versus off-site rotary kiln, fluidized bed, infrared and multiple-hearth incineration as well as pyrolysis, for effectiveness, implementability, and costs.

CERCLA exempts mobile units from permitting, but trial burn demonstrations, etc. are expected.

Item: Table 3 (Paragraph 8)

Response: Off-site disposal at a Treatment, Storage, and Disposal facility would not require a pilot test. Acceptance by facility and constituents analysis demonstration would be required, however.

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Item: General Comments (Page 6)

Response: Disposal of pre-treated shallow ground water to a POTW is considered in the FS.

Dewatering, as noted in the FS, generally consists of a slurry wall barrier and well-point system ground water collection.

A five to six foot increase in FOU mass is approximately a 50% increase in volume due to stabilization/solidification. Treatability studies indicate a worst case volume expansion of roughly 25%, or 3 feet. This expansion would possibly be conducive to future land use scenarios.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION II

JACOB K. JAVITS FEDERAL BUILDING

NEW YORK, NEW YORK 10278

MAR 24 1989

BY TELEFAX AND
CERTIFIED MAIL-- P 545 548 491
RETURN RECEIPT REQUESTED

H. Gilbert Weil
Union Carbide Corporation
P.O. Box 670
Bound Brook, New Jersey

Re: SCP-Carlstadt Site, Administrative Orders Index No. II-CERCLA-50114 and II-CERCLA-60102

Dear Mr. Weil:

This is to transmit EPA's comments on ERM's "Interim Status Report for Phase II" of the Feasibility Study ("FS") being conducted by Respondents to the above-referenced Administrative Orders. These comments were verbally transmitted to and discussed with ERM and Respondents' representatives at a meeting on March 6, 1989. Written comments are being provided in order to further assist respondents in preparation of the Preliminary FS report.

section	comment
all	For illustration purposes, conceptual figures should be provided for each alternative.
2.1.1	In general, the alternatives are not described in enough detail. The intention of the groundwater alternatives presented is unclear - is the purpose to clean the site groundwater independently, or to dewater the site for implementation of soil remediation? Other factors which must be addressed include time frames of operation, volume of water to be treated, pumping rates, and groundwater collection methods. Will barriers be installed around the site? Can the groundwater treatment unit also handle any fluids/ wastewaters that will be generated from an on-site soil treatment unit (i.e. incineration, in-situ flushing, vitrification), where the concentrations of contaminants will be higher than in site groundwater? All of these details must be addressed to ensure integration of media alternatives. The description of alternatives also leaves many factors unresolved - when will the decisions regarding polishing steps be made? The treatability

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2.1.1 testing results may provide some information, however, biological and precipitation tests are not being performed. Therefore, engineering evaluations of the treatment units should be performed now, in order to perform alternative screening. Some other treatment units may need to be added, such as pH adjustment after chemical precipitation and maybe filtration prior to GAC and UV/Peroxidation.

In the description of groundwater alternatives, the purpose of each technology should be spelled out clearly. In Alternative GW-3, are both the oxidation and biological treatment steps necessary? Chemical Precipitation could be done first, since the removal of suspended solid will help oxidation. Also, the biological treatment units, sequencing batch reactors should be defined more clearly (anaerobic vs. aerobic, fixed film vs. activated sludge, capabilities, contact time, and operation).

In alternatives GW-5, GW-6, and GW-7, how will the GAC continue to remove organics if saturated? What will be the disposition of the concentrated liquid waste stream?

2.1.2 Again, more detail must be provided concerning the soil alternatives - what are the expected treatment times, what will be dewatering methods, will a wet excavation/grout curtain method be used? In order to develop costs for these alternatives, more details regarding implementation must be presented.

In alternative S/S-4, how will VOC emission be controlled during excavation? Some clean soil back fill would be required due to volume reduction. How will wastewater from the air quality control system be disposed of?

In alternative S/S-5, Have any off-site incineration facilities been identified? If so, pre-treatment requirements must be addressed. Consideration should be given to the potential need for further dewatering/ moisture control prior to off-site shipment of soils.

Shouldn't Alternative S/S-6 include dewatering along with the excavation? As has been suggested repeatedly, some of this dewatered groundwater may be used in the stabilization process, which would reduce the volume of groundwater requiring treatment. If wet excavation is proposed, should groundwater barriers be installed to control the moisture content for fixation?

2.1.2 Also, the significant volume increase must be addressed.

In Alternative S/S-7, how will dewatering be done to prevent further infiltration of groundwater into the treatment area? Will the groundwater table be maintained constantly below the treatment area, across the entire site? Will barriers be installed or will vitrification be performed around the site perimeter, first? Cost comparisons between wet vs. dry vitrification should be made. Clean backfill may be required with this alternative, too.

The land disposal restrictions should rule out Alternative S/S-8; this can be addressed in Phase I. (Also applies to Alternative T-5)

Why has in-situ flushing reappeared in Alternative S/S-9, when it had been screened out in Phase I due to non-homogeneity of the fill material. What is the objective of in-situ flushing here? What type of delivery system is expected - spraying, ponding, infiltration beds? What about the potential for contaminating other aquifers at the site, or will the pipe spacing preclude this? What type of fluids are being considered? Is dewatering necessary for this alternative? Why are two different collection systems being proposed - drains for flushing and extraction wells for groundwater? More detail must be provided to explain the drain system and how it will work. What is the expected treatment rate for flushing? Consideration must be given to the expected concentrations of contaminants in the fluid vs. those in the site groundwater, as this will effect the selection of the treatment system.

For all alternatives including in-situ stabilization, consideration should be given to fixating the soils around the site perimeter first, in order to form a groundwater barrier to minimize the volume of groundwater to be treated.

In Alternative S/S-10, dewatering would be required along with the excavation. Why is a RCRA unit required for on-site disposal. The volume increase from stabilization must be addressed.

In alterative S/S-11, why are both in-situ vacuuming and in-situ situ-flushing necessary? In-situ vacuuming is not expected to be effective in saturated soils - will the dewatering method maintain unsaturated conditions?

section	comment
2.1.2	In alternative S/S-12, how will metals be treated? it is difficult to apply acid extraction in-situ to remove heavy metals. How will volatiles be handled in Alternative S/S-13? Has enhanced volatilization been considered? What type of reinjection system is proposed for Alternative S/S-14?
2.1.3	It is unlikely that any of the tank alternatives will be feasible, as presented. Pre-treatment will probably be necessary for any of the alternatives discussed. Tank alternatives involving sequential treatment processes should be developed.
Table 3	The screening comments for each groundwater alternatives are nearly identical. Can't any distinguishing remarks be made, i.e. the effects of longer treatment time on short-term worker/ environmental exposure? The groundwater treatment alternatives <u>will</u> meet ARARs during remediation; action-specific requirements must be met. For the no action and limited action groundwater alternatives, the last statement "Short-term Protectiveness" is incorrect; water table aquifer is connected with an aquifer which <u>is</u> a potable water supply. For the other groundwater alternatives, the wording in the last statement under "Short-Term Protectiveness" should be revised. What is meant by "no <u>acceptable</u> short-term risks"? Is the correct word "significant"? If so, explain why there are no significant risks. Alternative S/S-3 does <u>not</u> satisfy remedial action objectives. Why are there short-term risks to workers and community during implementation of S/S-4? Wouldn't there be controls for air emissions? Some further explanation should be provided to justify why some soil alternatives will achieve TBCs and others will not. For example, why will S/S-9 (in-situ flushing/ stabilization) achieve TBCs and S/S-10 (extraction/stabilization) will not? Also, how will S/S-12 (in-situ vacuuming/flushing) achieve TBCs? What about metals?

section	comment
Table 3	Why are pilot studies referred to in Alternative S/S-6? There are none being conducted for vitrification. In S/S-13 and S/S-14, there is no excavation components to the alternatives, since they both apply technologies in-situ, therefore, there should be no risks related to [illegible]. Additional distinguishing comments should be made, i.e., relative risks for short-term exposure, exposure to solvents for relevant alternatives, effects of any residual solvents, or other treatment additives.
Table 4	More detailed comparisons should be made between the alternatives - based on this table, they are all equally implementable. Comparisons can be made in terms of complexity of operation, the need for skilled operators, potential for system upsets, required treatment units, reliability, energy and chemical additive requirements, and other auxiliary process requirements. For groundwater alternatives, the frequency of sampling/analysis has not yet been determined; sampling may be more, or less often than semi-annually. For soil alternatives, explanations should be provided as to why the technology capabilities are limited. Why are land use restrictions applicable to S/S-12? Why are land use restrictions applicable to S/S-11 when Table 3 indicates that TBCs will be achieved? Why is limited equipment availability applicable to incineration alternatives, but not others such as extraction? For S/S-4, local opposition to this alternative can not be predicted at this time.
general	An additional table should be prepared presenting a rating of the screening criteria, in terms of high, medium, and low, for each alternative, so that comparisons of alternatives can be made.

As discussed at the March 6th meeting, the Phase II report was incomplete. This phase was supposed to cover "screening" of alternatives - the Report submitted to EPA did not follow through the screening process. No cost evaluations or comparisons were presented. While I realize that treatability study results will be incorporated when available, the FS could certainly have proceeded further pending receipt of these results.

As you may notice, many of the comments provided herein were provided to ERM prior to the March 6th meeting, including

comments relating to dewatering, disposal of treated fluids, and increases in material volume relating to stabilization alternatives.

I am concerned, based upon the Phase I and Phase II reports, that the FS is not being conducted in a thorough and technically sound manner. I trust that you will ensure that all of EPA's comments on these reports are addressed, and reiterate my staff's request to informally review the work which has been done to complete Phase II and Phase III prior to submission of the Preliminary FS report by April 1, 1989.

If you have any questions regarding these comments, please contact Janet Feldstein of my staff, at (212) 264-0613.

Sincerely yours,

Raymond Basso

Raymond Basso, Chief
New Jersey Compliance Branch

cc: William Warren, Esq.
Thomas Armstrong, General Electric
Pamela Lange, NJDEP

RESOLUTION TO USEPA CORRESPONDENCE CONCERNING INTERIM STATUS REPORT, PHASE II

Item: All

Response: Conceptual flow diagrams are provided for each alternative considered in Phase II of the FS.

Item: Section 2.1.1 (Paragraph 1)

Response: Alternatives for the soil/sludge on site, tank sludge, and ground water have been described in detail in the FS.

Item: Section 2.1.1 (Paragraph 2)

Response: Treatability studies and chemical analyses revealed technology capabilities and limitations. Discharge limits for treated ground water from the site remain to be set, however. For this reason, polishing requirement decisions have not been made as of yet.

Treatability testing also provided information not included in the RI, such as BOD, COD. From these chemical analytical results, engineering evaluations for biological treatment, as well as other main process options and pretreatment, have been made.

Item: Section 2.1.1 (Paragraph 3)

Response: The alternatives have been described in detail in the FS, including purposes of each technology.

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Sequencing batch reactors, as defined in the FS, are a series of aerobic activated sludge treatment systems.

Item: Section 2.1.1 (Paragraph 4)

Response: GW-6 and GW-7 had proposed to utilize GAC as a potentially required polish. GW-5 utilized GAC as a buffer prior to biological treatment. Initially all GAC adsorbable compounds will remain on the carbon. As the carbon becomes saturated, less adsorbable compounds will be replaced on the carbon by more adsorbable compounds, resulting in the bleeding-in of the less adsorbables. (Note that this FS has revised these alternatives).

Item: Section 2.1.2 (Paragraph 1)

Response: The alternatives for soil/sludge have been described in greater detail in the FS.

Item: Section 2.1.2 (Paragraph 2)

Response: As indicated in the FS, VOC emissions would be controlled by initially removing volatile organics with a vacuum extraction system.

If the ash does not require stabilization/ solidification, volume reductions for the site would be dealt with by backfilling clean soil.

As discussed in the FS, wastewater from the incinerator would be discharged to the on-site ground water treatment system.

Item: Section 2.1.2 (Paragraph 3)

Response: As noted in the FS, S/S-14 (off-site incineration) identifies off-site facilities as well as pretreatment and dewatering requirements.

Item: Section 2.1.2 (Paragraph 4)

Response: As discussed in the FS, dewatering is required prior to excavation. This water may be incorporated into the stabilization/solidification process.

Significant volume increases (i.e., >25% increase) are not expected to occur.

Item: Section 2.1.2 (Paragraph 5)

Response: As discussed in the FS, a slurry wall and well point dewatering system would be utilized to remove as much water as possible prior to vitrification. Cost estimates have shown more cost-effective treatment options for ground water than in situ vitrification.

Clean backfill, as noted in the FS, will be utilized as a cover.

Item: Section 2.1.2 (Paragraph 6)

Response: Land disposal restrictions on wastes can not be evaluated until a sample of waste is taken prior to disposal. It may be possible that the leachate generated will pass treatment standards. Alternatives involving off-site disposal were thus retained to Phase II.

Item: Section 2.1.2 (Paragraph 7)

Response: In situ soil flushing was reevaluated and reinstated to Phase II. Even due to the rubble, ~50% of contaminants could be removed by flushing.

Soil flushing alternatives have been updated and include detailed descriptions.

Ground water treatment system compatibility with extraction fluids has been considered.

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Item: Section 2.1.2 (Paragraph 8)

Response: The alternatives propose a slurry wall, which will minimize infiltration of ground water from adjacent fill units.

Item: Section 2.1.2 (Paragraph 9)

Response: The Interim Report as well as the FS (S/S-9) includes dewatering prior to excavation.

The stabilized soils will be replaced on site. Volume increases should be minimal.

Item: Section 2.1.2 (Paragraph 10)

Response: In situ vacuuming was proposed to remove volatiles, while soil flushing was proposed to remove non-vacuumable compounds such as PCBs.

In situ vacuuming is not effective on saturated soils, thus dewatering is required first. The well points utilized for vacuuming will initially be utilized for dewatering as well.

Item: Section 2.1.2 (Paragraph 11)

Response: In the Interim Report, no metals treatment was proposed for Alternative S/S-12; an associated risk was thus included with this alternative.

Item: Section 2.1.2 (Paragraph 12)

Response: In the Interim Report, volatile organics would have been included in the mass of contaminants to be stabilized. This FS has added in situ soil vacuuming to remove volatiles initially and enhance stabilization.

Item: Section 2.1.2 (Paragraph 13)

Response: In situ bioreclamation would utilize a well distribution system or percolation field system for distribution. Please note that this technology is screened out in Phase I in this FS.

Item: Section 2.1.3

Response: In situ vitrification does not require any pretreatment for the tank.

Alternatives in this FS involve sequential treatment processes.

Item: Table 3 (Paragraph 1)

Response: This FS evaluates alternatives so as to distinguish and allow comparison and screening.

Item: Table 3 (Paragraph 2)

Response: This FS discusses both ARARs and action-specific requirements.

Item: Table 3 (Paragraph 3)

Response: As noted in the Summary Table and discussed in the FS, there is no unacceptable risk as shallow ground water is not currently used a potable water supply, nor is the till aquifer; bedrock aquifer contamination is undefined.

Item: Table 3 (Paragraph 4)

Response: As noted in the FS, these and other tables are summaries of the evaluation criteria discussions. "Short-term" and "acceptable" risks are delineated and evaluated in these discussions.

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Item: Table 3 (Paragraph 5)

Response: The remedial action objectives of the FS are satisfied for the long term for Alternative S/S-3.

Item: Table 3 (Paragraph 6)

Response: Alternative S/S-4, on-site incineration, utilizes controls for air emissions. There would be potential short-term risks resulting from uncontrolled emissions, if any exist.

Item: Table 3 (Paragraph 7)

Response: This FS discusses how each alternative is effective over the long-term. In particular, Phase III discusses TBCs.

Item: Table 3 (Paragraph 8)

Response: No pilot studies were conducted as part of the treatability work. The vitrification vendor requests pilot work to better characterize emissions, cost, and operational parameters.

Item: Table 3 (Paragraph 9)

Response: Although both alternatives involve in situ technologies as the main process option, both involve dewatering in which some excavation may be required to aid in slurry wall and well point system installation.

Item: Table 3 (Paragraph 10)

Response: The FS discussion and summary table has been revised since submission of this Interim Report (Table 3-13).

Item: Table 4 (Paragraph 1)

Response: Detailed comparisons are included in this FS, to distinguish and screen alternatives. As noted earlier, Table 4 of the Interim Report is a summary table of the evaluation discussions and has undergone revisions for this FS (Table 3-14).

Item: Table 4 (Paragraph 2)

Response: To estimate O&M requirements and costs, semi-annual sampling was assumed.

Item: Table 4 (Paragraph 3)

Response: This FS discusses in detail the technologies and their limitations as they apply to the alternatives.

Equipment availability is addressed for alternatives in the FS (Table 3-14).

Item: Table 4 (Paragraph 4)

Response: Public acceptance comments will be addressed in public hearings.

Item: General Comments (Paragraph 1)

Response: This FS contains a summary table for Phase II, for comparison and screening (Table 3-15).

Item: General Comments (Paragraph 2)

Response: The Interim Status Report of 24 February 1989 summarized the Phase II activities conducted to that date. It intended to show activities completed and was not intended to be a comprehensive Phase II, as indicated in Section 1 of the Interim Report.

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Appendix C
Ground Water
Treatability Testing

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APPENDIX C
RESULTS OF GROUND WATER TREATABILITY TESTING

Results of treatability testing for water-table aquifer ground water from the SCP/Carlstadt site are discussed in Section 3.1.2.1 of the FS document. This Appendix includes the vendor reports of this treatability testing and the preliminary laboratory data upon which these reports were based. It is noted that these data have not undergone final analytical QA review. Reports from the following vendors are included.

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C-5 Results of analyses on raw ground water collected by ERM Inc., from Monitoring Wells MW-3S and 7S at the SCP Site.

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APPENDIX C-1
CF SYSTEMS
CRITICAL FLUID EXTRACTION

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TREATABILITY TESTING OF GROUNDWATER USING CARBON DIOXIDE SOLVENT

PREPARED FOR

ENVIRONMENTAL RESOURCES MANAGEMENT, INC.
855 SPRINGDALE DRIVE
EXTON, PENNSYLVANIA 19341

PREPARED BY

CF SYSTEMS CORPORATION
140 SECOND AVENUE
WALTHAM, MASSACHUSETTS 02154

MARCH 1989

CFS PROJECT NO. 52001

CORPORATION

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V. SUMMARY AND CONCLUSIONS

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I. INTRODUCTION

Environmental Resources Management (ERM) has contracted with CF Systems to perform treatability testing on a groundwater sample. CF Systems has performed batch extractions using CO_2 solvent to extract the organic contaminants from this groundwater sample. ERM has provided the analysis of the feed and raffinate samples from CF Systems. From the lab data and analytical results CF Systems has developed preliminary sizing and cost estimate for a CO_2 extraction unit capable of handling up to 50 GPM of groundwater feed. Also included is a description of the process and what the utility requirements are for this unit.

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II. PROCESS DESCRIPTION

A. CONCEPTUAL DESCRIPTION

The CF Systems Organic Extraction unit is a solvent extraction system that uses liquid CO_2 as solvent to extract a wide variety of organic contaminants from wastewater. This solvent has high solubilities for many hazardous organic compounds and in addition, CO_2 is inexpensive, non-toxic and can be easily separated from the extracted compounds.

The units capacity is up to 50 gallons of wastewater per minute or about 25,000,000 gallons per year. The unit can accept wastewater varying in contamination levels from parts per million up to 30 percent organics.

The unit can be designed for indoor or outdoor use, is skid mounted, and is fully automated including control routines for startup, shutdown and cleanout. All motors and instrumentation are explosion-proof or intrinsically safe. The hardware that comprises the unit is made of corrosion-resistant material to maximize structural integrity.

The system requires approximately 2500 square feet of space to allow for: the main skid portion of the system, area for heat exchanger bundle removal, compressor skids and a room to house the control computer, laboratory, water heater, motor control center and working aisles. An extractor tower stands about 35 feet and requires an additional 100 square feet of floor space, either indoors or outdoors.

II B. DESCRIPTION OF FULL-SCALE SYSTEM

Process flows for the extraction of organics from wastewater are shown in the simplified one-line diagram in Figure 1. For description purposes, the process has been divided into the following steps:

- Extraction
- Pressure Letdown and Carbon Dioxide Distillation
- Extract Stream Flash Evaporation
- Raffinate Stream Flash Evaporation
- Carbon Dioxide Recompression, Condensing, and Recycling

Extraction

From the feed drum, wastewater is pumped by the Feed Pump (P-1) to the Extractor (T-1) and flows downward countercurrent to the CO_2 solvent stream which enters at the bottom of the extractor. This arrangement allows for optimum mixing and contact between the fluids to accomplish extraction of the organics into the CO_2 solvent.

During the contercurrent contact between CO_2 and wastewaters, organics are dissolved out of the water phase to form a CO_2/organics phase, or extract which continuously exits from the top of the extractor.

Pressure Letdown and Carbon Dioxide Distillation

An important feature of the CO_2 distillation and stripping is that the bulk of the CO_2 in the extract stream is separated from the product organics at a pressure that is very near the extractor pressure. This minimizes the compression work needed to recycle the CO_2 back to the extractor.

The CO_2 separation is performed in the Solvent Recovery Column (T-2). Vaporization heat is supplied by the hot compressed CO_2 vapor discharged from the Main Compressor (C-1) as it cools from the vapor phase and condenses into the liquid phase. A kettle type heat exchanger, Column Reboiler, (E-1) is provided to perform the heat exchange.

Extract Stream Flash Evaporation

The overhead CO_2 vapor from T-2 is fed to the suction of compressor C-1. The still bottoms stream is fed into cascaded flash evaporation stages for further CO_2 removal.

CO_2 vapor goes to the Low Pressure Compressor (C-3) and the Medium Pressure Compressor (C-2), it is then recompressed and recycled to the recovery column. The organics extract stream is withdrawn on level control and is pumped to storage.

Raffinate Stream Flash Evaporation

The raffinate let down system is analogous to the extract system and the recovered vapors are similarly recycled.

Carbon Dioxide Recompression, Condensing and Recycling

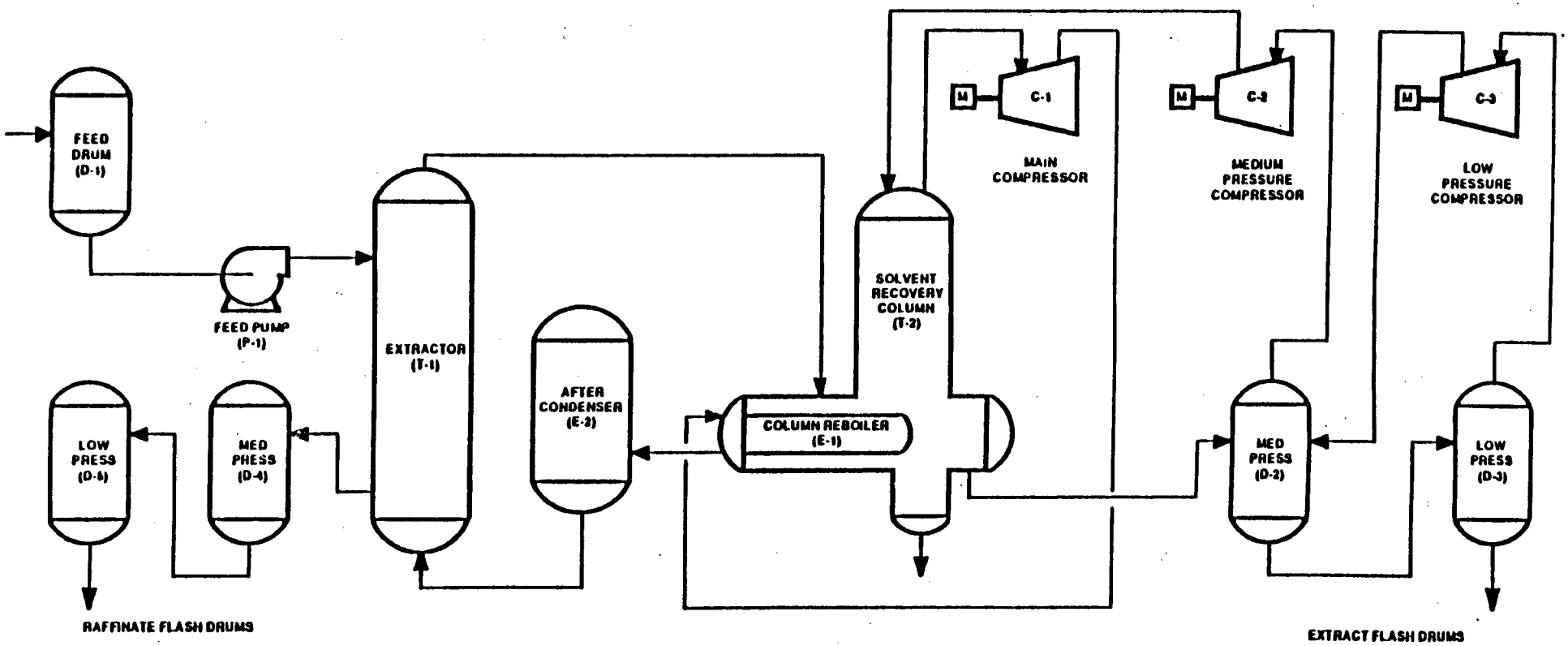
The last process involves recompressing, condensing, and recycling the CO_2. The low pressure CO_2 vapor is compressed by compressor, C-3 and further compressed by compressor C-2 to the Solvent Recovery Column (T-2) pressure. The overhead vapor from T-2 is fed to compressor C-1 for recompression to final system pressure.

From the main compressor (C-1) discharge, the CO_2 is condensed, and subcooled for recycle to the extractor tower. It is condensed by supplying the heat of vaporization of CO_2 in the kettle.

CORPORATION

FIGURE I

CF SYSTEMS ORGANICS EXTRACTION UNIT
Simplified One-Line Diagram



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III. TREATABLILITY TEST

A. TESTING EQUIPMENT DESCRIPTION

A one line diagram for the testing equipment is shown in Figure II. Liquefied CO_2 is pumped to the extraction vessel from a CO_2 cylinder equipped with an eductor tube. Before entering the pump the CO_2 passes through a water cooled heat exchanger to ensure that all the CO_2 is in the liquid phase before entering the pump. The pump is an air driven diaphragm pump which boosts the pressure of the CO_2 to the desired extraction pressure.

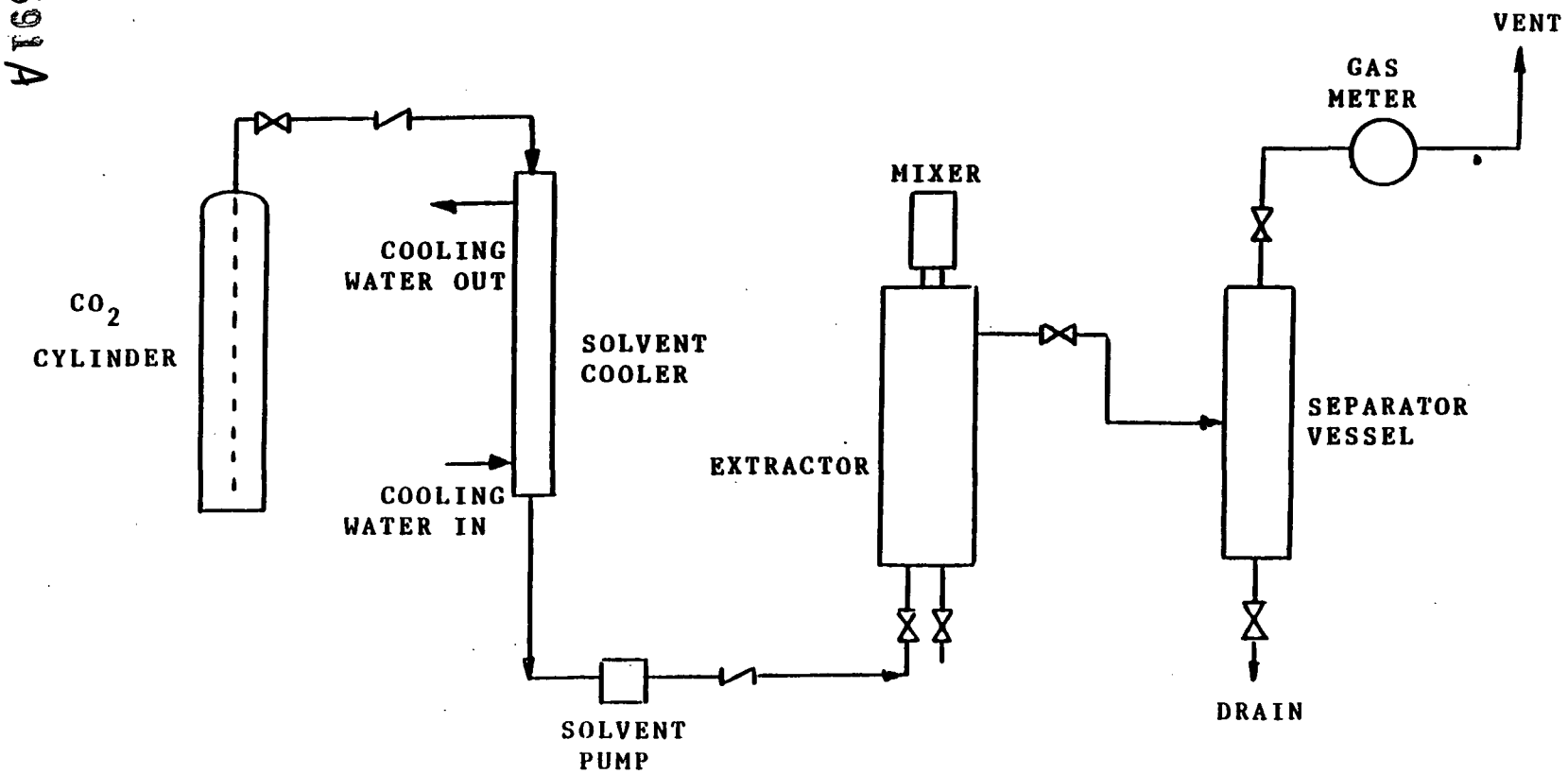
Prior to pumping in liquid CO_2 the extractor had been opened, the desired amount of sample added and then closed up. The liquid CO_2 is then pumped in until the extraction vessel is filled.

The extractor is equipped with an air driven mixer. After the specified mixing and settling times the CO_2/organic phase is displaced from the extractor into the seperator vessel. Fresh clean liquid CO_2 is pumped into the extractor to displace the CO_2/organics phase into the separator.

In the separator vessel the CO_2 is vaporized by reducing the pressure. CO_2 vapor is vented through a dry gas meter to measure the amount of CO_2 that has been displaced from the extractor. Extracted organics are drained from the bottom of the separator, degassed and weighted to determine how much organics have been extracted.

FIGURE II

LABORATORY TESTING EQUIPMENT



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III B. TESTING PROGRAM

The experimental program consisted of three batch extraction runs. Two runs were made in the 3.75 liter solid body extractor and one run in the one liter windowed extractor. The extraction run within the windowed extractor was to observe the separation of the extract and raffinate phase when the mixing was stopped.

For each run the gallon jug of feed was inverted to mix the solution and approximately two liters loaded into the extraction vessel. The gallon jug was left open so as to be exposed to air for the same length of time as the sample put into the extractor. One of the VOA vials was filled with feed at this time.

After the extraction was completed the raffinate was collected in one liter bottles, allowed to degas and then weighed. Also at this time a VOA vial was filled with raffinate. This procedure was repeated for the second two liter batch extraction.

The remaining feed was combined and the bottles for AE/BN analysis and the bottles for pesticide/PCB analysis were filled. The raffinates were combined and the bottles for AE/BN analysis and the bottles for pesticide/PCB analysis were filled. All samples, feeds and raffinates, were refrigerated when not in use. Samples sent for analysis were shipped with overnight ice packs.

III C. TEST RESULTS

The lab data for the three batch extractions is shown in Tables 1, 2, and 3 attached at the back of this report. All three extractions were carried out at 70°F and 1,200 psig. The mixer speed was about 1,000 RPM for all runs.

Mixing time was twenty minutes for each mixing/settling cycle. Settling time at first was twenty minutes but this was found to be too short to separate the foam formed during the first couple of mixes. This time was increased to sixty minutes for more complete settling of the foam. Shorter settling times were adequate for the remaining mixing/settling cycles.

The feed contained 0.4 wt percent organics by analysis. For 1,800 grams of feed there should be approximately 7.2 grams of extract However for Runs 1 and 2 about 150 grams and 81 grams of extract were obtained, respectively. This would indicate that water was carried over with the CO_2/organic extract. The amount of water carried over was reduced considerably when the settling time was increased from 20 minutes for Run 1 to 60 minutes for Run 2.

Analysis of the feed and raffinate samples are also attached at the back of this report. These analyses show that for any compound, where there are analysis numbers for the feed stream, there was greater than 95 percent removal. Benzoic acid analysis for the feed and raffinate was uncertain due to levels being below detection limits. Typically for the chlorinated compounds greater than 99.99% removal was obtained. Other compounds with very high percentage removal were; acetone 99.7%, toluene 99.99%, nitrobenzene 99.96%, and 2-butanone 99.96%.

The lowest extraction efficiencies were obtained with; phenol, naphthalene and PCB 1242, but even for these compounds greater than 95% was extracted.

IV. EVALUATION OF TECHNOLOGY

A. FEASIBILITY ANALYSIS

The greater than 99.9% removal for most of the chlorinated compounds indicated the applicability of this process to the clean up of this ground water stream. The bench scale extractor removed greater than 95% of each of the measurable compounds in the water stream. While most of the compounds showed greater than 99.9% removal only phenol, methyl phenol, naphthalene and PCB-1242 were at the 95% removal level. These levels of recovery would be at least as good in the continuous full scale unit.

IV B. COST ANALYSIS

The total estimated installed cost for a 50 GPM groundwater treatment unit is $5.5MM.

This estimate excludes cost for site preparation civil engineering work and a building for the unit.

The utilities requirement for the unit are given in Table 4.

The installed cost estimate is based on the following:

- A completed cost for a 20 GPM unit having equivalent specifications.
- Quoted installation costs for the above unit.
- Price escalation due to materials cost increases and labor cost increases.
- Scaling of final cost based on modified throughput using confirmed scaling factor for these units.

TABLE 4

OPERATING REQUIREMENTS

UTILITIES

Electricity
350 Kw.Hr/Hr

Refrigerated Water
Flow = 260 GPM (Δ T = 15°F)

Hot Water
550,000 BTU/Hr

Instrument Air
40 SCFM

SOLVENT MAKE-UP

Carbon Dioxide
300 lb/day

LABOR

1 Operator/Shift

CORPORATION

IV C. TIMEFRAME TO IMPLEMENTATION

From receipt of an order it will take approximately nine months to complete the fabrication of the system. The long delivery time is due primarily to the current market conditions for Stainless Steels and Hastalloys.

V. SUMMARY AND CONCLUSION

The CF Systems technology has demonstrated a high level of removal for all organics in the groundwater except for benzoic acid.

The cost of implementing a groundwater clean up using the CF Systems technology would be competitive with any of the available technology.

The recovery of the organic contaminants might yield a net-back to the operation unlike other destructive technologies.

TABLE 1

CF Systems Bench Scale Extraction Report

CFS Sample No.: 533 Date: 15-Feb-89
Client: ERM
Location: Exton, PA

		Feed	Raffinate
(Lab Analyses as received)	Oil	0.4%	
	Solids	0.0%	
	Water	99.6%	

Solvent: Carbon Dioxide

Feed Charged: 1830.16 grams Oil Extracted: 150.39 grams
Solvent Charged: 1535.87 grams 8.22%

Mix	Mixing Time (min.)	Settling Time (min.)	Collection Time (min.)	Solvent Weight (grams)	Extract Weight (grams)
1	20	20	47.12	1578.71	107.14
2	20	60	39.4	1634.19	5.33
3	20	60	49.33	1658.13	2.61
4	20	80	45.52	2768.49	12.02
5	20	30	46.72	1194.91	3.69
6	20	49	35.58	1371.23	3.28
7	20	20	42.12	1523.04	0.43
8	20	50	50.6	2244.47	0.59
9	20	25	50.93	2492.64	0.85
10	20	32	34.88	1377.31	6.78
11	20	30	103.15	4148.84	0.92
12	20	30	70.9	3747.18	6.75
13					
14					
Total				27275.01	150.39

Average
Mixer Speed 1000 RPM
Pressure 1200 PSIG
Temperature 70 Degrees F

Settling Characteristics

Upon initial mixing at 1000 rpm, sample foamed. Foam required a minimum of 1 hour settling for the first few mixes. Subsequent mixings required less settling time.

Observations

Feed was dirty water with a strong organic (pesticide) odor and an oil sheen. Extract collected was mostly water/sample but did seem to have a stronger odor. The raffinate was similar to the feed, though there was no evidence of oil and little odor.

TABLE 2

CF Systems Bench Scale Extraction Report

CFS Sample No.: 533 Date: 15-Feb-89
Client: ERM
Location: Exton, PA

		Feed	Raffinate
(Lab Analyses as received)	Oil	0.4%	
	Solids	0.0%	
	Water	99.6%	

Solvent: Carbon Dioxide

Feed Charged: 1800.44 grams Oil Extracted: 81.22 grams
Solvent Charged: 1559.65 grams 4.51%

Mix	Mixing Time (min.)	Settling Time (min.)	Collection Time (min.)	Solvent Weight (grams)	Extract Weight (grams)
1	20	60	42	984.58	55.60
2	20	60	54.72	1363.75	1.08
3	20	70	22	1138.86	4.87
4	20	60	38.12	1169.07	3.60
5	20	40	38.3	1692.14	0.96
6	20	30	37.93	1551.73	0.06
7	20	30	43.37	1864.66	1.67
8	20	50	37.63	954.37	3.50
9	20	30	63.25	2818.46	3.73
10	20	30	41.53	637.83	0.14
11	20	20	57.65	2514.46	3.83
12	20	20	81.4	2956.78	1.37
13	20	20	110.93	3014.54	0.81
14					
Total				24220.88	81.22

Average
Mixer Speed 1000 RPM
Pressure 1200 PSIG
Temperature 70 Degrees F

Settling Characteristics

Upon initial mixing at 1000 rpm, sample foamed. Foam required a minimum of 1 hour settling for the first few mixes. Subsequent mixings required less settling time.

Observations

eed was dirty water with a strong organic (pesticide) odor and an oil sheen. Extract collected was mostly water/sample but did seem to have a stronger odor. The raffinate was similar to the feed, though there was no evidence of oil and little odor.

TABLE 3

CF Systems Bench Scale Extraction Report

CFS Sample No.: 533 Date: 15-Feb-89
Client: ERM
Location: Exton, PA

		Feed	Raffinate
(Lab Analyses as received)	Oil	0.4%	
	Solids	0.0%	
	Water	99.6%	

Solvent: Carbon Dioxide

Feed Charged: 230.92 grams Oil Extracted: 3.34 grams
Solvent Charged: 631.64 grams 1.45%

Mix	Mixing Time (min.)	Settling Time (min.)	Collection Time (min.)	Solvent Weight (grams)	Extract Weight (grams)
1	20	60	15.04	565.06	0.02
2	20	60	18.23	842.65	0.05
3	20	30	34.47	776.96	0.30
4	20	30	37.07	942.02	0.20
5	20	15	22.92	749.36	0.03
6	20	49	22.9	433.77	1.70
7	20	15	28.7	651.32	0.60
8	20	25	19.45	659.49	0.44
9					
10					
11					
12					
13					
14					
Total				6252.27	3.34

Average
Mixer Speed 1000 RPM
Pressure 1200 PSIG
Temperature 70 Degrees F

Settling Characteristics

Upon initial mixing at 1000 rpm, sample foamed. Foam required a minimum of 1 hour settling for the first few mixes. Subsequent mixings required less settling time.

Observations

Feed was dirty water with a strong organic (pesticide) odor and an oil sheen. Extract collected was mostly water/sample but did seem to have a stronger odor. The raffinate was similar to the feed, though there was no evidence of oil and little odor.

002596A

ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LL Sample No. EL 1358691

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/15/89
Discard Date 3/31/89
Collected by KSO
P.O. 802-01-07-01KS
Rel.

14900 SCP CF Systems Unprocessed Water Sample
Collected on 01/31/89, 02/06/89, 02/14/89 by KS

TCL Volatiles	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE
1 COPY TO Data Package Group			

The American Association for Laboratory Accreditation Chemical, Biological & Environmental fields of testing.

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Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

ANALYSIS REPORT

Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLL Sample No. EL 1358691

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855 Springdale Drive
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P.O. 802-01-07-01KS
Rel.

14900 SCP CF Systems Unprocessed Water Sample
Collected on 01/31/89, 02/06/89, 02/14/89 by KS

ANALYSIS	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE
TCL Volatiles	attached		092226000S
TCL Semi-Volatiles	attached		092352500S
TCL Semi-Volatiles (cont)	attached		092400000S
TCL Pesticides	attached		093723000S

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO C F Systems, Inc. ATTN: Karen Shaw
1 COPY TO Data Package Group

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Member American Council of

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Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

ANALYSIS REPORT

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Rel.

14900 SCP CF Systems Unprocessed Water Sample
Collected on 01/31/89, 02/06/89, 02/14/89 by KS

TCL Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Chloromethane	< 25,000.	ug/l	25000.	082700000S
Bromomethane	< 25,000.	ug/l	25000.	082800000S
Vinyl Chloride	< 25,000.	ug/l	25000.	082900000S
Chloroethane	< 25,000.	ug/l	25000.	083000000S
Methylene Chloride	35,000.	ug/l	12000.	083100000S
Acetone	82,000.	ug/l	25000.	091400000S
Carbon Disulfide	< 12,000.	ug/l	12000.	091500000S
1,1-Dichloroethene	< 12,000.	ug/l	12000.	083200000S
1,1-Dichloroethane	< 12,000.	ug/l	12000.	083300000S
trans-1,2-Dichloroethene	17,000.	ug/l	12000.	083400000S
Chloroform	180,000.	ug/l	12000.	083500000S
1,2-Dichloroethane	180,000.	ug/l	12000.	083600000S
2-Butanone	520,000.	ug/l	25000.	091600000S
1,1,1-Trichloroethane	22,000.	ug/l	12000.	083700000S
Carbon Tetrachloride	< 12,000.	ug/l	12000.	083800000S
Vinyl Acetate	< 25,000.	ug/l	25000.	091700000S
Bromodichloromethane	< 12,000.	ug/l	12000.	083900000S
1,2-Dichloropropane	< 12,000.	ug/l	12000.	084000000S
cis-1,3-Dichloropropene	< 12,000.	ug/l	12000.	084400000S
Trichloroethene	77,000.	ug/l	12000.	084200000S
Dibromochloromethane	< 12,000.	ug/l	12000.	084600000S
1,1,2-Trichloroethane	< 12,000.	ug/l	12000.	084500000S
Benzene	< 12,000.	ug/l	12000.	084300000S
trans-1,3-Dichloropropene	< 12,000.	ug/l	12000.	084100000S
Bromoform	< 12,000.	ug/l	12000.	084700000S
4-Methyl-2-Pentanone	39,000.	ug/l	25000.	091900000S
2-Hexanone	< 25,000.	ug/l	25000.	091800000S
Tetrachloroethene	20,000.	ug/l	12000.	084800000S
1,1,2,2-Tetrachloroethane	< 12,000.	ug/l	12000.	084900000S
Toluene	44,000.	ug/l	12000.	085000000S
Chlorobenzene	< 12,000.	ug/l	12000.	085100000S
Ethylbenzene	< 12,000.	ug/l	12000.	085200000S
Styrene	< 12,000.	ug/l	12000.	092000000S
Xylenes (total)	< 12,000.	ug/l	12000.	092100000S

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO C F Systems, Inc. ATTN: Karen Shaw

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LWL Sample No. RL 1358691

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/15/89
Discard Date 3/31/89
Collected by KSO
P.O. 802-01-07-01KS
Rel.

14900 SCP CF Systems Unprocessed Water Sample
Collected on 01/31/89, 02/06/89, 02/14/89 by KS

TCL Semi-Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
phenol	4,000.	ug/l	200.	065500000S
bis (2-chloroethyl) ether	800.	ug/l	200.	066700000S
2-chlorophenol	< 200.	ug/l	200.	064600000S
1,3-dichlorobenzene	< 200.	ug/l	200.	067700000S
1,4-dichlorobenzene	< 200.	ug/l	200.	067800000S
benzyl alcohol	1,000.	ug/l	200.	092600000S
1,2-dichlorobenzene	600.	ug/l	200.	067600000S
2-methylphenol	400.	ug/l	200.	092700000S
bis (2-chloroisopropyl) ether	< 200.	ug/l	200.	066800000S
4-methylphenol	3,100.	ug/l	200.	092800000S
N-nitrosodi-n-propylamine	< 200.	ug/l	200.	069800000S
hexachloroethane	< 200.	ug/l	200.	069200000S
nitrobenzene	52,000.	ug/l	4000.	069600000S
isophorone	2,900.	ug/l	200.	0694000[illegible]
2-nitrophenol	< 200.	ug/l	200.	06510000[illegible]
2,4-dimethylphenol	900.	ug/l	200.	064800000S
benzoic acid	< 1,000.	ug/l	1000.	092900000S
bis (2-chloroethoxy) methane	< 200.	ug/l	200.	066600000S
2,4-dichlorophenol	< 200.	ug/l	200.	064700000S
1,2,4-trichlorobenzene	< 200.	ug/l	200.	070200000S
naphthalene	400.	ug/l	200.	069500000S
4-chloroaniline	< 200.	ug/l	200.	093000000S
hexachlorobutadiene	< 200.	ug/l	200.	069000000S
4-chloro-3-methylphenol	< 200.	ug/l	200.	065300000S
2-methylnaphthalene	< 200.	ug/l	200.	093100000S
hexachlorocyclopentadiene	< 200.	ug/l	200.	069100000S
2,4,6-trichlorophenol	< 200.	ug/l	200.	065600000S
2,4,5-trichlorophenol	< 1,000.	ug/l	1000.	093200000S
2-chloronaphthalene	< 200.	ug/l	200.	067200000S
2-nitroaniline	< 1,000.	ug/l	1000.	093300000S
dimethyl phthalate	400.	ug/l	200.	068100000S
acenaphthylene	< 200.	ug/l	200.	065800000S

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1 COPY TO C F Systems, Inc. ATTN: Karen Shaw
1 COPY TO Data Package Group

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Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. EL 135869

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/15/89
Discard Date 3/31/89
Collected by KSO
P.O. 802-01-07-01KS
Rel.

14900 SCP CF Systems Unprocessed Water Sample
Collected on 01/31/89, 02/06/89, 02/14/89 by KS

TCL Semi-Volatiles (cont)	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
3-nitroaniline	< 1,000.	ug/l	1000.	093400000S
acenaphthene	< 200.	ug/l	200.	065700000S
2,4-dinitrophenol	< 1,000.	ug/l	1000.	065000000S
4-nitrophenol	< 1,000.	ug/l	1000.	065200000S
dibenzofuran	< 200.	ug/l	200.	093500000S
2,4-dinitrotoluene	< 200.	ug/l	200.	068300000S
2,6-dinitrotoluene	< 200.	ug/l	200.	068400000S
diethyl phthalate	< 200.	ug/l	200.	068000000S
4-chlorophenyl phenyl ether	< 200.	ug/l	200.	067300000S
fluorene	< 200.	ug/l	200.	068800000S
4-nitroaniline	< 1,000.	ug/l	1000.	093600000S
2-methyl-4,6-dinitrophenol	< 1,000.	ug/l	1000.	064900000S
N-nitrosodiphenylamine	< 200.	ug/l	200.	069900000S
4-bromophenyl phenyl ether	< 200.	ug/l	200.	067000000S
hexachlorobenzene	< 200.	ug/l	200.	068900000S
pentachlorophenol	< 1,000.	ug/l	1000.	065400000S
phenanthrene	< 200.	ug/l	200.	070000000S
anthracene	< 200.	ug/l	200.	065900000S
di-n-butyl phthalate	400.	ug/l	200.	068200000S
fluoranthene	< 200.	ug/l	200.	068700000S
pyrene	< 200.	ug/l	200.	070100000S
butyl benzyl phthalate	< 200.	ug/l	200.	067100000S
3,3'-dichlorobenzidine	< 400.	ug/l	400.	067900000S
benzo (a) anthracene	< 200.	ug/l	200.	066100000S
bis (2-ethylhexyl) phthalate	4,800.	ug/l	200.	066900000S
chrysene	< 200.	ug/l	200.	067400000S
di-n-octyl phthalate	< 200.	ug/l	200.	068500000S
benzo (b) fluoranthene	< 200.	ug/l	200.	066300000S
benzo (K) fluoranthene	< 200.	ug/l	200.	066500000S
benzo (a) pyrene	< 200.	ug/l	200.	066200000S
indeno (1,2,3-cd) pyrene	< 200.	ug/l	200.	069300000S
dibenzo (a,h) anthracene	< 200.	ug/l	200.	067500000S
benzo (ghi) perylene	< 200.	ug/l	200.	066400000S

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1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

American Association for Laboratory Accreditation
Chemical, Biological & Environmental Fields of testing

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LL Sample No. EH 1358691

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
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P.O. 802-01-07-01KS
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14900 SCP CF Systems Unprocessed Water Sample
Collected on 01/31/89, 02/06/89, 02/14/89 by KS

TCL Pesticides	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Alpha BHC	< 100.	ug/l	100.	060900000S
Beta BHC	< 100.	ug/l	100.	061000000S
Delta BHC	< 100.	ug/l	100.	061200000S
Gamma BHC - Lindane	< 100.	ug/l	100.	045300000S
Heptachlor	< 100.	ug/l	100.	045400000S
Aldrin	< 100.	ug/l	100.	045500000S
Heptachlor Epoxide	< 50.	ug/l	50.	061500000S
Endosulfan I	< 50.	ug/l	50.	062700000S
Dieldrin	< 100.	ug/l	100.	046900000S
DDE	< 100.	ug/l	100.	061600000S
Endrin	< 100.	ug/l	100.	047700000S
Endosulfan II	< 100.	ug/l	100.	062800000S
DDD	< 10.	ug/l	10.	061700000S
Endosulfan Sulfate	< 10.	ug/l	10.	062900000S
DDT	< 10.	ug/l	10.	047800000S
Endrin Ketone	< 10.	ug/l	10.	093800000S
Methoxychlor	< 50.	ug/l	50.	062100000S
Alpha Chlordane	< 500.	ug/l	500.	136100000S
Gamma Chlordane	< 500.	ug/l	500.	136200000S
Toxaphene	< 100.	ug/l	100.	094200000S
PCB-1016	< 3,100.	ug/l	3100.	063900000S
PCB-1221	< 4,200.	ug/l	4200.	064000000S
PCB-1232	< 7,200.	ug/l	7200.	064100000S
PCB-1242	3,100.	ug/l	500.	064200000S
PCB-1248	< 4,800.	ug/l	4800.	064300000S
PCB-1254	400.	ug/l	100.	064400000S
PCB-1260	< 100.	ug/l	100.	064500000S

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1 COPY TO C F Systems, Inc. ATTN: Karen Shaw
1 COPY TO Data Package Group

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Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Charles J. Neslund, B.S.
Group Leader, Pesticides/PCB's

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LL Sample No. EL 1358692

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/15/89
Discard Date 3/31/89
Collected by KSO
P.O. 802-01-07-01KS
Rel.

14900 SCP CF Systems Extracted Water Sample
Collected on 002/06/89, 02/I4/89, 02/14/89 by KS

TCL Volatiles	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE

1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

Lab Sample No. EL 1358692

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TCL Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Chloromethane	< 10.	ug/l	10.	082700000S
Bromomethane	< 10.	ug/l	10.	082800000S
Vinyl Chloride	< 10.	ug/l	10.	082900000S
Chloroethane	< 10.	ug/l	10.	083000000S
Methylene Chloride	< 5.	ug/l	5.	083100000S
Acetone	220.	ug/l	10.	091400000S
Carbon Disulfide	< 5.	ug/l	5.	091500000S
1,1-Dichloroethene	< 5.	ug/l	5.	083200000S
1,1-Dichloroethane	< 5.	ug/l	5.	083300000S
trans-1,2-Dichloroethene	< 5.	ug/l	5.	083400000S
Chloroform	< 5.	ug/l	5.	083500000S
1,2-Dichloroethane	< 5.	ug/l	5.	083600000S
2-Butanone	200.	ug/l	10.	091600000S
1,1,1-Trichloroethane	< 5.	ug/l	5.	083700000S
Carbon Tetrachloride	< 5.	ug/l	5.	083800000S
Vinyl Acetate	< 10.	ug/l	10.	091700000S
Bromodichloromethane	< 5.	ug/l	5.	083900000S
1,2-Dichloropropane	< 5.	ug/l	5.	084000000S
cis-1,3-Dichloropropene	< 5.	ug/l	5.	084400000S
Trichloroethene	< 5.	ug/l	5.	084200000S
Dibromochloromethane	< 5.	ug/l	5.	084600000S
1,1,2-Trichloroethane	< 5.	ug/l	5.	084500000S
Benzene	< 5.	ug/l	5.	084300000S
trans-1,3-Dichloropropene	< 5.	ug/l	5.	084100000S
Bromoform	< 5.	ug/l	5.	084700000S
4-Methyl-2-Pentanone	< 10.	ug/l	10.	091900000S
2-Hexanone	< 10.	ug/l	10.	091800000S
Tetrachloroethene	< 5.	ug/l	5.	084800000S
1,1,2,2-Tetrachloroethane	< 5.	ug/l	5.	084900000S
Toluene	< 5.	ug/l	5.	085000000S
Chlorobenzene	< 5.	ug/l	5.	085100000S
Ethylbenzene	< 5.	ug/l	5.	085200000S
Styrene	< 5.	ug/l	5.	092000000S
Xylenes (total)	< 5.	ug/l	5.	092100000S

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO C F Systems, Inc. ATTN: Karen Shaw

(002600A

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LL Sample No. EL 1358692

Environ. Resources Management
855 Springdale Drive
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14900 SCP CF Systems Extracted Water Sample
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TCL Semi-Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
phenol	210.	ug/l	20.	065500000S
bis (2-chloroethyl) ether	< 20.	ug/l	20.	066700000S
2-chlorophenol	< 20.	ug/l	20.	064600000S
1,3-dichlorobenzene	< 20.	ug/l	20.	067700000S
1,4-dichlorobenzene	< 20.	ug/l	20.	067800000S
benzyl alcohol	20.	ug/l	20.	092600000S
1,2-dichlorobenzene	< 20.	ug/l	20.	067600000S
2-methylphenol	< 20.	ug/l	20.	092700000S
bis (2-chloroisopropyl) ether	< 20.	ug/l	20.	066800000S
4-methylphenol	< 20.	ug/l	20.	092800000S
N-nitrosodi-n-propylamine	< 20.	ug/l	20.	069800000S
hexachloroethane	< 20.	ug/l	20.	069200000S
nitrobenzene	< 20.	ug/l	20.	069600000S
isophorone	< 20.	ug/l	20.	069400000S
2-nitrophenol	< 20.	ug/l	20.	065100000S
2,4-dimethylphenol	< 20.	ug/l	20.	064800000S
benzoic acid	900.	ug/l	100.	092900000S
bis (2-chloroethoxy) methane	< 20.	ug/l	20.	066600000S
2,4-dichlorophenol	< 20.	ug/l	20.	064700000S
1,2,4-trichlorobenzene	< 20.	ug/l	20.	070200000S
naphthalene	< 20.	ug/l	20.	069500000S
4-chloroaniline	< 20.	ug/l	20.	093000000S
hexachlorobutadiene	< 20.	ug/l	20.	069000000S
4-chloro-3-methylphenol	< 20.	ug/l	20.	065300000S
2-methylnaphthalene	< 20.	ug/l	20.	093100000S
hexachlorocyclopentadiene	< 20.	ug/l	20.	069100000S
2,4,6-trichlorophenol	< 20.	ug/l	20.	065600000S
2,4,5-trichlorophenol	< 100.	ug/l	100.	093200000S
2-chloronaphthalene	< 20.	ug/l	20.	067200000S
2-nitroaniline	< 100.	ug/l	100.	093300000S
dimethyl phthalate	< 20.	ug/l	20.	068100000S
acenaphthylene	< 20.	ug/l	20.	065800000S

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO C F Systems, Inc. ATTN: Karen Shaw
1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

American Association for Laboratory Accreditation Chemical, Biological & Environmental fields of testing.

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. EL 1358692

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/15/89
Discard Date 3/31/89
Collected by KSO
P.O. 802-01-07-01KS
Rel.

14900 SCP CF Systems Extracted Water Sample
Collected on 002/06/89, 02/14/89, 02/14/89 by KS

TCL Semi-Volatiles (cont)	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
3-nitroaniline	< 100.	ug/l	100.	093400000S
acenaphthene	< 20.	ug/l	20.	065700000S
2,4-dinitrophenol	< 100.	ug/l	100.	065000000S
4-nitrophenol	< 100.	ug/l	100.	065200000S
dibenzofuran	< 20.	ug/l	20.	093500000S
2,4-dinitrotoluene	< 20.	ug/l	20.	068300000S
2,6-dinitrotoluene	< 20.	ug/l	20.	068400000S
diethyl phthalate	< 20.	ug/l	20.	068000000S
4-chlorophenyl phenyl ether	< 20.	ug/l	20.	067300000S
fluorene	< 20.	ug/l	20.	068800000S
4-nitroaniline	< 100.	ug/l	100.	093600000S
2-methyl-4,6-dinitrophenol	< 100.	ug/l	100.	064900000S
N-nitrosodiphenylamine	< 20.	ug/l	20.	069900000S
4-bromophenyl phenyl ether	< 20.	ug/l	20.	067000000
hexachlorobenzene	< 20.	ug/l	20.	068900000S
pentachlorophenol	< 100.	ug/l	100.	065400000S
phenanthrene	< 20.	ug/l	20.	070000000S
anthracene	< 20.	ug/l	20.	065900000S
di-n-butyl phthalate	< 20.	ug/l	20.	068200000S
fluoranthene	< 20.	ug/l	20.	068700000S
pyrene	< 20.	ug/l	20.	070100000S
butyl benzyl phthalate	< 20.	ug/l	20.	067100000S
3,3'-dichlorobenzidine	< 40.	ug/l	40.	067900000S
benzo (a) anthracene	< 20.	ug/l	20.	066100000S
bis (2-ethylhexyl) phthalate	150.	ug/l	20.	066900000S
chrysene	< 20.	ug/l	20.	067400000S
di-n-octyl phthalate	< 20.	ug/l	20.	068500000S
benzo (b) fluoranthene	< 20.	ug/l	20.	066300000S
benzo (K) fluoranthene	< 20.	ug/l	20.	066500000S
benzo (a) pyrene	< 20.	ug/l	20.	066200000S
indeno (1,2,3-cd) pyrene	< 20.	ug/l	20.	069300000S
dibenzo (a,h) anthracene	< 20.	ug/l	20.	067500000S
benzo (ghi) perylene	< 20.	ug/l	20.	066400000S

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1 COPY TO C F Systems, Inc. ATTN: Karen Shaw
1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. EL 1358692

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/15/89
Discard Date 3/31/89
Collected by KSO
P.O. 802-01-07-01KS
Rel.

14900 SCP CF Systems Extracted Water Sample
Collected on 002/06/89, 02/14/89, 02/14/89 by KS

TCL Pesticides	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Alpha BHC	< 5.	ug/l	5.	060900000S
Beta BHC	< 5.	ug/l	5.	061000000S
Delta BHC	< 5.	ug/l	5.	061200000S
Gamma BHC - Lindane	< 5.	ug/l	5.	045300000S
Heptachlor	< 5.	ug/l	5.	045400000S
Aldrin	< 5.	ug/l	5.	045500000S
Heptachlor Epoxide	< 5.	ug/l	5.	061500000S
Endosulfan I	< 10.	ug/l	10.	062700000S
Dieldrin	< 10.	ug/l	10.	046900000S
DDE	< 10.	ug/l	10.	061600000S
Endrin	< 10.	ug/l	10.	047700000S
Endosulfan II	< 10.	ug/l	10.	062800000S
DDD	< 10.	ug/l	10.	061700000S
Endosulfan Sulfate	< 10.	ug/l	10.	062900000S
DDT	< 10.	ug/l	10.	047800000S
Endrin Ketone	< 10.	ug/l	10.	093800000S
Methoxychlor	< 50.	ug/l	50.	062100000S
Alpha Chlordane	< 50.	ug/l	50.	136100000S
Gamma Chlordane	< 50.	ug/l	50.	136200000S
Toxaphene	< 100.	ug/l	100.	094200000S
PCB-1016	< 140.	ug/l	140.	063900000S
PCB-1221	< 110.	ug/l	110.	064000000S
PCB-1232	< 310.	ug/l	310.	064100000S
PCB-1242	150.	ug/l	50.	064200000S
PCB-1248	< 200.	ug/l	200.	064300000S
PCB-1254	< 100.	ug/l	100.	064400000S
PCB-1260	< 100.	ug/l	100.	064500000S

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO C F Systems, Inc. ATTN: Karen Shaw
1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Charles J. Neslund, B.S.
Group Leader, Pesticides/PCB's

American Association for Laboratory Accreditation
Chemical, Biological & Environmental fields of testing.

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002602

ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. PL 1358692

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/15/89
Discard Date 3/31/89
Collected by KSO
P.O. 802-01-07-01KS
Rel.

14900 SCP CF Systems Extracted Water Sample
Collected on 002/06/89, 02/14/89, 02/14/89 by KS

ANALYSIS	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE
TCL Volatiles	attached		092226000S
TCL Semi-Volatiles	attached		092352500S
TCL Semi-Volatiles (cont)	attached		092400000S
TCL Pesticides	attached		093723000S

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO C F Systems, Inc. ATTN: Karen Shaw
1 COPY TO Data Package Group

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Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

APPENDIX C-2
PEROXIDATION SYSTEMS, INC.
UV/PEROXIDATION

Note: In the following report, UV sources A and B are referenced. Both these sources resulted in a UV intensity of 207 W/l. The characteristics of the light from the two sources are somewhat different, but the light intensity, the parameter of interest, is not affected by these characteristics.

002603

002603 A

CONFIDENTIAL TESTING REPORT

DESTRUCTION OF ORGANIC CONTAMINANTS IN GROUNDWATER WITH THE perox-pure^{tm} PROCESS

for

Environment Resources Management, Inc.
Exton, Pennsylvania
Work Order No. 802-01-07-01

by

Peroxidation Systems, Inc.
4400 E. Broadway, Suite 602
Tucson, Arizona 85711

March 29, 1989

The information contained in this report includes descriptions and procedures which are confidential to Peroxidation Systems, Inc. The report shall not e copied nor released to third parties without prior approval from Peroxidation Systems, Inc.

002604 A

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INTRODUCTION

The perox-pure^{tm} Process destroys dissolved organic contaminants in water by means of chemical oxidation. Ultraviolet (UV) light catalyzes the chemical oxidation of organic contaminants in water by its combined effect upon the organic contaminants and its reaction with hydrogen peroxide (H202). Many organic contaminants absorb UV light and may undergo a change in their chemical structure or may become more reactive with chemical oxidants. More importantly, UV light at less than 400 nm wavelength reacts with H202 molecules to form hydroxyl radicals. These powerful chemical oxidants then react with the organic contaminants in the water. If carried to completion the reaction products of hydrocarbon oxidation with the perox-pure^{tm} Process are carbon dioxide and water.

Peroxidation Systems, Inc. (PSI) was contracted by Environmental Resources Management, Inc. (ERM) to perform a treatability study on a groundwater from Wells MW3S and MW7S at the SCP site in Carlstadt, New Jersey. Aquifer sampling data from the site indicated that an average of 1430 mg/l of volatile organics, 53 mg/l of semivolatile organics, 4.3 mg/l of PCB's and 0.017 mg/l of pesticides were present in the groundwater. The treatment objective specified by Ruth Baker (ERM) was destruction of the organics to less than 1 mg/l each.

002606

TESTING PROCEDURES

Description of Groundwater

On February 1, 1989, 10 gallons of groundwater was received from ERM at the PSI Laboratory in Tucson, Arizona. The water was contained in two 5-gallon metal gasoline cans.

Characterization of the groundwater was performed by PSI to determine parameters of importance for perox-pure^{tm} treatment. The results are shown in Table 1. Because of the dark color and high turbidity of the sample, the water was clarified with 200 mg/l alum, and then gravity filtered through a glass fiber filter with 10 um particle retention. The alum dosage was not optimized because of the limited amount of water available for testing. The characterization results for the pretreated water are shown in Table 1.

Table 1

SCP Groundwater Sample Characteristics

Parameter	Before Pretreatment	After Pretreatment
Visual Color	Cloudy, dark brown	Clear, brown
pH	7.7	6.8
Iron (mg/l)	10	0.3
Chloride (mg/l)	500	500
Turbidity (NTU)	130	15
COD (mg/l)	8500	4500
TDS (mg/l)	470	470

Testing Protocol

Prior to pretreatment, the bench-scale equipment was charged with an aliquot of groundwater. The water was circulated through the system as during a typical perox-pure^{tm} test, except that no UV light or H202 was introduced. A sample was collected after 30 minutes, equivalent to the longest treatment time in the perox-pure^{tm} tests, to evaluate volatilization of the contaminants during testing.

For perox-pure^{tm} treatment, the bench-scale unit was charged by placing an aliquot of the pretreated groundwater into a glass recycle reservoir. A pump was started to circulate the solution through the oxidation chamber, which housed the UV lamp, and back into the reservoir providing continual mixing in the closed system. The UV lamp was illuminated to start a test, and H202 was added as required to maintain a constant concentration in solution. The solution temperature was controlled through use of an in-line cooling coil.

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Untreated and treated groundwater samples were shipped to Lancaster Laboratories, Inc. in Lancaster, Pennsylvania under chain of custody for analysis of volatile organics, semivolatile organics, PCB's and pesticides. At ERM's request, selected samples were shipped to Lancaster Laboratories for metals analysis, and a sample of the pretreatment sludge was included for dewatering.

TESTING RESULTS

Three bench-scale perox-pure^{tm} tests were performed by PSI on the groundwater. These tests were designed to determine the effects of UV intensity, H202 dosage and oxidation time on the rates of contaminant destruction. The test conditions are shown in Table 2.

Table 2

Bench-Scale perox-pure^{tm} Treatment Conditions for SCP Groundwater Sample

Test	UV Source	H202 in Solution (mg/l)	Samples at Oxidation Time (minutes)
1	A	750	10,30
2	B	750	20
3	B	400	20

A limited number of samples were collected in each test because of the large volume of water required for the sample analyses. Only one sample was collected in Tests 2 and 3 because of the lack of available groundwater. Also, the groundwater in Test 3 was diluted with tap water to 2/3 of its original concentration in order to produce enough water for the test. The resulting water color was similar to that of Tests 1 and 2. The results for Test 3, shown below, were corrected for the dilution by multiplying them by 3/2 to enable direct comparison with the other results.

The perox-pure^{tm} test results are shown in Table 3. The laboratory analysis reports are provided in Appendix A, 2-butanone, 1,2-dichloroethane, chloroform and acetone were the primary contaminants in the pretreated groundwater with a combined concentration of 1,130 mg/l. Twenty-three other contaminants were detected in the samples, with a combined concentration of approximately 140 mg/l in the pretreated groundwater. All of the contaminants were treated most effectively in Test 2 which utilized UV Source B and 750 mg/l H202 in solution. The rate of destruction of the primary contaminants is slower than anticipated, probably because of the brown color of the pretreated groundwater and the need for more H202 in solution. Rate determination for many of the compounds is not possible because of the variation in detection limit between the treated and untreated sample results. This variation is caused by the change in sample dilution at the analytical lab, and is probably also responsible for the apparent increases in the concentrations of some of the contaminants with treatment.

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Table 3

Bench-Scale perox-pure[tm] Treatment Results
for SCP Groundwater Sample

Contaminant (mg/l)	0 Min.	Test 1 10 Min.	Test 1 30 Min.	Test 2 20 Min.	Test 3 20 Min.
Methylene Chloride	32	<25	22	18	23
Acetone	90	70	71	62	92
Chloroform	150	110	98	77	87
1,2-Dichloroethane	160	130	110	100	116
2-Butanone (MEK)	730	620	510	490	630
Trichloroethene	44	30	15	<12	<20
Toluene	31	<25	<12	<12	<20
Phenol	1.60	2.60	1.00	1.50	1.50
BIS (2-chloroethyl) Ether	1.00	0.70	0.26	0.32	0.29
Benzyl Alcohol	1.00	1.10	0.30	0.70	0.39
2-Methylphenol	0.30	<0.20	0.28	0.28	0.39
4-Methylphenol	1.90	1.40	1.30	1.00	1.50
Nitrobenzene	22.00	30.00	22.00	30.00	24.00
Isophorone	1.70	1.60	2.00	2.00	1.50
2,4-Dimethylphenol	0.80	<0.20	0.01	0.04	0.04
Dimethyl Phthalate	0.20	0.40	0.22	0.22	0.20
2-Chlorophenol	<0.20	<0.20	0.02	<0.01	0.02
1,2-Dichlorobenzene	<0.20	<0.20	0.04	0.05	0.05
2-Nitrophenol	<0.20	<0.20	0.10	0.13	0.15
Napthalene	<0.20	<0.20	0.02	0.02	<0.01
4-Nitrophenol	<1.00	<1.00	0.14	0.14	<0.08
Diethyl Phthalate	<0.20	<0.20	0.05	0.05	0.05
Di-N-Butyl Phthalate	<0.20	<0.20	0.03	0.03	0.05
Butyl Benzyl Phthalate	<0.20	<0.20	0.01	<0.01	0.02
BIS (2-ethylhexyl) Phthalate	<0.20	<0.20	0.03	0.04	0.12
2,4-Dichlorophenol	<0.20	<0.20	<0.02	0.03	<0.02
Methoxylchlor	<0.01	---	0.01	---	0.01

The results of the volatilization test are shown in Table 4. The laboratory analysis reports for this test are provided in Appendix B. The more volatile contaminants, acetone, chloroform and 1,2=dichloroethane were reportedly not reduced at all during the test. 2-Butanone reportedly increased in concentration by 4%. Methylene chloride and trichloroethene were reportedly reduced by 10% and toluene by 5%. However, the results for the semi-volatile contaminants and PCB's are somewhat questionable. Some of the less volatile contaminants decreased by nearly 50% while others reportedly increased by more than 95%. Estimation of volatilization was not possible for many of the contaminants because of the same variation in detection limits as was experienced with the perox-pure™ test results.

The laboratory analysis reports for the metals in the untreated sample and the 30 minute sample from Test 1 are provided in Appendix C. While there are some reductions in the concentrations of certain metals, these reductions are due to the pretreatment process and not the perox-pure™ Process.

The organic contaminant analytical results for this study have a number of irregularities which not only prevent rate determination for most of the contaminants, but have variations which in some cases make the results unbelievable. In order to project full-scale process conditions, the reliable information available from this study will be evaluated along with the results from previous perox-pure™ studies on similar water samples.

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Table 4

Bench-Scale Volatilization Test Results
for SCP Groundwater Sample

Contaminant (mg/l)	0 Min.	30 Min.
Methylene Chloride	40	36
Acetone	90	90
Chloroform	200	200
1,2-Dichloroethane	190	190
2-Butanone (MEK)	780	810
Trichloroethene	73	65
Toluene	48	46
Phenol	4.80	3.20
BIS (2-Chloroethyl) Ether	<0.02	0.80
Benzyl Alcohol	0.60	1.00
1,2-Dichlorobenzene	0.22	<0.40
2-Methylphenol	0.19	0.40
4-Methylphenol	2.00	2.70
Nitrobenzene	48.00	40.00
Isophorone	4.00	2.30
2,4-Dimethylphenol	1.00	0.90
2-Methylnapthalene	0.08	<0.40
2-Chloronapthalene	0.07	<0.40
Dimethyl Phthalate	0.27	<0.40
Diethyl Phthalate	0.06	<0.40
Phenanthrene	0.04	<0.40
Di-N-Butyl Phthalate	0.12	<0.40
Fluoranthrene	0.02	<0.40
Pyrene	0.02	<0.40
Butyl Benzyl Phthalate	0.04	<0.40
BIS (2-ethylhexyl) Phthalate	4.00	2.20
Di-N-Octyl Phthalate	0.03	<0.40
PCB-1242	0.48	0.94
PCB-1254	0.04	0.07

FULL-SCALE TREATMENT CONDITIONS

Treatment Criteria

The criteria used to project full-scale treatment parameters for the perox-pure^{tm} Process are summarized in Table 5. The flow rate was specified by Ruth Baker (ERM) in a letter to Chris Giggy (PSI) dated January 30, 1989. The influent criteria are taken as the contaminant concentrations detected in pretreated groundwater sample reported above in Table 3. The effluent criteria was specified to Emery Froelich (PSI) by Ruth Baker during a telecon on March 28, 1989.

Table 5

Criteria for Full-Scale perox-pure^{tm} Treatment of SCP Groundwater

Flow Rate (GPM)	40
Influent	Per contaminant concentration in pretreated groundwater reported in Table 3.
Effluent	Less than 1 mg/l each contaminant.

Recommended Process Conditions

As a result of this study, some bench-scale data were obtained for perox-pure^{tm} treatment of the organic contaminants in the sample. Pretreatment of the groundwater would be required before perox-pure^{tm} treatment, but the costs of pretreatment are not considered below. The bench-scale results were compared with existing laboratory and field data to estimate the process requirements in full-scale perox-pure^{tm} equipment. The scale-up is based upon the more efficient design of the full-scale process which includes:

- multiple UV lamps
- more efficient UV lamps
- increased UV utilization
- optimized use of H202
- proprietary mixing design

Full-scale perox-pure^{tm} Process conditions are projected in Table 6. The full-scale oxidation time was calculated from the treatment criteria in Table 5 using the adjusted full-scale rate data. The oxidation time was then used along with the flow rate from Table 5 to determine the appropriate perox-pure^{tm} equipment size. The H202 dosage was increased over the concentration maintained in Test 2 to increase contaminant reaction rates, and then adjusted using a scale-up factor which accounts for the more efficient use of H202 in full-scale perox-pure^{tm} equipment.

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CAPITAL AND OPERATING COST PROJECTIONS

Capital Cost

Two **perox-pure**™ Model CW-360's are recommended to meet the treatment criteria in Table 5. The capital costs associated with a PSI owned system with Full Service Contract and a customer owned system are shown below.

	PSI Owned System with Full Service Contract	Customer Owned and Operated System
Two Model CW 360's	Included	$560,900
Freight	By Customer	By Customer
Site Preparation & Foundation	By Customer	By Customer
Power to the Battery Limits	By Customer	By Customer
Influent/Effluent Pipes, Pumps & Tanks	By Customer	By Customer
H202 Storage & Feed System	Included	Included with H202 Contract
Start-up Services & Training	$12,000	Included

Operating Costs

The projected costs for **perox-pure**™ treatment of the groundwater at 40 gpm on a 24 hour basis are shown below. The energy cost was assumed to be $0.07/KWH. Repair/replacement parts and labor are estimated at 15% of the capital investment per year and amortization at 20% of the capital per year. The PSI fee includes equipment lease, chemical supply, and repair/replacement parts and labor for a five year Full Service Contract.

	PSI Owned System with Full Service Contract ($/1000 gal.)	Customer Owned and Operated System ($/1000 gal).
UV Energy @ $0.07/KWH	$21.00	$21.00
H202 @ $0.75/lb. (delivered)	Included	18.75
Repair/Replacement Parts & Labor	Included	4.06
Amortization of Capital	Included	5.41
PSI Fee	$26.25	---
Total	$47.25	$49.22

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Table 6

Full-scale perox-pure™ Process Conditions for Treatment of the SCP Groundwater

Oxidation Time (minutes)	26
perox-pure™ Model	Two CW 360's
Power Demand (KW)	720
H202 Dosage (lbs/1000 gallons)	25

The perox-pure™ Process is dependent upon a number of reaction conditions which can affect both performance and cost. Some process variables are inherent to the properties of the contaminated water while other process variables can be controlled by the treatment system design and operation. The design of the perox-pure™ equipment assures the user of optimum performance over a wide range of process conditions. The perox-pure™ units are equipped with instruments and controls to monitor process variables including UV energy and oxidant addition.

002610A

SUMMARY AND RECOMMENDATIONS

This bench-scale testing program has demonstrated that the perox-pure™ Process can destroy the major contaminants in the clarified SCP groundwater sample. Two **perox-pure™** Model CW 360's were projected to treat the organic contaminants in the pretreated groundwater to less than 1 mg/l each, although the concentrations of the alkenes, aromatics and PCB's would be reduced to far below this level because of their greater reactivity. The operating cost for the above mentioned **perox-pure™** treatment is estimated to be $47.25/1000 gallons for a PSI owned system with Full Service Contract.

A more economical method of treating the SCP groundwater would be steam stripping followed by a **perox-pure™** polishing step. The steam stripper would reduce the concentrations of the volatile contaminants, and to a lesser extent the semi-volatile contaminants, to the low mg/l levels. The **perox-pure™** Process could then rapidly destroy the remaining contaminants to acceptable levels, perhaps with a **perox-pure™** model as small as an LV 60 and with a minimum H202 dosage.

002611

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APPENDIX A

Laboratory Analysis Reports for Bench-Scale perox-pure™ Tests on the SCP Groundwater Sample

Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. EL-1355161

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/ 4/89
Discard Date 3/31/89
Collected by C
P.O. 802-01-07-01 CG
Rel.

ERMG3-1 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Pesticides	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Alpha BHC	< 13.	ug/l	13.	060900000P
Beta BHC	< 13.	ug/l	13.	061000000P
Delta BHC	< 13.	ug/l	13.	061200000P
Gamma BHC - Lindane	< 13.	ug/l	13.	045300000P
Heptachlor	< 2.5	ug/l	2.5	045400000P
Aldrin	< 13.	ug/l	13.	045500000P
Heptachlor Epoxide	< 2.5	ug/l	2.5	061500000P
Endosulfan I	< 2.5	ug/l	2.5	062700000P
Dieldrin	< 5.	ug/l	5.	046900000P
DDE	< 5.	ug/l	5.	061600000P
Endrin	< 5.	ug/l	5.	047700000P
Endosulfan II	< 5.	ug/l	5.	062800000P
DDD	< 0.5	ug/l	0.5	061700000P
Endosulfan Sulfate	< 5.	ug/l	5.	062900000P
DDT	< 0.5	ug/l	0.5	047800000P
Endrin Ketone	< 0.5	ug/l	0.5	093800000P
Methoxychlor	8.5	ug/l	2.5	062100000P
Alpha Chlordane	< 25.	ug/l	25.	136100000P
Gamma Chlordane	< 25.	ug/l	25.	136200000P
Toxaphene	< 50.	ug/l	50.	094200000P
PCB-1016	< 130.	ug/l	130.	063900000P
PCB-1221	< 130.	ug/l	130.	064000000P
PCB-1232	< 130.	ug/l	130.	064100000P
PCB-1242	< 130.	ug/l	130.	064200000P
PCB-1248	< 130.	ug/l	130.	064300000P
PCB-1254	< 50.	ug/l	50.	064400000P
PCB-1260	< 5.	ug/l	5.	064500000P

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1 COPY TO Peroxidation Systems Inc. ATTN: Chris Giggy
1 COPY TO Data Package Group

002612A

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Charles J. Neslund, B.S.
Group Leader, Pesticides/PCB's

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...Accreditation
...ological & Environmental
...ing.

...r American Council of
...ndent Laboratories, Inc.

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Our Standard Terms And Conditions

Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. EL-1355161

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/ 4/89
Discard Date 3/31/89
Collected by C
P.O. 802-01-07-01 CG
Rel.

ERMG3-1 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Semi-Volatiles (cont)	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
3-nitroaniline	< 50.	ug/l	50.	093400000P
acenaphthene	< 10.	ug/l	10.	065700000P
2,4-dinitrophenol	< 50.	ug/l	50.	065000000P
4-nitrophenol	< 50.	ug/l	50.	065200000P
dibenzofuran	< 10.	ug/l	10.	093500000P
2,4-dinitrotoluene	< 10.	ug/l	10.	068300000P
2,6-dinitrotoluene	< 10.	ug/l	10.	068400000P
diethyl phthalate	30.	ug/l	10.	068000000P
4-chlorophenyl phenyl ether	< 10.	ug/l	10.	067300000P
fluorene	< 10.	ug/l	10.	068800000P
4-nitroaniline	< 50.	ug/l	50.	093600000P
2-methyl-4,6-dinitrophenol	< 50.	ug/l	50.	064900000P
N-nitrosodiphenylamine	< 10.	ug/l	10.	069900000P
4-bromophenyl phenyl ether	< 10.	ug/l	10.	067000000P
hexachlorobenzene	< 10.	ug/l	10.	068900000P
pentachlorophenol	< 50.	ug/l	50.	065400000P
phenanthrene	< 10.	ug/l	10.	070000000P
anthracene	< 10.	ug/l	10.	065900000P
di-n-butyl phthalate	30.	ug/l	10.	068200000P
fluoranthene	< 10.	ug/l	10.	068700000P
pyrene	< 10.	ug/l	10.	070100000P
butyl benzyl phthalate	10.	ug/l	10.	067100000P
3,3'-dichlorobenzidine	< 20.	ug/l	20.	067900000P
benzo (a) anthracene	< 10.	ug/l	10.	066100000P
bis (2-ethylhexyl) phthalate	80.	ug/l	10.	066900000P
chrysene	< 10.	ug/l	10.	067400000P
di-n-octyl phthalate	< 10.	ug/l	10.	068500000P
benzo (b) fluoranthene	< 10.	ug/l	10.	066300000P
benzo (K) fluoranthene	< 10.	ug/l	10.	066500000P
benzo (a) pyrene	< 10.	ug/l	10.	066200000P
indeno (1,2,3-cd) pyrene	< 10.	ug/l	10.	069300000P
dibenzo (a,h) anthracene	< 10.	ug/l	10.	067500000P
benzo (ghi) perylene	< 10.	ug/l	10.	066400000P

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO Peroxidation Systems Inc. ATTN: Chris Giggy
1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

American Association for Laboratory Accreditation Biological & Environmental Testing.

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Member: American Council of Independent Laboratories, Inc.

Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLL Sample No. RL 1355161

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/ 4/89
Discard Date 3/31/89
Collected by C
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ERMG3-1 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Semi-Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
phenol	1,000.	ug/l	1000.	065500000P
bis (2-chloroethyl) ether	190.	ug/l	10.	066700000P
2-chlorophenol	10.	ug/l	10.	064600000P
1,3-dichlorobenzene	< 10.	ug/l	10.	067700000P
1,4-dichlorobenzene	< 10.	ug/l	10.	067800000P
benzyl alcohol	260.	ug/l	10.	092600000P
1,2-dichlorobenzene	30.	ug/l	10.	067600000P
2-methylphenol	260.	ug/l	10.	092700000P
bis (2-chloroisopropyl) ether	< 10.	ug/l	10.	066800000P
4-methylphenol	1,000.	ug/l	200.	092800000P
N-nitrosodi-n-propylamine	< 10.	ug/l	10.	069800000P
hexachloroethane	< 10.	ug/l	10.	069200000P
nitrobenzene	16,000.	ug/l	1000.	069600000P
isophorone	1,000.	ug/l	1000.	069400000P
2-nitrophenol	100.	ug/l	10.	065100000P
2,4-dimethylphenol	30.	ug/l	10.	064800000P
benzoic acid	< 50.	ug/l	50.	092900000P
bis (2-chloroethoxy) methane	< 10.	ug/l	10.	066600000P
2,4-dichlorophenol	< 10.	ug/l	10.	064700000P
1,2,4-trichlorobenzene	< 10.	ug/l	10.	070200000P
naphthalene	< 10.	ug/l	10.	069500000P
4-chloroaniline	< 10.	ug/l	10.	093000000P
hexachlorobutadiene	< 10.	ug/l	10.	069000000P
4-chloro-3-methylphenol	< 10.	ug/l	10.	065300000P
2-methylnaphthalene	< 10.	ug/l	10.	093100000P
hexachlorocyclopentadiene	< 10.	ug/l	10.	069100000P
2,4,6-trichlorophenol	< 10.	ug/l	10.	065600000P
2,4,5-trichlorophenol	< 50.	ug/l	50.	093200000P
2-chloronaphthalene	< 10.	ug/l	10.	067200000P
2-nitroaniline	< 50.	ug/l	50.	093300000P
dimethyl phthalate	130.	ug/l	10.	068100000P
acenaphthylene	< 10.	ug/l	10.	065800000P

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1 COPY TO Peroxidation Systems Inc. ATTN: Chris Giggy
1 COPY TO Data Package Group

002613A

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

American Association for Accreditation Biological & Environmental Testing.

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American Council of Independent Laboratories, Inc.

Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. EL 1355161

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/ 4/89
Discard Date 3/31/89
Collected by C
P.O. 802-01-07-01 CG
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ERMG3-1 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Volatiles	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE

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1 COPY TO Peroxidation Systems Inc. ATTN: Chris Giggy
1 COPY TO Data Package Group

American Association for Laboratory Accreditation (Chemical, Biological & Environmental Testing)

Member: American Council of Independent Laboratories, Inc.

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Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

Lancaster Laboratories INCORPORATED
25 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. PL 1355161

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/ 4/89
Discard Date 3/31/89
Collected by C
P.O. 802-01-07-01 CG
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ERMG3-1 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Chloromethane	< 25,000.	ug/l	25000.	082700000P
Bromomethane	< 25,000.	ug/l	25000.	082800000P
Vinyl Chloride	< 25,000.	ug/l	25000.	082900000P
Chloroethane	< 25,000.	ug/l	25000.	083000000P
Methylene Chloride	15,000.	ug/l	12000.	083100000P
Acetone	61,000.	ug/l	25000.	091400000P
Carbon Disulfide	< 12,000.	ug/l	12000.	091500000P
1,1-Dichloroethene	< 12,000.	ug/l	12000.	083200000P
1,1-Dichloroethane	< 12,000.	ug/l	12000.	083300000P
trans-1,2-Dichloroethene	< 12,000.	ug/l	12000.	083400000P
Chloroform	58,000.	ug/l	12000.	083500000P
1,2-Dichloroethane	77,000.	ug/l	12000.	083600000P
2-Butanone	420,000.	ug/l	25000.	091600000P
1,1,1-Trichloroethane	< 12,000.	ug/l	12000.	083700000P
Carbon Tetrachloride	< 12,000.	ug/l	12000.	083800000P
Vinyl Acetate	< 25,000.	ug/l	25000.	091700000P
Bromodichloromethane	< 12,000.	ug/l	12000.	083900000P
1,2-Dichloropropane	< 12,000.	ug/l	12000.	084000000P
cis-1,3-Dichloropropene	< 12,000.	ug/l	12000.	084400000P
Trichloroethene	< 12,000.	ug/l	12000.	084200000P
Dibromochloromethane	< 12,000.	ug/l	12000.	084600000P
1,1,2-Trichloroethane	< 12,000.	ug/l	12000.	084500000P
Benzene	< 12,000.	ug/l	12000.	084300000P
trans-1,3-Dichloropropene	< 12,000.	ug/l	12000.	084100000P
Bromoform	< 12,000.	ug/l	12000.	084700000P
4-Methyl-2-Pentanone	< 25,000.	ug/l	25000.	091900000P
2-Hexanone	< 25,000.	ug/l	25000.	091800000P
Tetrachloroethene	< 12,000.	ug/l	12000.	084800000P
1,1,2,2-Tetrachloroethane	< 12,000.	ug/l	12000.	084900000P
Toluene	< 12,000.	ug/l	12000.	085000000P
Chlorobenzene	< 12,000.	ug/l	12000.	085100000P
Ethylbenzene	< 12,000.	ug/l	12000.	085200000P
Styrene	< 12,000.	ug/l	12000.	092000000P
Xylenes (total)	< 12,000.	ug/l	12000.	092100000P

Due to the level of 2-butanone, the reporting limits for all compounds were increased.

-002614A

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

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Biological & Environmental
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Our Standard Terms And Conditions

By American Council of
Independent Laboratories, Inc.

Lancaster Laboratories INCORPORATED
2425 New Holland Pike Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. EL 1355161

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
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Discard Date 3/31/89
Collected by C
P.O. 802-01-07-01 CG
Rel.

ERMG3-1 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

ANALYSIS	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE
TCL Volatiles	attached		092226000P
TCL Semi-Volatiles	attached		092352500P
TCL Semi-Volatiles (cont)	attached		092400000P
TCL Pesticides	attached		093723000P

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1 COPY TO Data Package Group

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228 00767 130.00 114500

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Member American Council of Independent Laboratories, Inc.

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

Lancaster Laboratories INCORPORATED
New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. EL-1355160

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/ 4/89
Discard Date 3/31/89
Collected by C
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Rel.

ERMG2-1 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Semi-Volatiles (cont)	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
3-nitroaniline	< 50.	ug/l	50.	093400000P
acenaphthene	< 10.	ug/l	10.	065700000P
2,4-dinitrophenol	< 50.	ug/l	50.	065000000P
4-nitrophenol	140.	ug/l	50.	065200000P
dibenzofuran	< 10.	ug/l	10.	093500000P
2,4-dinitrotoluene	< 10.	ug/l	10.	068300000P
2,6-dinitrotoluene	< 10.	ug/l	10.	068400000P
diethyl phthalate	50.	ug/l	10.	068000000P
4-chlorophenyl phenyl ether	< 10.	ug/l	10.	067300000P
fluorene	< 10.	ug/l	10.	068800000P
4-nitroaniline	< 50.	ug/l	50.	093600000P
2-methyl-4,6-dinitrophenol	< 50.	ug/l	50.	064900000P
N-nitrosodiphenylamine	< 10.	ug/l	10.	069900000P
4-bromophenyl phenyl ether	< 10.	ug/l	10.	067000000P
hexachlorobenzene	< 10.	ug/l	10.	068900000P
pentachlorophenol	< 50.	ug/l	50.	065400000P
phenanthrene	< 10.	ug/l	10.	070000000P
anthracene	< 10.	ug/l	10.	065900000P
di-n-butyl phthalate	30.	ug/l	10.	068200000P
fluoranthene	< 10.	ug/l	10.	068700000P
pyrene	< 10.	ug/l	10.	070100000P
butyl benzyl phthalate	< 10.	ug/l	10.	067100000P
3,3'-dichlorobenzidine	< 20.	ug/l	20.	067900000P
benzo (a) anthracene	< 10.	ug/l	10.	066100000P
bis (2-ethylhexyl) phthalate	40.	ug/l	10.	066900000P
chrysene	< 10.	ug/l	10.	067400000P
di-n-octyl phthalate	< 10.	ug/l	10.	068500000P
benzo (b) fluoranthene	< 10.	ug/l	10.	066300000P
benzo (K) fluoranthene	< 10.	ug/l	10.	066500000P
benzo (a) pyrene	< 10.	ug/l	10.	066200000P
indeno (1,2,3-cd) pyrene	< 10.	ug/l	10.	069300000P
dibenzo (a,h) anthracene	< 10.	ug/l	10.	067500000P
benzo (ghi) perylene	< 10.	ug/l	10.	066400000P

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1 COPY TO Peroxidation Systems Inc. ATTN: Chris Giggy
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Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

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Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. EL 1355160

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/ 4/89
Discard Date 3/31/89
Collected by C
P.O. 802-01-07-01 CG
Rel.

ERMG2-1 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Semi-Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
phenol	1,500.	ug/l	100.	065500000P
bis (2-chloroethyl) ether	320.	ug/l	10.	066700000P
2-chlorophenol	< 10.	ug/l	10.	064600000P
1,3-dichlorobenzene	< 10.	ug/l	10.	067700000P
1,4-dichlorobenzene	< 10.	ug/l	10.	067800000P
benzyl alcohol	700.	ug/l	200.	092600000P
1,2-dichlorobenzene	50.	ug/l	10.	067600000P
2-methylphenol	280.	ug/l	10.	092700000P
bis (2-chloroisopropyl) ether	< 10.	ug/l	10.	066800000P
4-methylphenol	1,000.	ug/l	1000.	092800000P
N-nitrosodi-n-propylamine	< 10.	ug/l	10.	069800000P
hexachloroethane	< 10.	ug/l	10.	069200000P
nitrobenzene	30,000.	ug/l	1000.	069600000P
isophorone	2,000.	ug/l	1000.	069400000P
2-nitrophenol	130.	ug/l	10.	065100000P
2,4-dimethylphenol	40.	ug/l	10.	064800000P
benzoic acid	< 50.	ug/l	50.	092900000P
bis (2-chloroethoxy) methane	< 10.	ug/l	10.	066600000P
2,4-dichlorophenol	30.	ug/l	10.	064700000P
1,2,4-trichlorobenzene	< 10.	ug/l	10.	070200000P
naphthalene	20.	ug/l	10.	069500000P
4-chloroaniline	< 10.	ug/l	10.	093000000P
hexachlorobutadiene	< 10.	ug/l	10.	069000000P
4-chloro-3-methylphenol	< 10.	ug/l	10.	065300000P
2-methylnaphthalene	< 10.	ug/l	10.	093100000P
hexachlorocyclopentadiene	< 10.	ug/l	10.	069100000P
2,4,6-trichlorophenol	< 10.	ug/l	10.	065600000P
2,4,5-trichlorophenol	< 50.	ug/l	50.	093200000P
2-chloronaphthalene	< 10.	ug/l	10.	067200000P
2-nitroaniline	< 50.	ug/l	50.	093300000P
dimethyl phthalate	220.	ug/l	10.	068100000P
acenaphthylene	< 10.	ug/l	10.	065800000P

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1 COPY TO Peroxidation Systems Inc. ATTN: Chris Giggy
1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

American Association for Laboratory Accreditation
Chemical, Biological & Environmental Fields of testing.

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

251 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. BL 1355160

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/ 4/89
Discard Date 3/31/89
Collected by C
P.O. 802-01-07-01 CG
Rel.

ERMG2-1 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE
TCL Volatiles			
1 COPY TO Data Package Group			

002616A

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

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American Council of Independent Laboratories, Inc.

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Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. EL-1355160

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

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ERMG2-1 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Chloromethane	< 25,000.	ug/l	25000.	082700000P
Bromomethane	< 25,000.	ug/l	25000.	082800000P
Vinyl Chloride	< 25,000.	ug/l	25000.	082900000P
Chloroethane	< 25,000.	ug/l	25000.	083000000P
Methylene Chloride	18,000.	ug/l	12000.	083100000P
Acetone	62,000.	ug/l	25000.	091400000P
Carbon Disulfide	< 12,000.	ug/l	12000.	091500000P
1,1-Dichloroethene	< 12,000.	ug/l	12000.	083200000P
1,1-Dichloroethane	< 12,000.	ug/l	12000.	083300000P
trans-1,2-Dichloroethene	< 12,000.	ug/l	12000.	083400000P
Chloroform	77,000.	ug/l	12000.	083500000P
1,2-Dichloroethane	100,000.	ug/l	12000.	083600000P
2-Butanone	490,000.	ug/l	25000.	091600000P
1,1,1-Trichloroethane	< 12,000.	ug/l	12000.	083700000P
Carbon Tetrachloride	< 12,000.	ug/l	12000.	083800000P
Vinyl Acetate	< 25,000.	ug/l	25000.	091700000P
Bromodichloromethane	< 12,000.	ug/l	12000.	083900000P
1,2-Dichloropropane	< 12,000.	ug/l	12000.	084000000P
cis-1,3-Dichloropropene	< 12,000.	ug/l	12000.	084400000P
Trichloroethene	< 12,000.	ug/l	12000.	084200000P
Dibromochloromethane	< 12,000.	ug/l	12000.	084600000P
1,1,2-Trichloroethane	< 12,000.	ug/l	12000.	084500000P
Benzene	< 12,000.	ug/l	12000.	084300000P
trans-1,3-Dichloropropene	< 12,000.	ug/l	12000.	084100000P
Bromoform	< 12,000.	ug/l	12000.	084700000P
4-Methyl-2-Pentanone	< 25,000.	ug/l	25000.	091900000P
2-Hexanone	< 25,000.	ug/l	25000.	091800000P
Tetrachloroethene	< 12,000.	ug/l	12000.	084800000P
1,1,2,2-Tetrachloroethane	< 12,000.	ug/l	12000.	084900000P
Toluene	< 12,000.	ug/l	12000.	085000000P
Chlorobenzene	< 12,000.	ug/l	12000.	085100000P
Ethylbenzene	< 12,000.	ug/l	12000.	085200000P
Styrene	< 12,000.	ug/l	12000.	092000000P
Xylenes (total)	< 12,000.	ug/l	12000.	092100000P

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO Peroxidation Systems Inc. ATTN: Chris Giggy

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

The American Association for Laboratory Accreditation (Biological & Environmental Testing)

Member American Council of Independent Laboratories, Inc.

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Lancaster Laboratories INCORPORATED
[illegible] New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. EL 1355160

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/ 4/89
Discard Date 3/31/89
Collected by C
P.O. 802-01-07-01 CG
Rel.

ERMG2-1 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

ANALYSIS	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE
TCL Volatiles	attached		092226000P
TCL Semi-Volatiles	attached		092352500P
TCL Semi-Volatiles (cont)	attached		092400000P

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO Peroxidation Systems Inc. ATTN: Chris Giggy
1 COPY TO Data Package Group

002617A

228 00767 85.00 087000

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

[illegible]n Association for [illegible]ccreditation [illegible]ological & Environmental [illegible]ng.

[illegible] American Council of [illegible]dent Laboratories, Inc.

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1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

1355159

Lab Name: LANCASTER LABS Contract: ERM

Code: LANCAS Case No.: _____. SAS No.: _____. SDG No.: _____.

Matrix: (soil/water) WATER Lab Sample ID: 1355159 038 wa A

Sample wt/vol: 1000(g/mL) ML Lab File ID: >D5151

Level: (low/med) LOW Date Received: 02/04/89

% Moisture: not dec. _____. dec. _____. Date Extracted: 02/07/89

Extraction: (SepF/Cont/Sonc) SEPF Date Analyzed: 02/09/89

GPC Cleanup: (Y/N) N pH: _____. Dilution Factor: 1.000

Number TICs found: 20

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.		Unknown	4.59	150.	J
2.		Unknown	4.75	350.	J
3.		Unknown	5.22	150.	J
4.	71363	1-Butanol	5.32	160.	J
5.		Unknown	5.69	210.	J
6.	79016	Ethene, trichloro-	5.94	520.	J
7.	513860	2-Butanone, 3-hydroxy-	6.46	150.	J
8.	108101	2-Pentanone, 4-methyl-	6.98	1100.	J
9.		Unknown	7.67	490.	J
10.		Unknown	7.77	180.	J
11.	127184	Ethene, tetrachloro-	8.93	230.	J
12.		Unknown	9.67	380.	J
13.	62338174	2-Hexanone, 4-hydroxy-3-prop	10.07	150.	J
14.		Unknown	10.18	180.	J
15.		Unknown	11.16	390.	J
16.	100527	Benzaldehyde	12.85	140.	J
17.		Unknown	14.41	610.	J
18.	501520	Benzenepropanoic acid	21.28	240.	J
19.		Unknown	22.12	260.	J
20.		Unknown	30.37	430.	J
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					

Lancaster Laboratories INCORPORATED
215 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. RL 1355159

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/ 4/89
Discard Date 3/31/89
Collected by C
P.O. 802-01-07-01 CG
Rel.

ERMG1-2 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Pesticides	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Alpha BHC	< 13.	ug/l	13.	060900000P
Beta BHC	< 13.	ug/l	13.	061000000P
Delta BHC	< 13.	ug/l	13.	061200000P
Gamma BHC - Lindane	< 13.	ug/l	13.	045300000P
Heptachlor	< 13.	ug/l	13.	045400000P
Aldrin	< 2.5	ug/l	2.5	045500000P
Heptachlor Epoxide	< 2.5	ug/l	2.5	061500000P
Endosulfan I	< 2.5	ug/l	2.5	062700000P
Dieldrin	< 5.	ug/l	5.	046900000P
DDE	< 5.	ug/l	5.	061600000P
Endrin	< 5.	ug/l	5.	047700000P
Endosulfan II	< 5.	ug/l	5.	062800000P
DDD	< 5.	ug/l	5.	061700000P
Endosulfan Sulfate	< 5.	ug/l	5.	062900000P
DDT	< 5.	ug/l	5.	047800000P
Endrin Ketone	< 0.5	ug/l	0.5	093800000P
Methoxychlor	8.5	ug/l	2.5	062100000P
Alpha Chlordane	< 25.	ug/l	25.	136100000P
Gamma Chlordane	< 25.	ug/l	25.	136200000P
Toxaphene	< 50.	ug/l	50.	094200000P
PCB-1016	< 130.	ug/l	130.	063900000P
PCB-1221	< 130.	ug/l	130.	064000000P
PCB-1232	< 130.	ug/l	130.	064100000P
PCB-1242	< 130.	ug/l	130.	064200000P
PCB-1248	< 130.	ug/l	130.	064300000P
PCB-1254	< 50.	ug/l	50.	064400000P
PCB-1260	< 5.	ug/l	5.	064500000P

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO Peroxidation Systems Inc. ATTN: Chris Giggy
1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Charles J. Neslund, B.S.
Group Leader, Pesticides/PCB's

American Association for Laboratory Accreditation
Biological & Environmental Testing.

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Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2301

LLI Sample No. EL 1355159

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/ 4/89
Discard Date 3/31/89
Collected by C
P.O. 802-01-07-01 CG
Rel.

ERMG1-2 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Semi-Volatiles (cont)	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
3-nitroaniline	< 50.	ug/l	50.	093400000P
acenaphthene	< 10.	ug/l	10.	065700000P
2,4-dinitrophenol	< 50.	ug/l	50.	065000000P
4-nitrophenol	140.	ug/l	50.	065200000P
dibenzofuran	< 10.	ug/l	10.	093500000P
2,4-dinitrotoluene	< 10.	ug/l	10.	068300000P
2,6-dinitrotoluene	< 10.	ug/l	10.	068400000P
diethyl phthalate	50.	ug/l	10.	068000000P
4-chlorophenyl phenyl ether	< 10.	ug/l	10.	067300000P
fluorene	< 10.	ug/l	10.	068800000P
4-nitroaniline	< 50.	ug/l	50.	093600000P
2-methyl-4,6-dinitrophenol	< 50.	ug/l	50.	064900000P
N-nitrosodiphenylamine	< 10.	ug/l	10.	069900000P
4-bromophenyl phenyl ether	< 10.	ug/l	10.	067000000P
hexachlorobenzene	< 10.	ug/l	10.	068900000P
pentachlorophenol	< 50.	ug/l	50.	065400000P
phenanthrene	< 10.	ug/l	10.	070000000P
anthracene	< 10.	ug/l	10.	065900000P
di-n-butyl phthalate	30.	ug/l	10.	068200000P
fluoranthene	< 10.	ug/l	10.	068700000P
pyrene	< 10.	ug/l	10.	070100000P
butyl benzyl phthalate	10.	ug/l	10.	067100000P
3,3'-dichlorobenzidine	< 20.	ug/l	20.	067900000P
benzo (a) anthracene	< 10.	ug/l	10.	066100000P
bis (2-ethylhexyl) phthalate	30.	ug/l	10.	066900000P
chrysene	< 10.	ug/l	10.	067400000P
di-n-octyl phthalate	< 10.	ug/l	10.	068500000P
benzo (b) fluoranthene	< 10.	ug/l	10.	066300000P
benzo (K) fluoranthene	< 10.	ug/l	10.	066500000P
benzo (a) pyrene	< 10.	ug/l	10.	066200000P
indeno (1,2,3-cd) pyrene	< 10.	ug/l	10.	069300000P
dibenzo (a,h) anthracene	< 10.	ug/l	10.	067500000P
benzo (ghi) perylene	< 10.	ug/l	10.	066400000P

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
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1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

American Association for Accreditation of Biological & Environmental Testing.

Member American Council of Independent Laboratories, Inc.

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Lancaster Laboratories INCORPORATED
New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. PL-1355159

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/ 4/89
Discard Date 3/31/89
Collected by C
P.O. 802-01-07-01 CG
Rel.

ERMG1-2 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Semi-Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
phenol	1,000.	ug/l	1000.	065500000P
bis (2-chloroethyl) ether	260.	ug/l	10.	066700000P
2-chlorophenol	20.	ug/l	10.	064600000P
1,3-dichlorobenzene	< 10.	ug/l	10.	067700000P
1,4-dichlorobenzene	< 10.	ug/l	10.	067800000P
benzyl alcohol	300.	ug/l	10.	092600000P
1,2-dichlorobenzene	40.	ug/l	10.	067600000P
2-methylphenol	280.	ug/l	10.	092700000P
bis (2-chloroisopropyl) ether	< 10.	ug/l	10.	066800000P
4-methylphenol	1,300.	ug/l	200.	092800000P
N-nitrosodi-n-propylamine	< 10.	ug/l	10.	069800000P
hexachloroethane	< 10.	ug/l	10.	069200000P
nitrobenzene	22,000.	ug/l	1000.	069600000P
isophorone	2,000.	ug/l	1000.	069400000P
-nitrophenol	100.	ug/l	10.	065100000P
4-dimethylphenol	10.	ug/l	10.	064800000P
benzoic acid	< 50.	ug/l	50.	092900000P
bis (2-chloroethoxy) methane	< 10.	ug/l	10.	066600000P
2,4-dichlorophenol	< 10.	ug/l	10.	064700000P
1,2,4-trichlorobenzene	< 10.	ug/l	10.	070200000P
naphthalene	20.	ug/l	10.	069500000P
4-chloroaniline	< 10.	ug/l	10.	093000000P
hexachlorobutadiene	< 10.	ug/l	10.	069000000P
4-chloro-3-methylphenol	< 10.	ug/l	10.	065300000P
2-methylnaphthalene	< 10.	ug/l	10.	093100000P
hexachlorocyclopentadiene	< 10.	ug/l	10.	069100000P
2,4,6-trichlorophenol	< 10.	ug/l	10.	065600000P
2,4,5-trichlorophenol	< 50.	ug/l	50.	093200000P
2-chloronaphthalene	< 10.	ug/l	10.	067200000P
2-nitroaniline	< 50.	ug/l	50.	093300000P
dimethyl phthalate	220.	ug/l	10.	068100000P
acenaphthylene	< 10.	ug/l	10.	065800000P

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO Peroxidation Systems Inc. ATTN: Chris Giggy
1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

Association for
Accreditation
Analytical & Environmental
Labs.

American Council of
Independent Laboratories, Inc.

002619A

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Of Symbols And Abbreviations And
Our Standard Terms And Conditions

ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

Mail Address: Hollinger & Pine, Lancaster, PA 17604-6994 (717) 656-2301

LLI Sample No. EL 1355159

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/ 4/89
Discard Date 3/31/89
Collected by C
P.O. 802-01-07-01 CG
Rel.

ERMG1-2 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Volatiles	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO Peroxidation Systems Inc. ATTN: Chris Giggy
1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

American Association for Accreditation of Biological & Environmental testing.

Member American Council of Independent Laboratories, Inc.

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Lancaster Laboratories INCORPORATED
25 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. EL 1355159

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
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Rel.

ERMG1-2 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Chloromethane	< 25,000.	ug/l	25000.	082700000P
Bromomethane	< 25,000.	ug/l	25000.	082800000P
Vinyl Chloride	< 25,000.	ug/l	25000.	082900000P
Chloroethane	< 25,000.	ug/l	25000.	083000000P
Methylene Chloride	22,000.	ug/l	12000.	083100000P
Acetone	71,000.	ug/l	25000.	091400000P
Carbon Disulfide	< 12,000.	ug/l	12000.	091500000P
1,1-Dichloroethene	< 12,000.	ug/l	12000.	083200000P
1,1-Dichloroethane	< 12,000.	ug/l	12000.	083300000P
trans-1,2-Dichloroethene	< 12,000.	ug/l	12000.	083400000P
Chloroform	98,000.	ug/l	12000.	083500000P
1,2-Dichloroethane	110,000.	ug/l	12000.	083600000P
2-Butanone	510,000.	ug/l	25000.	091600000P
1,1,1-Trichloroethane	< 12,000.	ug/l	12000.	083700000P
Carbon Tetrachloride	< 12,000.	ug/l	12000.	083800000P
Vinyl Acetate	< 25,000.	ug/l	25000.	091700000P
Bromodichloromethane	< 12,000.	ug/l	12000.	083900000P
1,2-Dichloropropane	< 12,000.	ug/l	12000.	084000000P
cis-1,3-Dichloropropene	< 12,000.	ug/l	12000.	084400000P
Trichloroethene	15,000.	ug/l	12000.	084200000P
Dibromochloromethane	< 12,000.	ug/l	12000.	084600000P
1,1,2-Trichloroethane	< 12,000.	ug/l	12000.	084500000P
Benzene	< 12,000.	ug/l	12000.	084300000P
trans-1,3-Dichloropropene	< 12,000.	ug/l	12000.	084100000P
Bromoform	< 12,000.	ug/l	12000.	084700000P
4-Methyl-2-Pentanone	< 25,000.	ug/l	25000.	091900000P
2-Hexanone	< 25,000.	ug/l	25000.	091800000P
Tetrachloroethene	< 12,000.	ug/l	12000.	084800000P
1,1,2,2-Tetrachloroethane	< 12,000.	ug/l	12000.	084900000P
Toluene	< 12,000.	ug/l	12000.	085000000P
Chlorobenzene	< 12,000.	ug/l	12000.	085100000P
Ethylbenzene	< 12,000.	ug/l	12000.	085200000P
Styrene	< 12,000.	ug/l	12000.	092000000P
Xylenes (total)	< 12,000.	ug/l	12000.	092100000P

Due to the level of 2-butanone, the reporting limits for all compounds were increased.

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

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Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-6994 (717) 656-2301

LLI Sample No. EL 1355159

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
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Rel.

ERMG1-2 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
VOA GC/MS Library Search Volatile compounds	0.	15 peaks	0.	089800000P

VOLATILE ORGANICS TENTATIVELY IDENTIFIED COMPOUNDS

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	The data indicated that no significant extraneous peaks were observed.				
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					

B=detected in method blank J=estimated concentration D=diluted sample

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO Peroxidation Systems Inc. ATTN: Chris Giggy
1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

American Association for Laboratory Accreditation
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New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. EL-1355159

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Rel.

ERMG1-2 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

ANALYSIS		RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE
VOA GC/MS Library Search		attached		089004000P
Semivolatile Library Search	See Attached	25 peaks	0.	089307000P
TCL Volatiles		attached		092226000P
TCL Semi-Volatiles		attached		092352500P
TCL Semi-Volatiles (cont)		attached		092400000P
TCL Pesticides		attached		093723000P

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1 COPY TO Data Package Group

002621A
228 00767 130.00 125500

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

American Association for Accreditation ological & Environmental ng.

by American Council of ndent Laboratories, Inc.

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LLI Sample No. EL 1355165

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
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P.O. 802-01-07-01 CG
Rel.

ERMG1-1 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Semi-Volatiles (cont)	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
3-nitroaniline	< 1,000.	ug/l	1000.	093400000P
acenaphthene	< 200.	ug/l	200.	065700000P
2,4-dinitrophenol	< 1,000.	ug/l	1000.	065000000P
4-nitrophenol	< 1,000.	ug/l	1000.	065200000P
dibenzofuran	< 200.	ug/l	200.	093500000P
2,4-dinitrotoluene	< 200.	ug/l	200.	068300000P
2,6-dinitrotoluene	< 200.	ug/l	200.	068400000P
diethyl phthalate	< 200.	ug/l	200.	068000000P
4-chlorophenyl phenyl ether	< 200.	ug/l	200.	067300000P
fluorene	< 200.	ug/l	200.	068800000P
4-nitroaniline	< 1,000.	ug/l	1000.	093600000P
2-methyl-4,6-dinitrophenol	< 1,000.	ug/l	1000.	064900000P
N-nitrosodiphenylamine	< 200.	ug/l	200.	069900000P
4-bromophenyl phenyl ether	< 200.	ug/l	200.	067000000P
hexachlorobenzene	< 200.	ug/l	200.	068900000P
pentachlorophenol	< 1,000.	ug/l	1000.	065400000P
phenanthrene	< 200.	ug/l	200.	070000000P
anthracene	< 200.	ug/l	200.	065900000P
di-n-butyl phthalate	< 200.	ug/l	200.	068200000P
fluoranthene	< 200.	ug/l	200.	068700000P
pyrene	< 200.	ug/l	200.	070100000P
butyl benzyl phthalate	< 200.	ug/l	200.	067100000P
3,3'-dichlorobenzidine	< 400.	ug/l	400.	067900000P
benzo (a) anthracene	< 200.	ug/l	200.	066100000P
bis (2-ethylhexyl) phthalate	< 200.	ug/l	200.	066900000P
chrysene	< 200.	ug/l	200.	067400000P
di-n-octyl phthalate	< 200.	ug/l	200.	068500000P
benzo (b) fluoranthene	< 200.	ug/l	200.	066300000P
benzo (K) fluoranthene	< 200.	ug/l	200.	066500000P
benzo (a) pyrene	< 200.	ug/l	200.	066200000P
indeno (1,2,3-cd) pyrene	< 200.	ug/l	200.	069300000P
dibenzo (a,h) anthracene	< 200.	ug/l	200.	067500000P
benzo (ghi) perylene	< 200.	ug/l	200.	066400000P

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Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

American Association for Accreditation of Biological & Environmental Testing.

Member American Council of Independent Laboratories, Inc.

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

Holland E. Hess, President, P.O. Box 12425, Lancaster, PA 17605-2425 (717) 656-2301

LLI Sample No. EL 1355165

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/ 4/89
Discard Date 3/31/89
Collected by C
P.O. 802-01-07-01 CG
Rel.

ERMG1-1 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Semi-Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
phenol	2,600.	ug/l	200.	065500000P
bis (2-chloroethyl) ether	700.	ug/l	200.	066700000P
2-chlorophenol	< 200.	ug/l	200.	064600000P
1,3-dichlorobenzene	< 200.	ug/l	200.	067700000P
1,4-dichlorobenzene	< 200.	ug/l	200.	067800000P
benzyl alcohol	1,100.	ug/l	200.	092600000P
1,2-dichlorobenzene	< 200.	ug/l	200.	067600000P
2-methylphenol	< 200.	ug/l	200.	092700000P
bis (2-chloroisopropyl) ether	< 200.	ug/l	200.	066800000P
4-methylphenol	1,400.	ug/l	200.	092800000P
N-nitrosodi-n-propylamine	< 200.	ug/l	200.	069800000P
hexachloroethane	< 200.	ug/l	200.	069200000P
nitrobenzene	30,000.	ug/l	10000.	069600000P
isophorone	1,600.	ug/l	200.	069400000P
-nitrophenol	< 200.	ug/l	200.	065100000P
,4-dimethylphenol	< 200.	ug/l	200.	064800000P
benzoic acid	< 1,000.	ug/l	1000.	092900000P
bis (2-chloroethoxy) methane	< 200.	ug/l	200.	066600000P
2,4-dichlorophenol	< 200.	ug/l	200.	064700000P
1,2,4-trichlorobenzene	< 200.	ug/l	200.	070200000P
naphthalene	< 200.	ug/l	200.	069500000P
4-chloroaniline	< 200.	ug/l	200.	093000000P
hexachlorobutadiene	< 200.	ug/l	200.	069000000P
4-chloro-3-methylphenol	< 200.	ug/l	200.	065300000P
2-methylnaphthalene	< 200.	ug/l	200.	093100000P
hexachlorocyclopentadiene	< 200.	ug/l	200.	069100000P
2,4,6-trichlorophenol	< 200.	ug/l	200.	065600000P
2,4,5-trichlorophenol	< 1,000.	ug/l	1000.	093200000P
2-chloronaphthalene	< 200.	ug/l	200.	067200000P
2-nitroaniline	< 1,000.	ug/l	1000.	093300000P
dimethyl phthalate	400.	ug/l	200.	068100000P
acenaphthylene	< 200.	ug/l	200.	065800000P

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO Peroxidation Systems Inc. ATTN: Chris Giggy
1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

Association for Accreditation Biological & Environmental Eng.

American Council of Independent Laboratories, Inc.

L002622A

See Reverse Side For Explanation Of Symbols And Abbreviations And Our Standard Terms And Conditions

Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2301

LLI Sample No. EL 1355165

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
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P.O. 802-01-07-01 CG
Rel.

ERMG1-1 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Volatiles	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE

1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

American Association for Laboratory Accreditation in Biological & Environmental Testing.

Member American Council of Independent Laboratories, Inc.

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. EL 1355165

Environ. Resources Management
855 Springdale Drive
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ERMG1-1 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Chloromethane	< 50,000.	ug/l	50000.	082700000P
Bromomethane	< 50,000.	ug/l	50000.	082800000P
Vinyl Chloride	< 50,000.	ug/l	50000.	082900000P
Chloroethane	< 50,000.	ug/l	50000.	083000000P
Methylene Chloride	< 25,000.	ug/l	25000.	083100000P
Acetone	70,000.	ug/l	50000.	091400000P
Carbon Disulfide	< 25,000.	ug/l	25000.	091500000P
1,1-Dichloroethene	< 25,000.	ug/l	25000.	083200000P
1,1-Dichloroethane	< 25,000.	ug/l	25000.	083300000P
trans-1,2-Dichloroethene	< 25,000.	ug/l	25000.	083400000P
Chloroform	110,000.	ug/l	25000.	083500000P
1,2-Dichloroethane	130,000.	ug/l	25000.	083600000P
2-Butanone	620,000.	ug/l	50000.	091600000P
1,1,1-Trichloroethane	< 25,000.	ug/l	25000.	083700000P
Carbon Tetrachloride	< 25,000.	ug/l	25000.	083800000P
Vinyl Acetate	< 50,000.	ug/l	50000.	091700000P
Bromodichloromethane	< 25,000.	ug/l	25000.	083900000P
1,2-Dichloropropane	< 25,000.	ug/l	25000.	084000000P
cis-1,3-Dichloropropene	< 25,000.	ug/l	25000.	084400000P
Trichloroethene	30,000.	ug/l	25000.	084200000P
Dibromochloromethane	< 25,000.	ug/l	25000.	084600000P
1,1,2-Trichloroethane	< 25,000.	ug/l	25000.	084500000P
Benzene	< 25,000.	ug/l	25000.	084300000P
trans-1,3-Dichloropropene	< 25,000.	ug/l	25000.	084100000P
Bromoform	< 25,000.	ug/l	25000.	084700000P
4-Methyl-2-Pentanone	< 50,000.	ug/l	50000.	091900000P
2-Hexanone	< 50,000.	ug/l	50000.	091800000P
Tetrachloroethene	< 25,000.	ug/l	25000.	084800000P
1,1,2,2-Tetrachloroethane	< 25,000.	ug/l	25000.	084900000P
Toluene	< 25,000.	ug/l	25000.	085000000P
Chlorobenzene	< 25,000.	ug/l	25000.	085100000P
Ethylbenzene	< 25,000.	ug/l	25000.	085200000P
Styrene	< 25,000.	ug/l	25000.	092000000P
Xylenes (total)	< 25,000.	ug/l	25000.	092100000P

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO Peroxidation Systems Inc. ATTN: Chris Giggy

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

ican Association for
y Accreditation
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C002623A

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. BL 1355165

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
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Rel.

ERMG1-1 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

ANALYSIS	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE
TCL Volatiles	attached		092226000P
TCL Semi-Volatiles	attached		092352500P
TCL Semi-Volatiles (cont)	attached		092400000P

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
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1 COPY TO Data Package Group

228 00767 85.00 087000

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

American Association for Laboratory Accreditation
Member: American Council of Independent Laboratories, Inc.

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

P.O. New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

Lab Sample No. RL 1355164

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
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ERMG-OP SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Pesticides	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Alpha BHC	< 5.	ug/l	5.	060900000P
Beta BHC	< 5.	ug/l	5.	061000000P
Delta BHC	< 5.	ug/l	5.	061200000P
Gamma BHC - Lindane	< 5.	ug/l	5.	045300000P
Heptachlor	< 2.5	ug/l	2.5	045400000P
Aldrin	< 2.5	ug/l	2.5	045500000P
Heptachlor Epoxide	< 2.5	ug/l	2.5	061500000P
Endosulfan I	< 2.5	ug/l	2.5	062700000P
Dieldrin	< 0.5	ug/l	0.5	046900000P
DDE	< 5.	ug/l	5.	061600000P
Endrin	< 0.5	ug/l	0.5	047700000P
Endosulfan II	< 0.5	ug/l	0.5	062800000P
DDD	< 0.5	ug/l	0.5	061700000P
Endosulfan Sulfate	< 0.5	ug/l	0.5	062900000P
DT	< 0.5	ug/l	0.5	047800000P
ndrin Ketone	< 0.5	ug/l	0.5	093800000P
Methoxychlor	< 2.5	ug/l	2.5	062100000P
Alpha Chlordane	< 25.	ug/l	25.	136100000P
Gamma Chlordane	< 25.	ug/l	25.	136200000P
Toxaphene	< 5.	ug/l	5.	094200000P
PCB-1016	< 50.	ug/l	50.	063900000P
PCB-1221	< 50.	ug/l	50.	064000000P
PCB-1232	< 50.	ug/l	50.	064100000P
PCB-1242	< 50.	ug/l	50.	064200000P
PCB-1248	< 50.	ug/l	50.	064300000P
PCB-1254	< 5.	ug/l	5.	064400000P
PCB-1260	< 5.	ug/l	5.	064500000P

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO Peroxidation Systems Inc. ATTN: Chris Giggy
1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Charles J. Neslund, B.S.
Group Leader, Pesticides/PCB's

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ndent Laboratories, Inc.

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. RL 1355164

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/ 4/89
Discard Date 3/31/89
Collected by C
P.O. 802-01-07-01 CG
Rel.

ERMG-OP SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Semi-Volatiles (cont)	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO Peroxidation Systems Inc. ATTN: Chris Giggy
1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

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...Council of ...ations, Inc.

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. KL-1355164

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/ 4/89
Discard Date 3/31/89
Collected by C
P.O. 802-01-07-01 CG
Rel.

ERMG-OP SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Semi-Volatiles (cont)	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
3-nitroaniline	< 1,000.	ug/l	1000.	093400000P
acenaphthene	< 200.	ug/l	200.	065700000P
2,4-dinitrophenol	< 1,000.	ug/l	1000.	065000000P
4-nitrophenol	< 1,000.	ug/l	1000.	065200000P
dibenzofuran	< 200.	ug/l	200.	093500000P
2,4-dinitrotoluene	< 200.	ug/l	200.	068300000P
2,6-dinitrotoluene	< 200.	ug/l	200.	068400000P
diethyl phthalate	< 200.	ug/l	200.	068000000P
4-chlorophenyl phenyl ether	< 200.	ug/l	200.	067300000P
fluorene	< 200.	ug/l	200.	068800000P
4-nitroaniline	< 1,000.	ug/l	1000.	093600000P
2-methyl-4,6-dinitrophenol	< 1,000.	ug/l	1000.	064900000P
N-nitrosodiphenylamine	< 200.	ug/l	200.	069900000P
4-bromophenyl phenyl ether	< 200.	ug/l	200.	067000000P
hexachlorobenzene	< 200.	ug/l	200.	068900000P
pentachlorophenol	< 1,000.	ug/l	1000.	065400000P
phenanthrene	< 200.	ug/l	200.	070000000P
anthracene	< 200.	ug/l	200.	065900000P
di-n-butyl phthalate	< 200.	ug/l	200.	068200000P
fluoranthene	< 200.	ug/l	200.	068700000P
pyrene	< 200.	ug/l	200.	070100000P
butyl benzyl phthalate	< 200.	ug/l	200.	067100000P
3,3'-dichlorobenzidine	< 400.	ug/l	400.	067900000P
benzo (a) anthracene	< 200.	ug/l	200.	066100000P
bis (2-ethylhexyl) phthalate	< 200.	ug/l	200.	066900000P
chrysene	< 200.	ug/l	200.	067400000P
di-n-octyl phthalate	< 200.	ug/l	200.	068500000P
benzo (b) fluoranthene	< 200.	ug/l	200.	066300000P
benzo (K) fluoranthene	< 200.	ug/l	200.	066500000P
benzo (a) pyrene	< 200.	ug/l	200.	066200000P
indeno (1,2,3-cd) pyrene	< 200.	ug/l	200.	069300000P
dibenzo (a,h) anthracene	< 200.	ug/l	200.	067500000P
benzo (ghi) perylene	< 200.	ug/l	200.	066400000P

The usual reporting limits could not be attained due to the matrix of the sample or interferences observed in the GC/MS analysis.

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

an Association for Accreditation ological & Environmental ating.

American Council of ndent Laboratories, Inc.

002625A

See Reverse Side For Explanation Of Symbols And Abbreviations And Our Standard Terms And Conditions

ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. EL 1355164

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
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ERMG-OP SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Semi-Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
phenol	1,600.	ug/l	200.	065500000P
bis (2-chloroethyl) ether	1,000.	ug/l	200.	066700000P
2-chlorophenol	< 200.	ug/l	200.	064600000P
1,3-dichlorobenzene	< 200.	ug/l	200.	067700000P
1,4-dichlorobenzene	< 200.	ug/l	200.	067800000P
benzyl alcohol	1,000.	ug/l	200.	092600000P
1,2-dichlorobenzene	< 200.	ug/l	200.	067600000P
2-methylphenol	300.	ug/l	200.	092700000P
bis (2-chloroisopropyl) ether	< 200.	ug/l	200.	066800000P
4-methylphenol	1,900.	ug/l	200.	092800000P
N-nitrosodi-n-propylamine	< 200.	ug/l	200.	069800000P
hexachloroethane	< 200.	ug/l	200.	069200000P
nitrobenzene	22,000.	ug/l	2000.	069600000P
isophorone	1,700.	ug/l	200.	069400000P
2-nitrophenol	< 200.	ug/l	200.	065100000P
2,4-dimethylphenol	800.	ug/l	200.	064800000P
benzoic acid	< 1,000.	ug/l	1000.	092900000P
bis (2-chloroethoxy) methane	< 200.	ug/l	200.	066600000P
2,4-dichlorophenol	< 200.	ug/l	200.	064700000P
1,2,4-trichlorobenzene	< 200.	ug/l	200.	070200000P
naphthalene	< 200.	ug/l	200.	069500000P
4-chloroaniline	< 200.	ug/l	200.	093000000P
hexachlorobutadiene	< 200.	ug/l	200.	069000000P
4-chloro-3-methylphenol	< 200.	ug/l	200.	065300000P
2-methylnaphthalene	< 200.	ug/l	200.	093100000P
hexachlorocyclopentadiene	< 200.	ug/l	200.	069100000P
2,4,6-trichlorophenol	< 200.	ug/l	200.	065600000P
2,4,5-trichlorophenol	< 1,000.	ug/l	1000.	093200000P
2-chloronaphthalene	< 200.	ug/l	200.	067200000P
2-nitroaniline	< 1,000.	ug/l	1000.	093300000P
dimethyl phthalate	200.	ug/l	200.	068100000P
acenaphthylene	< 200.	ug/l	200.	065800000P

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO Peroxidation Systems Inc. ATTN: Chris Giggy
1 COPY TO Data Package Group

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Richard S. Rodgers, B.S.
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Lancaster Laboratories INCORPORATED
25 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. RL-1355164

Environ. Resources Management
855 Springdale Drive
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ERMG-OP SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE
TCL Volatiles			
1 COPY TO Data Package Group			

C002626A

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

Association for
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Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

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ERMG-OP SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Chloromethane	< 50,000.	ug/l	50000.	082700000P
Bromomethane	< 50,000.	ug/l	50000.	082800000P
Vinyl Chloride	< 50,000.	ug/l	50000.	082900000P
Chloroethane	< 50,000.	ug/l	50000.	083000000P
Methylene Chloride	32,000.	ug/l	25000.	083100000P
Acetone	90,000.	ug/l	50000.	091400000P
Carbon Disulfide	< 25,000.	ug/l	25000.	091500000P
1,1-Dichloroethene	< 25,000.	ug/l	25000.	083200000P
1,1-Dichloroethane	< 25,000.	ug/l	25000.	083300000P
trans-1,2-Dichloroethene	< 25,000.	ug/l	25000.	083400000P
Chloroform	150,000.	ug/l	25000.	083500000P
1,2-Dichloroethane	160,000.	ug/l	25000.	083600000P
2-Butanone	730,000.	ug/l	50000.	091600000P
1,1,1-Trichloroethane	< 25,000.	ug/l	25000.	083700000P
Carbon Tetrachloride	< 25,000.	ug/l	25000.	083800000P
Vinyl Acetate	< 50,000.	ug/l	50000.	091700000P
Bromodichloromethane	< 25,000.	ug/l	25000.	083900000P
1,2-Dichloropropane	< 25,000.	ug/l	25000.	084000000P
cis-1,3-Dichloropropene	< 25,000.	ug/l	25000.	084400000P
Trichloroethene	44,000.	ug/l	25000.	084200000P
Dibromochloromethane	< 25,000.	ug/l	25000.	084600000P
1,1,2-Trichloroethane	< 25,000.	ug/l	25000.	084500000P
Benzene	< 25,000.	ug/l	25000.	084300000P
trans-1,3-Dichloropropene	< 25,000.	ug/l	25000.	084100000P
Bromoform	< 25,000.	ug/l	25000.	084700000P
4-Methyl-2-Pentanone	< 50,000.	ug/l	50000.	091900000P
2-Hexanone	< 50,000.	ug/l	50000.	091800000P
Tetrachloroethene	< 25,000.	ug/l	25000.	084800000P
1,1,2,2-Tetrachloroethane	< 25,000.	ug/l	25000.	084900000P
Toluene	31,000.	ug/l	25000.	085000000P
Chlorobenzene	< 25,000.	ug/l	25000.	085100000P
Ethylbenzene	< 25,000.	ug/l	25000.	085200000P
Styrene	< 25,000.	ug/l	25000.	092000000P
Xylenes (total)	< 25,000.	ug/l	25000.	092100000P

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO Peroxidation Systems Inc. ATTN: Chris Giggy

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

2425 New Holland Pike, Lancaster, PA 17601-5994, (717) 656-2301

LLI Sample No. EL 1355164

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/ 4/89
Discard Date 3/31/89
Collected by C
P.O. 802-01-07-01 CG
Rel.

ERMG-OP SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

ANALYSIS	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE
TCL Volatiles	attached		092226000P
TCL Semi-Volatiles	attached		092352500P
TCL Semi-Volatiles (cont)	attached		092400000P
TCL Pesticides	attached		093723000P

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO Peroxidation Systems Inc. ATTN: Chris Giggy
1 COPY TO Data Package Group

002627A

228 00767 130.00 114500

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

American Association for Accreditation of Biological & Environmental Testing.

American Council of Independent Laboratories, Inc.

See Reverse Side For Explanation Of Symbols And Abbreviations And Our Standard Terms And Conditions

APPENDIX B

Laboratory Analysis Reports for the Bench-Scale Volatilization Test on the SCP Groundwater Sample

ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LL Sample No. H 1355163

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Rel.

ERMGV SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Pesticides	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Alpha BHC	< 40.	ug/l	40.	060900000P
Beta BHC	< 25.	ug/l	25.	061000000P
Delta BHC	< 25.	ug/l	25.	061200000P
Gamma BHC - Lindane	< 25.	ug/l	25.	045300000P
Heptachlor	< 25.	ug/l	25.	045400000P
Aldrin	< 25.	ug/l	25.	045500000P
Heptachlor Epoxide	< 13.	ug/l	13.	061500000P
Endosulfan I	< 13.	ug/l	13.	062700000P
Dieldrin	< 25.	ug/l	25.	046900000P
DDE	< 25.	ug/l	25.	061600000P
Endrin	< 2.5	ug/l	2.5	047700000P
Endosulfan II	< 25.	ug/l	25.	062800000P
DDD	< 2.5	ug/l	2.5	061700000P
Endosulfan Sulfate	< 2.5	ug/l	2.5	062900000P
DDT	< 2.5	ug/l	2.5	047800000P
Endrin Ketone	< 2.5	ug/l	2.5	093800000P
Methoxychlor	< 13.	ug/l	13.	062100000P
Alpha Chlordane	< 130.	ug/l	130.	136100000P
Gamma Chlordane	< 130.	ug/l	130.	136200000P
Toxaphene	< 250.	ug/l	250.	094200000P
PCB-1016	< 1,000.	ug/l	1000.	063900000P
PCB-1221	< 1,000.	ug/l	1000.	064000000P
PCB-1232	< 2,000.	ug/l	2000.	064100000P
PCB-1242	940.	ug/l	130.	064200000P
PCB-1248	< 400.	ug/l	400.	064300000P
PCB-1254	69.	ug/l	25.	064400000P
PCB-1260	< 25.	ug/l	25.	064500000P

Due to the presence of Aroclor 1242, the values reported represent the lowest detection limits obtainable.

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO Peroxidation Systems Inc. ATTN: Chris Giggy
1 COPY TO Data Package Group

002628A

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Charles J. Neslund, B.S.
Group Leader, Pesticides/PCB's

American Association for Accreditation of Biological & Environmental Testing.

American Council of Independent Laboratories, Inc.

See Reverse Side For Explanation Of Symbols And Abbreviations And Our Standard Terms And Conditions

Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. RL 1355163

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/ 4/89
Discard Date 3/31/89
Collected by C
P.O. 802-01-07-01 CG
Rel.

ERMGV SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Semi-Volatiles (cont)	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO Peroxidation Systems Inc. ATTN: Chris Giggy
1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

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Lancaster Laboratories INCORPORATED
25 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. PI 1355163

Environ. Resources Management
855 Springdale Drive
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Date Reported 2/28/89
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Rel.

ERMGV SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Semi-Volatiles (cont)	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
3-nitroaniline	< 2,000.	ug/l	2000.	093400000P
acenaphthene	< 400.	ug/l	400.	065700000P
2,4-dinitrophenol	< 2,000.	ug/l	2000.	065000000P
4-nitrophenol	< 2,000.	ug/l	2000.	065200000P
dibenzofuran	< 400.	ug/l	400.	093500000P
2,4-dinitrotoluene	< 400.	ug/l	400.	068300000P
2,6-dinitrotoluene	< 400.	ug/l	400.	068400000P
diethyl phthalate	< 400.	ug/l	400.	068000000P
4-chlorophenyl phenyl ether	< 400.	ug/l	400.	067300000P
fluorene	< 400.	ug/l	400.	068800000P
4-nitroaniline	< 2,000.	ug/l	2000.	093600000P
2-methyl-4,6-dinitrophenol	< 2,000.	ug/l	2000.	064900000P
N-nitrosodiphenylamine	< 400.	ug/l	400.	069900000P
4-bromophenyl phenyl ether	< 400.	ug/l	400.	067000000P
hexachlorobenzene	< 400.	ug/l	400.	068900000P
pentachlorophenol	< 2,000.	ug/l	2000.	065400000P
phenanthrene	< 400.	ug/l	400.	070000000P
anthracene	< 400.	ug/l	400.	065900000P
di-n-butyl phthalate	< 400.	ug/l	400.	068200000P
fluoranthene	< 400.	ug/l	400.	068700000P
pyrene	< 400.	ug/l	400.	070100000P
butyl benzyl phthalate	< 400.	ug/l	400.	067100000P
3,3'-dichlorobenzidine	< 800.	ug/l	800.	067900000P
benzo (a) anthracene	< 400.	ug/l	400.	066100000P
bis (2-ethylhexyl) phthalate	2,200.	ug/l	400.	066900000P
chrysene	< 400.	ug/l	400.	067400000P
di-n-octyl phthalate	< 400.	ug/l	400.	068500000P
benzo (b) fluoranthene	< 400.	ug/l	400.	066300000P
benzo (K) fluoranthene	< 400.	ug/l	400.	066500000P
benzo (a) pyrene	< 400.	ug/l	400.	066200000P
indeno (1,2,3-cd) pyrene	< 400.	ug/l	400.	069300000P
dibenzo (a,h) anthracene	< 400.	ug/l	400.	067500000P
benzo (ghi) perylene	< 400.	ug/l	400.	066400000P

The usual reporting limits could not be attained due to the matrix of the sample or interferences observed in the GC/MS analysis.

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

American Association for Accreditation of Biological & Environmental Testing.

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Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. PL-1355163

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
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Discard Date 3/31/89
Collected by C
P.O. 802-01-07-01 CG
Rel.

ERMGV SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Semi-Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
phenol	3,200.	ug/l	400.	065500000P
bis (2-chloroethyl) ether	800.	ug/l	400.	066700000P
2-chlorophenol	< 400.	ug/l	400.	064600000P
1,3-dichlorobenzene	< 400.	ug/l	400.	067700000P
1,4-dichlorobenzene	< 400.	ug/l	400.	067800000P
benzyl alcohol	1,000.	ug/l	400.	092600000P
1,2-dichlorobenzene	< 400.	ug/l	400.	067600000P
2-methylphenol	400.	ug/l	400.	092700000P
bis (2-chloroisopropyl) ether	< 400.	ug/l	400.	066800000P
4-methylphenol	2,700.	ug/l	400.	092800000P
N-nitrosodi-n-propylamine	< 400.	ug/l	400.	069800000P
hexachloroethane	< 400.	ug/l	400.	069200000P
nitrobenzene	40,000.	ug/l	4000.	069600000P
isophorone	2,300.	ug/l	400.	069400000P
2-nitrophenol	< 400.	ug/l	400.	065100000P
2,4-dimethylphenol	900.	ug/l	400.	064800000P
benzoic acid	< 2,000.	ug/l	2000.	092900000P
bis (2-chloroethoxy) methane	< 400.	ug/l	400.	066600000P
2,4-dichlorophenol	< 400.	ug/l	400.	064700000P
1,2,4-trichlorobenzene	< 400.	ug/l	400.	070200000P
naphthalene	< 400.	ug/l	400.	069500000P
4-chloroaniline	< 400.	ug/l	400.	093000000P
hexachlorobutadiene	< 400.	ug/l	400.	069000000P
4-chloro-3-methylphenol	< 400.	ug/l	400.	065300000P
2-methylnaphthalene	< 400.	ug/l	400.	093100000P
hexachlorocyclopentadiene	< 400.	ug/l	400.	069100000P
2,4,6-trichlorophenol	< 400.	ug/l	400.	065600000P
2,4,5-trichlorophenol	< 2,000.	ug/l	2000.	093200000P
2-chloronaphthalene	< 400.	ug/l	400.	067200000P
2-nitroaniline	< 2,000.	ug/l	2000.	093300000P
dimethyl phthalate	< 400.	ug/l	400.	068100000P
acenaphthylene	< 400.	ug/l	400.	065800000P

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO Peroxidation Systems Inc. ATTN: Chris Giggy
1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

American Association for Laboratory Accreditation
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Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. BL 1355163

Environ. Resources Management
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P.O. 802-01-07-01 CG
Rel.

ERMGV SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE
TCL Volatiles			
1 COPY TO Data Package Group			

C002630A

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

American Association for Accreditation Biological & Environmental Testing.

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ERMGV SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Chloromethane	< 50,000.	ug/l	50000.	082700000P
Bromomethane	< 50,000.	ug/l	50000.	082800000P
Vinyl Chloride	< 50,000.	ug/l	50000.	082900000P
Chloroethane	< 50,000.	ug/l	50000.	083000000P
Methylene Chloride	36,000.	ug/l	25000.	083100000P
Acetone	90,000.	ug/l	50000.	091400000P
Carbon Disulfide	< 25,000.	ug/l	25000.	091500000P
1,1-Dichloroethene	< 25,000.	ug/l	25000.	083200000P
1,1-Dichloroethane	< 25,000.	ug/l	25000.	083300000P
trans-1,2-Dichloroethene	< 25,000.	ug/l	25000.	083400000P
Chloroform	200,000.	ug/l	25000.	083500000P
1,2-Dichloroethane	190,000.	ug/l	25000.	083600000P
2-Butanone	810,000.	ug/l	50000.	091600000P
1,1,1-Trichloroethane	< 25,000.	ug/l	25000.	083700000P
Carbon Tetrachloride	< 25,000.	ug/l	25000.	083800000P
Vinyl Acetate	< 50,000.	ug/l	50000.	091700000P
Bromodichloromethane	< 25,000.	ug/l	25000.	083900000P
1,2-Dichloropropane	< 25,000.	ug/l	25000.	084000000P
cis-1,3-Dichloropropene	< 25,000.	ug/l	25000.	084400000P
Trichloroethene	65,000.	ug/l	25000.	084200000P
Dibromochloromethane	< 25,000.	ug/l	25000.	084600000P
1,1,2-Trichloroethane	< 25,000.	ug/l	25000.	084500000P
Benzene	< 25,000.	ug/l	25000.	084300000P
trans-1,3-Dichloropropene	< 25,000.	ug/l	25000.	084100000P
Bromoform	< 25,000.	ug/l	25000.	084700000P
4-Methyl-2-Pentanone	< 50,000.	ug/l	50000.	091900000P
2-Hexanone	< 50,000.	ug/l	50000.	091800000P
Tetrachloroethene	< 25,000.	ug/l	25000.	084800000P
1,1,2,2-Tetrachloroethane	< 25,000.	ug/l	25000.	084900000P
Toluene	46,000.	ug/l	25000.	085000000P
Chlorobenzene	< 25,000.	ug/l	25000.	085100000P
Ethylbenzene	< 25,000.	ug/l	25000.	085200000P
Styrene	< 25,000.	ug/l	25000.	092000000P
Xylenes (total)	< 25,000.	ug/l	25000.	092100000P

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
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Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

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Lancaster Laboratories INCORPORATED
25 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

WK1224 ID 4 7

LLI Sample No. BL 1355163

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

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Rel.

ERMGV SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

ANALYSIS	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE
TCL Volatiles	attached		092226000P
TCL Semi-Volatiles	attached		092352500P
TCL Semi-Volatiles (cont)	attached		092400000P
TCL Pesticides	attached		093723000P

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002631A

228 00767 130.00 114500

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

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ing.

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1355162

Lab Name: LANCASTER LABS Contract: ERM

Lab Code: LANCAS Case No.: _____. SAS No.: _____. SDG No.: _____.

Matrix: (soil/water) WATER Lab Sample ID: 1355162

Sample wt/vol: 1000(g/mL) ML Lab File ID: >05255

Level: (low/med) LOW Date Received: 02/04/89

% Moisture: not dec. _____. dec. _____. Date Extracted: 02/07/89

Extraction: (SepF/Cont/Sonc) SEPF Date Analyzed: 02/10/89

GPC Cleanup: (Y/N) N pH: _____. Dilution Factor: 1.000

Number TICs found: 17

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CK

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.		2-Butanone, 3-methyl- ***	5.56	60.	J
2.	123911	1,4-Dioxane	6.04	32.	J
3.		Unknown	7.60	240.	J
4.		Unknown	10.01	44.	J
5.		Unknown	10.11	32.	J
6.		Unknown	10.24	60.	J
7.	106683	3-Octanone	12.14	28.	J
8.	62533	Aniline	13.24	190.	J
9.		Unknown	14.34	160.	J
10.		Unknown	19.25	280.	J
11.		Unknown	20.94	110.	J
12.	101848	Benzene, 1,1'-oxybis-	22.31	600.	J
13.		Unknown	22.82	320.	J
14.		Unknown	24.25	340.	J
15.		Unknown	30.25	160.	J
16.	131577	Methanone, (2-hydroxy-4-meth	32.13	120.	J
17.	122623	Decanedioic acid, bis(2-ethy	42.69	72.	J
18.					
19.					
20.					
21.					
22.					
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24.					
25.					
26.					
27.					
28.					
29.					
30.					

*** Unknown Isomer of...

FORM I SV-TIC 1/87 Rev.

Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301
1K1224 D 4 7

LLI Sample No. BL 1355162

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ERMGO SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Pesticides	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Alpha BHC	< 40.	ug/l	40.	060900000P
Beta BHC	< 13.	ug/l	13.	061000000P
Delta BHC	< 13.	ug/l	13.	061200000P
Gamma BHC - Lindane	< 13.	ug/l	13.	045300000P
Heptachlor	< 20.	ug/l	20.	045400000P
Aldrin	< 13.	ug/l	13.	045500000P
Heptachlor Epoxide	< 20.	ug/l	20.	061500000P
Endosulfan I	< 13.	ug/l	13.	062700000P
Dieldrin	< 25.	ug/l	25.	046900000P
DDE	< 25.	ug/l	25.	061600000P
Endrin	< 2.5	ug/l	2.5	047700000P
Endosulfan II	< 25.	ug/l	25.	062800000P
DDD	< 2.5	ug/l	2.5	061700000P
Endosulfan Sulfate	< 2.5	ug/l	2.5	062900000P
DDT	< 2.5	ug/l	2.5	047800000P
Endrin Ketone	< 2.5	ug/l	2.5	093800000P
Methoxychlor	< 13.	ug/l	13.	062100000P
Alpha Chlordane	< 130.	ug/l	130.	136100000P
Gamma Chlordane	< 130.	ug/l	130.	136200000P
Toxaphene	< 200.	ug/l	200.	094200000P
PCB-1016	< 500.	ug/l	500.	063900000P
PCB-1221	< 700.	ug/l	700.	064000000P
PCB-1232	< 1,100.	ug/l	1100.	064100000P
PCB-1242	480.	ug/l	130.	064200000P
PCB-1248	< 300.	ug/l	300.	064300000P
PCB-1254	48.	ug/l	25.	064400000P
PCB-1260	< 25.	ug/l	25.	064500000P

Due to the presence of Aroclor 1242, the values reported represent the lowest detection limits obtainable.

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Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Charles J. Neslund, B.S.
Group Leader, Pesticides/PCB's

Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

VK1224 D 4 7

LLI Sample No. EL 1355162

Environ. Resources Management
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Date Reported 2/28/89
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Collected by C
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Rel.

ERMGO SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Semi-Volatiles (cont)	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
3-nitroaniline	< 100.	ug/l	100.	093400000P
acenaphthene	< 20.	ug/l	20.	065700000P
2,4-dinitrophenol	< 100.	ug/l	100.	065000000P
4-nitrophenol	< 100.	ug/l	100.	065200000P
dibenzofuran	< 20.	ug/l	20.	093500000P
2,4-dinitrotoluene	< 20.	ug/l	20.	068300000P
2,6-dinitrotoluene	< 20.	ug/l	20.	068400000P
diethyl phthalate	60.	ug/l	20.	068000000P
4-chlorophenyl phenyl ether	< 20.	ug/l	20.	067300000P
fluorene	< 20.	ug/l	20.	068800000P
4-nitroaniline	< 100.	ug/l	100.	093600000P
2-methyl-4,6-dinitrophenol	< 100.	ug/l	100.	064900000P
N-nitrosodiphenylamine	< 20.	ug/l	20.	069900000P
4-bromophenyl phenyl ether	< 20.	ug/l	20.	067000000P
hexachlorobenzene	< 20.	ug/l	20.	068900000P
pentachlorophenol	< 100.	ug/l	100.	065400000P
phenanthrene	40.	ug/l	20.	070000000P
anthracene	< 20.	ug/l	20.	065900000P
di-n-butyl phthalate	120.	ug/l	20.	068200000P
fluoranthene	20.	ug/l	20.	068700000P
pyrene	20.	ug/l	20.	070100000P
butyl benzyl phthalate	40.	ug/l	20.	067100000P
3,3'-dichlorobenzidine	< 40.	ug/l	40.	067900000P
benzo (a) anthracene	< 20.	ug/l	20.	066100000P
bis (2-ethylhexyl) phthalate	4,000.	ug/l	400.	066900000P
chrysene	< 20.	ug/l	20.	067400000P
di-n-octyl phthalate	30.	ug/l	20.	068500000P
benzo (b) fluoranthene	< 20.	ug/l	20.	066300000P
benzo (K) fluoranthene	< 20.	ug/l	20.	066500000P
benzo (a) pyrene	< 20.	ug/l	20.	066200000P
indeno (1,2,3-cd) pyrene	< 20.	ug/l	20.	069300000P
dibenzo (a,h) anthracene	< 20.	ug/l	20.	067500000P
benzo (ghi) perylene	< 20.	ug/l	20.	066400000P

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Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

Lancaster Laboratories INCORPORATED
25 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. EL 1355162

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
Date Submitted 2/ 4/89
Discard Date 3/31/89
Collected by C
P.O. 802-01-07-01 CG
Rel.

ERMGO SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Semi-Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
phenol	4,800.	ug/l	400.	065500000P
bis (2-chloroethyl) ether	< 20.	ug/l	20.	066700000P
2-chlorophenol	< 20.	ug/l	20.	064600000P
1,3-dichlorobenzene	< 20.	ug/l	20.	067700000P
1,4-dichlorobenzene	< 20.	ug/l	20.	067800000P
benzyl alcohol	600.	ug/l	20.	092600000P
1,2-dichlorobenzene	220.	ug/l	20.	067600000P
2-methylphenol	190.	ug/l	20.	092700000P
bis (2-chloroisopropyl) ether	< 20.	ug/l	20.	066800000P
4-methylphenol	2,000.	ug/l	2000.	092800000P
N-nitrosodi-n-propylamine	< 20.	ug/l	20.	069800000P
hexachloroethane	< 20.	ug/l	20.	069200000P
nitrobenzene	48,000.	ug/l	2000.	069600000P
isophorone	4,000.	ug/l	2000.	069400000P
2-nitrophenol	< 20.	ug/l	20.	065100000P
2,4-dimethylphenol	1,000.	ug/l	400.	064800000P
benzoic acid	< 100.	ug/l	100.	092900000P
bis (2-chloroethoxy) methane	< 20.	ug/l	20.	066600000P
2,4-dichlorophenol	< 20.	ug/l	20.	064700000P
1,2,4-trichlorobenzene	< 20.	ug/l	20.	070200000P
naphthalene	< 20.	ug/l	20.	069500000P
4-chloroaniline	< 20.	ug/l	20.	093000000P
hexachlorobutadiene	< 20.	ug/l	20.	069000000P
4-chloro-3-methylphenol	< 20.	ug/l	20.	065300000P
2-methylnaphthalene	80.	ug/l	20.	093100000P
hexachlorocyclopentadiene	< 20.	ug/l	20.	069100000P
2,4,6-trichlorophenol	< 20.	ug/l	20.	065600000P
2,4,5-trichlorophenol	< 100.	ug/l	100.	093200000P
2-chloronaphthalene	70.	ug/l	20.	067200000P
2-nitroaniline	< 100.	ug/l	100.	093300000P
dimethyl phthalate	270.	ug/l	20.	068100000P
acenaphthylene	< 20.	ug/l	20.	065800000P

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Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

2425 New Holland Pike, Lancaster, PA (717) 656-2301

WK1224 D 4 7

LLI Sample No. EL 1355162

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

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ERMGO SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Volatiles	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE
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Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

2951 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

WK1224 D 4 7

LLI Sample No. EL 1355162

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/28/89
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ERMGO SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

TCL Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Chloromethane	< 50,000.	ug/l	50000.	082700000P
Bromomethane	< 50,000.	ug/l	50000.	082800000P
Vinyl Chloride	< 50,000.	ug/l	50000.	082900000P
Chloroethane	< 50,000.	ug/l	50000.	083000000P
Methylene Chloride	40,000.	ug/l	25000.	083100000P
Acetone	90,000.	ug/l	50000.	091400000P
Carbon Disulfide	< 25,000.	ug/l	25000.	091500000P
1,1-Dichloroethene	< 25,000.	ug/l	25000.	083200000P
1,1-Dichloroethane	< 25,000.	ug/l	25000.	083300000P
trans-1,2-Dichloroethene	< 25,000.	ug/l	25000.	083400000P
Chloroform	200,000.	ug/l	25000.	083500000P
1,2-Dichloroethane	190,000.	ug/l	25000.	083600000P
2-Butanone	780,000.	ug/l	50000.	091600000P
1,1,1-Trichloroethane	< 25,000.	ug/l	25000.	083700000P
Carbon Tetrachloride	< 25,000.	ug/l	25000.	083800000P
Vinyl Acetate	< 50,000.	ug/l	50000.	091700000P
Bromodichloromethane	< 25,000.	ug/l	25000.	083900000P
1,2-Dichloropropane	< 25,000.	ug/l	25000.	084000000P
cis-1,3-Dichloropropene	< 25,000.	ug/l	25000.	084400000P
Trichloroethene	73,000.	ug/l	25000.	084200000P
Dibromochloromethane	< 25,000.	ug/l	25000.	084600000P
1,1,2-Trichloroethane	< 25,000.	ug/l	25000.	084500000P
Benzene	< 25,000.	ug/l	25000.	084300000P
trans-1,3-Dichloropropene	< 25,000.	ug/l	25000.	084100000P
Bromoform	< 25,000.	ug/l	25000.	084700000P
4-Methyl-2-Pentanone	< 50,000.	ug/l	50000.	091900000P
2-Hexanone	< 50,000.	ug/l	50000.	091800000P
Tetrachloroethene	< 25,000.	ug/l	25000.	084800000P
1,1,2,2-Tetrachloroethane	< 25,000.	ug/l	25000.	084900000P
Toluene	48,000.	ug/l	25000.	085000000P
Chlorobenzene	< 25,000.	ug/l	25000.	085100000P
Ethylbenzene	< 25,000.	ug/l	25000.	085200000P
Styrene	< 25,000.	ug/l	25000.	092000000P
Xylenes (total)	< 25,000.	ug/l	25000.	092100000P

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Lancaster Laboratories, Inc.
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Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

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2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

VK1224 D # 4 7

LLI Sample No. EL 1355162

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Date Reported 2/28/89
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P.O. 802-01-07-01 CG
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ERMGO SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
VOA GC/MS Library Search Volatile compounds	0.	15 peaks	0.	089800000P

VOLATILE ORGANICS TENTATIVELY IDENTIFIED COMPOUNDS

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	The data indicated that no significant extraneous peaks were observed.				
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					

B=detected in method blank J=estimated concentration D=diluted sample

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Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

25 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. EL 1355162

Environ. Resources Management
855 Springdale Drive
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ERMGO SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89

ANALYSIS		RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE
VOA GC/MS Library Search		attached		089004000P
Semivolatile Library Search	See Attached	25 peaks	0.	089307000P
TCL Volatiles		attached		092226000P
TCL Semi-Volatiles		attached		092352500P
TCL Semi-Volatiles (cont)		attached		092400000P
TCL Pesticides		attached		093723000P

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Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

APPENDIX C

Laboratory Analysis Reports for Metals in the SCP Groundwater Sample

ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. RL 1362054

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

SCP-Carlstadt (PSI) Method Blank Sample

Date Reported 3/15/89
Date Submitted 2/ 4/89
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P.O.
Rel.

ANALYSIS	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Beryllium	< 50.	ug/l	50.	024701300S
Chromium	< 50.	ug/l	50.	025101300S
Copper	< 100.	ug/l	100.	025301300S
Mercury	< 2.	ug/l	2.	025902500S
Nickel	< 200.	ug/l	200.	026101300S
Silver	< 50.	ug/l	50.	026601300S
Zinc	< 100.	ug/l	100.	027201300S
Arsenic (furnace method)	< 50.	ug/l	50.	104503000S

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Lancaster Laboratories, Inc.
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Lee A. Seats, B.S. Mgr.
Inorganic Analysis

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Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. BL 1362054

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 3/13/89
Date Submitted 2/ 4/89
Discard Date 4/13/89
Collected by C
P.O.
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SCP-Carlstadt (PSI) Method Blank Sample

ANALYSIS	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Beryllium	< 50.	ug/l	50.	024701300S
Chromium	< 50.	ug/l	50.	025101300S
Copper	< 100.	ug/l	100.	025301300S
Mercury	< 2.	ug/l	2.	025902500S
Nickel	< 200.	ug/l	200.	026101300S
Silver	< 50.	ug/l	50.	026601300S
Zinc	< 100.	ug/l	100.	027201300S
Arsenic (furnace method)	< 10.	ug/l	10.	104503000S

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Lancaster Laboratories, Inc.
Reviewed and Approved by:

Lee A. Seats, B.S. Mgr.
Inorganic Analysis

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. RI 1362053

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 3/15/89
Date Submitted 2/ 4/89
Discard Date 4/15/89
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P.O.
Rel.

ERMG1-2 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89
Previous LLI 1355159

ANALYSIS	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Beryllium	< 50.	ug/l	50.	024701300S
Chromium	100.	ug/l	50.	025101300S
Copper	100.	ug/l	100.	025301300S
Mercury	< 2.	ug/l	2.	025902500S
Nickel	< 200.	ug/l	200.	026101300S
Silver	< 50.	ug/l	50.	026601300S
Zinc	100.	ug/l	100.	027201300S
Arsenic (furnace method)	< 50.	ug/l	50.	104503000S

Sample was preserved with sodium thiosulfate.
Sample was filtered in the laboratory.

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LLI-Sample No. EL 1362053

Environ. Resources Management
855 Springdale Drive
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ERMG1-2 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89
Previous LLI 1355159

ANALYSIS	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Beryllium	< 50.	ug/l	50.	024701300S
Chromium	100.	ug/l	50.	025101300S
Copper	100.	ug/l	100.	025301300S
Mercury	< 2.	ug/l	2.	025902500S
Nickel	< 200.	ug/l	200.	026101300S
Silver	< 50.	ug/l	50.	026601300S
Zinc	100.	ug/l	100.	027201300S
Arsenic (furnace method)	< 10.	ug/l	10.	104503000S

Sample was preserved with sodium thiosulfate.
Sample was filtered in the laboratory.

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LLI Sample No. RI 1362837

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ERMG 1-2 SCP-Carlstadt Water Sample
Collected on 02/03/89
Previous LLI# 1355159

ANALYSIS	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Beryllium	< 50.	ug/l	50.	024701300S
Chromium	90.	ug/l	50.	025101300S
Copper	100.	ug/l	100.	025301300S
Mercury	3.2	ug/l	0.2	025902500S
Nickel	< 200.	ug/l	200.	026101300S
Silver	< 50.	ug/l	50.	026601300S
Zinc	200.	ug/l	100.	027201300S
Arsenic (furnace method)	< 50.	ug/l	50.	104503000S

Sample was preserved with Sodium thiosulfate.

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ANALYSIS REPORT

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LLI Sample No. EL 1362837

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855 Springdale Drive
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Date Reported 3/13/89
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Rel.

ERMG 1-2 SCP-Carlstadt Water Sample
Collected on 02/03/89
Previous LLI# 1355159

ANALYSIS	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Beryllium	< 50.	ug/l	50.	024701300S
Chromium	90.	ug/l	50.	025101300S
Copper	100.	ug/l	100.	025301300S
Mercury	3.2	ug/l	0.2	025902500S
Nickel	< 200.	ug/l	200.	026101300S
Silver	< 50.	ug/l	50.	026601300S
Zinc	200.	ug/l	100.	027201300S
Arsenic (furnace method)	< 10.	ug/l	10.	104503000S

Sample was preserved with Sodium thiosulfate.

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LLI Sample No. RI 1362052

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ERMG 0 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89
Previous LLI 1355162

ANALYSIS	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Beryllium	< 50.	ug/l	50.	024701300S
Chromium	230.	ug/l	50.	025101300S
Copper	300.	ug/l	100.	025301300S
Mercury	2.	ug/l	2.	025902500S
Nickel	< 200.	ug/l	200.	026101300S
Silver	< 50.	ug/l	50.	026601300S
Zinc	300.	ug/l	100.	027201300S
Arsenic (furnace method)	60.	ug/l	50.	104503000S

Sample was preserved with sodium thiosulfate.
Sample was filtered in the laboratory.

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LLI=Sample No. EL-1362052

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ERMG 0 SCP-Carlstadt (PSI) Water Sample
Collected on 02/03/89
Previous LLI 1355162

ANALYSIS	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Beryllium	< 50.	ug/l	50.	024701300S
Chromium	230.	ug/l	50.	025101300S
Copper	300.	ug/l	100.	025301300S
Mercury	2.	ug/l	2.	025902500S
Nickel	< 200.	ug/l	200.	026101300S
Silver	< 50.	ug/l	50.	026601300S
Zinc	300.	ug/l	100.	027201300S
Arsenic (furnace method)	10.	ug/l	10.	104503000S

Sample was preserved with sodium thiosulfate.
Sample was filtered in the laboratory.

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2640

Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LWL Sample No. BL 1362836

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 3/15/89
Date Submitted 2/28/89
Discard Date 4/15/89
Collected by C
P.O. 802-01-07-01 CG
Rel.

ERMG 0 SCP-Carlstadt Water Sample
Collected on 02/03/89
Previous LLI# 1355162

ANALYSIS	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Beryllium	< 50.	ug/l	50.	024701300S
Chromium	270.	ug/l	50.	025101300S
Copper	500.	ug/l	100.	025301300S
Mercury	3.2	ug/l	0.2	025902500S
Nickel	< 200.	ug/l	200.	026101300S
Silver	< 50.	ug/l	50.	026601300S
Zinc	400.	ug/l	100.	027201300S
Arsenic (furnace method)	70.	ug/l	50.	104503000S

Sample was preserved with Sodium thiosulfate.

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO Peroxidation Systems, Inc. ATTN: Chris Giggy
1 COPY TO Data Package Group

C002640A

041 00767 60.00 019300

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Lee A. Seats, B.S. Mgr.
Inorganic Analysis

American Association for Accreditation Biological & Environmental Testing.

American Council of Independent Laboratories, Inc.

See Reverse Side For Explanation Of Symbols And Abbreviations And Our Standard Terms And Conditions

ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. BL 1362836

Environ. Resources Management
855 Springdale Drive
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Copper	500.	ug/l	100.	025301300S
Mercury	3.2	ug/l	0.2	025902500S
Nickel	< 200.	ug/l	200.	026101300S
Silver	< 50.	ug/l	50.	026601300S
Zinc	400.	ug/l	100.	027201300S
Arsenic (furnace method)	10.	ug/l	10.	104503000S

Sample was preserved with Sodium thiosulfate.

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002641A

APPENDIX C-3
CALGON CARBON CORPORATION
GRANULAR ACTIVATED CARBON

C002642A

Technical Service Report No. 0189-29

TREATABILITY STUDY

Removal of Select Organic Compounds From Groundwater Containing Multiorganic Compounds and Solids

Prepared For:

Environmental Resources Management, Inc.
SCP Chemical Site
Carlstadt, NJ

By

Calgon Carbon Corporation
Research & Development
Application Services Department

March 15, 1989

Investigators: J. S. Bellissimo

S. D. Cifrulak

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INTRODUCTION

Groundwater samples were received from the SCP Chemical, Carlstadt, NJ site after collection at the site by ERM, Inc. Based on average organic constituent analyses of the groundwaters obtained from a number of wells into the site aquifer, the amount of compounds present is extensive. In addition, the samples received were highly turbid and contained solids. Because of the complex nature of the samples the treatability study was designed to: 1) remove solids that would effect carbon column adsorption testing, and 2) analyze for specific target compounds as they broke through the column. These compounds would be reflective of carbon removal capabilities over a wide range. Final treated samples would be completely analyzed for organic constituents by an independent laboratory selected by ERM, Inc. The primary objectives of this treatability study were to demonstrate activated carbon's ability to remove a variety of organic compounds from the groundwater, to profile the effluent after and during carbon treatment, and to estimate carbon utilization rates.

SUMMARY AND CONCLUSIONS

The sample, as received, was a dark amber-brown color and highly turbid. It also had a slight oil film floating on top and a sharp petroleum-type odor. Pre-treatment to remove the solids was necessary. Simple filtration proved unsuccessful. It was necessary to institute a more severe separation technique. Addition of alum, lime, and anionic polyelectrolytic polymer resulted in successful removal of the solids but the dark amber-brown color and odor remained.

An accelerated column test (ACT) procedure was conducted on the pre-treated sample. The ACT simulated a model 7.5 carbon adsorber containing 10,000 lbs of Service carbon; the surface loading rate was 0.57 gpm/ft^2. Initial effluent from the ACT column was water-white. After about 5.4 simulated days running time, color breakthrough was observed. All effluent samples had a putrid, highly offensive odor. The odor was not identified and activated carbon treatment did not appear to remove it to any extent.

A variety of organic compounds were monitored for breakthrough in the ACT effluent. Instantaneous breakthrough of Total Organic Carbon (TOC) and methyl ethyl ketone (MEK) was observed. It is expected that the bulk of TOC is due to MEK in the column effluent. Other components broke through the ACT column at various levels. Based on a full-size Model 7.5 adsorber filled with 10,000 lbs of Service carbon the following simulated profile is expected:

	Breakthrough Profile		
Component	Simulated Days	Simulated 1000 Gal Treated	Dosage Lbs/1000 Gal
Methylene Chloride	3.3	119	84
Vinyl Chloride	5.8	207	48
1,2-dichloroethane	5.8	207	48
Nitrobenzene	12.7	457	22
Phenol	13.5	486	21
1,2-dichlorobenzene	15.6	560	18
Chlorobenzene	>37.5	>1353	<7.4
Perchloroethylene	>37.5	>1353	<7.4

RECOMMENDATIONS

This study indicates that further work to derive the optimal treatment process is warranted. Additional analytical work is needed to identify odor causing compounds. More extensive pretreatment will be required to remove solids/metals, etc. Air stripping to remove VOC will reduce carbon usage and treatment costs. Carbon treatment is highly effective in removing the semi-volatile compounds. However, additional post-treatment may be necessary to remove offensive odor- and color-causing compounds.

EXPERIMENTAL

A. Samples

The samples were collected by the sponsor and shipped to Calgon Carbon Corporation in two 7-gallon glass carboys packed in styrofoam shipping containers and one 5-gallon metal can. All sample containers, as received, had appreciable empty headspace which would cause a loss of volatile organic components. A composite sample was prepared by Calgon Carbon using equal volumes from each container.

The samples, as received, were dark amber-brown (color of coffee) and highly turbid. A slight oil film was present on all samples; this was accompanied by a sharp petroleum-type odor. Characterization data of the "raw" composite sample is presented in Table 1. Detection limits for the organic constituents were effected by matrix interferences during gas chromatographic (GC) analysis.

B. Activated Carbon

The Accelerated Column Test (ACT) was conducted using Service carbon, i.e. activated carbon that had been reactivated. The Apparent Density is 0.544 g/cc and the Iodine Number is 730 mg/g. Additional carbon characterization data is listed in Table 2. The carbon was crushed and screened to 100X325 mesh, according to the ACT protocol, prior to testing.

C. Constituent Analysis

Basic parameters such as pH, TOC, suspended solids, and conductivity were measured using protocols described in "Standard Methods for the Examination of Water and Wastewater," current edition. Gas chromatograph (GC) methods were used to analyze for all organic consitutents. USEPA methods or minor modification of the same were used:

1. Method 601 - Purgeable Halocarbons
2. Method 602 - Purgeable Aromatics
3. Method 604 - Phenols
4. Method 609 - Nitroaromatics and Isophorone
5. Method 612 - Chlorinated Hydrocarbons

Observations were made for color and odor but no attempts were made for quantification.

D. Solids Removal

1. Filtration

The composite sample was shaken and then gravity filtered through a glass-fiber filter. Only minor solids removal was achieved. The filtrate was very turbid.

2. Coagulation-Flocculation

Jar testing to effect coagulation-flocculation of the sample was conducted using a modification of ASTM Test Method D2035-80. The testing was successful and resulted in a clear amber solution. The treatment scheme was as follows:

Three one-gallon bottles were filled to the neck of the container with raw composite sample. To each gallon container 3000 ppm of alum, 500 ppm of lime, and 0.6 ppm of Calgon Corporation anionic R200 polyelectrolytic polymer was added. The container were turned-over, end to end, six times and allowed to settle. A thick, brown-colored, large-sized floc occurred and started to settle to the bottom of the containers. An overnight settling (16 hours) resulted in a clear amber supernatant. No attempts were made to quantify sludge volume or mass that resulted since the prime purpose was to remove solids that would hinder carbon adsorption testing. Suspended solids were reduced from 284 mg/l in the raw composite to <1mg/l in the supernatant used as the influent feed to the ACT study. Table 1 compares the raw and feed samples.

E. ACT Study Protocol

The Accelerated Column Test (ACT) procedure uses a miniature carbon-filled column to rapidly simulate the adsorption breakthrough curve that would be obtained by treating an aqueous stream in a large carbon adsorption system. This technique developed at Calgon Carbon Research has been shown to accurately simulate the carbon treatment of a wide range of waters and wastewaters under various conditions.

The principal advantage of the ACT procedure compared to one-inch diameter column adsorption tests is its increased speed. Typically, an ACT can be completed in one-twentieth to one-tenth of the time required for a one-inch diameter column study. Basic description of the ACT system is defined in the attached article, "High-Pressure Technique for Rapid Screening of Activated Carbons for Use in Potable Water."

Scale factors for sizing the full-scale adsorbers from the ACT column data are developed by a proprietary method based on the chemistry of adsorption on activated carbon. To predict the volume breakthrough curve for the full-scale adsorber, the ACT results must be multiplied by the volume

scale factor determined for each carbon type. The time breakthrough curve for the full-scale adsorber can be calculated by either of two methods. First, one can divide the predicted volumes calculated above by the flow rate in the full-scale system. Second, one can multiply the run time of the ACT by the scale factor determined for each carbon type.

Virtually all coal and coconut based activated carbons commonly employed for liquid-phase organic removal can be adequately modeled by the ACT procedure. In addition, the ACT procedure has been shown to model the removal of a wide array of organics in concentrations ranging from low ppb to high ppm levels and from streams ranging from relatively pure groundwaters to highly polluted industrial wastewaters.

F. Quality Control/Quality Assurance (QC/QA)

Analysis for specific chemicals or generic-type tests such as TOC (total organic carbon), color, etc. are conducted primarily to evaluate various stages in the treatment process. Analysis for specific chemicals is usually accomplished by standard EPA acceptable sample preparation and analytical methods. If a non-EPA-methodology is used for specific chemical analysis, details of the procedure are described. In a Treatability Study, the primary means of determining efficacy of the treatment is if the chemicals of concern have been removed to the levels required. Assurance that this has been accomplished can be determined by a referee laboratory (mutually agreed to by Calgon Carbon and the study generator) through analysis of pre-treatment and post-treatment samples using approved EPA methodologies, if necessary.

Under normal circumstances, an adaptation of the protocols as described in USEPA SW-846 "Test Methods for Evaluating Solid Waste" (RCRA) are used where possible for the analysis and QA/QC activities for various chemical compounds:

1. Use of EPA-approved sample preparation and analytical methods.
2. Calibration of laboratory instruments to within acceptable limits, according to manufacturer's specifications (as appropriate) before, after, or during use. Reference standards are used when necessary.
3. Periodic inspection, maintenance, and servicing (as necessary) of all laboratory instruments.
4. The use of reference standards and QC samples (e.g. checks, spikes, laboratory blanks, duplicates, splits, etc.) as necessary to determine the accuracy and precision of procedures, instruments, and operators.
5. A continuous review of results in order to identify and correct problems within the measurement system (e.g. instrument problems, inadequate operator training, inaccurate measurement technologies).
6. Maintenance and storage of complete records, charts, or logs of all pertinent laboratory calibration, analytical, and QC activities and data.

C. Outside Laboratory

At the request of the sponsor samples of raw groundwater, solids-free groundwater (influent to ACT), ACT effluent representing a composite of samples simulating 0 to 19.2 days of carbon treatment, and a composite simulating 19.2 days to 38 days of carbon treatment were sent to Lancaster Laboratories, Lancaster, PA for GC/MS analysis by Methods 624/625, PCB/Pesticides analysis, and Metals Analysis (Table 3). The sponsor will receive the results of analysis directly from Lancaster Laboratories. Compositing of the carbon treated samples was necessary to obtain the required volumes necessary for testing.

DISCUSSION

The influent for the ACT study consisted of groundwater after solids were removed by coagulation-flocculation induced by the addition of alum, lime, and anionic polyelectrolytic polymer. The ACT system was designed to simulate operation of a Model 7.5 activated carbon adsorber containing 10,000 lbs of Service carbon and treating groundwater at a surface loading rate of 0.566 gpm/ft^2. About 0.8 days of ACT lab run time simulates 15.6 days of full-scale treatment.

The study was run continuously from 2-17-89 through 2-19-89. The ACT column was monitored by collecting continuous effluent samples every hour and grab samples for VOC analysis every hour using automated samples. The samples were analyzed for organics using standard GC methods and TOC analysis.

The initial effluent samples were water-white in color until 5.4 simulated full-scale days were achieved. At that point color breakthrough was observed. Although the influent (ACT feed) sample had a characteristic petroleum-type odor all the effluent (carbon treated) samples had a putrid, highly offensive odor. TOC breakthrough was immediate; within one day actual laboratory run time TOC level of the effluent was 98% of the influent level. The study was continued for another day of actual laboratory run time. The data is presented in Table 4 and breakthrough curves of the individual organic components are presented in the figures in the appendix. The following give treatability parameters for the key organic compounds:

A. Purged TOC (i.e. SOC)

Instantaneous breakthrough of TOC was observed. TOC was initially 755 mg/l than gradually increased to 98% of influent concentration (influent TOC = 1240 mg/l) after 21 simulated operating days and simulated treatment of 751 thousand gallons of groundwater.

B. MEK

Instantaneous breakthrough of MEK was observed and its breakthrough curve parallels the TOC breakthrough curve suggesting that MEK is the prime contributor of TOC in the groundwater.

C. Methylene Chloride

Initial breakthrough of methylene chloride was observed after 3.3 simulated days of operation and simulated treatment of 119 thousand gallons of groundwater. The effluent concentration at initial breakthrough was 0.005 mg/l. The estimated carbon usage rate is 84 lbs per 1000 gallons of water treated.

D. Vinyl Chloride

Initial breakthrough of vinyl chloride was observed after 5.8 simulated days of operation and simulated treatment of 207 thousand gallons of groundwater. The estimated carbon usage rate is 48 lbs per 1000 gallons.

E. 1,2 - Dichloroethane

Breakthrough of 1,2-DCA mirrors the breakthrough curve of vinyl chloride. Initial breakthrough occurs after 5.8 simulated days of operation and simulated treatment of 207 thousand gallons of groundwater. The estimated carbon usage rate is 48 lbs per 1000 gallons.

F. Nitrobenzene

Breakthrough of nitrobenzene is observed after 12.7 simulated days of operation and simulated treatment of 457 thousand gallons of groundwater. The estimated carbon usage rate is 22 lbs per 1000 gallons.

G. Phenol

Breakthrough of phenol is observed after 13.5 simulated days of operation and simulated treatment of 486 thousand gallons of groundwater. The estimated carbon usage rate is 21 lbs per 1000 gallons.

H. 1,2-Dichlorobenzene

Breakthrough of DCB is observed after 15.6 simulated days of operation and simulated treatment of 560 thousand gallons of groundwater. The estimated carbon usage rate is 18 lbs/1000 gallons.

I. Other

At termination of the study there was no evidence of perchloroethylene/1,1,2,2,-tetrachlorethane or chlorobenzene breakthrough. At termination of the study 37.5 days of simulated operation had occurred and simulated treatment of 1353 thousand gallons of groundwater was achieved. Estimated carbon usage rate is less than 7.4 lbs/1000 gallons.

Background TOC and solvation effects of the MEK probably contribute to the sequence of elution for the various organic compounds and definitely effect the

estimated carbon dosages. Removal of background TOC and MEK by other techniques such as air stripping, etc. may dramatically improve carbon usage rates. The foul, putrid odor was not removed from the water by carbon treatment. Identification of the compound causing the odor was not feasible in the time duration allowed for this study.

njt
Attachments

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TABLE I

ERM, INC., EXTON, PA
TSR #0189-29

Characterization Data Composites

Analyses	Concentration mg/l	
	Raw Composite	ACT Feed (After Solids Removal)
pH	7.9	6.9
Conductivity, umhos/cm	7200	7800
Purged TOC	1400	1240
Suspended Solids	284	<1
Methyl Ethyl Ketone	1000	800
t-1,2-Dichloroethylene + Chloroform	325	NA
1,2-Dichloroethane	271	150
Trichloroethane	81	NA
Toluene	50	NA
Methylene Chloride	35	14
1,1,1-Trichloroethane	26	NA
Nitrobenzene	56	47
Tetrachloroethylene	14	5
Phenol	7.2	7.8
P-Xylene	6*	NA
1,2-Dichlorobenzene	4*	5.4*
1,1-Dichloroethane	3.9	NA
Chlorobenzene	2*	0.95
Ethyl Benzene	2*	NA
m-Xylene	2*	NA
Vinyl Chloride	2.2	1.1
1,1-Dichloroethylene	0.32	NA
Chloroethane	<0.10**	NA
2,4-Dichlorophenol	Not Found	

* Detection Limit = 1 mg/l due to matrix interferences
** Detection Limit = 0.1 mg/l due to matrix interferences
NA = Not Analyzed

Table 2

ERM, INC., EXTON, PA
TSR #0189-29

Activated Carbon Characterization Data

Material Properties		Service Carbon
A.D., g/cc		0.544
Screen, % On	8	0.4
	12	12.6
	16	24.6
	20	31.1
	30	21.1
	40	10.0
	-40	0.2
Abrasion No., %		84.8
MPD, mm		1.142
Ash Properties		
Moisture Oven, %		0.41
Ash, %		9.5
A/S Ash, %		2.45
W/S Ash, %		0.27
pH Extractable		9.6
Activity Properties		
Molasses No.		207
Iodine No., mg/g		730
CCl_4 No., %		36.5
Butane W/C g/100cc		4.14

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Table 3

OUTSIDE LABORATORY

Samples Sent to Lancaster Laboratories

Sample	VOA	AE	B/N	PCB/Pesticide	Metals
Raw	2-40 ml Hypovials	1 liter	1 liter	1 liter	1 liter
ACT Feed (Solids Removed)	2-40 ml Hypovials	1 liter	1 liter	1 liter	1 liter
ACT Effluent Samples 1-24*	—	—	—	1 liter	0.3 liter
ACT Effluent Samples 25-47**	—	—	—	1 liter	0.3 liter

* Composite of effluents simulating 0-19.2 days of full-scale operation.
** Composite of effluents simulating 19.2 - 38 days of full-scale operation.

Table 4

ENVIRONMENTAL RESOURCES MANAGEMENT, EXTON, PA - TSR #0189-29

Accelerated Column Test Simulation Data of Carbon Treatment of Superfund Groundwater

A	B	C	D	E	F	G	H	I	J	K	L	M	N
0.46	16.4	610	210	--	--	--	--	--	--	--	--	--	--
0.87	31.1	322	--	13.4	--	--	--	--	--	--	--	--	ND++
1.28	45.8	218	350	--	--	--	--	--	--	--	--	--	--
1.69	60.4	166	--	--	ND**	ND**	ND**	--	ND**	ND**	--	--	--
2.09	75.1	133	755	--	--	--	--	--	--	--	--	--	--
2.50	89.8	111	--	1000	--	--	--	--	--	--	--	--	--
2.91	104	96	755		--	--	--	--	--	--	--	--	--
3.32	119	84	--		ND***	0.005***	ND***	--	ND***	ND***	--	--	--
3.73	134	75	790		--	--		--	--	--	--	--	--
4.95	178	56	--		ND+	11	ND+	--	ND+	ND+	--	--	--
5.36	193	52	820		--	--	--	ND+++	--	--	--	ND#	--
5.77	207	48	--		ND***	26	0.055	--	ND***	ND***	--	--	--
6.58	237	42	--		1.3	15	180	--	ND++	ND++	--	--	--
6.99	251	40	850		--	--	--	--	--	--	--	--	--
7.81	281	36	860		--	--	--	--	--	--	--	--	--
8.21	295	33	--		1.25	--	--	--	--	--	--	--	--
8.62	310	32	870		--	--	--	--	--	--	--	--	--
9.44	339	29	860		--	--	--	--	--	--	--	--	--
9.85	354	28	--		--	16	170	--	--	--	--	--	--
10.3	369	27	--					ND+++	--	--	--	ND+++	--
11.1	398	25	890					--	--	--	--	--	--
11.5	413	24	--					--	--	--	ND+++	--	--
11.9	428	23	--					ND+++	--	--	--	ND+++	--
12.7	457	22	950					--	--	--	0.9	--	--
13.5	486	21	--					0.84	--	--	--	ND+++	--
14.3	516	19	1000					--	--	--	--	--	--
15.2	545	18	--					3.1	--	--	--	ND+++	--
15.6	560	18	--					--		--	--	--	<0.1
16.0	574	17	1020					--	--	--	--	--	--
16.8	604	17	--					6.8	--	--	--	ND#	--
17.2	618	16	--						--	--	--	--	0.3
17.6	633	16	1030						--	--	5.3	--	--
18.8	[illegible]77	15	--						--	--	--	--	0.6
19.2	[illegible]2	14	1120						--	--	--	--	--

Table 4, Continued

ENVIRONMENTAL RESOURCES MANAGEMENT, EXTON, PA - TSR #0189-29

Accelerated Column Test Simulation Data of Carbon Treatment of Superfund Groundwater

A	B	C	D	E	F	G	H	I	J	K	L	M	N
20.5	736	14	--						--	--	--	--	0.9
20.9	751	13	1220						--	--	6.5	--	--
23.7	853	12	--						--	--	--	--	2.9
25.6	922	11	--						--	--	6.6	--	--
27.0	971	10	--							--	--	--	4.2
29.0	1044	9.6	--							--	6.6	--	--
33.9	1220	8.2	--						--	--	6.3	--	--
37.2	1338	7.5	--						--	--	7.9	--	--
37.6	1353	7.4	--						ND+++	ND+++	--	--	--
Influent Concentration			1240	800	1.1	14	150	7.8	5.0	0.95*	47	ND#	5.4*

Due to Matrix Interferences

* Detection Limit 1 mg/l
** Detection Limit 1 ug/l
*** Detection Limit 5 ug/l

Due to matrix Interferences

\+ Detection Limit 10 ug/l
++ Detection Limit 100 ug/l
+++ Detection Limit 50 ug/l
\# Detection Limit 250 ug/l

Column Codes

A - Days of Operation
B - Volume Treated 1000 Gallons
C - Carbon Use Rate, Lbs/1000 Gallons
D - Purged TOC, mg/l
E - MEK, mg/l
F - Vinyl Chloride, mg/l
G - Methylene Chloride, mg/l
H - 1,2-Dichloroethane, mg/l
I - Phenol, mg/l
J - Perchloroethylene & 1,1,2,2-Tetrachloroethane, mg/l
K - Chlorobenzene, mg/l
L - Nitrobenzene, mg/l
M - 2,4-Dichlorophenol, mg/l
N - 1,2-Dichlorobenzene, mg/l

Conditions Simulated

Adsorber:	Model 7.5 Vessel
Carbon:	Service 10,000 Lbs
Flow:	25 gpm
Surface Loading:	0.566 gpm/ft^2
EBCT:	88 Minutes

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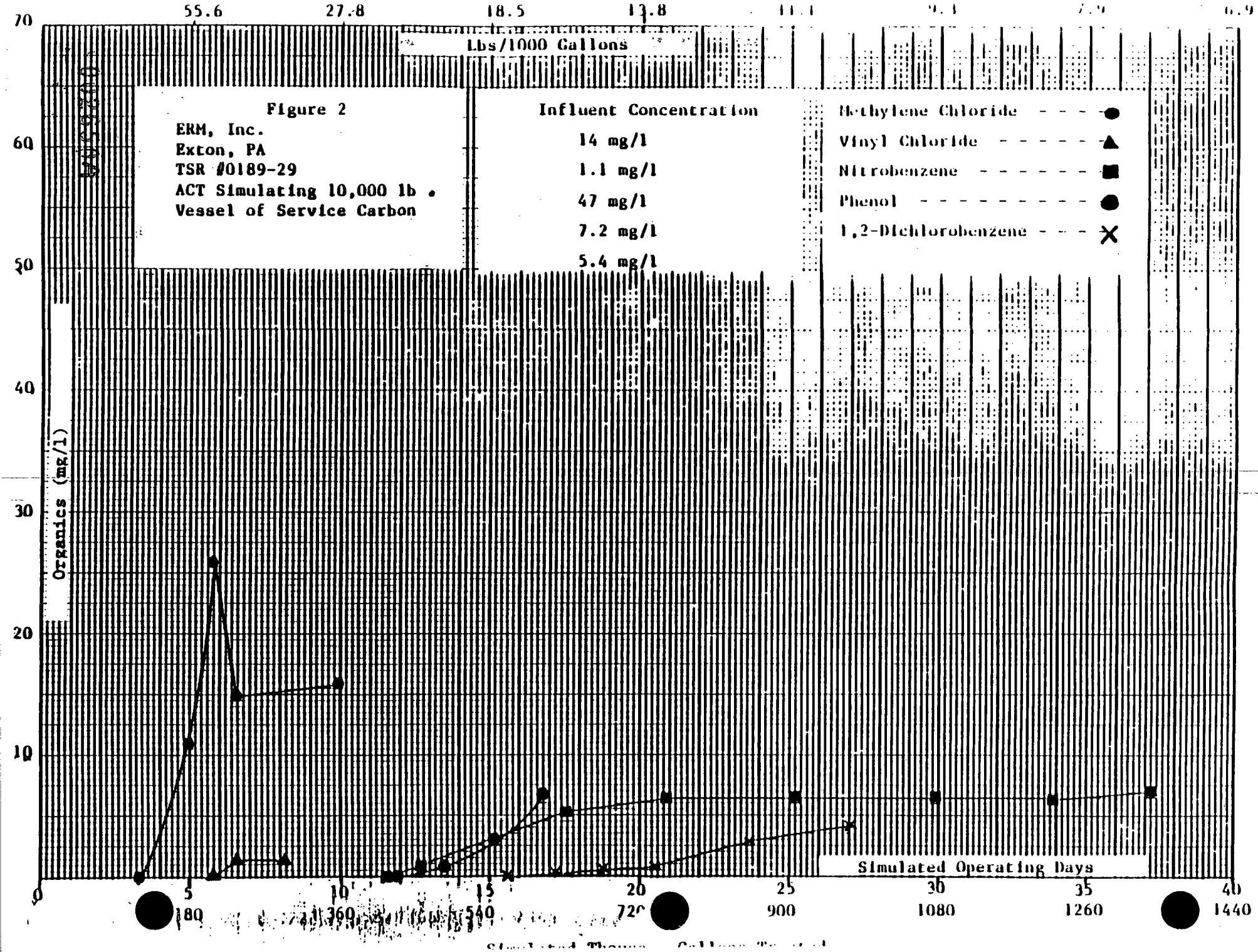
Figure 2
ERM, Inc.
Exton, PA
TSR #0189-29
ACT Simulating 10,000 lb
Vessel of Service Carbon
Influent Concentration
14 mg/l
1.1 mg/l
47 mg/l
7.2 mg/l
5.4 mg/l
Methylene Chloride
Vinyl Chloride
Nitrobenzene
Phenol
1,2-Dichlorobenzene
Lbs/1000 Gallons
55.6
27.8
18.5
13.8
Organics (mg/l)
70
60
50
40
30
20
10
0
Simulated Operating Days
5
10
15
20
25
30
35
40
180
360
540
720
900
1080
1260
1440

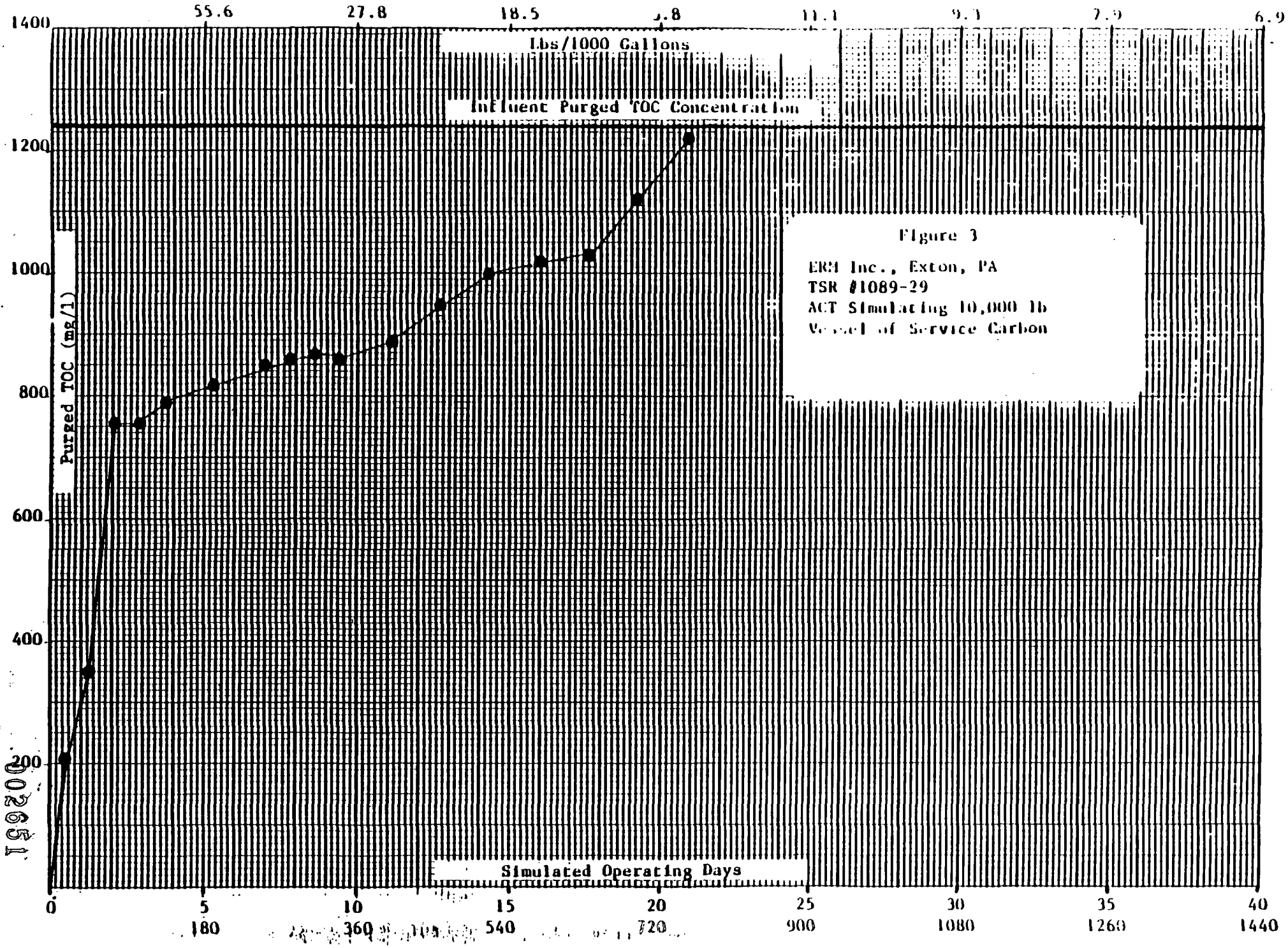

Figure 3

ERM Inc., Exton, PA
TSR #1089-29
ACT Simulating 10,000 lb
Vessel of Service Carbon

002651

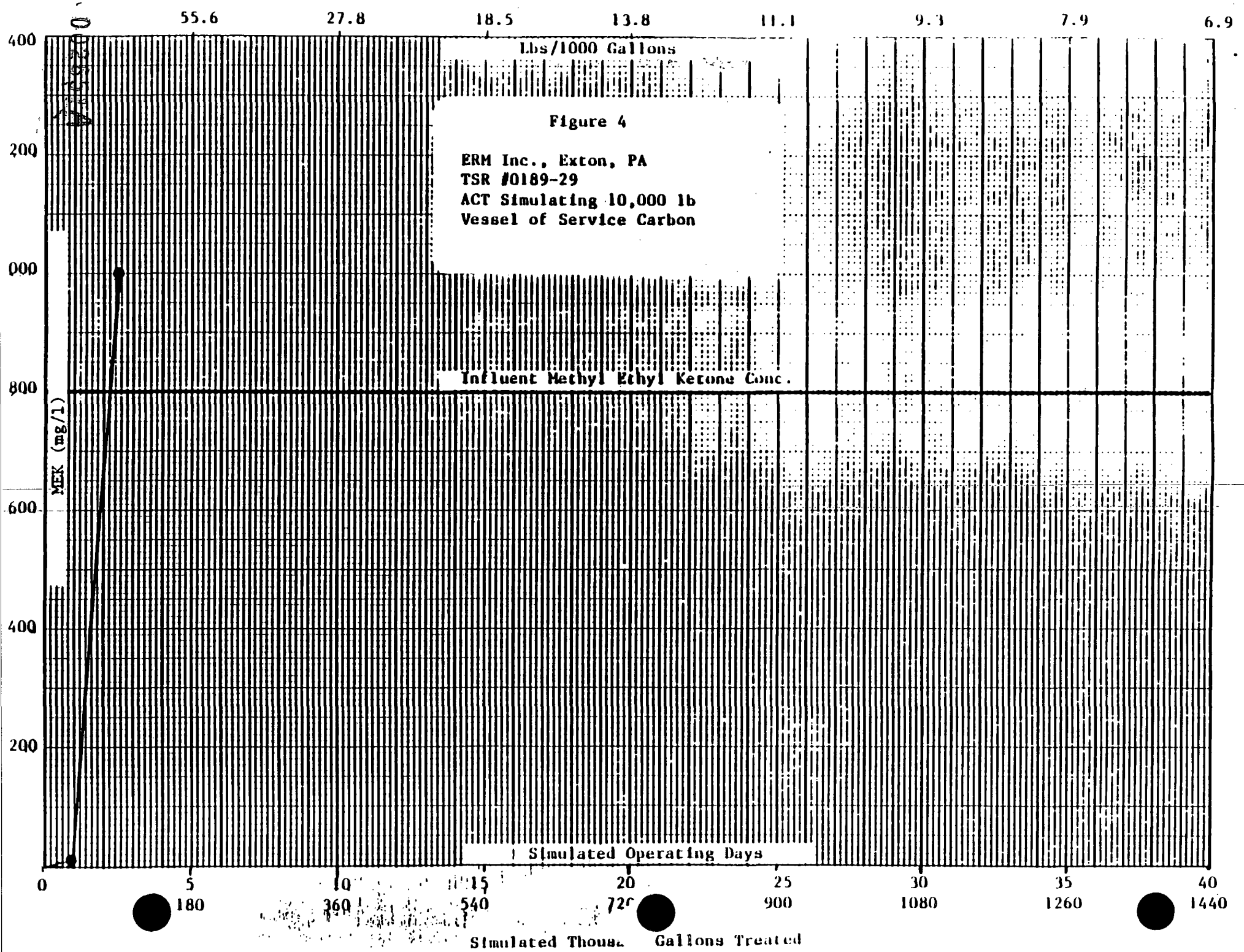

Figure 4

ERM Inc., Exton, PA
TSR #0189-29
ACT Simulating 10,000 lb
Vessel of Service Carbon

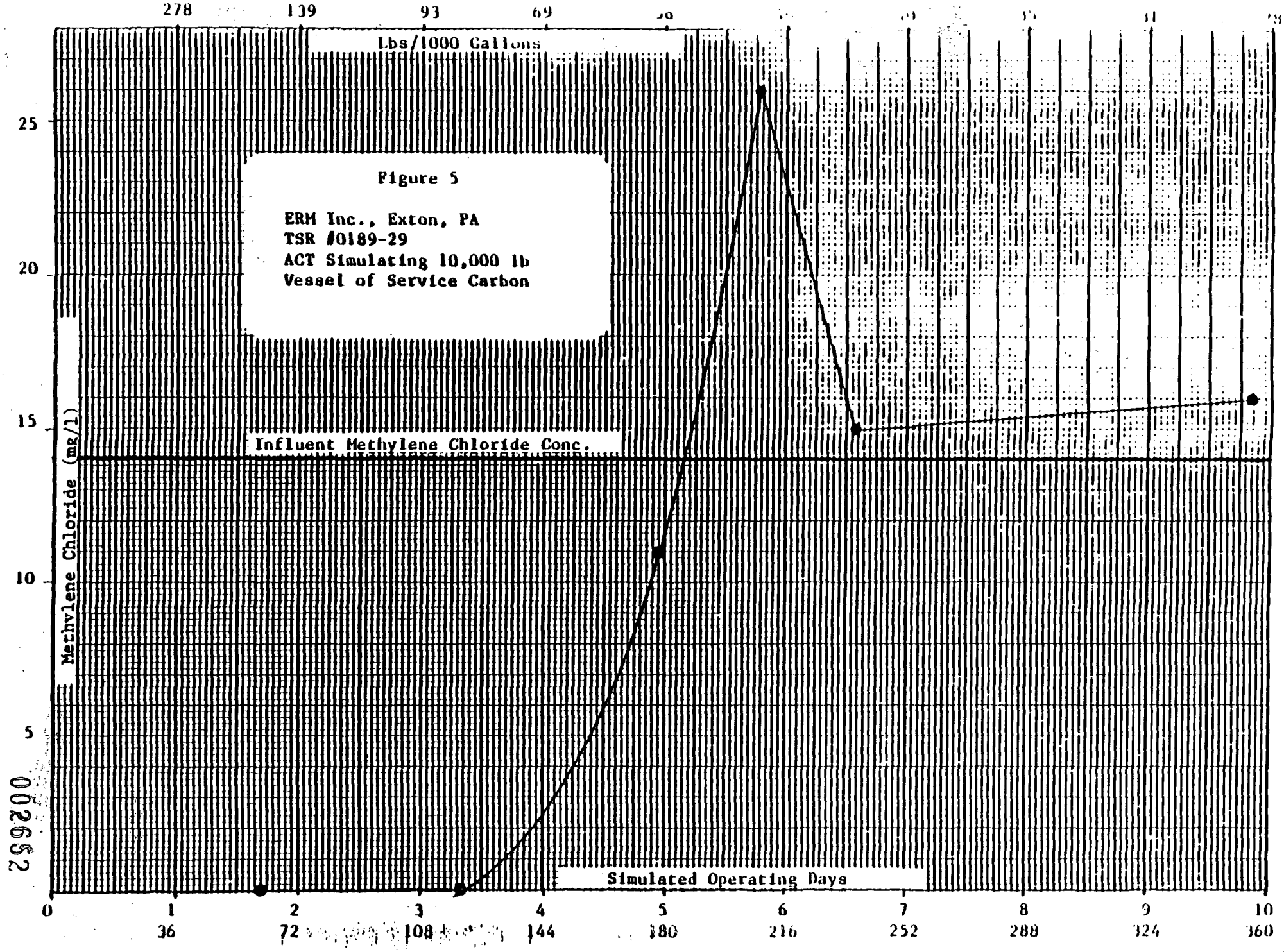

Figure 5

ERM Inc., Exton, PA
TSR #0189-29
ACT Simulating 10,000 lb
Vessel of Service Carbon

002652

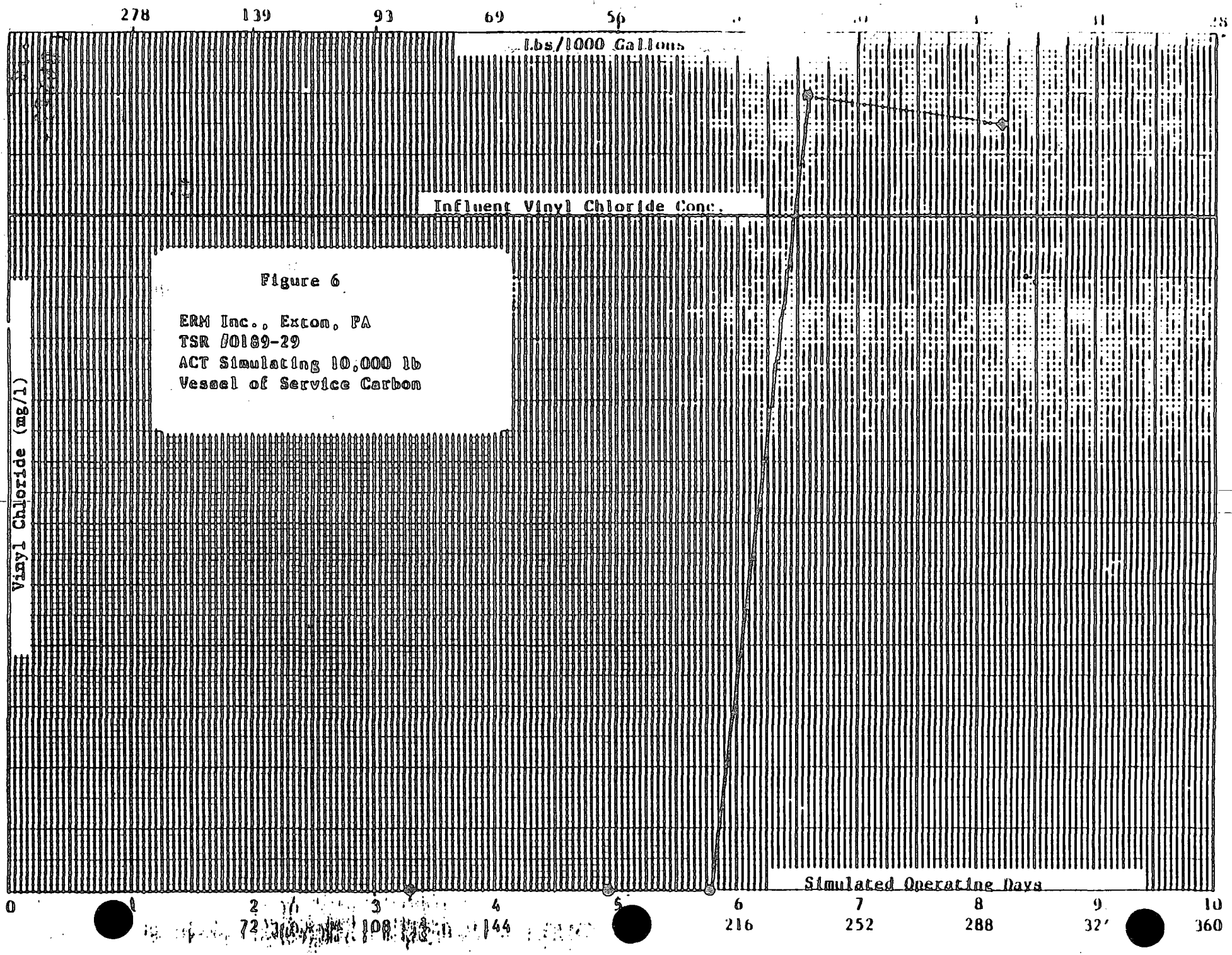

Figure 6

ERM Inc., Exton, PA
TSR 70189-29
ACT Simulating 10,000 lb
Vessel of Service Carbon

2652A

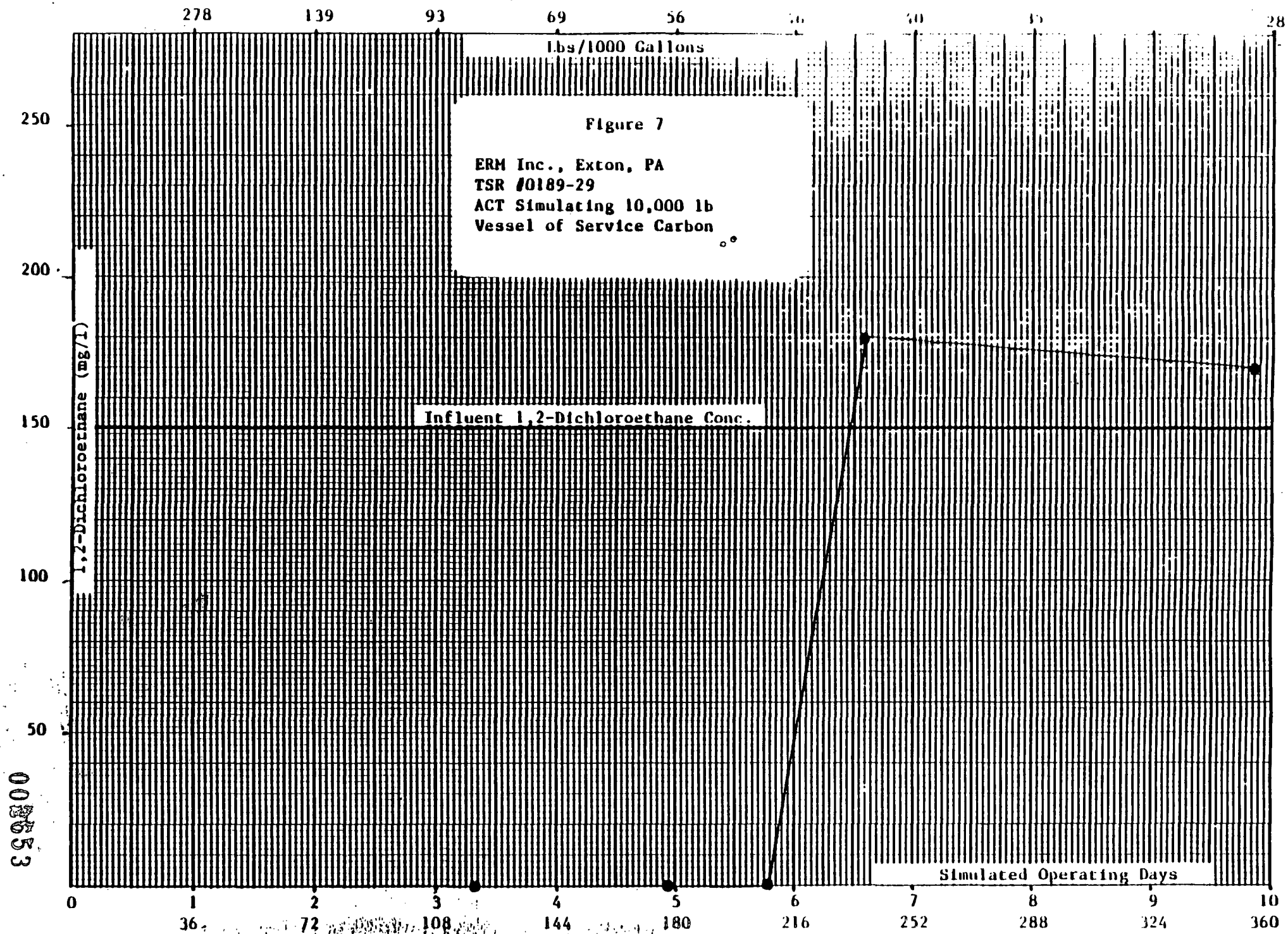

Figure 7

ERM Inc., Exton, PA
TSR #0189-29
ACT Simulating 10,000 lb
Vessel of Service Carbon

00 7653

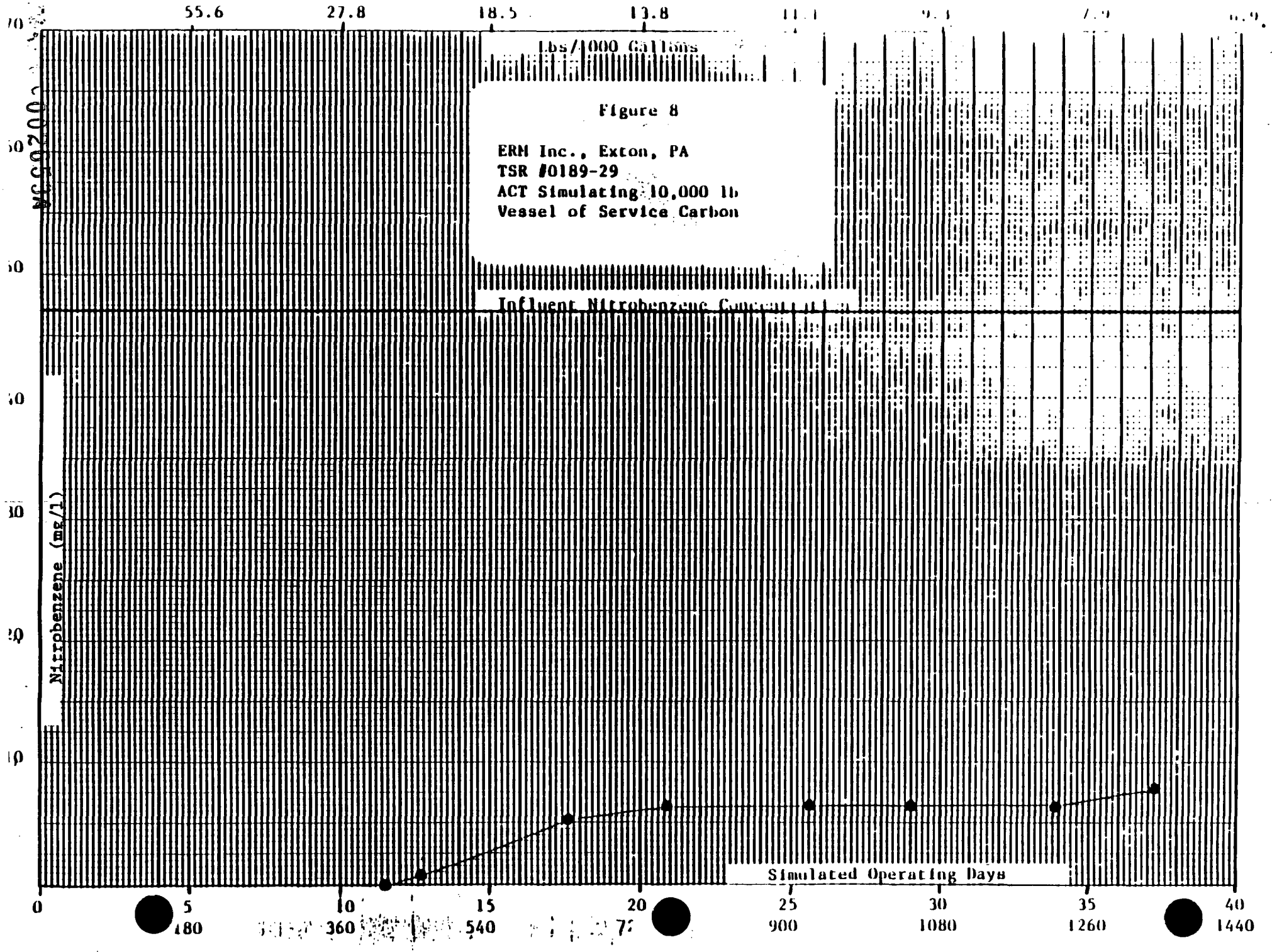

Figure 8

ERM Inc., Exton, PA
TSR #0189-29
ACT Simulating 10,000 lb
Vessel of Service Carbon

MCC0200

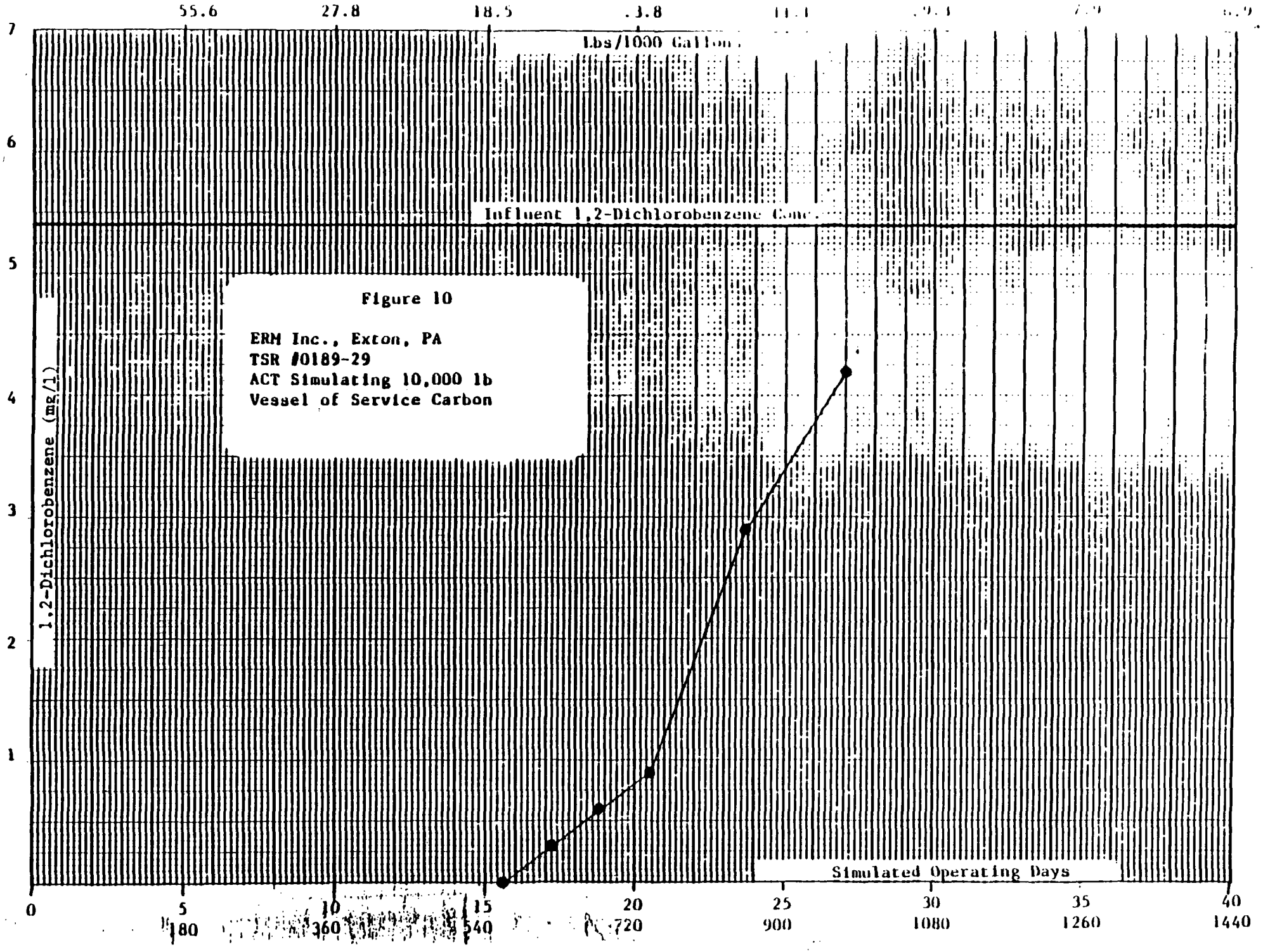

Figure 10

ERM Inc., Exton, PA
TSR #0189-29
ACT Simulating 10,000 lb
Vessel of Service Carbon

002654

C002654A

ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

LLI Sample No. EL 1364277

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 3/20/89
Date Submitted 3/ 2/89
Discard Date 4/20/89
Collected by JB
P.O. 802-01-07-01JB
Rel.

SCP, Carlstadt (Calgon Carbon) Raw Water Sample
Collected on 03/01/89 at 1130 by JB

TCL Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Chloromethane	< 10,000.	ug/l	10000.	082700000S
Bromomethane	< 10,000.	ug/l	10000.	082800000S
Vinyl Chloride	< 10,000.	ug/l	10000.	082900000S
Chloroethane	< 10,000.	ug/l	10000.	083000000S
Methylene Chloride	50,000.	ug/l	5000.	083100000S
Acetone	130,000.	ug/l	10000.	091400000S
Carbon Disulfide	< 5,000.	ug/l	5000.	091500000S
1,1-Dichloroethene	< 5,000.	ug/l	5000.	083200000S
1,1-Dichloroethane	< 5,000.	ug/l	5000.	083300000S
trans-1,2-Dichloroethene	22,000.	ug/l	5000.	083400000S
Chloroform	220,000.	ug/l	5000.	083500000S
1,2-Dichloroethane	180,000.	ug/l	5000.	083600000S
2-Butanone	920,000.	ug/l	10000.	091600000S
1,1,1-Trichloroethane	18,000.	ug/l	5000.	083700000S
Carbon Tetrachloride	< 5,000.	ug/l	5000.	083800000S
Vinyl Acetate	< 10,000.	ug/l	10000.	091700000S
Bromodichloromethane	< 5,000.	ug/l	5000.	083900000S
1,2-Dichloropropane	< 5,000.	ug/l	5000.	084000000S
cis-1,3-Dichloropropene	< 5,000.	ug/l	5000.	084400000S
Trichloroethene	63,000.	ug/l	5000.	084200000S
Dibromochloromethane	< 5,000.	ug/l	5000.	084600000S
1,1,2-Trichloroethane	< 5,000.	ug/l	5000.	084500000S
Benzene	< 5,000.	ug/l	5000.	084300000S
trans-1,3-Dichloropropene	< 5,000.	ug/l	5000.	084100000S
Bromoform	< 5,000.	ug/l	5000.	084700000S
4-Methyl-2-Pentanone	60,000.	ug/l	10000.	091900000S
2-Hexanone	< 10,000.	ug/l	10000.	091800000S
Tetrachloroethene	12,000.	ug/l	5000.	084800000S
1,1,2,2-Tetrachloroethane	< 5,000.	ug/l	5000.	084900000S
Toluene	48,000.	ug/l	5000.	085000000S
Chlorobenzene	< 5,000.	ug/l	5000.	085100000S
Ethylbenzene	< 5,000.	ug/l	5000.	085200000S
Styrene	< 5,000.	ug/l	5000.	092000000S
Xylenes (total)	10,000.	ug/l	5000.	092100000S

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO Calgon Carbon Corporation ATTN: Joe Bellissimo

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

American Association for Laboratory Accreditation
Biological & Environmental Testing

Member American Council of Independent Laboratories Inc

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Lancaster Laboratories INCORPORATED

LLI Sample No. EL 1364277

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

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Date Submitted 3/ 2/89
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Collected by JB
P.O. 802-01-07-01JB
Rel.

SCP, Carlstadt (Calgon Carbon) Raw Water Sample
Collected on 03/01/89 at 1130 by JB

TCL Semi-Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
phenol	4,000.	ug/l	2000.	065500000S
bis (2-chloroethyl) ether	< 2,000.	ug/l	2000.	066700000S
2-chlorophenol	< 2,000.	ug/l	2000.	064600000S
1,3-dichlorobenzene	< 2,000.	ug/l	2000.	067700000S
1,4-dichlorobenzene	< 2,000.	ug/l	2000.	067800000S
benzyl alcohol	< 2,000.	ug/l	2000.	092600000S
1,2-dichlorobenzene	< 2,000.	ug/l	2000.	067600000S
2-methylphenol	< 2,000.	ug/l	2000.	092700000S
bis (2-chloroisopropyl) ether	< 2,000.	ug/l	2000.	066800000S
4-methylphenol	2,000.	ug/l	2000.	092800000S
N-nitrosodi-n-propylamine	< 2,000.	ug/l	2000.	069800000S
hexachloroethane	< 2,000.	ug/l	2000.	069200000S
nitrobenzene	38,000.	ug/l	2000.	069600000S
isophorone	2,000.	ug/l	2000.	069400000S
2-nitrophenol	< 2,000.	ug/l	2000.	065100000S
2,4-dimethylphenol	< 2,000.	ug/l	2000.	064800000S
benzoic acid	< 10,000.	ug/l	10000.	092900000S
bis (2-chloroethoxy) methane	< 2,000.	ug/l	2000.	066600000S
2,4-dichlorophenol	< 2,000.	ug/l	2000.	064700000S
1,2,4-trichlorobenzene	< 2,000.	ug/l	2000.	070200000S
naphthalene	< 2,000.	ug/l	2000.	069500000S
4-chloroaniline	< 2,000.	ug/l	2000.	093000000S
hexachlorobutadiene	< 2,000.	ug/l	2000.	069000000S
4-chloro-3-methylphenol	< 2,000.	ug/l	2000.	065300000S
2-methylnaphthalene	< 2,000.	ug/l	2000.	093100000S
hexachlorocyclopentadiene	< 2,000.	ug/l	2000.	069100000S
2,4,6-trichlorophenol	< 2,000.	ug/l	2000.	065600000S
2,4,5-trichlorophenol	< 10,000.	ug/l	10000.	093200000S
2-chloronaphthalene	< 2,000.	ug/l	2000.	067200000S
2-nitroaniline	< 10,000.	ug/l	10000.	093300000S
dimethyl phthalate	< 2,000.	ug/l	2000.	068100000S
acenaphthylene	< 2,000.	ug/l	2000.	065800000S

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1 COPY TO Calgon Carbon Corporation ATTN: Joe Bellissimo
1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

American Association for Laboratory Accreditation
Clinical Biological & Environmental Testing

Member American Council of Independent Laboratories Inc.

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Lancaster Laboratories INCORPORATED
[illegible] Pitney Road, Lancaster, PA 17601-[illegible] (717) [illegible]

LLI Sample No. EL 1364277

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 3/20/89
Date Submitted 3/ 2/89
Discard Date 4/20/89
Collected by JB
P.O. 802-01-07-01JB
Rel.

SCP, Carlstadt (Calgon Carbon) Raw Water Sample
Collected on 03/01/89 at 1130 by JB

TCL Semi-Volatiles (cont)	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
3-nitroaniline	< 10,000.	ug/l	10000.	093400000S
acenaphthene	< 2,000.	ug/l	2000.	065700000S
2,4-dinitrophenol	< 10,000.	ug/l	10000.	065000000S
4-nitrophenol	< 10,000.	ug/l	10000.	065200000S
dibenzofuran	< 2,000.	ug/l	2000.	093500000S
2,4-dinitrotoluene	< 2,000.	ug/l	2000.	068300000S
2,6-dinitrotoluene	< 2,000.	ug/l	2000.	068400000S
diethyl phthalate	< 2,000.	ug/l	2000.	068000000S
4-chlorophenyl phenyl ether	< 2,000.	ug/l	2000.	067300000S
fluorene	< 2,000.	ug/l	2000.	068800000S
4-nitroaniline	< 10,000.	ug/l	10000.	093600000S
2-methyl-4,6-dinitrophenol	< 10,000.	ug/l	10000.	064900000S
N-nitrosodiphenylamine	< 2,000.	ug/l	2000.	069900000S
4-bromophenyl phenyl ether	< 2,000.	ug/l	2000.	067000000S
hexachlorobenzene	< 2,000.	ug/l	2000.	068900000S
pentachlorophenol	< 10,000.	ug/l	10000.	065400000S
phenanthrene	< 2,000.	ug/l	2000.	070000000S
anthracene	< 2,000.	ug/l	2000.	065900000S
di-n-butyl phthalate	< 2,000.	ug/l	2000.	068200000S
fluoranthene	< 2,000.	ug/l	2000.	068700000S
pyrene	< 2,000.	ug/l	2000.	070100000S
butyl benzyl phthalate	< 2,000.	ug/l	2000.	067100000S
3,3'-dichlorobenzidine	< 4,000.	ug/l	4000.	067900000S
benzo (a) anthracene	< 2,000.	ug/l	2000.	066100000S
bis (2-ethylhexyl) phthalate	< 2,000.	ug/l	2000.	066900000S
chrysene	< 2,000.	ug/l	2000.	067400000S
di-n-octyl phthalate	< 2,000.	ug/l	2000.	068500000S
benzo (b) fluoranthene	< 2,000.	ug/l	2000.	066300000S
benzo (K) fluoranthene	< 2,000.	ug/l	2000.	066500000S
benzo (a) pyrene	< 2,000.	ug/l	2000.	066200000S
indeno (1,2,3-cd) pyrene	< 2,000.	ug/l	2000.	069300000S
dibenzo (a,h) anthracene	< 2,000.	ug/l	2000.	067500000S
benzo (ghi) perylene	< 2,000.	ug/l	2000.	066400000S

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1 COPY TO Calgon Carbon Corporation ATTN: Joe Bellissimo
1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

American Association for Laboratory Accreditation
Chemical, Biological & Environmental Testing

Member American Council of Independent Laboratories, Inc.

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

LLI Sample No. EL 1364277

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 3/20/89
Date Submitted 3/ 2/89
Discard Date 4/20/89
Collected by JB
P.O. 802-01-07-01JB
Rel.

SCP, Carlstadt (Calgon Carbon) Raw Water Sample
Collected on 03/01/89 at 1130 by JB

TCL Pesticides	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Alpha BHC	< 25.	ug/l	25.	060900000S
Beta BHC	< 50.	ug/l	50.	061000000S
Delta BHC	< 25.	ug/l	25.	061200000S
Gamma BHC - Lindane	< 25.	ug/l	25.	045300000S
Heptachlor	< 25.	ug/l	25.	045400000S
Aldrin	< 25.	ug/l	25.	045500000S
Heptachlor Epoxide	< 10.	ug/l	10.	061500000S
Endosulfan I	< 5.	ug/l	5.	062700000S
Dieldrin	< 10.	ug/l	10.	046900000S
DDE	< 10.	ug/l	10.	061600000S
Endrin	< 10.	ug/l	10.	047700000S
Endosulfan II	< 10.	ug/l	10.	062800000S
DDD	< 10.	ug/l	10.	061700000S
Endosulfan Sulfate	< 10.	ug/l	10.	062900000S
DDT	< 10.	ug/l	10.	047800000S
Endrin Ketone	< 10.	ug/l	10.	093800000S
Methoxychlor	< 50.	ug/l	50.	062100000S
Alpha Chlordane	< 50.	ug/l	50.	136100000S
Gamma Chlordane	< 50.	ug/l	50.	136200000S
Toxaphene	< 100.	ug/l	100.	094200000S
PCB-1016	< 670.	ug/l	670.	063900000S
PCB-1221	< 1,300.	ug/l	1300.	064000000S
PCB-1232	< 1,800.	ug/l	1800.	064100000S
PCB-1242	780.	ug/l	50.	064200000S
PCB-1248	< 470.	ug/l	470.	064300000S
PCB-1254	100.	ug/l	100.	064400000S
PCB-1260	< 100.	ug/l	100.	064500000S

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1 COPY TO Calgon Carbon Corporation ATTN: Joe Bellissimo
1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Charles J. Neslund, B.S.
Group Leader, Pesticides/PCB's

American Association for Laboratory Accreditation
Chemical, Biological & Environmental Testing

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Lancaster Laboratories INCORPORATED

LLI Sample No. EL 1364277

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 3/20/89
Date Submitted 3/ 2/89
Discard Date 4/20/89
Collected by JB
P.O. 802-01-07-01JB
Rel.

SCP, Carlstadt (Calgon Carbon) Raw Water Sample
Collected on 03/01/89 at 1130 by JB

ANALYSIS	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Beryllium	< 5.	ug/l	5.	024701300S
Chromium	260.	ug/l	10.	025101300S
Copper	220.	ug/l	20.	025301300S
Mercury	1.3	ug/l	0.2	025902500S
Nickel	60.	ug/l	40.	026101300S
Silver	< 10.	ug/l	10.	026601300S
Zinc	220.	ug/l	20.	027201300S
TCL Volatiles		attached		092226000S
TCL Semi-Volatiles		attached		092352500S
TCL Semi-Volatiles (cont)		attached		092400000S
TCL Pesticides		attached		093723000S
Arsenic (furnace method)	50.	ug/l	10.	104503000S

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1 COPY TO Calgon Carbon Corporation ATTN: Joe Bellissimo
1 COPY TO Data Package Group

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MAR 21 1989
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Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Lee A. Seats, B.S. Mgr.
Inorganic Analysis

American Association for Laboratory Accreditation (Chemical, Biological & Environmental Testing)

135 00767 190.00 133800

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Lancaster Laboratories INCORPORATED
2425 New Holland Pike, Lancaster, PA 17601-5994 (717) 656-2301

LLI Sample No. EL 1364278

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 3/20/89
Date Submitted 3/ 2/89
Discard Date 4/20/89
Collected by JB
P.O. 802-01-07-01JB
Rel.

SCP, Carlstadt (Calgon Carbon) Influent Water
Collected on 03/01/89 at 1130 by JB

TCL Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Chloromethane	< 10,000.	ug/l	10000.	082700000S
Bromomethane	< 10,000.	ug/l	10000.	082800000S
Vinyl Chloride	< 10,000.	ug/l	10000.	082900000S
Chloroethane	< 10,000.	ug/l	10000.	083000000S
Methylene Chloride	18,000.	ug/l	5000.	083100000S
Acetone	70,000.	ug/l	10000.	091400000S
Carbon Disulfide	< 5,000.	ug/l	5000.	091500000S
1,1-Dichloroethene	< 5,000.	ug/l	5000.	083200000S
1,1-Dichloroethane	< 5,000.	ug/l	5000.	083300000S
trans-1,2-Dichloroethene	8,000.	ug/l	5000.	083400000S
Chloroform	98,000.	ug/l	5000.	083500000S
1,2-Dichloroethane	120,000.	ug/l	5000.	083600000S
2-Butanone	590,000.	ug/l	10000.	091600000S
1,1,1-Trichloroethane	7,000.	ug/l	5000.	083700000S
Carbon Tetrachloride	< 5,000.	ug/l	5000.	083800000S
Vinyl Acetate	< 10,000.	ug/l	10000.	091700000S
Bromodichloromethane	< 5,000.	ug/l	5000.	083900000S
1,2-Dichloropropane	< 5,000.	ug/l	5000.	084000000S
cis-1,3-Dichloropropene	< 5,000.	ug/l	5000.	084400000S
Trichloroethene	14,000.	ug/l	5000.	084200000S
Dibromochloromethane	< 5,000.	ug/l	5000.	084600000S
1,1,2-Trichloroethane	< 5,000.	ug/l	5000.	084500000S
Benzene	< 5,000.	ug/l	5000.	084300000S
trans-1,3-Dichloropropene	< 5,000.	ug/l	5000.	084100000S
Bromoform	< 5,000.	ug/l	5000.	084700000S
4-Methyl-2-Pentanone	30,000.	ug/l	10000.	091900000S
2-Hexanone	< 10,000.	ug/l	10000.	091800000S
Tetrachloroethene	< 5,000.	ug/l	5000.	084800000S
1,1,2,2-Tetrachloroethane	< 5,000.	ug/l	5000.	084900000S
Toluene	10,000.	ug/l	5000.	085000000S
Chlorobenzene	< 5,000.	ug/l	5000.	085100000S
Ethylbenzene	< 5,000.	ug/l	5000.	085200000S
Styrene	< 5,000.	ug/l	5000.	092000000S
Xylenes (total)	< 5,000.	ug/l	5000.	092100000S

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1 COPY TO Calgon Carbon Corporation ATTN: Joe Bellissimo

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

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Chemical, Biological & Environmental Testing

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

LLI Sample No. EL 1364278

Environ. Resources Management
855 Springdale Drive
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SCP, Carlstadt (Calgon Carbon) Influent Water
Collected on 03/01/89 at 1130 by JB

TCL Semi-Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
phenol	6,000.	ug/l	2000.	065500000S
bis (2-chloroethyl) ether	< 2,000.	ug/l	2000.	066700000S
2-chlorophenol	< 2,000.	ug/l	2000.	064600000S
1,3-dichlorobenzene	< 2,000.	ug/l	2000.	067700000S
1,4-dichlorobenzene	< 2,000.	ug/l	2000.	067800000S
benzyl alcohol	< 2,000.	ug/l	2000.	092600000S
1,2-dichlorobenzene	< 2,000.	ug/l	2000.	067600000S
2-methylphenol	< 2,000.	ug/l	2000.	092700000S
bis (2-chloroisopropyl) ether	< 2,000.	ug/l	2000.	066800000S
4-methylphenol	4,000.	ug/l	2000.	092800000S
N-nitrosodi-n-propylamine	< 2,000.	ug/l	2000.	069800000S
hexachloroethane	< 2,000.	ug/l	2000.	069200000S
nitrobenzene	42,000.	ug/l	2000.	069600000S
isophorone	3,000.	ug/l	2000.	069400000S
2-nitrophenol	< 2,000.	ug/l	2000.	065100000S
2,4-dimethylphenol	< 2,000.	ug/l	2000.	064800000S
benzoic acid	< 10,000.	ug/l	10000.	092900000S
bis (2-chloroethoxy) methane	< 2,000.	ug/l	2000.	066600000S
2,4-dichlorophenol	< 2,000.	ug/l	2000.	064700000S
1,2,4-trichlorobenzene	< 2,000.	ug/l	2000.	070200000S
naphthalene	< 2,000.	ug/l	2000.	069500000S
4-chloroaniline	< 2,000.	ug/l	2000.	093000000S
hexachlorobutadiene	< 2,000.	ug/l	2000.	069000000S
4-chloro-3-methylphenol	< 2,000.	ug/l	2000.	065300000S
2-methylnaphthalene	< 2,000.	ug/l	2000.	093100000S
hexachlorocyclopentadiene	< 2,000.	ug/l	2000.	069100000S
2,4,6-trichlorophenol	< 2,000.	ug/l	2000.	065600000S
2,4,5-trichlorophenol	< 10,000.	ug/l	10000.	093200000S
2-chloronaphthalene	< 2,000.	ug/l	2000.	067200000S
2-nitroaniline	< 10,000.	ug/l	10000.	093300000S
dimethyl phthalate	< 2,000.	ug/l	2000.	068100000S
acenaphthylene	< 2,000.	ug/l	2000.	065800000S

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1 COPY TO Data Package Group

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Group Leader, GC/MS

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SCP, Carlstadt (Calgon Carbon) Influent Water
Collected on 03/01/89 at 1130 by JB

TCL Semi-Volatiles (cont)	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
3-nitroaniline	< 10,000.	ug/l	10000.	093400000S
acenaphthene	< 2,000.	ug/l	2000.	065700000S
2,4-dinitrophenol	< 10,000.	ug/l	10000.	065000000S
4-nitrophenol	< 10,000.	ug/l	10000.	065200000S
dibenzofuran	< 2,000.	ug/l	2000.	093500000S
2,4-dinitrotoluene	< 2,000.	ug/l	2000.	068300000S
2,6-dinitrotoluene	< 2,000.	ug/l	2000.	068400000S
diethyl phthalate	< 2,000.	ug/l	2000.	068000000S
4-chlorophenyl phenyl ether	< 2,000.	ug/l	2000.	067300000S
fluorene	< 2,000.	ug/l	2000.	068800000S
4-nitroaniline	< 10,000.	ug/l	10000.	093600000S
2-methyl-4,6-dinitrophenol	< 10,000.	ug/l	10000.	064900000S
N-nitrosodiphenylamine	< 2,000.	ug/l	2000.	069900000S
4-bromophenyl phenyl ether	< 2,000.	ug/l	2000.	067000000S
hexachlorobenzene	< 2,000.	ug/l	2000.	068900000S
pentachlorophenol	< 10,000.	ug/l	10000.	065400000S
phenanthrene	< 2,000.	ug/l	2000.	070000000S
anthracene	< 2,000.	ug/l	2000.	065900000S
di-n-butyl phthalate	< 2,000.	ug/l	2000.	068200000S
fluoranthene	< 2,000.	ug/l	2000.	068700000S
pyrene	< 2,000.	ug/l	2000.	070100000S
butyl benzyl phthalate	< 2,000.	ug/l	2000.	067100000S
3,3'-dichlorobenzidine	< 4,000.	ug/l	4000.	067900000S
benzo (a) anthracene	< 2,000.	ug/l	2000.	066100000S
bis (2-ethylhexyl) phthalate	< 2,000.	ug/l	2000.	066900000S
chrysene	< 2,000.	ug/l	2000.	067400000S
di-n-octyl phthalate	< 2,000.	ug/l	2000.	068500000S
benzo (b) fluoranthene	< 2,000.	ug/l	2000.	066300000S
benzo (K) fluoranthene	< 2,000.	ug/l	2000.	066500000S
benzo (a) pyrene	< 2,000.	ug/l	2000.	066200000S
indeno (1,2,3-cd) pyrene	< 2,000.	ug/l	2000.	069300000S
dibenzo (a,h) anthracene	< 2,000.	ug/l	2000.	067500000S
benzo (ghi) perylene	< 2,000.	ug/l	2000.	066400000S

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Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

Lancaster Laboratories INCORPORATED

LLI Sample No. EL 1364278

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 3/20/89
Date Submitted 3/ 2/89
Discard Date 4/20/89
Collected by JB
P.O. 802-01-07-01JB
Rel.

SCP, Carlstadt (Calgon Carbon) Influent Water
Collected on 03/01/89 at 1130 by JB

TCL Pesticides	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Alpha BHC	< 5.	ug/l	5.	060900000S
Beta BHC	< 2.5	ug/l	2.5	061000000S
Delta BHC	< 2.5	ug/l	2.5	061200000S
Gamma BHC - Lindane	< 2.5	ug/l	2.5	045300000S
Heptachlor	< 2.5	ug/l	2.5	045400000S
Aldrin	< 2.5	ug/l	2.5	045500000S
Heptachlor Epoxide	< 2.5	ug/l	2.5	061500000S
Endosulfan I	< 0.5	ug/l	0.5	062700000S
Dieldrin	< 1.	ug/l	1.	046900000S
DDE	< 1.	ug/l	1.	061600000S
Endrin	< 1.	ug/l	1.	047700000S
Endosulfan II	< 1.	ug/l	1.	062800000S
DDD	< 1.	ug/l	1.	061700000S
Endosulfan Sulfate	< 1.	ug/l	1.	062900000S
DDT	< 1.	ug/l	1.	047800000S
Endrin Ketone	< 1.	ug/l	1.	093800000S
Methoxychlor	< 5.	ug/l	5.	062100000S
Alpha Chlordane	< 5.	ug/l	5.	136100000S
Gamma Chlordane	< 5.	ug/l	5.	136200000S
Toxaphene	< 10.	ug/l	10.	094200000S
PCB-1016	< 25.	ug/l	25.	063900000S
PCB-1221	< 50.	ug/l	50.	064000000S
PCB-1232	< 50.	ug/l	50.	064100000S
PCB-1242	< 25.	ug/l	25.	064200000S
PCB-1248	< 25.	ug/l	25.	064300000S
PCB-1254	< 10.	ug/l	10.	064400000S
PCB-1260	< 10.	ug/l	10.	064500000S

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Lancaster Laboratories, Inc.
Reviewed and Approved by:

Charles J. Neslund, B.S.
Group Leader, Pesticides/PCB's

002659

Lancaster Laboratories INCORPORATED

LLI Sample No. EL 1364278

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 3/20/89
Date Submitted 3/ 2/89
Discard Date 4/20/89
Collected by JB
P.O. 802-01-07-01JB
Rel.

SCP, Carlstadt (Calgon Carbon) Influent Water
Collected on 03/01/89 at 1130 by JB

ANALYSIS	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Beryllium	< 5.	ug/l	5.	024701300S
Chromium	30.	ug/l	10.	025101300S
Copper	< 20.	ug/l	20.	025301300S
Mercury	1.2	ug/l	0.4	025902500S
Nickel	60.	ug/l	40.	026101300S
Silver	< 10.	ug/l	10.	026601300S
Zinc	40.	ug/l	20.	027201300S
TCL Volatiles		attached		092226000S
TCL Semi-Volatiles		attached		092352500S
TCL Semi-Volatiles (cont)		attached		092400000S
TCL Pesticides		attached		093723000S
Arsenic (furnace method)	10.	ug/l	10.	104503000S

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Lancaster Laboratories, Inc.
Reviewed and Approved by:

Lee A. Seats, B.S. Mgr.
Inorganic Analysis

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Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 3/20/89
Date Submitted 3/ 2/89
Discard Date 4/20/89
Collected by JB
P.O. 802-01-07-01JB
Rel.

SCP, Carlstadt (Calgon Carbon) Effluent #1
Composite Water Sample
Collected on 03/01/89 at 1130 by JB

ANALYSIS	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Beryllium	< 5.	ug/l	5.	024701300S
Chromium	< 10.	ug/l	10.	025101300S
Copper	< 20.	ug/l	20.	025301300S
Mercury	0.6	ug/l	0.2	025902500S
Nickel	40.	ug/l	40.	026101300S
Silver	< 10.	ug/l	10.	026601300S
Zinc	< 20.	ug/l	20.	027201300S
TCL Pesticides		attached		093723000S
Arsenic (furnace method)	20.	ug/l	10.	104503000S

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Inorganic Analysis

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Lancaster Laboratories INCORPORATED

2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2301

LLL Sample No. EL 1364279

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 3/20/89
Date Submitted 3/ 2/89
Discard Date 4/20/89
Collected by JB
P.O. 802-01-07-01JB
Rel.

SCP, Carlstadt (Calgon Carbon) Effluent #1
Composite Water Sample
Collected on 03/01/89 at 1130 by JB

TCL Pesticides	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Alpha BHC	< 0.5	ug/l	0.5	060900000S
Beta BHC	< 0.5	ug/l	0.5	061000000S
Delta BHC	< 0.5	ug/l	0.5	061200000S
Gamma BHC - Lindane	< 0.5	ug/l	0.5	045300000S
Heptachlor	< 0.5	ug/l	0.5	045400000S
Aldrin	< 0.5	ug/l	0.5	045500000S
Heptachlor Epoxide	< 0.5	ug/l	0.5	061500000S
Endosulfan I	< 0.5	ug/l	0.5	062700000S
Dieldrin	< 1.	ug/l	1.	046900000S
DDE	< 1.	ug/l	1.	061600000S
Endrin	< 1.	ug/l	1.	047700000S
Endosulfan II	< 1.	ug/l	1.	062800000S
DDD	< 1.	ug/l	1.	061700000S
Endosulfan Sulfate	< 1.	ug/l	1.	062900000S
DDT	< 1.	ug/l	1.	047800000S
Endrin Ketone	< 1.	ug/l	1.	093800000
Methoxychlor	< 5.	ug/l	5.	062100000S
Alpha Chlordane	< 5.	ug/l	5.	136100000S
Gamma Chlordane	< 5.	ug/l	5.	136200000S
Toxaphene	< 10.	ug/l	10.	094200000S
PCB-1016	< 5.	ug/l	5.	063900000S
PCB-1221	< 5.	ug/l	5.	064000000S
PCB-1232	< 5.	ug/l	5.	064100000S
PCB-1242	< 5.	ug/l	5.	064200000S
PCB-1248	< 5.	ug/l	5.	064300000S
PCB-1254	< 10.	ug/l	10.	064400000S
PCB-1260	< 10.	ug/l	10.	064500000S

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Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Charles J. Neslund, B.S.
Group Leader, Pesticides/PCB's

Lancaster Laboratories INCORPORATED

[illegible] Flockland Pike, Lancaster, PA 17601 [illegible]

LLI Sample No. EL 1364280

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 3/20/89
Date Submitted 3/ 2/89
Discard Date 4/20/89
Collected by JB
P.O. 802-01-07-01JB
Rel.

SCP, Carlstadt (Calgon Carbon) Effluent #2
Composite Water Sample
Collected on 03/01/89 at 1130 by JB

ANALYSIS	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Beryllium	< 5.	ug/l	5.	024701300S
Chromium	20.	ug/l	10.	025101300S
Copper	< 20.	ug/l	20.	025301300S
Mercury	0.5	ug/l	0.2	025902500S
Nickel	60.	ug/l	40.	026101300S
Silver	< 10.	ug/l	10.	026601300S
Zinc	< 20.	ug/l	20.	027201300S
TCL Pesticides		attached		093723000S
Arsenic (furnace method)	10.	ug/l	10.	104503000S

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Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Lee A. Seats, B.S. Mgr.
Inorganic Analysis

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SCP, Carlstadt (Calgon Carbon) Effluent #2
Composite Water Sample
Collected on 03/01/89 at 1130 by JB

TCL Pesticides	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Alpha BHC	< 2.5	ug/l	2.5	060900000S
Beta BHC	< 2.5	ug/l	2.5	061000000S
Delta BHC	< 2.5	ug/l	2.5	061200000S
Gamma BHC - Lindane	< 2.5	ug/l	2.5	045300000S
Heptachlor	< 2.5	ug/l	2.5	045400000S
Aldrin	< 2.5	ug/l	2.5	045500000S
Heptachlor Epoxide	< 0.5	ug/l	0.5	061500000S
Endosulfan I	< 0.5	ug/l	0.5	062700000S
Dieldrin	< 1.	ug/l	1.	046900000S
DDE	< 1.	ug/l	1.	061600000S
Endrin	< 1.	ug/l	1.	047700000S
Endosulfan II	< 1.	ug/l	1.	062800000S
DDD	< 1.	ug/l	1.	061700000S
Endosulfan Sulfate	< 1.	ug/l	1.	062900000S
DDT	< 1.	ug/l	1.	047800000S
Endrin Ketone	< 1.	ug/l	1.	093800000S
Methoxychlor	< 5.	ug/l	5.	062100000S
Alpha Chlordane	< 5.	ug/l	5.	136100000S
Gamma Chlordane	< 5.	ug/l	5.	136200000S
Toxaphene	< 10.	ug/l	10.	094200000S
PCB-1016	< 25.	ug/l	25.	063900000S
PCB-1221	< 25.	ug/l	25.	064000000S
PCB-1232	< 25.	ug/l	25.	064100000S
PCB-1242	< 25.	ug/l	25.	064200000S
PCB-1248	< 25.	ug/l	25.	064300000S
PCB-1254	< 10.	ug/l	10.	064400000S
PCB-1260	< 10.	ug/l	10.	064500000S

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Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Charles J. Neslund, B.S.
Group Leader, Pesticides/PCB's

APPENDIX C-4
APV/CREPACO
STREAM STRIPPING

002662A

March 22, 1989

Test Report No. 2

APV

STEAM STRIPPING GROUND WATER FOR ENVIRONMENTAL RESOURCES MANAGEMENT, INC.

Circulation:

Ruth Baker (2)

A Cooper

File

Work done and reported by:

C T Cowan

002663

002663 A

1. OBJECTIVE

To remove volatile organic compounds from ground water using steam stripping. The composition of the ground water was as shown in Table 1.

2. EXPERIMENTAL

The general arrangement of the stripping column and associated equipment was as shown in the accompanying figure.

The column was packed to a height of 10 theoretical plates with 1/8" diameter Borad rings (double wrapped stainless steel gauze).

The column was fitted with thermocouples mounted against the column wall and on the exterior of the lagging thus enabling the differential temperature between the internal and external surfaces of the lagged column to be measured. The column was operated adiabatically by application of electrical energy to the column heater jacket.

Electrical energy to the thermosyphon reboiler was measured using a digital voltmeter/ammeter.

All condensers for vapor and product cooling were of the double surface type.

The feed pump was a positive displacement unit with a maximum delivery rate of 1.5 l/h.

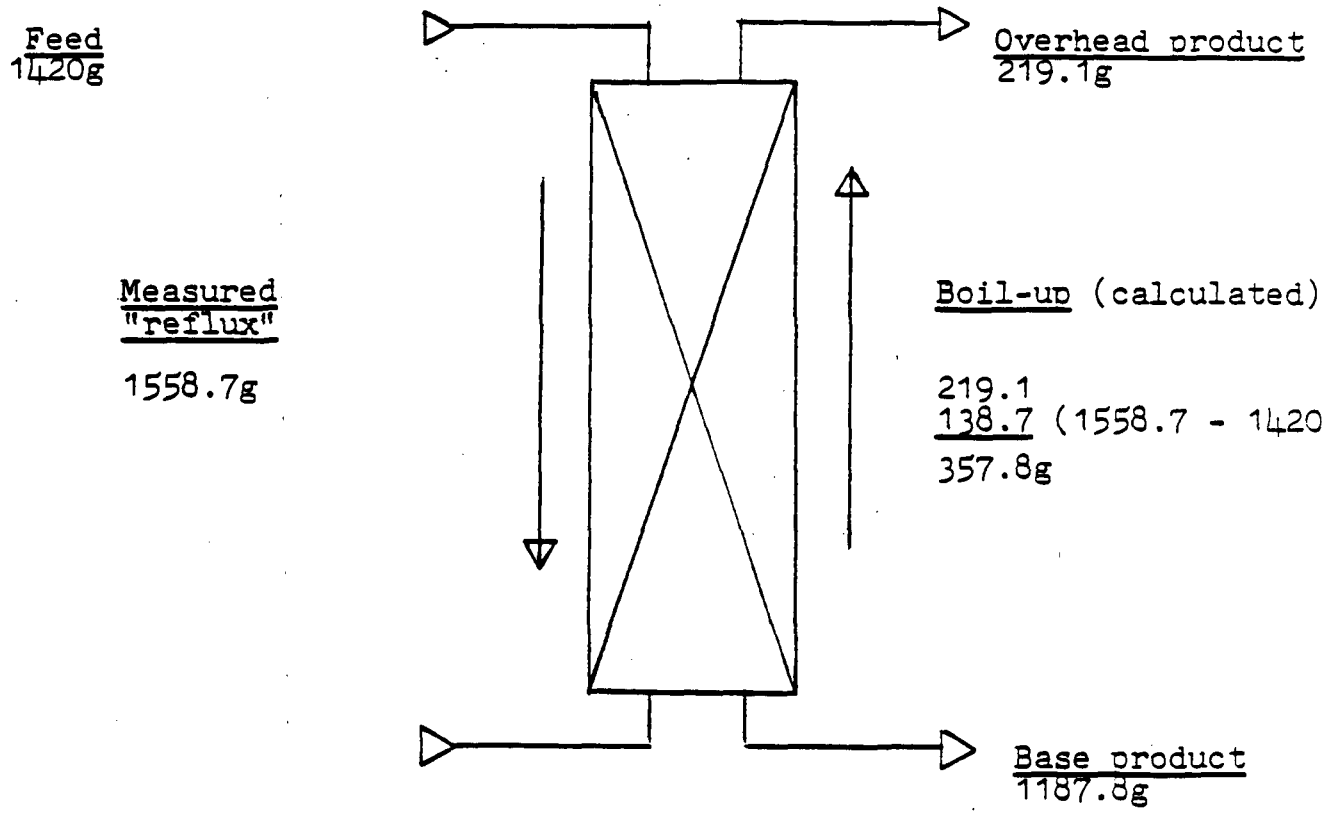
2.1 Run 1

The mean operating conditions for the run were:

Feed rate	- 710 g/hr
"Reflux" rate	- 779 g/hr
Overhead product	- 109.6 g/hr
Base product	- 593.9 g/hr
Heat input to reboiler	- 120 Watts 1720.8 cal/min
Feed preheat temperature	- 98°C
Overhead product temperature	- 98.9°C

002663B

2.1.1 Mass Balance



Heat input

206.5 K cal.
Boiler efficiency 93.6%

L/V based on feed/overhead = 6.48

L/V to include heat losses in column = 4.36

2.1.2 Comments -

1) Although the column was operated adiabatically there is a discrepancy between the measured reflux and theoretical value. This may be due to:
   i. condensation in the still head.
   ii. hold-up in the reboiler.
2) Very heavy scaling of all heat transfer surfaces occured, the scale subsequently being identified as calcium carbonate.
3) The run was aborted due to a blocked feed pump after two (2) hours.

0026643C

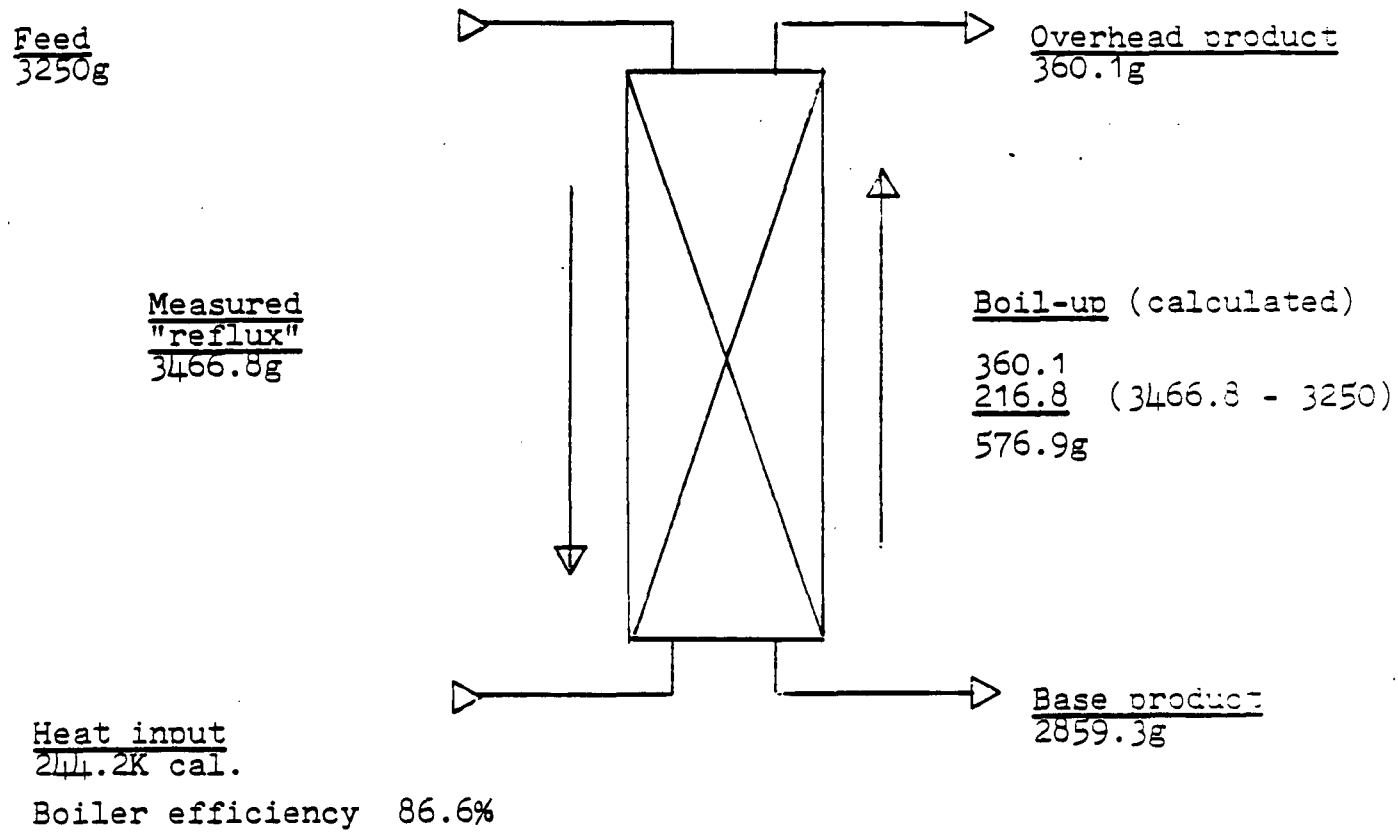
2.2 Run 2

The equipment used was as in Run 1 with the addition of a heating jacket on the still head to avoid condensation.

The mean operating conditions for the run were:

Feed rate	- 928.6 g/hr
"Reflux" rate	- 990.5 g/hr
Overhead product	- 102.9 g/hr
Base product	- 816.9 g/hr
Heat input to reboiler	- 81.08 Watts 1162.7 cal/min
Feed preheat temperature	- 98.5°C
Superheat at still head	- 7 - 10 C°
Overhead temperature	- 107-110°C

2.2.1 Mass Balance



L/V based on feed/overhead = 9.02

L/V based on heat input with 86.6% boiler efficiency = 8.3

3. ANALYTICAL RESULTS

Representative samples of the base product from Runs 1 and 2 were submitted to ERM for analysis. The following results were reported.

Constituent	Feed	Run 1	Run 2
Methylene chloride	29	0.025	n.d.
Acetone	90	0.29	0.2
Chloroform	130	n.d.	n.d.
1,2-dichloroethane	160	n.d.	n.d.
2-butanone	720	0.06	n.d.
Trichloroethylene	46	0.058	n.d.
Toluene	32	0.034	n.d.
Tetrachloroethylene	?	0.03	n.d.
Phenol	5	3.8	3.6
Bis(2-chloroethyl)ether	18	n.d.	n.d.
Benzyl alcohol	1	0.88	0.88
1,2-dichlorobenzene	0.3	n.d.	n.d.
2-methyl phenol	0.4	0.26	0.28
4-methyl phenol	2.8	2.6	2.7
Nitrobenzene	46	0.007	0.06
Iso-phorone	1.8	0.1	0.19
2,4-dimethylphenol	0.7	0.2	0.28
Benzonic acid	3.2	3.1	4.0
2,4-dichlorophenol	0.2	0.22	0.18
Naphthalene	0.2	n.d.	n.d.
Dimethyl phthalate	0.4	n.d.	n.d.
Di-n-butylphthalate	0.3	n.d.	n.d.
Bis(2-ethylhexyl)phthalate	2.6	0.8	2.2
Arachlor 1232	2.6	n.d.	n.d.
Arachlor 1254	0.16	n.d.	n.d.

n.d. - none detected

4. CONCLUSIONS

The work has shown that steam stripping the ground water using an L/V of 9:1 results in a dramatic reduction in the volatile organic constituents present. However, until acceptance criteria are laid down, further comment on the overall acceptability of the process cannot be made. It must be highlighted that the water is extremely "hard" and will cause fouling of all heating surfaces. Due cognizance of this must be taken into account in any design study for a full scale plant.

Colin T. Cowan

C T Cowan

TIME SHEET

Erection of column and precommissioning	1 day
Two (2) runs @ 1 per day	2 days
Clean-up and reporting	2 days
	5 days

0026605A

WATER TABLE AQUIFER SAMPLING DATA
SCP/CARLSTADT, NEW JERSEY

Compound	Average Concentration mg/l	Maximum Concentration mg/l	Number of Occurrences
Volatile Organics			
chloroform	304	614	4
1,2 dichloroethane	221	473	4
trichloroethylene	72.2	161	8
1,1,2,2-tetrachloroethane	4.40	7.35	4
tetrachloroethylene	16.9	24.5	3
1,1-dichloroethylene	0.400	0.400	1
benzene	3.48	6.83	10
vinyl chloride	3.86	7.29	9
2-butanone (MEK)	648	2000	5
trans-1,2-dichloroethylene	17.1	64.7	12
chlorobenzene	3.57	6.56	3
toluene	26.8	90.9	14
1,1-dichloroethane	3.08	11.7	8
methylene chloride	55.9	200	10
1,2-dichlorobenzene	0.076	0.192	12
1,1,1-trichloroethane	35.4	81.2	5
ethylbenzene	2.02	3.90	6
chloroethane	2.42	2.42	1
total xylenes	13.20	35.6	8
Subtotal	1431.0	3788.0	
Semi-volatile Organics			
bis(2-chloroethyl)ether	1.32	1.39	2
benzo[a]pyrene	0.090	0.090	1
bis(2-ethylhexyl)phthalate	0.269	0.654	5
2,4-dimethylphenol	0.275	0.109	11
phenol	3.46	17.1	14
diethyl phthalate	0.216	0.416	2
2,4-dichlorophenol	0.349	0.463	2
di-n-butylphthalate	0.165	0.318	2
2-chloronaphthalene	0.019	0.019	1
2-chlorophenol	0.016	0.018	2
2-nitrophenol	0.0045	0.0045	1
acenaphthene	0.013	0.040	4
acenaphthylene	0.040	0.074	2
anthracene	0.126	0.126	1
benzo[b]fluoranthene	0.141	0.141	1
butylbenzyl phthalate	0.010	0.010	1
chrysene	0.088	0.088	1
dimethyl phthalate	0.316	0.316	1
fluoranthene	0.091	0.266	3
fluorene	0.070	0.133	2
indeno[1,2,3-c,d]pyrene	0.060	0.060	1
isophorone	2.61	8.45	5
naphthalene	0.132	1.22	13
nitrobenzene	42.5	57.9	4
phenanthrene	0.316	0.620	2
pyrene	0.228	0.228	1
Subtotal	52.9	91.3	

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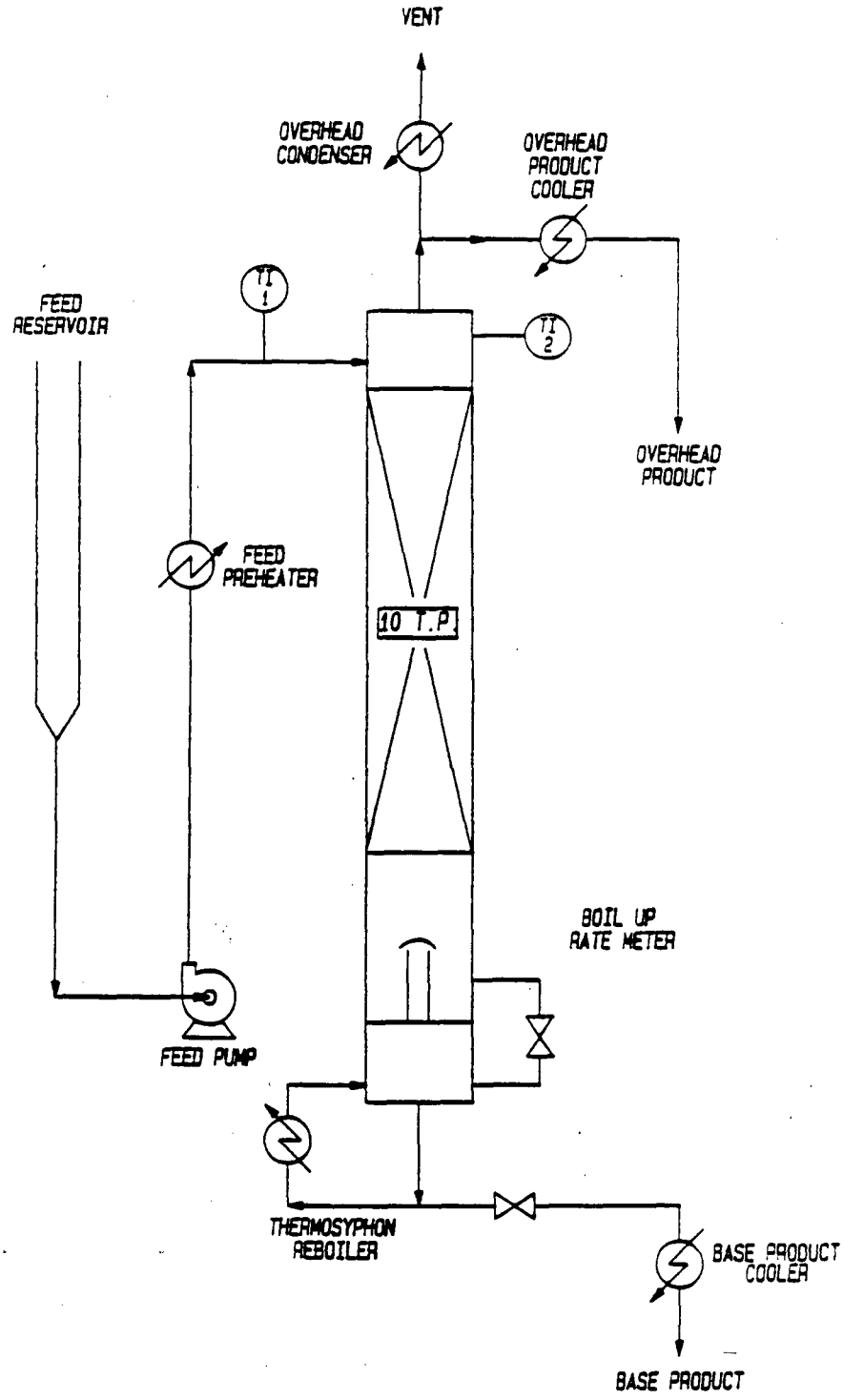

Rev	By	Date	Revision
D			
C			
B			
A			

Date

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ENVIRONMEN. RESOURS. MANAGEMENT, INC.

Date: 15 MAR 1989 | W.O. 90000

Scale: NTS | Sheet 1 of 1

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002667

L002667A

ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

LLI Sample No. EL 1357732

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/24/89
Date Submitted 2/10/89
Discard Date 3/27/89
Collected by SA
P.O. 802-01-07-01 SA/FN
Rel.

15255 SCP Carlstadt Raw (Feed) Water Sample
Collected on 02/07/89 by SA/FH (APV Crepaco, Inc.)

ANALYSIS	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE
TCL Volatiles	attached		092226000S
TCL Semi-Volatiles	attached		092352500S
TCL Semi-Volatiles (cont)	attached		092400000S
TCL Pesticides	attached		093723000S

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO APV Crepaco, Inc. ATTN: Tony Cooper
1 COPY TO Data Package Group

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FEB 21 1989
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228 00767 130.00 114500

See Reverse Side For Explanation Of Symbols And Abbreviations And Our Standard Terms And Conditions

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

002668

ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

LLL Sample No. RL 1357732

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/24/89
Date Submitted 2/10/89
Discard Date 3/27/89
Collected by SA
P.O. 802-01-07-01 SA/FN
Rel.

15255 SCP Carlstadt Raw (Feed) Water Sample
Collected on 02/07/89 by SA/FH (APV Crepaco, Inc.)

TCL Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Chloromethane	< 50,000.	ug/l	50000.	082700000S
Bromomethane	< 50,000.	ug/l	50000.	082800000S
Vinyl Chloride	< 50,000.	ug/l	50000.	082900000S
Chloroethane	< 50,000.	ug/l	50000.	083000000S
Methylene Chloride	29,000.	ug/l	25000.	083100000S
Acetone	90,000.	ug/l	50000.	091400000S
Carbon Disulfide	< 25,000.	ug/l	25000.	091500000S
1,1-Dichloroethene	< 25,000.	ug/l	25000.	083200000S
1,1-Dichloroethane	< 25,000.	ug/l	25000.	083300000S
trans-1,2-Dichloroethene	< 25,000.	ug/l	25000.	083400000S
Chloroform	130,000.	ug/l	25000.	083500000S
1,2-Dichloroethane	160,000.	ug/l	25000.	083600000S
2-Butanone	720,000.	ug/l	50000.	091600000S
1,1,1-Trichloroethane	< 25,000.	ug/l	25000.	083700000S
Carbon Tetrachloride	< 25,000.	ug/l	25000.	083800000S
Vinyl Acetate	< 50,000.	ug/l	50000.	091700000S
Bromodichloromethane	< 25,000.	ug/l	25000.	083900000S
1,2-Dichloropropane	< 25,000.	ug/l	25000.	084000000S
cis-1,3-Dichloropropene	< 25,000.	ug/l	25000.	084400000S
Trichloroethene	46,000.	ug/l	25000.	084200000S
Dibromochloromethane	< 25,000.	ug/l	25000.	084600000S
1,1,2-Trichloroethane	< 25,000.	ug/l	25000.	084500000S
Benzene	< 25,000.	ug/l	25000.	084300000S
trans-1,3-Dichloropropene	< 25,000.	ug/l	25000.	084100000S
Bromoform	< 25,000.	ug/l	25000.	084700000S
4-Methyl-2-Pentanone	< 50,000.	ug/l	50000.	091900000S
2-Hexanone	< 50,000.	ug/l	50000.	091800000S
Tetrachloroethene	< 25,000.	ug/l	25000.	084800000S
1,1,2,2-Tetrachloroethane	< 25,000.	ug/l	25000.	084900000S
Toluene	32,000.	ug/l	25000.	085000000S
Chlorobenzene	< 25,000.	ug/l	25000.	085100000S
Ethylbenzene	< 25,000.	ug/l	25000.	085200000S
Styrene	< 25,000.	ug/l	25000.	092000000S
Xylenes (total)	< 25,000.	ug/l	25000.	092100000S

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO APV Crepaco, Inc. ATTN: Tony Cooper

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

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Of Symbols And Abbreviations And
Our Standard Terms And Conditions

ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

LLL Sample No. EL 1357732

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/24/89
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Discard Date 3/27/89
Collected by SA
P.O. 802-01-07-01 SA/FN
Rel.

15255 SCP Carlstadt Raw (Feed) Water Sample
Collected on 02/07/89 by SA/FH (APV Crepaco, Inc.)

TCL Volatiles	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE

1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

WR2540 D 4 3

LLI Sample No. EL 1357732

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/24/89
Date Submitted 2/10/89
Discard Date 3/27/89
Collected by SA
P.O. 802-01-07-01 SA/FN
Rel.

15255 SCP Carlstadt Raw (Feed) Water Sample
Collected on 02/07/89 by SA/FH (APV Crepaco, Inc.)

TCL Semi-Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
phenol	5,000.	ug/l	2000.	065500000S
bis (2-chloroethyl) ether	18,000.	ug/l	2000.	066700000S
2-chlorophenol	< 100.	ug/l	100.	064600000S
1,3-dichlorobenzene	< 100.	ug/l	100.	067700000S
1,4-dichlorobenzene	< 100.	ug/l	100.	067800000S
benzyl alcohol	1,000.	ug/l	100.	092600000S
1,2-dichlorobenzene	300.	ug/l	100.	067600000S
2-methylphenol	400.	ug/l	100.	092700000S
bis (2-chloroisopropyl) ether	< 100.	ug/l	100.	066800000S
4-methylphenol	2,800.	ug/l	100.	092800000S
N-nitrosodi-n-propylamine	< 100.	ug/l	100.	069800000S
hexachloroethane	< 100.	ug/l	100.	069200000S
nitrobenzene	46,000.	ug/l	2000.	069600000S
isophorone	1,800.	ug/l	100.	069400000S
2-nitrophenol	< 100.	ug/l	100.	065100000S
2,4-dimethylphenol	700.	ug/l	100.	064800000S
benzoic acid	3,200.	ug/l	500.	092900000S
bis (2-chloroethoxy) methane	< 100.	ug/l	100.	066600000S
2,4-dichlorophenol	200.	ug/l	100.	064700000S
1,2,4-trichlorobenzene	< 100.	ug/l	100.	070200000S
naphthalene	200.	ug/l	100.	069500000S
4-chloroaniline	< 100.	ug/l	100.	093000000S
hexachlorobutadiene	< 100.	ug/l	100.	069000000S
4-chloro-3-methylphenol	< 100.	ug/l	100.	065300000S
2-methylnaphthalene	< 100.	ug/l	100.	093100000S
hexachlorocyclopentadiene	< 100.	ug/l	100.	069100000S
2,4,6-trichlorophenol	< 100.	ug/l	100.	065600000S
2,4,5-trichlorophenol	< 500.	ug/l	500.	093200000S
2-chloronaphthalene	< 100.	ug/l	100.	067200000S
2-nitroaniline	< 500.	ug/l	500.	093300000S
dimethyl phthalate	400.	ug/l	100.	068100000S
acenaphthylene	< 100.	ug/l	100.	065800000S

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1 COPY TO APV Crepaco, Inc. ATTN: Tony Cooper
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Chemical, Biological & Environmental Fields of Testing

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See Reverse Side For Explanation Of Symbols And Abbreviations And Our Standard Terms And Conditions

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

09:58:18 210437 RGP
WK2540 D 4 3

LLI Sample No. EL 1357732

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/24/89
Date Submitted 2/10/89
Discard Date 3/27/89
Collected by SA
P.O. 802-01-07-01 SA/FN
Rel.

15255 SCP Carlstadt Raw (Feed) Water Sample
Collected on 02/07/89 by SA/FH (APV Crepaco, Inc.)

TCL Semi-Volatiles (cont)	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
3-nitroaniline	< 500.	ug/l	500.	093400000S
acenaphthene	< 100.	ug/l	100.	065700000S
2,4-dinitrophenol	< 500.	ug/l	500.	065000000S
4-nitrophenol	< 500.	ug/l	500.	065200000S
dibenzofuran	< 100.	ug/l	100.	093500000S
2,4-dinitrotoluene	< 100.	ug/l	100.	068300000S
2,6-dinitrotoluene	< 100.	ug/l	100.	068400000S
diethyl phthalate	< 100.	ug/l	100.	068000000S
4-chlorophenyl phenyl ether	< 100.	ug/l	100.	067300000S
fluorene	< 100.	ug/l	100.	068800000S
4-nitroaniline	< 500.	ug/l	500.	093600000S
2-methyl-4,6-dinitrophenol	< 500.	ug/l	500.	064900000S
N-nitrosodiphenylamine	< 100.	ug/l	100.	069900000S
4-bromophenyl phenyl ether	< 100.	ug/l	100.	067000000S
hexachlorobenzene	< 100.	ug/l	100.	068900000S
pentachlorophenol	< 500.	ug/l	500.	065400000S
phenanthrene	< 100.	ug/l	100.	070000000S
anthracene	< 100.	ug/l	100.	065900000S
di-n-butyl phthalate	300.	ug/l	100.	068200000S
fluoranthene	< 100.	ug/l	100.	068700000S
pyrene	< 100.	ug/l	100.	070100000S
butyl benzyl phthalate	< 100.	ug/l	100.	067100000S
3,3'-dichlorobenzidine	< 200.	ug/l	200.	067900000S
benzo (a) anthracene	< 100.	ug/l	100.	066100000S
bis (2-ethylhexyl) phthalate	2,600.	ug/l	100.	066900000S
chrysene	< 100.	ug/l	100.	067400000S
di-n-octyl phthalate	< 100.	ug/l	100.	068500000S
benzo (b) fluoranthene	< 100.	ug/l	100.	066300000S
benzo (K) fluoranthene	< 100.	ug/l	100.	066500000S
benzo (a) pyrene	< 100.	ug/l	100.	066200000S
indeno (1,2,3-cd) pyrene	< 100.	ug/l	100.	069300000S
dibenzo (a,h) anthracene	< 100.	ug/l	100.	067500000S
benzo (ghi) perylene	< 100.	ug/l	100.	066400000S

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1 COPY TO APV Crepaco, Inc. ATTN: Tony Cooper
1 COPY TO Data Package Group

American Association for Laboratory Accreditation
Chemical, Biological & Environmental Fields of Testing

Member American Council of Independent Laboratories, Inc.

See Reverse Side For Explanation Of Symbols And Abbreviations And Our Standard Terms And Conditions

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

002670

ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

09:58:23 210437 REP
WC2540 D 4 3

LLI Sample No. EL 1357732

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/24/89
Date Submitted 2/10/89
Discard Date 3/27/89
Collected by SA
P.O. 802-01-07-01 SA/FN
Rel.

15255 SCP Carlstadt Raw (Feed) Water Sample
Collected on 02/07/89 by SA/FH (APV Crepaco, Inc.)

TCL Pesticides	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Alpha BHC	< 25.	ug/l	25.	060900000S
Beta BHC	< 25.	ug/l	25.	061000000S
Delta BHC	< 25.	ug/l	25.	061200000S
Gamma BHC - Lindane	< 25.	ug/l	25.	045300000S
Heptachlor	< 40.	ug/l	40.	045400000S
Aldrin	< 25.	ug/l	25.	045500000S
Heptachlor Epoxide	< 25.	ug/l	25.	061500000S
Endosulfan I	< 25.	ug/l	25.	062700000S
Dieldrin	< 50.	ug/l	50.	046900000S
DDE	< 50.	ug/l	50.	061600000S
Endrin	< 5.	ug/l	5.	047700000S
Endosulfan II	< 10.	ug/l	10.	062800000S
DDD	< 5.	ug/l	5.	061700000S
Endosulfan Sulfate	< 5.	ug/l	5.	062900000S
DDT	< 5.	ug/l	5.	047800000S
Endrin Ketone	< 5.	ug/l	5.	093800000S
Methoxychlor	< 25.	ug/l	25.	062100000S
Alpha Chlordane	< 250.	ug/l	250.	136100000S
Gamma Chlordane	< 250.	ug/l	250.	136200000S
Toxaphene	< 50.	ug/l	50.	094200000S
PCB-1016	< 1,300.	ug/l	1300.	063900000S
PCB-1221	< 2,000.	ug/l	2000.	064000000S
PCB-1232	2,600.	ug/l	500.	064100000S
PCB-1242	< 1,200.	ug/l	1200.	064200000S
PCB-1248	< 250.	ug/l	250.	064300000S
PCB-1254	130.	ug/l	50.	064400000S
PCB-1260	< 50.	ug/l	50.	064500000S

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1 COPY TO APV Crepaco, Inc. ATTN: Tony Cooper
1 COPY TO Data Package Group

American Association for Laboratory Accreditation (Biological & Environmental Fields of testing)

Member American Council of Independent Laboratories Inc

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See Reverse Side For Explanation Of Symbols And Abbreviations And Our Standard Terms And Conditions

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Charles J. Neslund, B.S.
Group Leader, Pesticides/PCB's

ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

LLI Sample No. EL 1357733

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/24/89
Date Submitted 2/10/89
Discard Date 3/27/89
Collected by SA
P.O. 802-01-07-01 SA/FN
Rel.

15255 SCP Carlstadt Run 1 Base Product Water Samp
Collected on 02/06/89 at by SA/FH (APV Crepaco)

ANALYSIS	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE
TCL Volatiles	attached		092226000S
TCL Semi-Volatiles	attached		092352500S
TCL Semi-Volatiles (cont)	attached		092400000S
TCL Pesticides	attached		093723000S

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO APV Crepaco, Inc. ATTN: Tony Cooper
1 COPY TO Data Package Group

American Association for Laboratory Accreditation
Chemical, Biological & Environmental Fields of Testing

228 00767 130.00 114500

Member American Council of Independent Laboratories, Inc.

See Reverse Side For Explanation Of Symbols And Abbreviations And Our Standard Terms And Conditions

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

[redacted]

LLL Sample No. FL 1357733

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/24/89
Date Submitted 2/10/89
Discard Date 3/27/89
Collected by SA
P.O. 802-01-07-01 SA/FN
Rel.

15255 SCP Carlstadt Run 1 Base Product Water Samp
Collected on 02/06/89 at by SA/FH (APV Crepaco)

TCL Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Chloromethane	< 50.	ug/l	50.	082700000S
Bromomethane	< 50.	ug/l	50.	082800000S
Vinyl Chloride	< 50.	ug/l	50.	082900000S
Chloroethane	< 50.	ug/l	50.	083000000S
Methylene Chloride	< 25.	ug/l	25.	083100000S
Acetone	290.	ug/l	50.	091400000S
Carbon Disulfide	< 25.	ug/l	25.	091500000S
1,1-Dichloroethene	< 25.	ug/l	25.	083200000S
1,1-Dichloroethane	< 25.	ug/l	25.	083300000S
trans-1,2-Dichloroethene	< 25.	ug/l	25.	083400000S
Chloroform	< 25.	ug/l	25.	083500000S
1,2-Dichloroethane	< 25.	ug/l	25.	083600000S
2-Butanone	60.	ug/l	50.	091600000S
1,1,1-Trichloroethane	< 25.	ug/l	25.	083700000S
Carbon Tetrachloride	< 25.	ug/l	25.	083800000S
Vinyl Acetate	< 50.	ug/l	50.	091700000S
Bromodichloromethane	< 25.	ug/l	25.	083900000S
1,2-Dichloropropane	< 25.	ug/l	25.	084000000S
cis-1,3-Dichloropropene	< 25.	ug/l	25.	084400000S
Trichloroethene	58.	ug/l	25.	084200000S
Dibromochloromethane	< 25.	ug/l	25.	084600000S
1,1,2-Trichloroethane	< 25.	ug/l	25.	084500000S
Benzene	< 25.	ug/l	25.	084300000S
trans-1,3-Dichloropropene	< 25.	ug/l	25.	084100000S
Bromoform	< 25.	ug/l	25.	084700000S
4-Methyl-2-Pentanone	< 50.	ug/l	50.	091900000S
2-Hexanone	< 50.	ug/l	50.	091800000S
Tetrachloroethene	30.	ug/l	25.	084800000S
1,1,2,2-Tetrachloroethane	< 25.	ug/l	25.	084900000S
Toluene	34.	ug/l	25.	085000000S
Chlorobenzene	< 25.	ug/l	25.	085100000S
Ethylbenzene	< 25.	ug/l	25.	085200000S
Styrene	< 25.	ug/l	25.	092000000S
Xylenes (total)	< 25.	ug/l	25.	092100000S

The reporting limits for all compounds were increased due to foaming of the sample during analysis.

C002671A

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

American Association for Laboratory Accreditation
Chemical, Biological & Environmental Fields of Testing

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

LLI Sample No. EL 1357733

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/24/89
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Collected by SA
P.O. 802-01-07-01 SA/FN
Rel.

15255 SCP Carlstadt Run 1 Base Product Water Samp
Collected on 02/06/89 at by SA/FH (APV Crepaco)

TCL Volatiles	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO APV Crepaco, Inc. ATTN: Tony Cooper
1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

LLI Sample No. PL 1357733

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

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15255 SCP Carlstadt Run 1 Base Product Water Samp
Collected on 02/06/89 at by SA/FH (APV Crepaco)

TCL Semi-Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
phenol	3,800.	ug/l	800.	065500000S
bis (2-chloroethyl) ether	< 40.	ug/l	40.	066700000S
2-chlorophenol	< 40.	ug/l	40.	064600000S
1,3-dichlorobenzene	< 40.	ug/l	40.	067700000S
1,4-dichlorobenzene	< 40.	ug/l	40.	067800000S
benzyl alcohol	880.	ug/l	40.	092600000S
1,2-dichlorobenzene	< 40.	ug/l	40.	067600000S
2-methylphenol	260.	ug/l	40.	092700000S
bis (2-chloroisopropyl) ether	< 40.	ug/l	40.	066800000S
4-methylphenol	2,600.	ug/l	800.	092800000S
N-nitrosodi-n-propylamine	< 40.	ug/l	40.	069800000S
hexachloroethane	< 40.	ug/l	40.	069200000S
nitrobenzene	70.	ug/l	40.	069600000S
isophorone	100.	ug/l	40.	069400000
2-nitrophenol	< 40.	ug/l	40.	065100000
2,4-dimethylphenol	200.	ug/l	40.	064800000S
benzoic acid	3,100.	ug/l	200.	092900000S
bis (2-chloroethoxy) methane	< 40.	ug/l	40.	066600000S
2,4-dichlorophenol	220.	ug/l	40.	064700000S
1,2,4-trichlorobenzene	< 40.	ug/l	40.	070200000S
naphthalene	< 40.	ug/l	40.	069500000S
4-chloroaniline	< 40.	ug/l	40.	093000000S
hexachlorobutadiene	< 40.	ug/l	40.	069000000S
4-chloro-3-methylphenol	< 40.	ug/l	40.	065300000S
2-methylnaphthalene	< 40.	ug/l	40.	093100000S
hexachlorocyclopentadiene	< 40.	ug/l	40.	069100000S
2,4,6-trichlorophenol	< 40.	ug/l	40.	065600000S
2,4,5-trichlorophenol	< 200.	ug/l	200.	093200000S
2-chloronaphthalene	< 40.	ug/l	40.	067200000S
2-nitroaniline	< 200.	ug/l	200.	093300000S
dimethyl phthalate	< 40.	ug/l	40.	068100000S
acenaphthylene	< 40.	ug/l	40.	065800000S

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO APV Crepaco, Inc. ATTN: Tony Cooper
1 COPY TO Data Package Group

C002672A

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

American Association for Laboratory Accreditation
Chemical, Biological & Environmental Fields of testing

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

LLI Sample No. Bh 1357733

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/24/89
Date Submitted 2/10/89
Discard Date 3/27/89
Collected by SA
P.O. 802-01-07-01 SA/FN
Rel.

15255 SCP Carlstadt Run 1 Base Product Water Samp
Collected on 02/06/89 at by SA/FH (APV Crepaco)

TCL Semi-Volatiles (cont)	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
3-nitroaniline	< 200.	ug/l	200.	093400000S
acenaphthene	< 40.	ug/l	40.	065700000S
2,4-dinitrophenol	< 200.	ug/l	200.	065000000S
4-nitrophenol	< 200.	ug/l	200.	065200000S
dibenzofuran	< 40.	ug/l	40.	093500000S
2,4-dinitrotoluene	< 40.	ug/l	40.	068300000S
2,6-dinitrotoluene	< 40.	ug/l	40.	068400000S
diethyl phthalate	< 40.	ug/l	40.	068000000S
4-chlorophenyl phenyl ether	< 40.	ug/l	40.	067300000S
fluorene	< 40.	ug/l	40.	068800000S
4-nitroaniline	< 200.	ug/l	200.	093600000S
2-methyl-4,6-dinitrophenol	< 200.	ug/l	200.	064900000S
N-nitrosodiphenylamine	< 40.	ug/l	40.	069900000S
4-bromophenyl phenyl ether	< 40.	ug/l	40.	067000000S
hexachlorobenzene	< 40.	ug/l	40.	068900000S
pentachlorophenol	< 200.	ug/l	200.	065400000S
phenanthrene	< 40.	ug/l	40.	070000000S
anthracene	< 40.	ug/l	40.	065900000S
di-n-butyl phthalate	< 40.	ug/l	40.	068200000S
fluoranthene	< 40.	ug/l	40.	068700000S
pyrene	< 40.	ug/l	40.	070100000S
butyl benzyl phthalate	< 40.	ug/l	40.	067100000S
3,3'-dichlorobenzidine	< 80.	ug/l	80.	067900000S
benzo (a) anthracene	< 40.	ug/l	40.	066100000S
bis (2-ethylhexyl) phthalate	800.	ug/l	40.	066900000S
chrysene	< 40.	ug/l	40.	067400000S
di-n-octyl phthalate	< 40.	ug/l	40.	068500000S
benzo (b) fluoranthene	< 40.	ug/l	40.	066300000S
benzo (K) fluoranthene	< 40.	ug/l	40.	066500000S
benzo (a) pyrene	< 40.	ug/l	40.	066200000S
indeno (1,2,3-cd) pyrene	< 40.	ug/l	40.	069300000S
dibenzo (a,h) anthracene	< 40.	ug/l	40.	067500000S
benzo (ghi) perylene	< 40.	ug/l	40.	066400000S

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO APV Crepaco, Inc. ATTN: Tony Cooper
1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

American Association for Laboratory Accreditation
Biological & Environmental Testing

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

[redacted]

LLI Sample No. PL 1357733

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/24/89
Date Submitted 2/10/89
Discard Date 3/27/89
Collected by SA
P.O. 802-01-07-01 SA/FN
Rel.

15255 SCP Carlstadt Run 1 Base Product Water Samp
Collected on 02/06/89 at by SA/FH (APV Crepaco)

TCL Pesticides	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Alpha BHC	< 2.5	ug/l	2.5	060900000S
Beta BHC	< 2.5	ug/l	2.5	061000000S
Delta BHC	< 2.5	ug/l	2.5	061200000S
Gamma BHC - Lindane	< 2.5	ug/l	2.5	045300000S
Heptachlor	< 2.5	ug/l	2.5	045400000S
Aldrin	< 2.5	ug/l	2.5	045500000S
Heptachlor Epoxide	< 2.5	ug/l	2.5	061500000S
Endosulfan I	< 0.5	ug/l	0.5	062700000S
Dieldrin	< 1.	ug/l	1.	046900000S
DDE	< 1.	ug/l	1.	061600000S
Endrin	< 1.	ug/l	1.	047700000S
Endosulfan II	< 1.	ug/l	1.	062800000S
DDD	< 2.	ug/l	2.	061700000S
Endosulfan Sulfate	< 1.	ug/l	1.	06290000C
DDT	< 1.	ug/l	1.	047800000
Endrin Ketone	< 1.	ug/l	1.	093800000S
Methoxychlor	< 5.	ug/l	5.	062100000S
Alpha Chlordane	< 5.	ug/l	5.	136100000S
Gamma Chlordane	< 25.	ug/l	25.	136200000S
Toxaphene	< 10.	ug/l	10.	094200000S
PCB-1016	< 60.	ug/l	60.	063900000S
PCB-1221	< 25.	ug/l	25.	064000000S
PCB-1232	< 120.	ug/l	120.	064100000S
PCB-1242	< 60.	ug/l	60.	064200000S
PCB-1248	< 80.	ug/l	80.	064300000S
PCB-1254	< 30.	ug/l	30.	064400000S
PCB-1260	< 10.	ug/l	10.	064500000S

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO APV Crepaco, Inc. ATTN: Tony Cooper
1 COPY TO Data Package Group

002673A

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Charles J. Neslund, B.S.
Group Leader, Pesticides/PCB's

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of testing.

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Our Standard Terms And Conditions

ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

LLL Sample No. EL 1357734

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/24/89
Date Submitted 2/10/89
Discard Date 3/27/89
Collected by SA
P.O. 802-01-07-01 SA/FN
Rel.

15255 SCP Carlstadt Run 2 Base Product Water Samp
Collected on 02/07/89 at by SA/FH (APV Crepaco)

ANALYSIS	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE
TCL Volatiles	attached		092226000S
TCL Semi-Volatiles	attached		092352500S
TCL Semi-Volatiles (cont)	attached		092400000S
TCL Pesticides	attached		093723000S

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1 COPY TO APV Crepaco, Inc. ATTN: Tony Cooper
1 COPY TO Data Package Group

228 00767 130.00 114500

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

American Association for Laboratory Accreditation
Chemical, Biological & Environmental Fields of Testing

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

[illegible] Holland Road, Lancaster PA 17601-[illegible]

LLI Sample No. FL 1357734

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/24/89
Date Submitted 2/10/89
Discard Date 3/27/89
Collected by SA
P.O. 802-01-07-01 SA/FN
Rel.

15255 SCP Carlstadt Run 2 Base Product Water Samp
Collected on 02/07/89 at by SA/FH (APV Crepaco)

TCL Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Chloromethane	< 100.	ug/l	100.	082700000S
Bromomethane	< 100.	ug/l	100.	082800000S
Vinyl Chloride	< 100.	ug/l	100.	082900000S
Chloroethane	< 100.	ug/l	100.	083000000S
Methylene Chloride	< 50.	ug/l	50.	083100000S
Acetone	200.	ug/l	100.	091400000S
Carbon Disulfide	< 50.	ug/l	50.	091500000S
1,1-Dichloroethene	< 50.	ug/l	50.	083200000S
1,1-Dichloroethane	< 50.	ug/l	50.	083300000S
trans-1,2-Dichloroethene	< 50.	ug/l	50.	083400000S
Chloroform	< 50.	ug/l	50.	083500000S
1,2-Dichloroethane	< 50.	ug/l	50.	083600000S
2-Butanone	< 100.	ug/l	100.	091600000S
1,1,1-Trichloroethane	< 50.	ug/l	50.	083700000[illegible]
Carbon Tetrachloride	< 50.	ug/l	50.	083800000[illegible]
Vinyl Acetate	< 100.	ug/l	100.	091700000S
Bromodichloromethane	< 50.	ug/l	50.	083900000S
1,2-Dichloropropane	< 50.	ug/l	50.	084000000S
cis-1,3-Dichloropropene	< 50.	ug/l	50.	084400000S
Trichloroethene	< 50.	ug/l	50.	084200000S
Dibromochloromethane	< 50.	ug/l	50.	084600000S
1,1,2-Trichloroethane	< 50.	ug/l	50.	084500000S
Benzene	< 50.	ug/l	50.	084300000S
trans-1,3-Dichloropropene	< 50.	ug/l	50.	084100000S
Bromoform	< 50.	ug/l	50.	084700000S
4-Methyl-2-Pentanone	< 100.	ug/l	100.	091900000S
2-Hexanone	< 100.	ug/l	100.	091800000S
Tetrachloroethene	< 50.	ug/l	50.	084800000S
1,1,2,2-Tetrachloroethane	< 50.	ug/l	50.	084900000S
Toluene	< 50.	ug/l	50.	085000000S
Chlorobenzene	< 50.	ug/l	50.	085100000S
Ethylbenzene	< 50.	ug/l	50.	085200000S
Styrene	< 50.	ug/l	50.	092000000S
Xylenes (total)	< 50.	ug/l	50.	092100000S

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO APV Crepaco, Inc. ATTN: Tony Cooper

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

LLL Sample No. EL 1357734

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/24/89
Date Submitted 2/10/89
Discard Date 3/27/89
Collected by SA
P.O. 802-01-07-01 SA/FN
Rel.

15255 SCP Carlstadt Run 2 Base Product Water Samp
Collected on 02/07/89 at by SA/FH (APV Crepaco)

TCL Volatiles	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE
1 COPY TO Data Package Group			

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Timothy S. Oostdyk, B.A.
Group Leader, GC/MS Volatiles

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of Testing

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

LLI Sample No. EL 1357734

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/24/89
Date Submitted 2/10/89
Discard Date 3/27/89
Collected by SA
P.O. 802-01-07-01 SA/FN
Rel.

15255 SCP Carlstadt Run 2 Base Product Water Samp
Collected on 02/07/89 at by SA/FH (APV Crepaco)

TCL Semi-Volatiles	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
phenol	3,600.	ug/l	800.	065500000S
bis (2-chloroethyl) ether	< 40.	ug/l	40.	066700000S
2-chlorophenol	< 40.	ug/l	40.	064600000S
1,3-dichlorobenzene	< 40.	ug/l	40.	067700000S
1,4-dichlorobenzene	< 40.	ug/l	40.	067800000S
benzyl alcohol	880.	ug/l	40.	092600000S
1,2-dichlorobenzene	< 40.	ug/l	40.	067600000S
2-methylphenol	280.	ug/l	40.	092700000S
bis (2-chloroisopropyl) ether	< 40.	ug/l	40.	066800000S
4-methylphenol	2,700.	ug/l	800.	092800000S
N-nitrosodi-n-propylamine	< 40.	ug/l	40.	069800000S
hexachloroethane	< 40.	ug/l	40.	069200000S
nitrobenzene	60.	ug/l	40.	069600000S
isophorone	190.	ug/l	40.	069400000[illegible]
2-nitrophenol	< 40.	ug/l	40.	065100000[illegible]
2,4-dimethylphenol	280.	ug/l	40.	064800000S
benzoic acid	4,000.	ug/l	4000.	092900000S
bis (2-chloroethoxy) methane	< 40.	ug/l	40.	066600000S
2,4-dichlorophenol	180.	ug/l	40.	064700000S
1,2,4-trichlorobenzene	< 40.	ug/l	40.	070200000S
naphthalene	< 40.	ug/l	40.	069500000S
4-chloroaniline	< 40.	ug/l	40.	093000000S
hexachlorobutadiene	< 40.	ug/l	40.	069000000S
4-chloro-3-methylphenol	< 40.	ug/l	40.	065300000S
2-methylnaphthalene	< 40.	ug/l	40.	093100000S
hexachlorocyclopentadiene	< 40.	ug/l	40.	069100000S
2,4,6-trichlorophenol	< 40.	ug/l	40.	065600000S
2,4,5-trichlorophenol	< 200.	ug/l	200.	093200000S
2-chloronaphthalene	< 40.	ug/l	40.	067200000S
2-nitroaniline	< 200.	ug/l	200.	093300000S
dimethyl phthalate	< 40.	ug/l	40.	068100000S
acenaphthylene	< 40.	ug/l	40.	065800000S

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO APV Crepaco, Inc. ATTN: Tony Cooper
1 COPY TO Data Package Group

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Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

LLI Sample No. EL 1357734

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/24/89
Date Submitted 2/10/89
Discard Date 3/27/89
Collected by SA
P.O. 802-01-07-01 SA/FN
Rel.

15255 SCP Carlstadt Run 2 Base Product Water Samp
Collected on 02/07/89 at by SA/FH (APV Crepaco)

TCL Semi-Volatiles (cont)	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
3-nitroaniline	< 200.	ug/l	200.	093400000S
acenaphthene	< 40.	ug/l	40.	065700000S
2,4-dinitrophenol	< 200.	ug/l	200.	065000000S
4-nitrophenol	< 200.	ug/l	200.	065200000S
dibenzofuran	< 40.	ug/l	40.	093500000S
2,4-dinitrotoluene	< 40.	ug/l	40.	068300000S
2,6-dinitrotoluene	< 40.	ug/l	40.	068400000S
diethyl phthalate	< 40.	ug/l	40.	068000000S
4-chlorophenyl phenyl ether	< 40.	ug/l	40.	067300000S
fluorene	< 40.	ug/l	40.	068800000S
4-nitroaniline	< 200.	ug/l	200.	093600000S
2-methyl-4,6-dinitrophenol	< 200.	ug/l	200.	064900000S
N-nitrosodiphenylamine	< 40.	ug/l	40.	069900000S
4-bromophenyl phenyl ether	< 40.	ug/l	40.	067000000S
hexachlorobenzene	< 40.	ug/l	40.	068900000S
pentachlorophenol	< 200.	ug/l	200.	065400000S
phenanthrene	< 40.	ug/l	40.	070000000S
anthracene	< 40.	ug/l	40.	065900000S
di-n-butyl phthalate	< 40.	ug/l	40.	068200000S
fluoranthene	< 40.	ug/l	40.	068700000S
pyrene	< 40.	ug/l	40.	070100000S
butyl benzyl phthalate	< 40.	ug/l	40.	067100000S
3,3'-dichlorobenzidine	< 80.	ug/l	80.	067900000S
benzo (a) anthracene	< 40.	ug/l	40.	066100000S
bis (2-ethylhexyl) phthalate	2,200.	ug/l	800.	066900000S
chrysene	< 40.	ug/l	40.	067400000S
di-n-octyl phthalate	< 40.	ug/l	40.	068500000S
benzo (b) fluoranthene	< 40.	ug/l	40.	066300000S
benzo (K) fluoranthene	< 40.	ug/l	40.	066500000S
benzo (a) pyrene	< 40.	ug/l	40.	066200000S
indeno (1,2,3-cd) pyrene	< 40.	ug/l	40.	069300000S
dibenzo (a,h) anthracene	< 40.	ug/l	40.	067500000S
benzo (ghi) perylene	< 40.	ug/l	40.	066400000S

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1 COPY TO APV Crepaco, Inc. ATTN: Tony Cooper
1 COPY TO Data Package Group

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Richard S. Rodgers, B.S.
Group Leader, GC/MS

American Association for Laboratory Accreditation
Environmental Biological & Environmental Fields of Testing

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

LLL Sample No. RL 1357734

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/24/89
Date Submitted 2/10/89
Discard Date 3/27/89
Collected by SA
P.O. 802-01-07-01 SA/FN
Rel.

15255 SCP Carlstadt Run 2 Base Product Water Samp
Collected on 02/07/89 at by SA/FH (APV Crepaco)

TCL Pesticides	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Alpha BHC	< 2.5	ug/l	2.5	060900000S
Beta BHC	< 2.5	ug/l	2.5	061000000S
Delta BHC	< 2.5	ug/l	2.5	061200000S
Gamma BHC - Lindane	< 2.5	ug/l	2.5	045300000S
Heptachlor	< 2.5	ug/l	2.5	045400000S
Aldrin	< 2.5	ug/l	2.5	045500000S
Heptachlor Epoxide	< 2.5	ug/l	2.5	061500000S
Endosulfan I	< 0.5	ug/l	0.5	062700000S
Dieldrin	< 1.	ug/l	1.	046900000S
DDE	< 1.	ug/l	1.	061600000S
Endrin	< 1.	ug/l	1.	047700000S
Endosulfan II	< 1.	ug/l	1.	062800000S
DDD	< 1.	ug/l	1.	061700000S
Endosulfan Sulfate	< 1.	ug/l	1.	062900000
DDT	< 1.	ug/l	1.	047800000S
Endrin Ketone	< 1.	ug/l	1.	093800000S
Methoxychlor	< 5.	ug/l	5.	062100000S
Alpha Chlordane	< 5.	ug/l	5.	136100000S
Gamma Chlordane	< 5.	ug/l	5.	136200000S
Toxaphene	< 10.	ug/l	10.	094200000S
PCB-1016	< 60.	ug/l	60.	063900000S
PCB-1221	< 25.	ug/l	25.	064000000S
PCB-1232	< 120.	ug/l	120.	064100000S
PCB-1242	< 60.	ug/l	60.	064200000S
PCB-1248	< 80.	ug/l	80.	064300000S
PCB-1254	< 40.	ug/l	40.	064400000S
PCB-1260	< 10.	ug/l	10.	064500000S

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye
1 COPY TO APV Crepaco, Inc. ATTN: Tony Cooper
1 COPY TO Data Package Group

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Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Charles J. Neslund, B.S.
Group Leader, Pesticides/PCB's

American Association for Laboratory Accreditation
Biological & Environmental of testing

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APPENDIX C-5
ANALYSIS OF RAW GROUND WATER FROM MONITORING WELLS MW-3S & MW-7S AT THE SCP SITE COLLECTED BY ERM INC. ON 29 JANUARY 1989

ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

LLI Sample No. EL 1353026

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/15/89
Date Submitted 1/30/89
Discard Date 3/18/89
Collected by ES
P.O. 80201-07-01 ES
Rel.

14922 SCP Carlstadt MW-35 MW 7S Composite Ground Water Sample
Collected on 01/29/89 at 0900 by ES

ANALYSIS	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Phenolphthalein Alk.	< 1.	mg/l	1.	020100800P
Total Alkalinity	2,690.	mg/l	5.	020200800P
Total Suspended Solids	390.	mg/l	40.	020601300P
Total Dissolved Solids	6,480.	mg/l	40.	021201300P
Chloride	1,440.	mg/l	1.	022401800P
Sulfate	180.	mg/l	10.	022801800P
Biochemical Oxygen Demand	2,270.	mg/l	6.	023503100P

2 COPIES TO Environmental Resources Mgmt. ATTN: David Blye

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FEB 16 1989
ERM

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Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Elizabeth White, Group Leader
Water Chemistry

American Association for Laboratory Accreditation
Chemical, Biological & Environmental Fields of Testing

026 00767 0.00 010900

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

2425 New Holland Pike, Lancaster, PA 17601 [illegible]

LLI Sample No. EL 1353027

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/15/89
Date Submitted 1/30/89
Discard Date 3/18/89
Collected by ES
P.O. 80201-07-01 ES
Rel.

14901 SCP Carlstadt MW-35 MW 7S Dup. Composite
Ground Water Sample
Collected on 01/29/89 at 0900 by ES

ANALYSIS	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Phenolphthalein Alk.	< 1.	mg/l	1.	020100800P
Total Alkalinity	2,680.	mg/l	5.	020200800P
Total Suspended Solids	350.	mg/l	80.	020601300P
Total Dissolved Solids	6,400.	mg/l	100.	021201300P
Chloride	1,500.	mg/l	1.	022401800P
Sulfate	190.	mg/l	10.	022801800P
Biochemical Oxygen Demand	2,410.	mg/l	6.	023503100P

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Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Elizabeth White, Group Leader
Water Chemistry

American Association for Laboratory Accreditation
Biological & Environmental Testing

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

LLI Sample No. EL 1353029

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/15/89
Date Submitted 1/30/89
Discard Date 3/18/89
Collected by ES
P.O. 80201-07-01 ES
Rel.

14923 SCP Carlstadt MW-35 MW 7S Composite Ground Water Sample
Collected on 01/29/89 at 0900 by ES

ANALYSIS	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Chemical Oxygen Demand	4,500.	mg/l	500.	023402800P
Total Organic Carbon	950.	mg/l	1.	027302500P

The Total Organic Carbon (TOC) result reported above was determined by measuring total carbon by a persulfate digestion/infrared detection method on an acidified sample which has been purged of inorganic carbon using nitrogen. It represents "non-purgeable TOC".

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Reviewed and Approved by:

Elizabeth White, Group Leader
Water Chemistry

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ANALYSIS REPORT

Lancaster Laboratories INCORPORATED

LLI Sample No. EL 1353030

Environ. Resources Management
855 Springdale Drive
Exton, PA 19341-2843

Date Reported 2/15/89
Date Submitted 1/30/89
Discard Date 3/18/89
Collected by ES
P.O. 80201-07-01 ES
Rel.

14898 SCP Carlstadt MW-35 MW S7 Composite Ground Water Sample
Collected on 01/29/89 at 0900 by ES

ANALYSIS	RESULT AS RECEIVED		LIMIT OF QUANTITATION	LAB CODE
Iron	25,600.	ug/l	50.	025401300P

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Elizabeth White, Group Leader
Water Chemistry

American Association for Laboratory Accreditation
Chemical, Biological & Environmental Fields of Testing

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Appendix D
Contaminant Extraction Testing

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TREATABILITY STUDY FOR CONTAMINANT EXTRACTION OF SOIL/SLUDGE IN THE FIRST OPERABLE UNIT SCP CARLSTADT SITE

27 July 1989

Prepared for:

SCP/Carlstadt PRP Committee
Carlstadt, New Jersey

Prepared by:

Environmental Resources Management, Inc.
855 Springdale Drive
Exton, Pennsylvania 19341

File: 802-01-06-01

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D-1 MSDS for Extraction Fluids

D-2 Complete Chemical Analysis for Treated Solids

D-3 Complete Chemical Anaysis for Used Fluids and Wash Liquids

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APPENDIX D
CONTAMINANT EXTRACTION TESTING FOR SOILS AND SLUDGES

D.1 EXECUTIVE SUMMARY

D.1.1 Objectives

The overall objective of the treatability study was to help evaluate the on-site extraction and in situ flushing technologies considered in the Feasibility Study for the First Operable Unit (FOU) at the SCP site. The specific objectives of the Contaminant Extraction Study were to provide a preliminary indication of the following :

- The feasibility of extracting metals and organic chemicals (hereafter referred to as constituents) from the site soils and sludges;
- The type(s) of extraction fluids that may remove significant percentages of the soil/sludge constituents;
- The types of constituents that may be difficult to remove;
- The contact time potentially required for removal of soil/sludge constituents;
- The levels of constituents that may be transferred to the used extraction fluids, and ultimately require pretreatment and/or disposal; and

D.1.2 Results and Conclusions

A major result of the treatability study was that an aqueous, citrate-based extraction fluid removed up to 93, 91, 99, 99, and 85 percent of PCBs (Aroclor 1254), xylenes, ethyl benzene, toluene, and 1,2-dichlorobenzene, respectively. An aqueous surfactant fluid generally removed up to 78, 98, 97, 99, and 99, of PCBs (Aroclor 1254), xylenes, ethyl benzene, toluene, and 1,2-dichlorobenzene, respectively. Thus, removals of PCBs (Aroclor 1254) appear markedly greater with the citrate-based extraction fluid than with the surfactant, but removals of other organics appear comparable for both fluids. Another study result

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was that a hydrochloric acid solution removed up to 98, 95, and 71 percent of lead, copper, and chromium, respectively. The removals for certain of the soil/sludge samples investigated were less than these maximums.

Other major study results include the concentrations of constituents in the used extraction fluids. Specifically,

- The surfactant fluid used for extraction may contain organics up to 160, 140, and 160, and 370 mg/L of PCBs (Aroclor 1254), xylenes, 1,2-dichlorobenzene, and total petroleum hydrocarbons, respectively, as well as up to 10.5, 16.2, and 5.1 mg/L of lead, copper, and chromium, respectively;
- A 10 percent citrate-based solvent used for extraction may contain organics up to 44, 470, 96 and 9,600 mg/L of PCBs (Aroclor 1242), xylenes, 1,2-dichlorobenzene, and total petroleum hydrocarbons, respectively, as well as up to 30.3, 1.3, and 5.7 mg/L of lead, copper, and chromium, respectively; and
- The dilute hydrochloric acid used for extraction may contain up to 650, 346, and 633 mg/L of lead, copper, and chromium, respectively, as well as organics up to 0.1, 2.4, 1.1, and 2.1 mg/L of PCBs (Aroclor 1242), xylenes, 1,2-dichlorobenzene, and total petroleum hydrocarbons, respectively.

Some of the constituents in the used or spent extraction fluids appear to be adsorbed on the surface of colloidal (not readily settleable) fines in those fluids. The actual constituent concentrations in the used fluids varied, depending on the sample type, fluid type, number of different fluids applied, and the total time during which the fluid was in contact with the sample (i.e., the system contact time).

ERM, Inc. concludes the following from the results of this study:

- Extraction of most of the organic and metal soil/sludge constituents is possible;
- All three extraction fluid types (dilute hydrochloric acid, aqueous surfactant, and a citrate-based solvent) appear suitable for removal of specific constituents;

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- Chromium, nickel, mercury and arsenic are constituents that may be more difficult to remove to acceptable residual levels via hydrochloric acid extraction. However, additional treatability tests would be required to confirm this result;
- Contact times required for removal of xylenes, and tetrachloroethene appeared to be 90 minutes and 45 minutes, respectively, from soil/sludge containing average constituent concentrations for the fill unit (i.e., an "overall soil composite"). In contrast, only about 45 minutes system contact time may be required for removal of xylenes, tetrachloroethylene, and total petroleum hydrocarbons, respectively, from a soil/sludge containing "hot spot" levels of constituents.
- The extraction fluids would be expected to contain significant concentrations of metal and organic constituents after extraction of the soils and sludges and, thus, require pretreatment prior to reuse and/or disposal; and
- The EPA-selected analytical methods (i.e., CLP protocol via the Low Level and Medium Level Concentration EPA methods) was not completely appropriate for precise determination of constituent levels in raw or treated soil/sludge samples, or in the used extraction fluids. Different analytical methods are needed for conducting bench, pilot or full-scale studies, since the high concentrations of a variety of organic and metal constituents in the soil/sludge and fluid samples prevent quantification of different constituents.

D.1.3 Recommendations

ERM recommends that extraction technologies receive further investigation for potential use in remediation of the SCP site soils and sludges, since this treatability study indicates the significant remediation potential of these technologies.

The following additional work would be required to fully evaluate the potential for constituent extraction for remediating the site soils and sludges:

- A followup treatability study designed to more closely simulate actual conditions in extraction systems of specific design. Additional materials segregations, fluid types, fluid

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application rates and contact times would be investigated; and

- A pilot-scale study designed to simulate full-scale operation via a specific extraction system design developed from the bench-scale study.

D.2 DRAFT TREATABILITY REPORT ON CONTAMINANT EXTRACTION

D.2.1 Background of the SCP Site and Treatability Study

D 2.1.1 Background of the SCP Site

[Deleted]

D.2.1.2 Contaminant Extraction Treatability Study

This treatability study was performed on the following six soil and sludge samples taken from the FOU as specified in the Work Plan (see Appendix A, Section 4):

- An Overall Soil Composite,
- A Hot Spot Soil Composite,
- A Hot Spot Soil-Lead grab sample,
- A Hot Spot Soil-PCBs grab sample,
- A Tank and Pit Sludge Composite, and
- A Hot Spot Sludge-Base Neutrals grab sample.

These samples represent composites of grab samples taken from sampling locations previously used and characterized by Dames & Moore during their Remedial Investigation at the site. Table I-1 presents the actual sampling locations and depths used to form the composites. A description of the six soil and sludge samples and details on the methods used to obtain these samples are provided in the next section.

D.2.2 Treatability Methods

This section describes methods used to sample the site soils and sludges; to prepare the samples in the laboratory prior to extraction; to determine the physical and chemical

characteristics of untreated (or raw) and treated solids, fresh extraction fluids, and used fluids; and to perform the extraction process trials.

D.2.2.1 Sampling of Site Soils and Sludges

D.2.2.1.1 Rationale for Sampling Point Selection

Generally, the rationale for selection of FOU soil and sludge sampling points was based on the following objectives:

- To obtain soil and sludge samples representative of the FOU, such as the volumes containing the highest constituent concentrations (i.e., for a "hot spot" sample) and volumes containing both relatively lower concentrations (i.e., for an overall composite of FOU soils and sludges). Generally, all locations at the site contain high concentrations of constituents and can be considered relative hot spots;
- To obtain composite samples containing each of the constituents of the FOU detected in the portion of the FOU to be represented by the sample; and
- To obtain grab samples containing a specific class of compounds (e.g., PCBs) detected in the FOU locations characterized as hot spots.

The rationale for selecting specific sampling locations is provided in Table II-1 and also provided in the Final Sampling Plan for Treatability Work for the SCP/Carlstadt Site (ERM, 1989).

D.2.2.1.2 Sampling Methods

Complete details on the methods used for obtaining soil and sludge samples are provided in the Final Sampling Plan for Treatability Work for the SCP/Carlstadt Site (ERM, 4 February 1989). D.2.2.1.3 Description of Samples

Two soil grab samples were prepared for treatability testing: a Soil Hot Spot-Lead sample representative of the highest lead concentration in FOU soils and a Soil Hot Spot-PCBs sample representative of the highest PCBs concentration. Concentrations were assumed to be equal to those reported in the 1988 Dames & Moore Remedial Investigation Report. Two

TABLE I-1

SAMPLING LOCATIONS AND DEPTHS

Sample Identification	Sampling Locations Used in Compositing [1]	Sampling Depth [1] (feet)
Hot Spot Soil Composite	B-1	0 to 2
	B-2	0 to 2
	B-3	5 to 6
	B-5	0 to 6
	MW-3S	5 to 6
Overall Soil Composite	B-4	0 to 6
	P-2	0 to 6
	P-3	0 to 6
	P-4	0 to 6
	MW-6S	0 to 6
Soil Hot Spot-Lead	P-3	5 to 6
Soil Hot Spot-PCBs	B-1	0 to 2
Sludge Tank and Pit Composite	Random locations	2 to 6 feet in the Pit Area Through the entire depth the tank sludge
Sludge Hot Spot-Base Neutrals	B-1	5 to 6

Footnotes: [1] Determinations were made from data in the 1988 Dames & Moore Remedial Investigation Report.

soil composite samples were also prepared: an Overall Soil Composite representative of all portions of the FOU soils except those identified as the "worst hot spots," and a Hot Spot Soil Composite representative of all of the worst soil hot spots. One sludge grab sample taken from the Former Pit Area (i.e., the Hot Spot Sludge-Base Neutrals) was prepared which represented the highest total base neutrals concentration detected in the pit sludge. Finally, one sludge composite (i.e., the Tank and Pit Sludge Composite) was prepared by combining random grab samples from both the Former Pit Area sludge and sludge from the 10,000-gallon tank (i.e., the "tank sludge").. The ERM sampling crew made the following observations while obtaining these samples:

- Soil Hot Spot-Lead sample: Concrete debris present.
- Soil Hot Spot-PCBs sample: Sampling point B-1 contained considerable rubble material at a 5 to 6-foot depth; a grease-like sludge and a chemical odor was present.
- Overall Soil Composite sample: Sampling point P-3 contains considerable rubble, which is stained black at the water table elevation; a chemical odor was present; sampling point MW-6S contained silty sand and rubble.
- Hot Spot Soil Composite sample: Dark, organic liquid noted in materials at one of the sampling locations (MW-3S); sampling points B-1 and B-3 contain considerable rubble material at a 5 to 6-foot depth; a chemical odor was present; sampling point B-3 contained sandy gravel with debris.
- Sludge Tank and Pit Composite sample: sampling point B-1 contained considerable rubble material at a 5 to 6-foot depth.

D.2.2.2 Sample Preparation in the Laboratory

Samples were prepared for testing by intimate mixing (to complete the compositing process) and subsequent segregation into two particle size fractions, as described below.

D.2.2.2.1 Mixing

The soil/sludge samples were first thoroughly mixed by manually tumbling them inside their Teflon bags, prior to unsealing the

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TABLE II-1

RATIONALE FOR SOIL AND SLUDGE SAMPLING LOCATIONS

SAMPLE IDENTIFICATION	SAMPLING LOCATION	SAMPLING DEPTH	CONSTITUENTS OF CONCERN [1]	RATIONALE FOR SELECTION [2]
Hot Spot Soil Composite	B-1	0 to 2	Ag,Cr,Ni,Pb,Zn,Cd, VOCs,PHCs,B/N, PCBs	Contains hot spots for 6 metals, VOCs, PHCs, B/Ns, and PCBs; concentrations of these were higher than at any other location and depth
	B-2	0 to 2	PCBs,B/N,VOCs, PHCs	Contains hot spots for PCB compounds; contains relatively high concentrations of B/N,VOCs, and PHCs; concentrations of these were higher than at any other location and depth
	B-3	5 to 6	VOCs	Contains the highest VOCs concentrations detected in the fill unit.
	B-5	0 to 6	Sb, Cu,As	Contains hot spot for these 3 metals.
	MW-3S	0 to 6	VOCs,PHCs,B/N, PCBs, 9 metals	Contains hot spot spots for PHCs, PCBs, B/N, Cr; contains relatively high concentrations of Pb, Cu, and Zn; concentrations of these were higher than at any other location and depth
	MW-3S	5 to 6	B/N	Contains the highest B/N concentration detected in the fill unit.
Overall Soil Composite	B-4	0 to 6	VOCs,PHCs,PCBs, B/Ns, and metals	Contains non-hot spot concentrations of VOCs,PHCs,B/Ns, and 9 metals
	P-2	0 to 6	VOCs,PHCs,PCBs, B/Ns, and metals	Contains non-hot spot concentrations of VOCs, PHCs, B/Ns, and 9 metals
	P-3	0 to 6	VOCs, PHCs,PCBs, B/Ns, and metals	Contains non-hot spot concentrations of VOCs, PHCs,PCBs,B/Ns, and 8 metals
	P-4	0 to 6	PHCs,PCBs,B/Ns, and metals	Contains non-hot spot concentrations of PHCs,PCBs,B/Ns, and 10 metals
	MW-6S	0 to 6	VOCs,PHCs, B/Ns, PCBs, and metals	Contains non-hot spot concentrations of VOCs,PHCs,B/Ns, and 10 metals; contains contains one hot spot depth for PCBs and one hot spot depth for VOCs
Soil Hot Spot-Lead	P-3	5 to 6	Pb	Contains the highest lead concentration detected in the fill unit.
Soil Hot Spot-PCBs	B-1	0 to 2	PCBs	Contains the highest PCB concentration detected in the fill unit.
Sludge Tank and Pit Composite	Random locations	2 to 6 for the Pit Area Entire sludge volume for the tank sludge	All parameters detected in the pit All parameters detected in the sludge	Random selection of 4 sample locations from each sludge source will produce an appropriate sample.
Sludge Hot Spot-Base Neutrals	B-1	5 to 6	B/N	Contains the highest B/N concentration detected in the sludge pit area.

Footnotes:
[1] VOCs refers to volatile organic compounds and B/Ns refers to base neutral organics.
[2] Determination of hot spot locations and depths is based on the 1988 Dames and Moore Remedial Investigatic Report.

bags. This mixing method not only provided intimate mixing between all layers and size fractions in the sample, but also prevented the loss of volatiles.

D.2.2.2.2 Segregation by Particle Size

Prior to the extraction tests, the particles in the soil/sludge samples were segregated into two size fractions: 1) greater than 1 cm and 2) less than or equal to 1 cm. The reason for this step was that certain of the larger particle size fractions in the soil and sludges may be treated separately (in full-scale operation) from the smaller size fractions. The demarcation between these two size fractions was set at 1 cm. (For example, the larger fraction may be remediated by washing constituents off the particle surfaces.) Segregation was accomplished by passing each sample individually through a 1-cm screen. Samples were screened gently to minimize the loss of volatiles as much as possible. It is recognized that full-scale soil/sludge processing may include similar size segregation, as well as intentional mechanical stripping and capture of volatiles prior to soil/sludge extraction with fluids. Size fractions of less than or equal to 1 cm were returned to their respective Teflon sample bags, again intimately mixed via the tumbling method, and subsequently used in the extraction tests.

D.2.2.3 Raw Sample Characterization

Individual soil and sludge samples were analyzed for physical and chemical characteristics prior to extraction. These characterizations revealed important data useful for evaluating the applicability of extraction technologies to the remediation of the entire FOU and useful for designing potential future treatability or pilot studies.

D.2.2.3.1 Physical Characterization

Table II-2 presents some physical characteristics of two samples that may be representative of the materials investigated: the Hot Spot Soil Composite and the Sludge Tank and Pit Composite.

D.2.2.3.2 Chemical Characterization

All six sample types had high organic and metal constituent concentrations, and certain sample types contained fragments of

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TABLE II-2

PHYSICAL CHARACTERISTICS OF RAW SOIL/SLUDGE SAMPLES- [1]
THE HOT SPOT SOIL COMPOSITE AND THE OVERALL SOIL COMPOSITE

SAMPLE IDENTIFICATION	SAMPLE CLASSIFICATION/ DESCRIPTION	PERCENT SAND	PERCENT SILT OR CLAY	PERCENT TOTAL CARBON	pH
Sludge Tank and Pit Composite	Brown, silty fine sand with organic matter	About 60 %	Less than 40 %	11%	6.31
Hot Spot Soil Composite	Brown silty fine sand with organic matter	About 70 %	Less than 30%	1%	7.36

Footnotes: [1] Per McClelland Consultants' analysis of samples.

concentrated organic solids or sludges. Notable chemical characteristics are summarized below:

- Soil Hot Spot-Lead sample: Contained 1,540mg/kg of lead;
- Soil Hot Spot-PCBs sample: Contained 5.2 mg/kg of PCBs (Aroclor 1260);
- Overall Soil Composite sample: Contained high concentrations of lead (596 mg/kg), chromium (190 mg/kg), zinc (874 mg/kg), mercury (8.5 mg/kg) and copper (399 mg/kg), xylene (14 mg/kg), tetrachlorobenzene (7.6 mg/kg), chloroform (3.8 mg/kg), and total PCBs. Contained relatively lower concentrations (less than 1.0 mg/kg each) of chlorobenzene, benzene, 1,1,1-trichloroethane and other organics.
- Soil Hot Spot Composite sample: Contained greater concentrations (than the Overall Soil Composite) of copper (1,790 mg/kg), lead (979 mg/kg), cadmium (18.6 mg/kg), xylene (390 mg/kg), ethylbenzene (88 mg/kg), toluene (530 mg/kg), trichloroethene (270 mg/kg) and many other organics;
- Sludge Hot Spot-Base Neutrals sample: Unexpectedly, this sample contained no detectable levels of base neutrals. (Consequently, the performance of extraction technologies for this sample type was inconclusive;)
- Tank and Pit Sludge Composite sample: Contained high concentrations of total PCBs (146,000 mg/kg), total xylenes (12,000 mg/kg), lead (59,700 mg/kg), copper (4,020 mg/kg), chromium (6,060 mg/kg), zinc (2,510 mg/kg), cadmium (361 mg/kg), and antimony (421 mg/kg).

Table II-3 presents the full chemical characterization of each sample type, based on an analysis for the following constituent classes:

- Volatile organics,
- Semivolatiles, including acid extractable and base neutral organics,
- PCBs,
- Total petroleum hydrocarbons, and

TABLE II-3

CHEMICAL CHARACTERISTICS OF THE RAW SAMPLES [1]

CONSTITUENTS INVESTIGATED IN THE STUDY	SAMPLE TYPE: Hot Spot Soil Composite (mg/kg)		Overall Soil Composite (mg/kg)	Soil Hot Spot-Lead [2] (mg/kg)	Soil Hot Spot-PCBs [3] (mg/kg)	Sludge Tank and Pit Composite (mg/kg)	Sludge Hot Spot-Base Neutrals [4] (mg/kg)
VOLATILES							
Methylene chloride	5.60	J	1.30			970.00	
Acetone	64.00		2.40			2,100.00	
trans-1,2-Dichloroethene	4.70	J	0.71				
Chloroform	140.00		3.60			4,800.00	
1,2-Dichloroethane	93.00					1,700.00	
1,1,1-Trichloroethane	47.00					600.00	
Trichloroethene	270.00					1,500.00	
4-Methyl-2-pentanone	28.00	J	0.16			2,400.00	
Trichloroethene			1.80			1,500.00	
Benzene			0.45			970.00	
Tetrachloroethene	210.00		7.60			70,000.00	
Toluene	530.00		3.60			29,000.00	
Chlorobenzene	7.30	J	0.45				
Ethylbenzene	68.00		1.20			3,000.00	
Xylenes	390.00		14.00			12,000.00	
Total Volatiles	1,877.60		33.87			130,540.00	
SEMIVOLATILES							(None detected)
Phenol						4,000.00	
1,2-Dichlorobenzene	17.00	J				16,000.00	
Naphthalene	31.00	J				290.00	
1,2,4-Trichlorobenzene						920.00	
2-Methylnaphthalene	15.00	J				140.00	
bis(2-Ethylhexyl) phthalate	150.00		27.00			2,700.00	
Diethyl phthalate	15.00	J				2,800.00	
Butylbenzylphthalate						300.00	
Phenanthrene	19.00	J					
Di-n-butylphthalate	29.00	J				270.00	
Total Semivolatiles	276.00		27.00			23,420.00	
PCBs							
Aroclor-1242	190.00					130,000.00	
Aroclor-1254	22.00	J				16,000.00	
Aroclor-1260					5.20	J	
Total PCBs	212.00		0.00		5.20	146,000.00	
METALS							
Antimony	3.90		3.80			421.00	
Arsenic	7.70		14.60			33.60	
Beryllium	0.60		0.43			0.10	
Cadmium	18.60		0.72			361.00	
Chromium	81.30		89.80			6,060.00	
Copper	1,790.00		399.00			4,020.00	
Lead	979.00		596.00	1,540.00		59,700.00	
Mercury	6.70		8.50			103.00	
Nickel	20.60		26.40			35.60	
Selenium	1.50		1.30			11.10	
Zinc	612.00		874.00			2,510.00	
Total Metals	3,522.10		2,014.75	1,540.00		73,255.60	

Footnotes:

[1] Due to problems observed with the CLP analytical methods, constituents other than those indicated above may be present in the samples.
[2] This sample was tested only for the parameter of interest (i.e., lead).
[3] This sample was tested only for the compounds of interest (i.e., PCBs). The PCB concentration was less than expected from a review of fill unit soils characterization in the Dames & Moore Remedial Investigation Report.
[4] This sample was tested only for the compounds of interest (i.e., the base neutral semivolatile compounds).

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- Heavy metals.

Individual metals and organic compounds were analyzed by a CLP contract laboratory (Lancaster Laboratories), except petroleum hydrocarbons were analyzed as a total compound class. For certain grab samples, only the constituent class making the sample a hot spot was analyzed; for example, the Soil Hot Spot-PCBs was only analyzed for PCBs.

Sample analyses conformed with the EPA Contract Laboratory Program (or CLP) protocol (SOW 1086 for organics, with revisions through SOW 7/87 and SOW 7/87 for inorganics). Depending on the constituent levels, either the CLP Low Concentration Method or the CLP Medium Concentration Method for solids was used. As with all other CLP laboratories EPA has not approved Lancaster Laboratories for analysis via the CLP High Concentration Method, Revision 9/88). Therefore, this method was not used for the study.

D.2.2.4 Extraction Fluid Characterization

The characteristics of the extraction fluids used in this study are important in the evaluation of the study results, as well as in evaluating the requirements for a potential pilot or full-scale extraction system. Three extraction chemicals were used:

- A nonionic, surfactant called Triton-X-100, which is manufactured by Rohm and Haas;
- A citrate-based solvent called Citrikleen, which is manufactured by Penetone Corporation; and
- Hydrochloric acid (using technical grade acid).

These chemicals were used to formulate four types of extraction fluids:

- A 5 percent solution of Triton-X-100;
- A 5 percent solution of Citrikleen;
- A 10 percent solution of Citrikleen; and
- A 10 percent solution of hydrochloric acid.

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D.2.2.4.1 Rationale for Fluid Selection

A survey of relevant literature and communication with vendors revealed that each of the chemical types used for extraction fluids have been used elsewhere, with promising results, for reducing organic and/or metal constituent levels in contaminated soils. Therefore, these chemicals were selected for this study on FOU soil/sludge. The chemical strength of the fluids were selected specifically for this study (as explained in Section D.2. 2.4.2 below).

For example, Penetone Corporation stated that their citrate-based solvent (i.e., Citrikleen) has been shown to be effective in cleaning up spills of oil contaminated with PCBs (Penetone, 1988). While Penetone could not provide documentation of their observations, their experience has been that spills could be cleaned up from both hard surfaces and from soils using their product.

This review also documented removals of volatiles (99.9 percent) and semivolatiles (greater than 99.9 percent) from a soil containing high organic concentrations using an aqueous solution of Institutional Formula Tide (a surfactant) (Esposito, P. et al, 1989). This soil was a synthetically prepared soil spiked with organic constituents of the type and concentration considered by EPA to be typical of that in NPL site soils. The size fraction tested was the greater than 2 mm particles.

In particular, General Electric Company has found that surfactants are capable of increasing the solubility of at least one PCB compound (Aroclor 1260) by a factor of up to 10^6 (The Hazardous Waste Consultant, 1986). Bench-scale tests consisting of extracting samples of laboratory sand spiked with 5,000 ppm of Aroclor 1260 with Triton-X-100 revealed this surfactant to remove the PCBs at an efficient rate. General Electric Company currently uses Citrikleen solutions for cleanup of PCB-contaminated oils from soils (Penetone, 1988).

In this treatability study, higher solution strengths (see Section D.2. below) were used than those reported in the literature, since the higher constituent concentrations in the SCP samples may have required a more aggressive fluid to achieve similar constituent removals.

Attachment D-1 provides the Material Safety Data Sheets for the raw chemicals used to prepare the three extraction fluids in the study.

D.2.2.4.2 Fluid Preparation

This study included sample extractions with a 5 percent by weight solution of aqueous surfactant (Triton-X-100), a 10 percent by volume solution of hydrochloric acid, and both a 5 percent and a 10 percent by weight solution of citrate solvent (Citrikleen). A three beam balance was used to weigh chemicals used to make up solutions prepared on a weight basis. Graduated cylinders were used to measure the distilled water (used for all solutions) and the chemicals used for making up solutions prepared on a volume basis.

D.2.2.4.3 Physical and Chemical Characterization

Table II-4 lists the physical characteristics of the Triton-X-100 surfactant, citrate solvent (Citrikleen), and the hydrochloric acid. All fluids at their application strength had relatively low viscosity. Both the surfactant and citrate solvent solutions were opaque and tended to foam when agitated. The hydrochloric acid solution tended to emit acid fumes when agitated. The surfactant had a musty odor, and the citrate solvent had its trademark odor of oranges.

Table II-5 summarizes the chemical characterization of the three fluids. The Triton-X-100 surfactant did not contain any of the Target Compound List (TCL) organic constituents detected in the soil/sludge samples, the Citrikleen contained only one (i.e., acetone) of these TCL compounds. Total petroleum hydrocarbons were detected at levels of 5.2 and 4.1 mg/L, in the 5 percent Triton-X-100 and the 5 percent Citrikleen solutions, respectively. The surfactant did contain 0.37, 0.19, and 0.07 mg/L of copper, lead, and zinx, respectively. The citrate solvent did contain 0.3, 0.14, 0.03, and 0.02 mg/L of copper, lead, zinc, and chromium, respectively. These hydrocarbon and metals levels could have been introduced in the ERM laboratory or the CLP analytical laboratory. The hydrochloric acid does not contain greater than trace amounts of any metals, and contains no organics.

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Chemical characterization of both the 5 percent Triton-X-100 and the 5 percent Citrikleen solutions was performed by Lancaster Laboratories. Chemical analyses conformed with the EPA Contract Laboratory Program (or CLP) protocol. Depending on the constituent levels, either the CLP Low Concentration Method or the CLP Medium Concentration Method for liquids was used. Chemical characterization of the hydrochloric acid was provided by the manufacturer on the material label.

D.2.2.5 Extraction Process Trials

D.2.2.5.1 Rationale for Selection of Trial Procedures

Table II-6 presents the rationale for the selection of process trial procedures. Generally, the limited time available for completing process trials (2 weeks) and for process sample analysis (3 weeks) required the study to focus on only two process variables: the type of extraction fluid, the number of different fluids, and the total time in which a sample type was in contact with an extraction fluid (or the "system contact time"). Fifty-one (51) process trials were performed and six different sample types were extracted under various process conditions.

D.2.2.5.2 Trial Descriptions

D.2.2.5.2.1 Process Variables Investigated

The type of extraction fluid used varied. A 10 percent solution of hydrochloric acid was used for process trials PT-1 through PT-12. A 5 percent solution of Triton-X-100 was used for PT-13 through PT-24. A 5 percent solution of Citrikleen was used for PT-25 through PT-36. A 10 percent solution of Citrikleen was used for PT-37 through PT-48. For PT-49, PT-50, and PT-51, the fluid applications were 5 percent Triton-X-100, followed by 10 percent hydrochloric acid, followed by 10 percent Citrikleen.

The system contact time was also varied. For extractions with hydrochloric acid, the contact time varied between 45, 90, and 180 minutes, depending on the process trial. For extractions with either Triton-X-100 or Citrikleen, the contact time varied between 45, 90, and 135 minutes. For extractions using three different fluids (Triton, acid, and Citrikleen), a 90-minute system contact time was used for each fluid.

TABLE II-4

GENERAL CHARACTERISTICS OF THE EXTRACTION FLUIDS

FLUID	CONSTITUENTS EXPECTED TO BE REMOVED BY FLUID	TENDENCY TO FOAM	ODOR	RELATIVE VISCOSITY
Triton-X-100, an aqueous surfactant (5 percent solution)	Nonpolar and polar organics, including PCBs	Yes	Musty	Low
Citrikleen SK, an aqueous organic solvent (5 and 10 percent solutions)	Nonpolar and polar organics, including PCBs	Sometimes	Similar to orange peels	Low
Hydrochloric acid (10 percent solution)	Polar organics Metals	Little	Acid (due to fumes)	Low

Footnotes: [1] Per McClelland Consultants' analysis of samples.

TABLE II-5

ANALYSIS OF FRESH EXTRACTION FLUIDS

TARGET COMPOUND LIST PARAMETER	CONCENTRATION IN 5% AQUEOUS SURFACTANT [1] (TRITON-X-100)	CONCENTRATION IN 5% AQUEOUS CITRATE-BASED SOLVENT (CITRIKLEEN SK)
Sample I.D.	CET-172	CET-173
Metals, (ug/L)		
Antimony		
Arsenic		
Beryllium		
Cadmium		
Chromium		20
Copper	370	300
Lead	190	143
Mercury		
Nickel		
Selenium		
Silver		
Zinc	70	80
Volatiles, (ug/L)		
Acetone		60,000
Semivolatiles (Base neutrals and acid extractables (ug/L) (None detected)		
Total Petroleum Hydrocarbons (mg/L)	5,200	4,100
PCBs/Pesticides (None detected)		

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TABLE II-6

RATIONALE FOR SELECTION OF PROCESS TRIAL PROCEDURES

PROCESS TRIAL	SPECIFICATION OR VARIATION IN PROCEDURE	RATIONALE
KINETIC TRIALS (PT-1 through PT-48)	Fluid type	o Hydrochloric acid (10% solution) selected since other acids (Eg. sulfuric) tend to lead to reprecipitation of certain metals on the solid when neutralized. Acid strength selected to provide an aggressive removal method for the fill unit samples.
		o Triton-X-100 selected since a literature review indicated its relative capabilities for extraction of organics from soils. selected as 3% higher than that reported in the literature, in order to provide an aggressive removal method.
		o Citrikleen selected since a vendor survey indicated its successful application for cleanup of PCB spills in the field. 5 and 10 percent solution strengths selected for comparison to extractions with 5% surfactant.
		O Triton-X-100 and Citrikleen used in separate trials to compare their relative effectiveness in extracting PCBs and other organics.
	Contact times	o For extractions with hydrochloric acid, stage contact times were selected by EPA, Region II. For extractions with Triton-X-100 surfactant, stage contact times were selected at about 60 to 70 percent higher than those suggested by vendors or indicated in the literature. The increase in time was expected to be potentially necessary due to the nature of the soil/sludge constituents.
	Application ratio	The timetable for completing treatability allowed for only one application ratio, which was selected as 10:1 (weight/weight) of fluid to sample based on a vendor's recommendation for an initial study.
	Three stages (i.e., separate extractions)	Presence of multiple constituent types at high concentrations is expected to result in the need for multiple extractions from a single soil/sludge volume.
	Extraction via mechanical shaking of the sample/fluid mixtures in glass flasks	This method selected to provide high-shear mixing that would separate sample particles and allow relatively intimate contact between the sample and the extraction fluid. The method also allowed the mixing speed to be kept relatively constant for all extractions.
	Vacuum filtration for sample/fluid separation	Provided rapid phase separation to limit delays during extractions and allowed better recovery of solids than with a centrifuge or other potential methods.

TABLE II-6 (Cont.d)

PROCESS TRIAL	SPECIFICATION OR VARIATION IN PROCEDURE	RATIONALE
SEQUENTIAL TRIALS (PT-49 through PT-51)	Fluid types	Same as for kinetic trials; in addition, only a 10% solution strength was used for the Citrikleen. Hydrochloric acid, Triton-X-100, and Citrikleen used to determine the extent to which all metal and organic constituents could be removed.
	Sequence of fluid application (i.e., Triton-X-100, then acid, then Citrikleen)	Triton-X-100 used first to potentially condition the sample, remove oils that might inhibit extraction of other constituents, and remove organics; acid then used to remove metals; Citrikleen used last due to its relatively greater cost.
	Contact times	90-minute contact time selected for comparison to kinetic trials having the same contact time.
	Application ratio	Same as for kinetic trials.
	Single stage with each type of extraction fluid	Only one stage selected in order to test the performance of extractions with a series of fluids versus the performance with a single fluid applied repeatedly (as in the kinetic trials)
	Extraction via mechanical shaking of the sample/fluid mixtures in glass flasks	Same as for kinetic trials.
	Vacuum filtration for sample/fluid separation	Same as for kinetic trials.

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In addition, treated solids were analyzed with and without a water wash, in order to determine whether this wash increased ultimate constituent removals.

Table II-7 lists the process variables investigated for each type of trial.

D.2.2.5.2.2 Kinetic Process Trials

This treatability study included 48 kinetic process trials (explained below) and 3 sequential process trials (explained in Section D.2.2.5.2.3).

Figure II-1 provides a simplified representation of the kinetic process trials (i.e., PT-1 through PT-48). As this figure indicates, each kinetic process trial consisted of three individual extractions (or process stages) performed on the same, preweighed volume of a single sample type. For each trial, the contact time in each stage (or "stage contact time") was the same. Consequently, these extractions were termed "kinetic process trials," and are distinct from the "sequential process trials" described in Section 3.c,. For every sample type and fluid type, three process trials were performed--each for a different system contact time--so that the effect of the time variable on the degree of constituent removal (i.e, to indicate the basic kinetics of the extraction process).

Among the different kinetic process trials, all six different soil/sludge sample types were tested, and all four fluid types were used (one type per trial). These four sets of kinetic trials were conducted:

- PT-1 through PT-12: Extraction with 10 percent hydrochloric acid solution;
- PT-13 through PT-24: Extraction with a 5 percent Triton-X-100 solution;
- PT-25 through PT-36: Extraction with a 5 percent Citrikleen solution; and
- PT-37 through PT-48: Extraction with a 10 percent Citrikleen solution.

The application ratio (i.e., weight of sample per weight of fluid) was kept at a constant 25 g sample per 250 ml of fluid for all

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TABLE II-7

PROCESS VARIABLES INVESTIGATED IN EACH TRIAL

TYPE OF PROCESS TRIALS	TRIAL NUMBERS	VARIABLES: FLUID TYPE	FLUID STRENGTH	SYSTEM CONTACT TIME (minutes)	STAGE CONTACT TIME (minutes)	NUMBER OF STAGES	TRIALS BY VARYING CONTACT TIME
KINETIC TRIALS	PT-1 to PT-12	Hydrochloric acid	10 percent	15 90 180	15 30 60	3	PT-1 to PT-4 PT-5 to PT-8 PT-9 to PT-12
	PT-13 to PT-24	Triton-X-100	5 percent	45 90 135	15 30 45	3	PT-13 to PT-16 PT-17 to PT-20 PT-21 to PT-24
	PT-25 to PT-36	Citrikleen SK	5 percent	45 90 135	15 30 45	3	PT-25 to PT-28 PT-29 to PT-32 PT-33 to PT-36
	PT-37 to PT-48	Citrikleen SK	10 percent	45 90 135	15 30 45	3	PT-37 to PT-40 PT-41 to PT-44 PT-45 to PT-48
SEQUENTIAL TRIALS	PT-49 to PT-51 (3 trials) 1	Triton-X-100	5 percent	270 (4.5 hr)	90	1	All three process trials
	2	Hydrochloric acid	10 percent		90	1	
	3	Citrikleen SK	10 percent		90	1	

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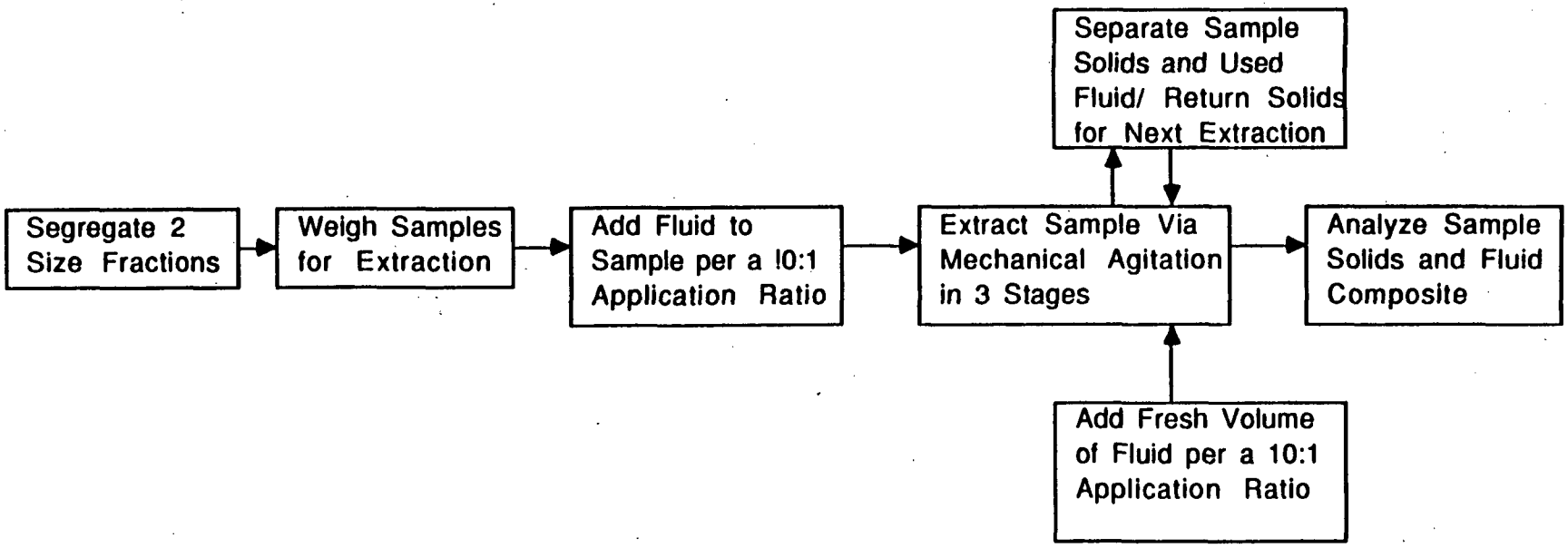
FIGURE II-1

SIMPLIFIED REPRESENTATION OF THE KINETIC PROCESS TRIALS



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kinetic trials. Table II-8 provides the soil/sludge sample type, fluid type, fluid strength, and application ratio for each kinetic process trial.

D.2.2.5.2.3 Sequential Process Trials

Figure II-2 provides a simplified representation of the three sequential process trials performed: PT-49 on the Soil Hot Spot-Composite, PT-50 on the Overall Soil Composite, and PT-51 on the Sludge Tank and Pit Composite. As the figure indicates, each sequential trial consisted of contacting a single sample type with three different extraction fluids. The fluids were applied separately, in the following order: 5 percent Triton-X-100, 10 percent hydrochloric acid, and 10 percent Citrikleen.

Each fluid was applied for 90 minutes in a single stage (i.e., only once, unlike the kinetic trials). Table II-8 provides the fluid type, fluid strength, application ratio, contact time, and soil/sludge sample type for each sequential process trial.

D.2.2.5.2.4 Minimization of Volatiles Loss

To the extent practicable, the loss of volatiles from the samples was minimized by instituting the following procedures:

- Keeping the sample bags closed between measuring out samples for extractions,
- Adding the extraction fluid immediately to the sample as it was placed in its extraction flask (thus eliminating the surface for volatilization),
- Performing the sample extractions immediately, and
- Placing extracted, or treated, samples immediately into sample jars for subsequent shipment to the laboratory for residuals analysis.

D.2.2.5.2.5 Visual Observations of Extraction Performance

Visual observations indicated that intimate contact between sample particles and extraction fluids was achieved, and that sample constituents were being dissolved into the fluids. The soil/sludge samples generally mixed readily with the applied fluids, so that manual solutioning of the mixture was not

TABLE II-8

IDENTIFICATION OF PROCESS TRIALS [1]

TYPE OF PROCESS TRIALS	FLUID TYPE/STRENGTH	TRIAL NUMBER	SAMPLE TYPE INVESTIGATED
KINETIC TRIALS	Hydrochloric acid / 10%	PT-1	Soil Hot Spot-Lead
		PT-2	Hot Spot Soil Composite
		PT-3	Overall Soil Composite
		PT-4	Sludge Tank and Pit Composite
		PT-5	Soil Hot Spot-Lead
		PT-6	Hot Spot Soil Composite
		PT-7	Overall Soil Composite
		PT-8	Sludge Tank and Pit Composite
		PT-9	Soil Hot Spot-Lead
		PT-10	Hot Spot Soil Composite
		PT-11	Overall Soil Composite
		PT-12	Sludge Tank and Pit Composite
	Triton-X-100 / 5%	PT-13	Soil Hot Spot-PCBs
		PT-14	Hot Spot Soil Composite
		PT-15	Overall Soil Composite
		PT-16	Sludge Tank and Pit Composite
		PT-17	Soil Hot Spot-PCBs
		PT-18	Hot Spot Soil Composite
		PT-19	Overall Soil Composite
		PT-20	Sludge Tank and Pit Composite
		PT-21	Soil Hot Spot-PCBs
		PT-22	Hot Spot Soil Composite
		PT-23	Overall Soil Composite
		PT-24	Sludge Tank and Pit Composite
	Citrikleen SK / 5%	PT-25	Soil Hot Spot-PCBs
		PT-26	Overall Soil Composite
		PT-27	Sludge Hot Spot-Base Neutrals
		PT-28	Sludge Tank and Pit Composite
		PT-29	Soil Hot Spot-PCBs
		PT-30	Overall Soil Composite
		PT-31	Sludge Hot Spot-Base Neutrals
		PT-32	Sludge Tank and Pit Composite
		PT-33	Soil Hot Spot-PCBs
		PT-34	Overall Soil Composite
		PT-35	Sludge Hot Spot-Base Neutrals
		PT-36	Sludge Tank and Pit Composite
	Citrikleen SK / 10%	PT-37	Soil Hot Spot-PCBs
		PT-38	Overall Soil Composite
		PT-39	Sludge Hot Spot-Base Neutrals
		PT-40	Sludge Tank and Pit Composite
		PT-41	Soil Hot Spot-PCBs
		PT-42	Overall Soil Composite
		PT-43	Sludge Hot Spot-Base Neutrals
		PT-44	Sludge Tank and Pit Composite
		PT-45	Soil Hot Spot-PCBs
		PT-46	Overall Soil Composite
		PT-47	Sludge Hot Spot-Base Neutrals
		PT-48	Sludge Tank and Pit Composite
SEQUENTIAL TRIALS	Triton-X-100 / 5%	PT-49	Hot Spot Soil Composite
		PT-50	Overall Soil Composite
	Hydrochloric acid / 10%	PT-51	Sludge Tank and Pit Composite
	Citrikleen SK / 10%		

Footnote: [1] The fluid application ratio (i.e., 10 g fluid per 1 g sample, or 10:1) was maintained constant for all process trials.

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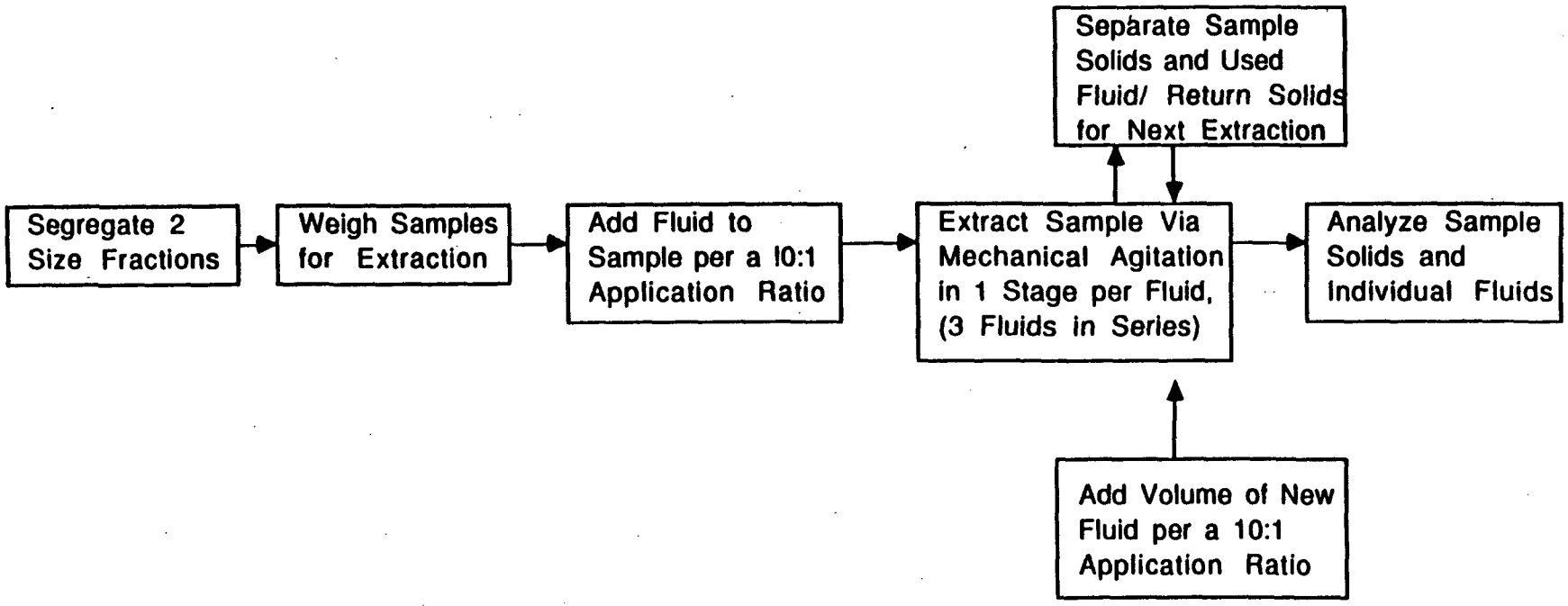
FIGURE II-2

SIMPLIFIED REPRESENTATION OF THE SEQUENTIAL PROCESS TRIALS



necessary prior to extraction. All extraction fluids became cloudy and dark-colored upon contact with the samples. During extraction with hydrochloric acid, the Soil Hot Spot-Composite and the Sludge Tank and Pit Composite developed a greenish-yellow color, potentially due to the extraction of chromium and nickel from the sample matrices. The sample/acid mixtures occasionally foamed and expanded a little during extraction.

The Triton-X-100 and Citrikleen fluids also became dark-colored due to extraction of the sample constituents in the fluid. During extraction with Triton-X-100, the sample/fluid mixture generally foamed and expanded to approximately an additional 5 to 10 percent of its original volume. Occasionally, this resulted in loss of fluid through the one-hole stopper of the extraction flask; extractions were rerun when this occurred. Foaming occurred to a lesser degree with Citrikleen.

D.2.2.5.2.6 Process Sample Collection Points

For each kinetic trial, half of the sample volume was collected for analysis prior to the final water wash step, and the other half of the sample was collected after the final wash. This was done to determine whether significant additional removals of sample constituents were possible with a final wash. The used fluid obtained from each stage of the process trial was combined into a composite sample. Both treated solid samples and the fluid composite were sent to the laboratory for analysis. Figures II-3 through II-6 show the types of process samples that were collected for each kinetic process trial, as well as their point of collection.

For each sequential trial, the sample was collected one time, i.e., after all extraction steps (including the final water wash) were completed. In addition, each type of liquid generated in the process trial was collected separately. These liquids included the used Triton-X-100, the used acid, the water wash following acid extraction, the sodium carbonate wash following this first water wash, the used Citrikleen, and the final water wash. Figure II-7 shows the process sample types and sample collection points for the sequential process trials.

Table II-9 identifies each of the process samples analyzed in the kinetic trials and the respective analytical parameters. The following seven types of process samples collected in the

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FIGURE II-3

CONTAMINANT EXTRACTION TREATABILITY STUDY

SCP/CARLSTADT SITE

Kinetic Process Trials Employing Aqueous Surfactant for Organics Extraction

APPLIES TO SAMPLE TYPES:
1) Soil Hot Spot- PCBs
2) Soil Hot Spot Composite
3) Overall Soil Composite
4) Sludge Tank and Pit Composite

TRIAL DESIGN PARAMETERS:
- Number of Stages per Trial: 3
- Number of Extraction Fluids: 1
- System Contact Times: (To vary among trials)
  45 minutes; 15 minutes per stage
  90 minutes; 30 minutes per stage
  135 minutes; 45 minutes per stage
- Fluid Strength/Brand: 5% Triton-X-100 solution
- Fluid Application Ratio: 25 g sample/ 250 ml fluid

PROCESS FLOW: 12 Process Trials: (1 fluid x 4 sample types x 3 contact times)

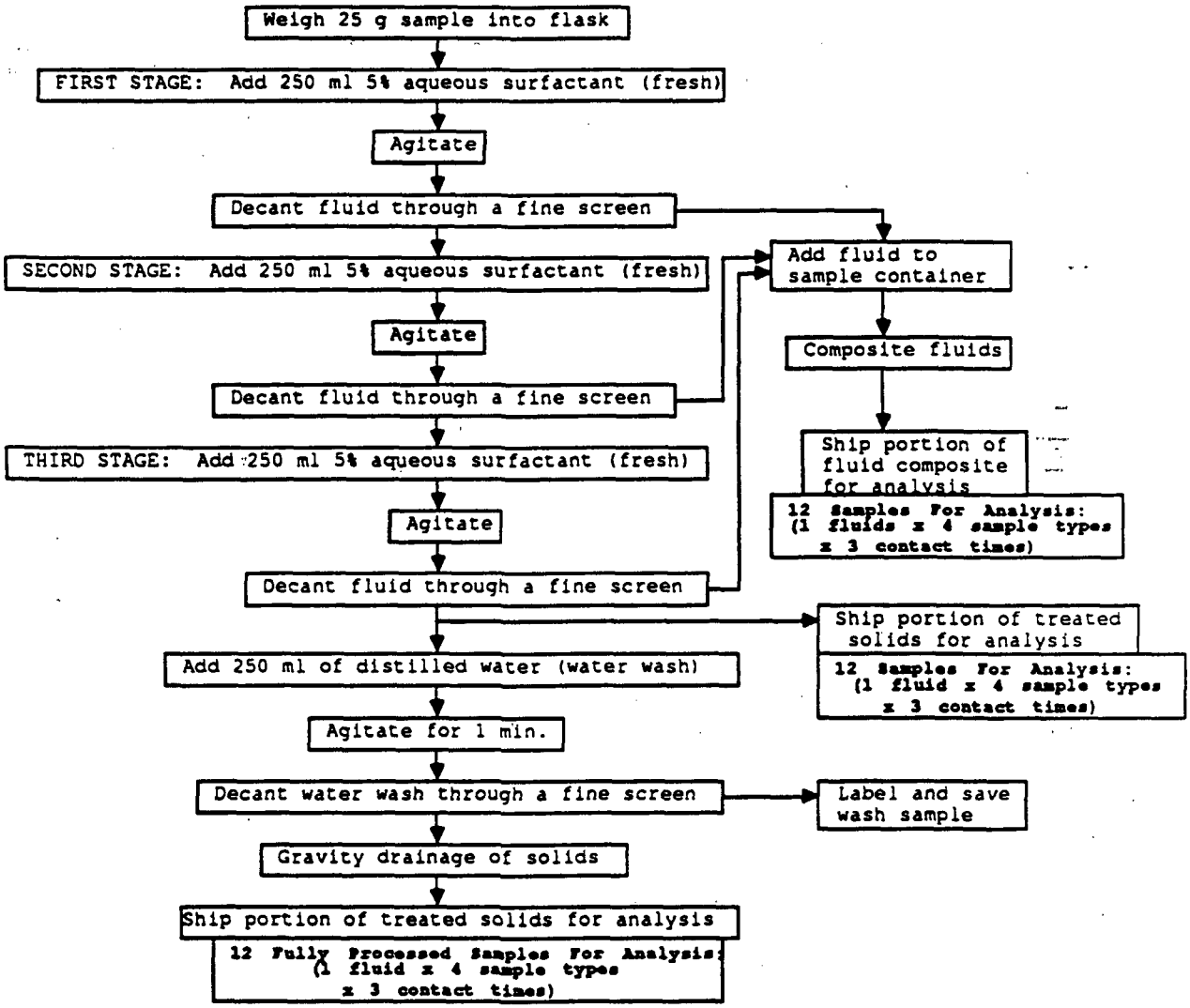

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FIGURE II-4

CONTAMINANT EXTRACTION TREATABILITY STUDY
SCP/CARLSTADT SITE

Kinetic Process Trials Employing 5% Citrikleen® for PCBs Extraction

APPLIES TO SAMPLE TYPES:
1) Soil Hot Spot- PCBs
2) Overall Soil Composite
3) Sludge Hot Spot- Base Neutrals (B/Ns)
4) Sludge Tank and Pit Composite

TRIAL DESIGN PARAMETERS:
- o Number of Stages per Trial
- o Number of Extraction Fluids: 1
- o System Contact Times: (To vary among trials)
  - 45 minutes; 15 minutes per stage
  - 90 minutes; 30 minutes per stage
  - 135 minutes; 45 minutes per stage
- o Fluid Strength: 5% Citrikleen® SK
- o Fluid Application Ratio: 25 g sample/ 250 ml fluid

PROCESS FLOW: 12 Process Trials: (1 fluid x 4 sample types x 3 contact times)

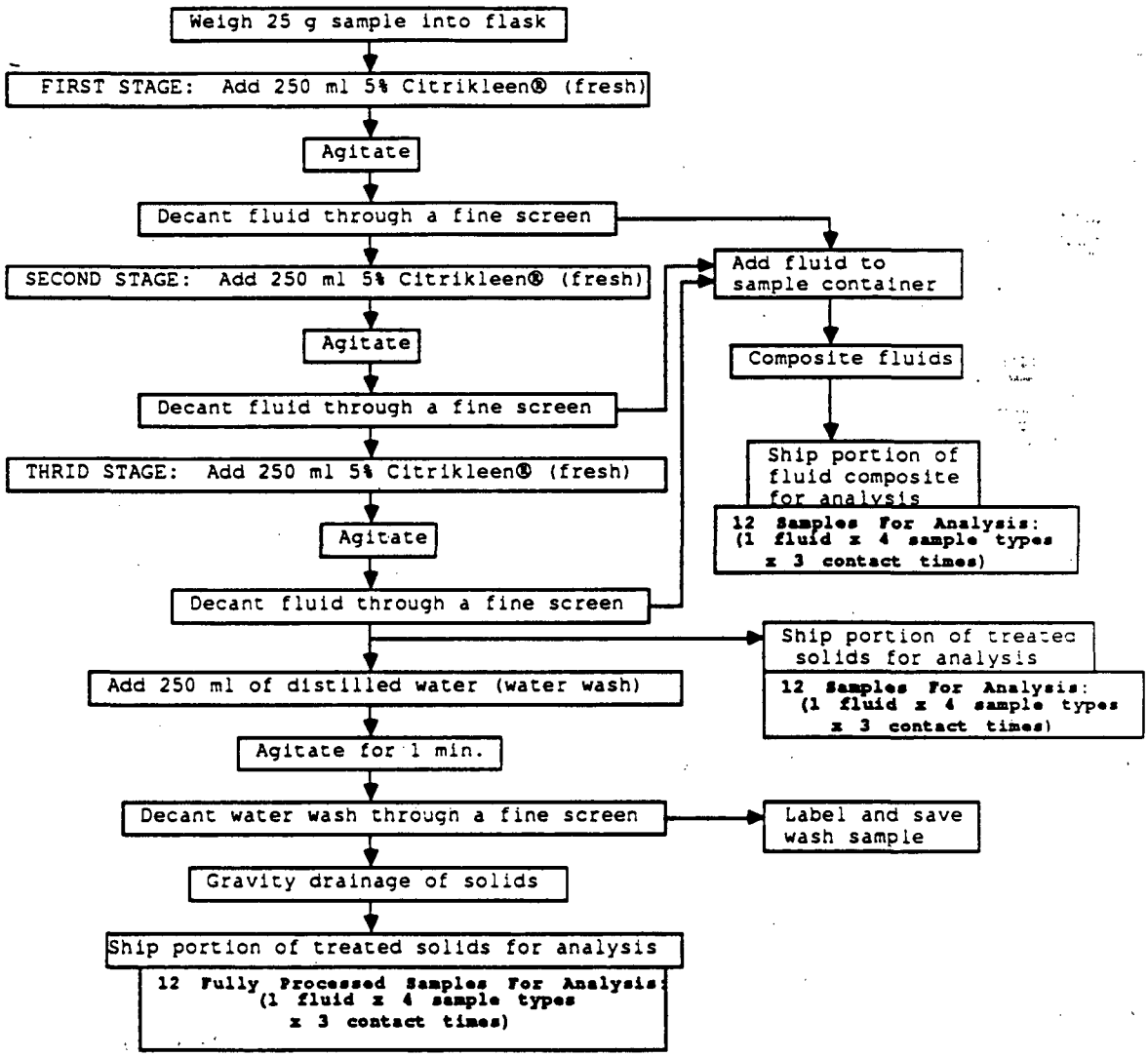

FIGURE II-5

CONTAMINANT EXTRACTION TREATABILITY STUDY

SCP/CARLSTADT SITE

Kinetic Process Trials Employing 10% Citrikleen® SK for PCBs Extraction

APPLIES TO SAMPLE TYPES:
1) Soil Hot Spot- PCBs
2) Overall Soil Composite
3) Sludge Hot Spot- Base Neutrals (B/Ns)
4) Sludge Tank and Pit Composite

TRIAL DESIGN PARAMETERS:
- Number of Stages per Trial: 3
- Number of Extraction Stages: 1
- System Contact Times: (To vary among trials)
  45 minutes; 15 minutes per stage
  90 minutes; 30 minutes per stage
  135 minutes; 45 minutes per stage
- Fluid Strength: 10% Citrikleen® SK
- Fluid Application Ratio: 25 g sample/ 250 ml fluid

PROCESS FLOW: 12 Process Trials: (1 fluid x 4 sample types x 3 contact times)

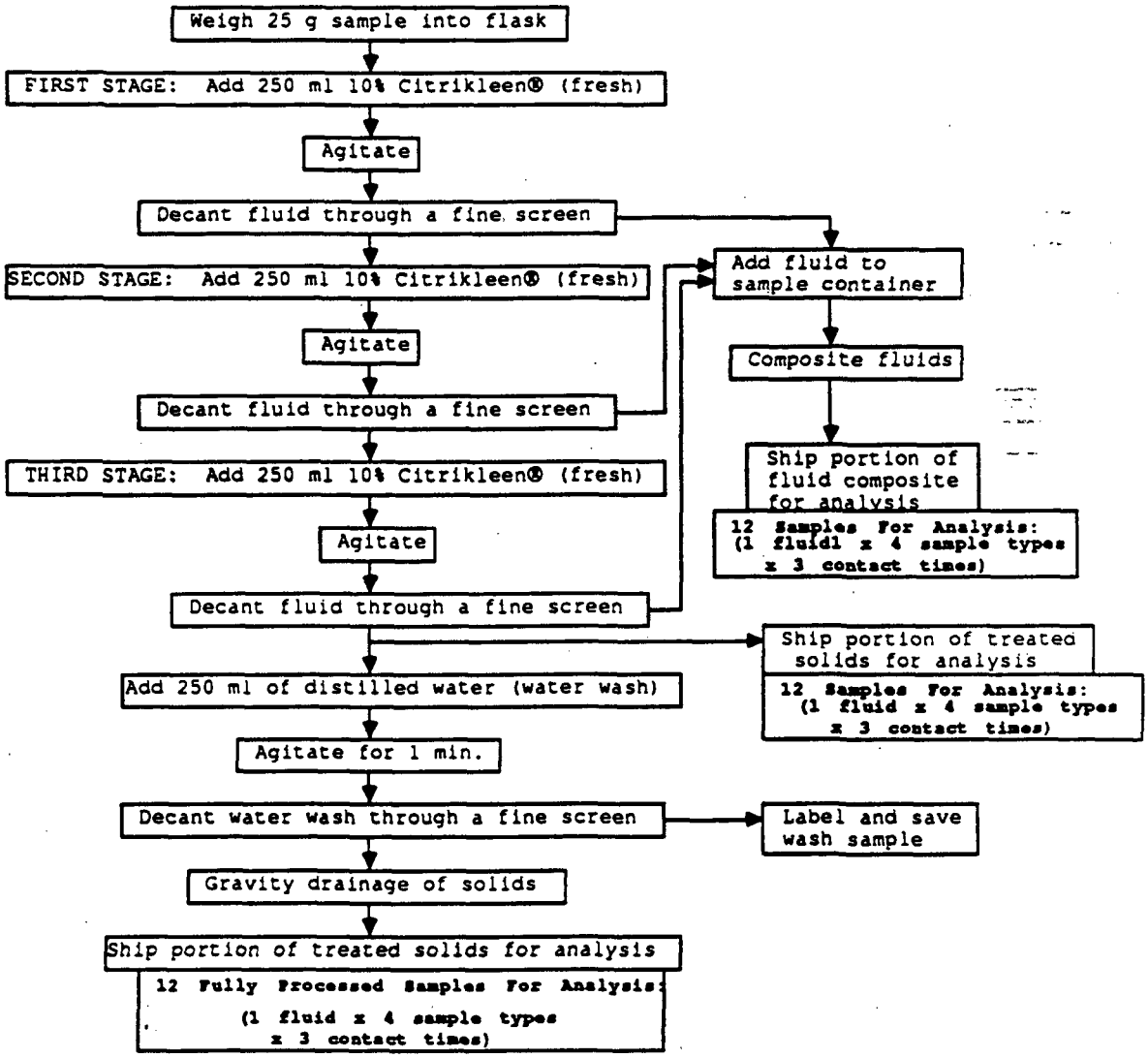

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FIGURE II-6

CONTAMINANT EXTRACTION TREATABILITY STUDY

SCP/CARLSTADT SITE

Kinetic Process Trials Employing Hydrochloric Acid for Metals Extraction

APPLIES TO SAMPLE TYPES:
1) Soil Hot Spot- Lead
2) Soil Hot Spot Composite
3) Overall Soil Composite
4) Sludge Tank and Pit Composite

TRIAL DESIGN PARAMETERS:
- o Number of Stages per Trial: 3
- o Number of Extraction Fluids: 1 per trial
- o System Contact Times: (Varied among trials)
  - 45 minutes; 15 minutes per stage
  - 90 minutes; 30 minutes per stage
  - 180 minutes; 60 minutes per stage
- o Fluid Strength: 10% hydrochloric acid
- o Fluid Application Ratio: 25 g sample/ 250 ml fluid

PROCESS FLOW: **12 Process Trials:** (1 fluid x 4 samples x 3 contact times)

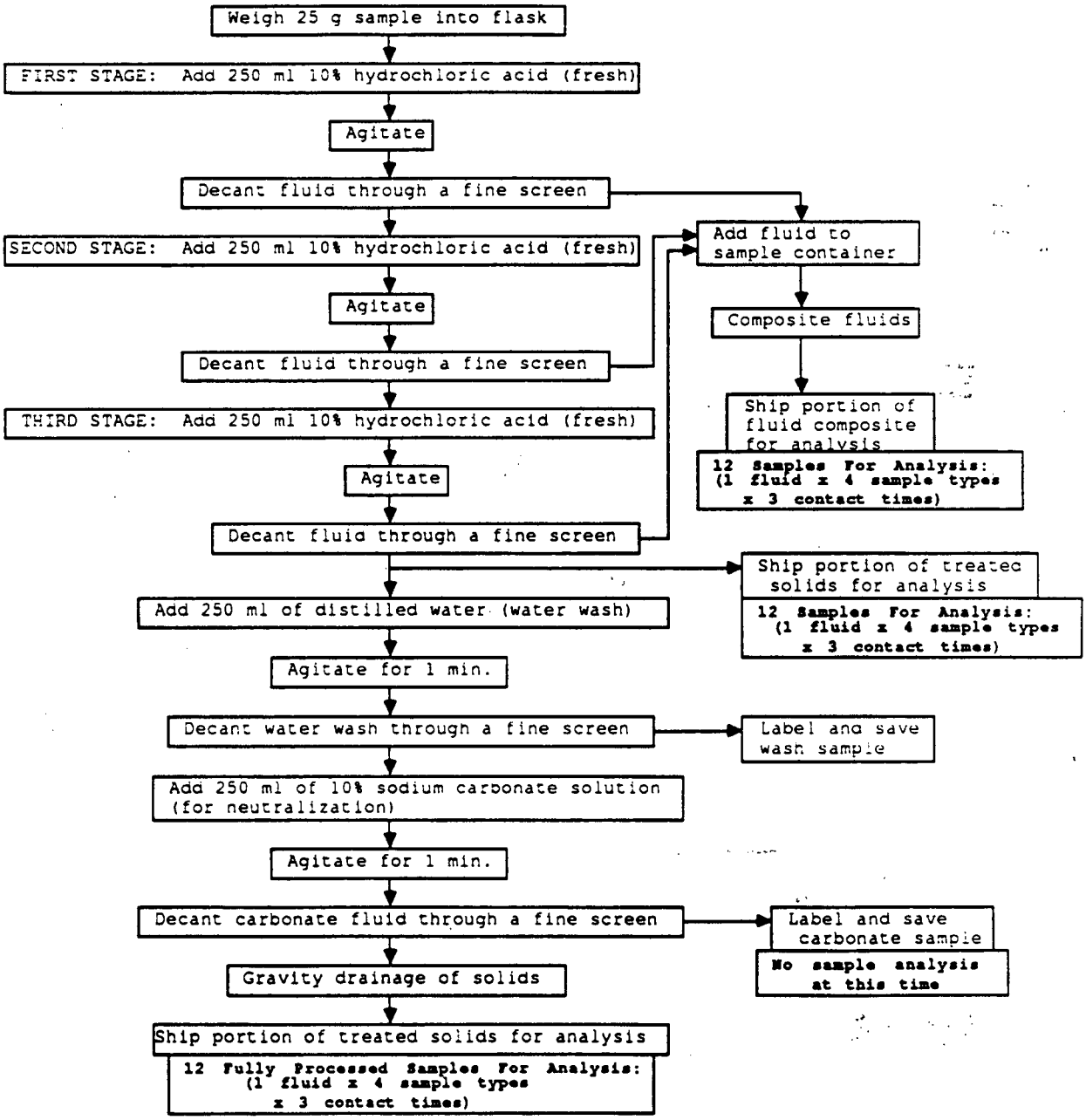

FIGURE II-7

CONTAMINANT EXTRACTION TREATABILITY STUDY

SCP/CARLSTADT SITE

Sequential Extraction Process Trials for Metals and Organics Removal

APPLIES TO SAMPLES:
1) Soil Hot Spot Composite
2) Overall Soil Composite
4) Sludge Tank and Pit Composite

TRIAL DESIGN PARAMETERS:
- Number of Stages per Trial: 3
- Number of Fluid Types: 3

- System Contact Times = 270 minutes:
  - 90 minutes for 5% aqueous surfactant
  - 90 minutes for 10% hydrochloric acid (HCl)
  - 90 minutes for 10% Citrikleen® SK
- Fluid Strengths: Varies, as indicated to left
- Fluid Application Ratio: 25 g sample/ 250 ml fluid

PROCESS FLOW: 3 Process Trials: (1 fluid system x 3 sample types x 1 system contact time)

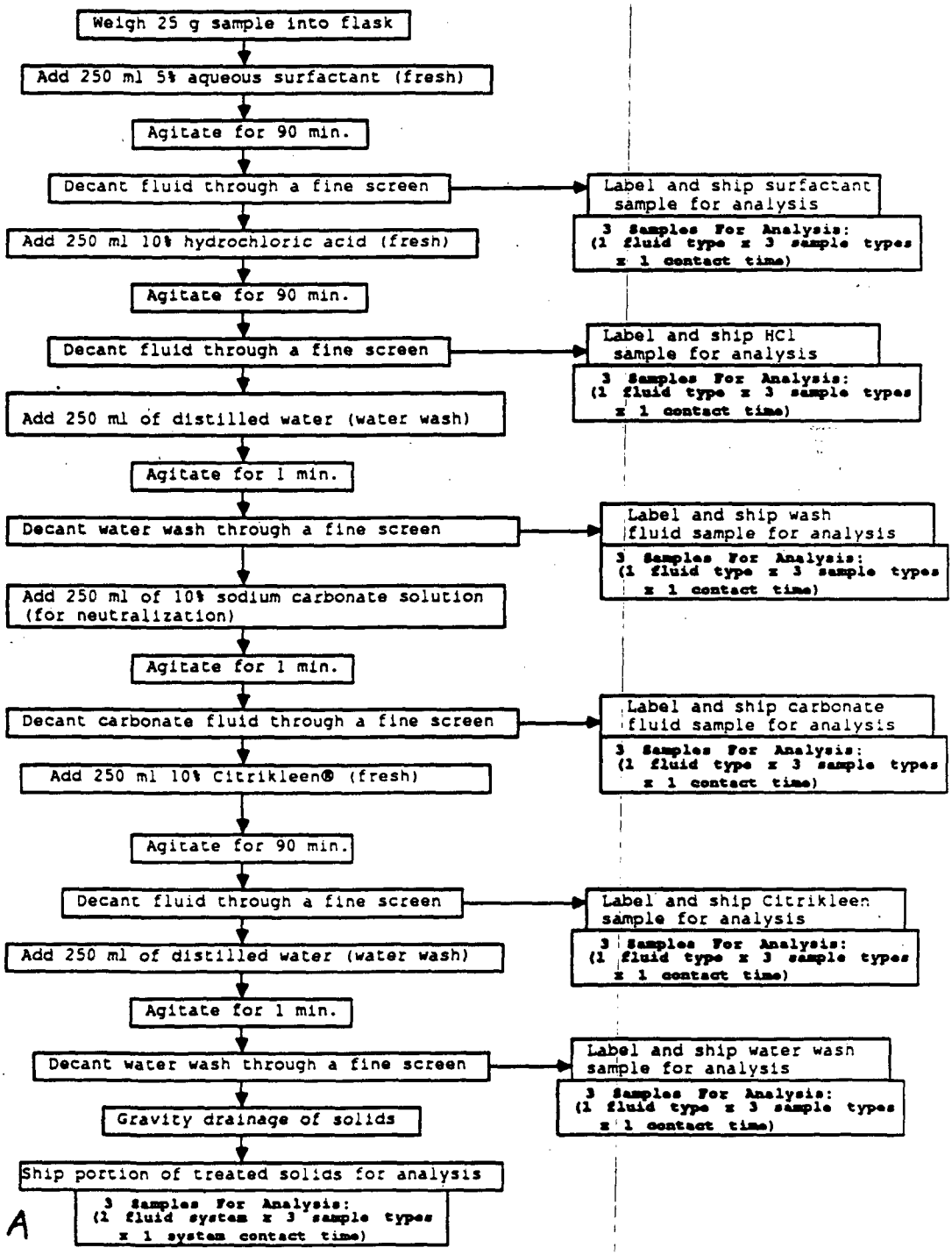

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TABLE II-9

PROCESS SAMPLE ANALYTICAL SCHEDULE FOR KINETIC TRIALS

TRIAL NUMBER	SAMPLE TYPE INVESTIGATED	TREATED SOLIDS (before and after a final distilled water wash) AND THE FLUID COMPOSITE
PT-1	Soil Hot Spot-Lead	Total Pb
PT-2	Hot Spot Soil Composite	Total Pb, Cu, Cr
PT-3	Overall Soil Composite	Total Pb, Cu, Cr
PT-4	Sludge Tank and Pit Composite	Total Pb, Cu, Cr
PT-5	Soil Hot Spot-Lead	Total Pb
PT-6	Hot Spot Soil Composite	Total Pb, Cu, Cr
PT-7	Overall Soil Composite	Total Pb, Cu, Cr
PT-8	Sludge Tank and Pit Composite	Total Pb, Cu, Cr
PT-9	Soil Hot Spot-Lead	Total Pb
PT-10	Hot Spot Soil Composite	Total Pb, Cu, Cr
PT-11	Overall Soil Composite	Total Pb, Cu, Cr
PT-12	Sludge Tank and Pit Composite	Total Pb, Cu, Cr
PT-13	Soil Hot Spot-PCBs	Total PCBs
PT-14	Hot Spot Soil Composite	TCL VOCs,SemiVOCs,PCBs; Total PHCs
PT-15	Overall Soil Composite	TCL VOCs,SemiVOCs,PCBs; Total PHCs
PT-16	Sludge Tank and Pit Composite	TCL VOCs,SemiVOCs,PCBs; Total PHCs
PT-17	Soil Hot Spot-PCBs	Total PCBs
PT-18	Hot Spot Soil Composite	TCL VOCs,SemiVOCs,PCBs; Total PHCs
PT-19	Overall Soil Composite	TCL VOCs,SemiVOCs,PCBs; Total PHCs
PT-20	Sludge Tank and Pit Composite	TCL VOCs,SemiVOCs,PCBs; Total PHCs
PT-21	Soil Hot Spot-PCBs	Total PCBs
PT-22	Hot Spot Soil Composite	TCL VOCs,SemiVOCs,PCBs; Total PHCs
PT-23	Overall Soil Composite	TCL VOCs,SemiVOCs,PCBs; Total PHCs
PT-24	Sludge Tank and Pit Composite	TCL VOCs,SemiVOCs,PCBs; Total PHCs
PT-25	Soil Hot Spot-PCBs	Total PCBs
PT-26	Overall Soil Composite	TCL VOCs,SemiVOCs,PCBs; Total PHCs
PT-27	Sludge Hot Spot-Base Neutrals	TCL B/Ns
PT-28	Sludge Tank and Pit Composite	TCL VOCs,SemiVOCs,PCBs; Total PHCs
PT-29	Soil Hot Spot-PCBs	Total PCBs
PT-30	Overall Soil Composite	TCL VOCs,SemiVOCs,PCBs; Total PHCs
PT-31	Sludge Hot Spot-Base Neutrals	TCL B/Ns
PT-32	Sludge Tank and Pit Composite	TCL VOCs,SemiVOCs,PCBs; Total PHCs
PT-33	Soil Hot Spot-PCBs	Total PCBs
PT-34	Overall Soil Composite	TCL VOCs,SemiVOCs,PCBs; Total PHCs
PT-35	Sludge Hot Spot-Base Neutrals	TCL B/Ns
PT-36	Sludge Tank and Pit Composite	TCL VOCs,SemiVOCs,PCBs; Total PHCs
PT-37	Soil Hot Spot-PCBs	Total PCBs
PT-38	Overall Soil Composite	TCL VOCs,SemiVOCs,PCBs; Total PHCs
PT-39	Sludge Hot Spot-Base Neutrals	TCL B/Ns
PT-40	Sludge Tank and Pit Composite	TCL VOCs,SemiVOCs,PCBs; Total PHCs
PT-41	Soil Hot Spot-PCBs	Total PCBs
PT-42	Overall Soil Composite	TCL VOCs,SemiVOCs,PCBs; Total PHCs
PT-43	Sludge Hot Spot-Base Neutrals	TCL B/Ns
PT-44	Sludge Tank and Pit Composite	TCL VOCs,SemiVOCs,PCBs; Total PHCs
PT-45	Soil Hot Spot-PCBs	Total PCBs
PT-46	Overall Soil Composite	TCL VOCs,SemiVOCs,PCBs; Total PHCs
PT-47	Sludge Hot Spot-Base Neutrals	TCL B/Ns
PT-48	Sludge Tank and Pit Composite	TCL VOCs,SemiVOCs,PCBs; Total PHCs

sequential trials were each analyzed for Target Compound List volatiles, semivolatiles, PCBs, and total petroleum hydrocarbons:

- Fully treated sample solids,
- Used 5% Triton-X-100,
- Used 10% hydrochloric acid,
- First distilled water wash,
- Used 10% sodium carbonate solution,
- Used 10% Citrikleen solution, and the
- Second distilled water wash.

D.2.2.5.2.7 EPA Contract Laboratory Program (CLP) Protocol for Sample Analyses

EPA Region II required the PRP Committee to have the process samples generated in this study analyzed in strict compliance with the EPA CLP protocol and by a CLP contract laboratory. Unfortunately, during the sample analyses, the contract laboratory selected by ERM (i.e., Lancaster Laboratories) encountered significant analytical problems due to the use of the CLP methods. In order of decreasing significance, these problems were as follows:

- The method frequently did not allow determination of precise constituent concentrations in solid and liquid process samples. For organics analysis, the laboratory could often only report that a constituent was less than a high value (typically between 10,000 and 2,500,000 ug/L), which represented the quantitation limit (i.e., the instrument detection limit multiplied by a high dilution factor). High sample dilutions were necessary to keep the chromatographic peaks for the constituents within the calibration scale of the instrument. PCBs analysis generally required greater dilutions than in the analysis for other organics.

  This problem was due to the high concentrations of multiple constituents in many of the samples, which caused an inability to obtain sufficient resolution (or distinction) between the chromatographic peaks for different constituents.

This provides an explanation for the difficulty in analyzing raw soil/sludge samples containing very high concentration of constituents in the samples. These high concentrations obscured analytical identification/differentiation for many constituents in the raw soil/sludge. However, analytical results were obtained for some of these same constituents in soil/sludge after treatment because concentrations were lowered to a point where calibration interferences were minimized. Therefore, anomalies in the results are present which is illustrated by some constituents being detected in residual soil/sludge samples which are not detected in the raw soil/sludge sample.

This problem was less pronounced for metals analysis. However, analysis for metals had to be repeated for several samples.

- The method did not include a procedure for analyzing samples containing surfactants (such as the used fluid comprised of aqueous surfactants or citrate solvents) such that low detection limits could be reported. This was due to the generation of foam in these samples during analysis, which could only be mitigated by repeated dilution of the sample prior to analysis.

Four analytical methods that could potentially be used for extraction treatability studies include both the EPA CLP Low Concentration and Medium Concentration methods (used in this study), the EPA CLP High Concentration method, and the EPA Priority Pollutant method. (Other methods may also be available.).

The major difference between these methods is the type of analytical instrument used to determine the constituent levels in the solvent extracts of waste samples. Use of a gas chromatograph/mass spectrometer (GC/MS) allows lower detection limits than a gas chromatograph/electron capture detector (GC/ECD) because GC/MS requires less sample dilution for constituent resolution.

The GC/MS also achieves greater resolution by performing a selected ion trace capable of analyzing the constituent of interest without interference from other constituents. Selected ion traces may potentially be used to achieve 2,000 to 5,000 ug/L

detection limits for semivolatiles and PCBs. The High Concentration method uses GC/MS to analyze for base neutrals, acid extractables, and PCBs. All the methods do vary somewhat in sample preparation; however, these variations are believed not to be contributing significantly to the constituent resolution problems encountered in this study.

D.2.2.5.3 Relationship Between Process Trial Procedures and Full-Scale Procedures

The process trial procedures selected for this treatability study were not intended to simulate the design or operating parameters for a full-scale extraction system. The time available for completing this study allowed only for preliminary treatability tests designed to investigate a limited number of treatment variables. Consequently, the treatability data should not be used for a final determination of feasibility. The treatability data should also not be used for concept or detailed design of an extraction system. Table II-10 emphasizes the appropriate ways in which the study data can be used, as well as ways which ERM, Inc. does not believe would be appropriate.

It can not be fully determined without further study which process system design is most appropriate for the SCP site soils/sludges. Similarly, further study is needed to confirm which extraction fluid or fluids are most appropriate, the method for decontaminating each different soil/sludge size fraction and, if more than one fluid is applied, the most appropriate sequence of application.

D.3.1 Observations

D.3.1.1 Variations in Raw Sample Characteristics

The characteristics of the raw soils and sludge samples varied considerably. This was expected, since the sample types were selected to allow the range of soil/sludge characteristics (i.e., both hot spot conditions and average conditions) to be investigated in this study. For example, one physical difference was that the Soil Hot Spot-Lead sample and the Sludge Hot Spot-Base Neutrals sample contained a high percentage of coarser particles than any of the other samples. Ranking in order of increasing amounts of sludge and organic solid content

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TABLE II-10

APPROPRIATE AND INAPPROPRIATE USES OF THE EXTRACTION STUDY DATA

APPROPRIATE USES

- Feasibility of extraction chemistry to remove soil constituents.
- Identification of difficult-to-remove constituents.
- Identification of potential problems in soil handling and constituent analysis.
- Basis for designing additional bench-scale studies.

INAPPROPRIATE USES

- Final selection of fluids for full-scale extraction.
- Basis for concept design of an extraction system.
- Detailed design of extraction equipment.
- Selection of extraction equipment.

were the Overall Soil Composite, the Soil Hot Spot Composite and the Sludge Tank and Pit Composite. Both the Soil Hot Spot-Lead sample and the Sludge Tank and Pit Composite were heavier, presumably due to their lead content, than the other samples.

The variation in chemical constituents and constituent levels among sample types was described earlier in Section D.2.2.3.

D.3.1.2 Factors Promoting Contaminant Extraction

A limited literature review and conversations with other investigators of soil extraction indicated three main factors that can promote extraction of contaminants from solid sample matrices:

- Disaggregation of soil/sludge particles (EPA,1989),
- Intimate contact between the sample and the extraction fluid (Biotrol,1988), and
- The solvency of soil/sludge constituents in a given fluid (EPA,1985).

These factors are described briefly below.

D.3.1.2.1 Disaggregation of Soil/Sludge Particles

The fluid must contact the surface of soil/sludge particles to allow the constituents to dissolve in or mix with the fluid. Therefore, a greater percentage of the constituents will transfer to the fluid if large soil/sludge aggregates are broken into smaller aggregates (or disaggregated) to expose more particle surfaces during processing.

D.3.1.2.2 Intimate Sample/Fluid Contact

When the soil/sludge is disaggregated or when the smaller particles are sheared from the larger particles, a higher percentage of the particle surface area is exposed. When this occurs, the fluid can permeate the soil/sludge better, allow intimate contact between the sample and the fluid, and increase the degree of extraction.

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D.3.1.2.3 Solvency of Soil/Sludge Constituents

Soil/sludge constituents vary in the degree to which they dissolve in a given extraction fluid (i.e., their solvency in the fluid). For the aqueous fluids applied in this study, the solvency depends on the solubility of the constituent in water, the degree to which the fluid lowers the wetting resistance of the soil/sludge, and the degree to which the fluid promotes the solutioning of low solubility constituents into the fluid. Polar organics are expected to dissolve readily in any of the fluids used in the study. Nonpolar organics, such as PCBs, are expected to dissolve more readily in an aqueous solution with surfactant properties (such as Triton-X-100 and Citrikleen) or with organics solvent properties (such as Citrikleen).

D.3.1.2.4 Degree of Solid/Fluid Separation Between Stages

The degree of solid/fluid separation achieved between each successive extraction stage is important. The major reason is that excessive residual fluid, which would contain extracted constituents, would lower the extraction capacity of fresh fluids applied to the soils/sludges in the next stage. Extraction process performance would be optimized by maximizing this phase separation between stages.

D.3.1.3 Solids Filtration

The extracted samples were decanted and then filtered to separate the solids from the extraction fluids prior to chemical analysis of the treated solids and used fluids. To enable completion of the treatability tests in the allotted time frame, the solids were vacuum filtered using a vacuum pump, sidearm flask, and Buchner funnel assembly. Rapid filtration of coarse sample particles and slow filtration of the soils/sludge fines was observed.

D.3.1.4 Volatile Emissions

Due to the high volatile organic concentrations in the soils/sludge samples, volatilization of organics could not be completely prevented. The nature of the extraction and subsequent solid-liquid separation steps promoted volatilization, although steps were taken to minimize this problem. Consequently, no attempt was made in this study to develop a

mass balance for the extracted volatile organics. Based on a limited literature and conversations with other investigators of extraction processes (Biotrol, 1988; Resources Conservation Corp., 1989), full-scale extraction operations could be engineered to include vapor collection and treatment units that would safely control volatile emissions.

D.4.1 Results

D.4.1.1 Kinetic Process Trials

The results of kinetic process trials PT-1 through PT-48 are summarized below, including the residual constituent concentrations in the solids remaining after extractions, the percent removals of constituents and the constituent concentrations in used fluids. An additional, more comprehensive treatability study should be conducted to determine the extent to which residual concentrations can be reduced and percent removals increased.

D.4.1.1.1 Analytical Results for Treated Soil/Sludge Solids

Extraction with hydrochloric acid (i.e, PT-1 through PT-12) generally removed a high percentage of lead from all four sample types investigated. However, the lead removals ranged widely:

- Between 70 and 95 percent for the Soil Hot Spot-Lead sample;
- Between 25 and 89 percent for the Soil Hot Spot Composite;
- Between 83 and 95 percent for the Overall Soil Composite; and
- Between 39 and 81 for the Sludge Tank and Pit Composite.

Greater percent lead removals were achieved from the Soil Hot Spot-Lead and the Overall Soil Composite sample than from the Soil Hot Spot Composite and the Sludge Tank and Pit Composite. The acid extraction also removed a high percentage of copper among the three sample types (between 60 and 95 percent). However, copper removal from the Sludge Tank and Pit Composite ranged between 52 and 82 percent. Acid extraction removed a lesser percentage of chromium (i.e.,

between 31 and 71 percent) among the four sample types than of the other two metals analyzed. The greatest copper and chromium removal occurred with the Soil Hot Spot Composite.

Extraction with 5 percent Triton-X-100 (i.e, PT-13 through PT-24) removed a high percentage of PCBs, ranging between 66 and 78, among the four sample types investigated. Comparable percent PCBs removals were noted from the Soil Hot Spot-PCB (75 percent) and the Soil Hot Spot Composite (78 percent). The Triton-X-100 extraction also removed a high percentage of xylene, ranging between 87 and 99, among the four sample types.

Percent removals with 5 percent Citrikleen (i.e, PT-25 through PT-36) were inconclusive, since PCBs were detected without an excessive dilution factor in only two process trials (PT-29 with 58 percent removal of PCBs from the Soil Hot Spot-PCBs sample) and PT-32 with 93 percent removal from the Sludge Tank and Pit Composite. This Citrikleen extraction also removed a high percentage of xylene (between 91 and 98 percent for the Overall Soil Composite and the Sludge Tank and Pit Composite, respectively. This Citrikleen extraction removed comparable percentages of carbon tetrachloride, tetrachloroethene, toluene, and ethylbenzene.

Extraction with 10 percent Citrikleen (i.e, PT-37 through PT-48) removed a high percentage of PCBs (77 percent) from the Soil Hot Spot-PCBs. However, PCBs removal from the other 3 sample types, via the 10 percent Citrikleen, was inconclusive due to analytical problems, i.e., limited PCB analytical data was available on raw soil/sludge samples due to problems with sample analysis. See D.2.2.5.2.7 for detailed discussion on sample analysis. This Citrikleen extraction also removed a high percentage of xylene, ranging between 90 and 92 percent for the Overall Soil Composite and ranging between 92 and 99 percent for the Sludge Tank and Pit Composite. This Citrikleen extraction removed a lesser percentage of phthalates (about 81 percent) from the Sludge Tank and Pit Composite.

This preliminary treatability study did not attempt to remove the maximum possible amount of metals and organics. Potentially due to this fact, residual concentrations of lead, copper, and chromium of up to 733, 363,and 68 mg/kg, respectively, occurred for the Soil Hot Spot Composite. Greater metals

residuals were detected in the Sludge Tank and Pit Composite: up to 85, 161, and 41 mg/kg, respectively. Between 81 and 451 mg/kg of lead residual was detected in the Soil Hot Spot-Lead sample, depending on the contact time.

Residual concentrations of PCBs, xylenes and toluene of up to 7.4, 9.6, and 4.8 mg/kg, respectively, occurred for the Soil Hot Spot Composite. Residual concentrations of xylenes and tetrachloroethene of up to 1.8 and 0.96 mg/kg, respectively, occurred for the Overall Soil Composite after Triton-X-100 extraction. The residual level of PCBs, xylenes, and toluene in the Overall Soil Composite was inconclusive. Greater xylenes and toluene residuals were detected in the Soil Hot Spot Composite and the Sludge Tank and Pit Composite than in other samples. About 1.4 mg/kg of PCBs residual was detected in the Soil Hot Spot-PCB sample.

A residual concentration of 1.2 mg/kg total PCBs occurred for the Soil Hot Spot-PCBs sample. Residual concentrations of PCBs, xylenes, and acetone of up to 7.2, 3.0, and 1.2 mg/kg, respectively, occurred for the Overall Soil Composite after extraction with 10 percent Citrikleen. Greater PCBs, xylene, and tetrachloroethene residuals were detected in the Sludge Tank and Pit Composite than in other sample types: up to 1,260, 920, and 3,900 mg/kg, respectively.

Three factors that may have contributed to the presence of detectable metals and organics residuals are: 1) the optimum length of sample to fluid contact may not have occurred, 2) only three stages of extraction were applied in any given process trial, and 3) the contact time may not have been optimum for the sample matrices. Also, the limited available time to complete the study meant foregoing process trials with adding chelating agents, which have been documented to increase metals removals from soils (REF), added to the acid.

The chemical analyses of the treated solids are summarized in Attachment D-2.

D.4.1.1.2 Effect of Process Variables on Extraction Performance

As explained below, the fluid type, system contact time, and use of a water wash are process variables shown by this study to effect the performance of extraction.

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D.4.1.1.2.1 Effect of Fluid Type

As expected, the type of fluid affects the feasibility of extraction. Only one fluid (i.e., the 10 percent hydrochloric acid solution) was used for metals extraction. However, three different fluids were used for removing organics (i.e., a 5 percent Triton-X-100 solution, a 5 percent and 10 percent Citrikleen solutions). As the tables in Attachment D-3 show, both the surfactant and the citrate-based solvent achieved high removals of the PCBs and other organics, with the citrate-based solvent providing somewhat high removals of PCBs than the surfactant. These tables also show that the 5 percent Triton-X-100 and Citrikleen solutions did not differ significantly in their removal of the following compounds from the Sludge Tank and Pit Composite:

- Tetrachloroethene,
- Toluene,
- Ethyl benzene, and
- Xylenes.

The 10 percent Citrikleen solution appeared to generally remove a slightly greater percentage of these organics than the other two fluids.

D.4.1.1.2.2 Effect of Contact Time

One objective of this treatability study was to provide a general indication of both the potential required contact time and the effect of varying contact time on the percent constituent removals. The use of a different analytical method may have allowed a firmer prediction of these, by allowing the development of plots of percent removals versus minutes of contact time, which give an indication of the optimum contact time. However, this treatability study provided the following general indications of the effect of contact time on the percent constituent removals, as well as some notable peculiarities in the data.

For example, for the Soil Hot Spot Composite the percent removal of PCBs via extraction with Triton-X-100 generally increased as the system contact time increased from 45 to 90 to 135 minutes. However, increasing the system contact time from 45 to 90 to 135 minutes did not appear to affect the percent

removals of tetrachloroethene, toluene, ethyl benzene, or xylenes from the Soil Hot Spot Composite. One peculiarity in the data was that 98 percent of xylenes were removed via a 90-minute extraction with 5 percent Citrikleen, while 81 percent was removed via a 135-minute extraction with this fluid. These comparisons are indicated by the results summarized in Attachment D-3..

Also, the percent removal of lead from the Soil Hot Spot Composite via acid extraction markedly increased as the system contact time increased from 30 to 90 to 180 minutes. However, a similar variation in contact time had no effect on the percentage of copper removed from this sample. It also had no effect on the percentage of chromium removed from the Overall Soil Composite (i.e, the removals remained fairly constant). A peculiarity of the data was that 76 percent of the lead was removed via either a 45-minute and a 90-minute extraction with the acid, while the data indicated that only 45 percent was removed via a 135-minute extraction with acid. These trends are also demonstrated in the Attachment D-3 tables.

D.4.1.1.2.3 Effect of Final Water Wash

This treatability study was to provide a general indication of the effect, on achievable removals, of completing the extraction procedure with a final water wash. No trend toward greater removals with the water wash could be detected from careful comparison of percent removals in treated solids before and after a final water was for organic constituents. However, metal removal rates were generally improved by the final water wash with increasing contact time (at 90 and 180 min). The use of a different analytical method may have allowed a firmer prediction of the effect.

The generally greater removals of constituents with the final water wash confirmed the theory that residual fluid (containing chemical constituents) in the treated samples should be flushed from the solid matrix using a water wash.

D.4.1.1.3 Constituent Concentrations in Used Extraction Fluids

Extraction with hydrochloric acid (i.e, PT-1 through PT-12) transferred high concentrations of lead, ranging between 23.5 and 650 mg/L, to the used acid solution. The acid extraction

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also transferred high concentrations of copper, ranging between 10.8 and 346 mg/L, to the used acid. Acid extraction transferred to the used acid lesser concentrations of chromium (i.e., between 1.3 and 252) than the other two metals. The exception to this was the extraction of the Soil Hot Spot-Lead sample for a 180-minute contact time, which transferred 633 mg/L of chromium into the acid fluid.

Among trials with extraction via 5 percent Triton-X-100 (i.e, PT-13 through PT-24), high concentrations of PCBs (between 0.60 and 160 mg/L of individual PCB compounds), were transferred to the fluid. The Triton-X-100 extraction also transferred high concentrations of xylene (32 to 140 mg/L) and petroleum hydrocarbons (19 to 370 mg/L) among the process trials. Triton-X-100 extraction appeared to transfer lesser concentrations of 1,2,4-dichlorobenzene, isophorone, and phthalates than other organic constituents detected in the untreated samples.

Among the trials involving extraction with 5 percent Citrikleen (i.e, PT-25 through PT-36) transferred high concentrations of PCBs, ranging between 0.3 and 460 mg/L to the fluid. This Citrikleen extraction also transferred high concentrations of tetrachloroethene (340 to 420 mg/L), toluene (130 to 150 mg/L) and petroleum hydrocarbons (920 to 5,900 mg/L)

This Citrikleen extraction transferred lesser concentrations of 1,2,4- dichlorobenzene, isophorone, and phthalates than other organic constituents detected in the untreated samples.

Extraction with 10 percent Citrikleen (i.e, PT-37 through PT-48) transferred high concentrations of PCBs, ranging between 0.2 and 44 mg/L, from all four sample types investigated. Among the process trials, this Citrikleen extraction also transferred high concentrations of tetrachloroethene (900 to 2,200 mg/L), toluene (260 to 760 mg/L), and xylene (170 to 470 mg/L) to the fluid.

D.4.1.1.4 Mass Balance on Solids and Constituents

The scope of this treatability study did not include performing a mass balance on solids and constituents. A mass balance on solids should be conducted if a more comprehensive treatability study is performed, in order to predict the requirements for

pretreatment and reuse of extraction fluids. A mass balance on organic and metal constituents should be performed once a better analytical method is identified or developed for the analysis of high constituent concentrations. Use of the EPA-required analytical methods (i.e., the Low and Medium Concentration methods under the CLP protocol) frequently prevented the CLP contract laboratory to achieve adequate resolution between different sample constituents. Therefore, many constituents were known to be present below a certain high concentration level reported by the lab, but it was not known how much they were below this level. Consequently, a mass balance was not attempted on the sample constituents.

D.4.1.2 Sequential Process Trials

The results of sequential process trials PT-49 through PT-51 are summarized below, including the residual constituent concentrations in the solids remaining after extractions, the percent removals of constituents and the constituent concentrations in used fluids. An additional, more comprehensive treatability study should be conducted to determine the extent to which residual concentrations can be reduced and percent removals increased.

D.4.1.2.1 Analytical Results of Treated Soil/Sludge Solids

Sequential Extraction with the three extraction fluids generally removed a high percentage of metals from the Sludge Tank and Pit Composite sample, ranging between 63 and 93 percent, for the following metals: arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc, with mercury having the highest percent removal. However, only 32 percent of selenium was removed from this same sample.

Sequential extraction removed a slightly lower percentage of the metals listed previously, excluding selenium and arsenic, from the Soil Hot Spot Composite (i.e., between 48 and 83 percent) and an even lesser percentage from the Overall Soil Composite with removals ranging between 9 and 63 percent, with the lowest percentage removal of zinc at 9 percent. The range of percent removals of metals from all 3 sample types are as follows:

- Between 63 and 93 percent removal of mercury

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- Between 63 and 77 percent removal of copper
- Between 62 and 72 percent removal of lead
- Between 43 and 86 percent removal of cadmium
- Between 53 and 76 percent removal of arsenic
- Between 52 and 63 percent removal of chromium
- Between 47 and 68 percent removal of nickel
- 76 percent removal of antimary from sludge tank and pit composite.

Sequential Extraction removed a high percentage of the following VOCs: chloroform, 1,2-dichloroethane, 1,1,1-trichloroethane, trichloroethene, tetrachloroethane, toluene, ethylbenzene and xylenes, ranging between 83 and 94, from the Soil Hot Spot Composite sample. Comparable percent VOC removals were noted from the sludge tank and pit composite, ranging between 78 and 92 percent removal for chloroform, tetrachloroethene, toluene, ethylbenzene, and xylenes. Sequential extraction also removed 80 percent of xylenes from the Overall Soil Composite.

Sequential Extraction removed high percentage of phenol (90 percent) and 1,2-dichlorobenzene (89 percent) from the Sludge Tank and Pit Composite sample and a lesser percentage of 1,2,4-trichlorobenzene (79 percent), napthalene (80 percent), and phthalates (about 82 percent). However, semivolatiles removal from the other 2 sample types, via sequential extraction, was inconclusive due to analytical problems.

Sequential extraction removed 91 percent of Arochlor-1254 from the Soil Hot Spot Composite sample, however, PCBs removal from the other 2 sample types was inconclusive due to analytical problems (See D.2.2.5.2.7).

This preliminary treatability study did not attempt to remove the maximum possible amount of metals and organics. Potentially due to this fact, residual concentrations of copper, lead and zinc of 417, 272 and 314 mg/kg, respectively, occurred for the Soil Hot Spot Composite.

Metals residuals detected in the Overall Soil Composite were 148, 225, and 796 mg/kg, respectively. Greater metals residu-

als were detected in the Sludge Tank and Pit Composite for chromium, copper, lead and zinc: 2,250, 1,070, 16,900 and 545 mg/kg, respectively. However, it should be noted that the raw Sludge Tank and Pit Composite sample contained much higher concentrations of these constituents compared to concentrations in the other 2 raw sample types.

Residual concentrations for PCBs, tetrachlorethene, toluene, xylenes and phthalates of 20, 35, 39, 38 and 81 mg/kg, respectively, occurred for the Soil Hot Spot Composite. Residual concentrations of PCBs, tetrachloroethene and toluene of 204, 13 and 4.2 mg/kg, respectively, occurred for the overall soil composite. Much greater PCBs, tetrachloroethene, toluene, xylenes, and vinyl acetate residuals were detected in the Sludge Tank and Pit Composite: up to 400, 15,000, 4,900, 2,700, and 950 mg/kg, respectively. 1,2-dichlorobenzene, phenol and phthalates residuals were detected up to 1,700, 417, and 492 mg/kg, respectively, in the Sludge Tank and Pit Composite.

Three factors that may have contributed to the presence of detectable metals and organics residuals are: 1) the optimum length of sample to fluid contact may not have occurred, 2) the number of stages of extraction applied in the sequential process trials, 3) the contact time may not have been optimum for the sample matrices. Also, the limited available time to complete the study meant foregoing process trials with adding chelating agents, which have been documented to increase metals removal from soils (REF), added to the acid.

The chemical analysis of the treated solid are summarized in Attachment D-2.

D.4.1.2.2 Effect of Process Variables on Extraction Performance

As explained below, the fluid type and use of a water wash are process variables shown by this study to effect the performance of extraction.

As expected, the type of fluid effects the feasibility of extraction. As the tables in Attachment D-3 show, all three fluid types and the first water wash achieved high removals of metals from all 3 sample types with the greatest removal generally occurring with the first water wash after extraction with the surfactant and the hydrochloric acid solution. These tables also show that the

aqueous surfactant provided the highest removal VOCs and semivolatiles from all 3 sample types and that the Citrikleen solution removed significantly greater concentrations of total petroleum hydrocarbons than any other extraction fluid. Greatest PCBs removal from all 3 sample types was achieved by extraction with the surfactant and Citrikleen solutions.

Extraction with the 3 fluid types, the 2 water washes and the sodium carbonate solution wash transferred high concentrations of metals, VOCs, semivolatiles and PCBs to the used solutions. Refer to the table in Attachment D-3 for constituent concentration analysis in the used extraction fluids.

D.5.1. Conclusions and Recommendations

The following conclusions and recommendations can be made from the results of this study:

- Removal of volatile and semivolatile organics, petroleum hydrocarbons, PCBs, and a variety of heavy metals is feasible via contaminant extraction. However, additional treatability and pilot-scale studies are recommended to determine relative effectiveness and most appropriate method for remediating soils and sludges to achieve cleanup goals for the FOU.

- Both the aqueous surfactant and the aqueous citrate-based solvent are effective for high removals of all classes of organic compounds tested. The citrate-based solvent appears to be somewhat more effective than the surfactant for PCBs removal. Additional treatability studies would need to be performed to determine whether the surfactant or the citrate-based solvent were necessary to achieve cleanup goals.

- The highest percent removals would occur for those sample types with the greatest initial constituent concentrations (i.e., the Hot Spot Soil Composite and the Sludge Tank and Pit Composite). However, all sample types were treatable via extraction.

- A single stage of extraction would be capable of removing high percentages of constituents. However, due to the level

of residual concentrations in this study, a greater number of stages would be required for treatment that would achieve the FOU cleanup goals.

- This study did not provide conclusive data for required contact time. However, approximately 45 minutes system contact time may be sufficient for metals removal. Also, the apparent required system contact time for high organics removal varied between 45 and 90 minutes.
- As expected, sequential extraction was successful in removing large percentages of both organic and metal constituents,including PCBs and lead, as demonstrated by the analytical results provided in Attachment D-3..
- Used extraction fluids would require significant pretreatment prior to recycling back into an extraction system for reuse due to their high constituent levels. Complete replacement with fresh fluid volumes during soils/sludge processing and off-site disposal of pretreated fluids would be expected.
- Volatile emissions control would be necessary during extraction of soils and sludges.
- The CLP protocol used for process sample analysis was not suitable due to the high constituent concentrations. An alternative analytical method should be found for further treatability and pilot-scale studies.

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ATTACHMENTS

ATTACHMENT D-1

MSDS FOR EXTRACTION FLUIDS

penetone® CORPORATION
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MATERIAL SAFETY DATA SHEET

(Confidential Formula — Information not to be disclosed to other than recipient and other regulatory agencies.)

DATE February 24, 1986

SECTION I — PRODUCT IDENTIFICATION

TRADE NAME: CITRIKLEEN MOD

CHEMICAL FAMILY:

SECTION II — HAZARDOUS INGREDIENTS

COMPONENT OR MATERIAL CHEMICAL NAMES	CAS NO.	% by	TLV (Units)
None			

SECTION III — PHYSICAL DATA

BOILING POINT (°F): Approximately 210-220°F	VAPOR PRESSURE, mm Hg @ 20°C (68°F): Not established
EVAPORATION RATE (ETHER=1): 0.1	VAPOR DENSITY (AIR=1) @ 50-90°F: Not established
SOLUBILITY IN H_2O, % by wt @ 20°C (68°F): Complete	% VOLATILES by VOL. @ 70°F: None
SPECIFIC GRAVITY H_2O = 1 @ 75°F: 0.940	pH: (as received) approximately 9.5

APPEARANCE & ODOR: Clear, Yellow liquid, citrus odor

SECTION IV — FIRE AND EXPLOSION DATA

FLASH POINT (Method Used)	FLAMMABLE EXPLOSIVE LIMITS	UPPER	LOWER
125°F (P.M.C.C.)			

EXTINGUISHING MEDIA: CO_2, foam, etc.; treat as Class B (oil type) fire.

SPECIAL FIRE FIGHTING PROCEDURES: None

UNUSUAL FIRE & EXPLOSION HAZARDS: None

SECTION V — EMERGENCY AND FIRST AID PROCEDURES

EYES: Wash with water. If irritation persists, seek medical aid.

SKIN: Wash with water

INHALATION: Remove to fresh air; seek medical assistance.

INGESTION: Do not induce vomiting; use stomach lavage. See physician.

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SECTION VI - HEALTH DATA

THRESHOLD LIMIT VALUE

Not yet determined.

EFFECTS OF OVEREXPOSURE:
INHALATION

Nausea, dizziness

SKIN

Defatting and irritation upon repeated or prolonged contact

EYES

Irritation upon contact

CHRONIC OVEREXPOSURE EFFECTS

Not yet determined

SECTION VII - REACTIVITY DATA

CONDITIONS CONTRIBUTING TO INSTABILITY

Product is stable

INCOMPATIBILITY

Strong oxidizing agents i.e. chromates, sulfuric acid

HAZARDOUS DECOMPOSITION PRODUCTS

CONDITIONS CONTRIBUTING TO POLYMERIZATION

Will not polymerize

SECTION VIII - SPILL OR LEAK PROCEDURE

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

Wash to sanitary sewer according to local ordinances

NEUTRALIZING CHEMICALS

Dilute with water.

WASTE DISPOSAL METHOD

Wash to sanitary sewer after soil release if permitted by local, state, and Federal EPA regulations.

SECTION IX - VENTILATION AND PERSONAL PROTECTIVE EQUIPMENT

VENTILATION REQUIREMENTS

Forced ventilation recommended

SPECIAL PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY

None

EYE

Splash proof goggles if splashing is likely

GLOVES

Solvent resistant

OTHER CLOTHING & EQUIPMENT

None

SECTION X - SPECIAL PRECAUTIONS INCLUDING STORAGE

PRECAUTIONS TO BE TAKEN IN HANDLING & STORAGE (Always refer to label directions when using.)

Do not allow to freeze - if frozen allow to thaw

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Keep away from children.

D.O.T. SHIPPING CLASSIFICATION

Compound cleaning liquid; combustible liquid (NA-1993)

ATTACHMENT D-2

COMPLETE CHEMICAL ANALYSES FOR TREATED SOLIDS

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TABLE 1
RESULTS OF METALS REMOVAL - KINETICS TRIALS
TREATED SOLIDS ANALYSIS
EXTRACTION WITH 10% HYDROCHLORIC ACID SOLUTION [1]

SCP PROJECT - CARLSTADT, N.J.

RESIDUAL CONCENTRATIONS, SYSTEM CONTACT TIME AND PERCENT REMOVAL

System Contact Time (Min) [2]	Raw Sample I.D.	Sample Name	Metals Analyzed [3]	Concentration in Raw Sample (mg/kg)	PT-1 Before Final Wash (mg/kg) [4]	PT-1 Removal (%)	PT-1 After Final Wash (mg/kg) [5]	PT-1 Removal (%)	PT-2 Before Final Wash mg/kg	PT-2 Removal (%)	PT-2 After Final Wash (mg/kg	PT-2 Removal (%)	PT-3 Before Final Wash mg/kg	PT-3 Removal (%)	PT-3 After Final Wash (mg/kg	PT-3 Removal (%)	PT-4 Before Final Wash mg/kg	PT-4 Removal (%)	PT-4 After Final Wash (mg/kg	PT-4 Removal (%)
45	CET-1	Soil Hot	Chromium																	
		Spot/Lead	Copper																	
			Lead	1,540	457	70	2,020	-31												
	CET-3	Soil Hot	Chromium	81					50	38	46	43								
		Spot/	Copper	1,790					152	92	216	88								
		Composite	Lead	879					733	25	944	4								
	CET-4	Overall	Chromium	90									41	54	34	63				
		Soil	Copper	399									98	78	101	75				
		Composite	Lead	596									85	86	764	-28				
	CET-5	Sludge	Chromium	6,060													2,230	63	2,440	60
		Tank&Pit	Copper	4,020													1,120	72	1,140	72
		Composite	Lead	59,700													11,600	81	14,200	76
90	CET-1	Soil Hot	Chromium																	
		Spot/Lead	Copper																	
			Lead	1,540																
	CET-3	Soil Hot	Chromium	81																
		Spot/	Copper	1,790																
		Composite	Lead	879																
	CET-4	Overall	Chromium	90																
		Soil	Copper	399																
		Composite	Lead	596																
	CET-5	Sludge	Chromium	6,060																
		Tank&Pit	Copper	4,020																
		Composite	Lead	59,700																
180	CET-1	Soil Hot	Chromium																	
		Spot/Lead	Copper																	
			Lead	1,540																
	CET-3	Soil Hot	Chromium	81																
		Spot/	Copper	1,790																
		Composite	Lead	879																
	CET-4	Overall	Chromium	90																
		Soil	Copper	399																
		Composite	Lead	596																
	CET-5	Sludge	Chromium	6,060																
		Tank&Pit	Copper	4,020																
		Composite	Lead	59,700																

Footnotes: [1] The surfactant used was manufactured by Rohm & Haas.
[2] System contact time is the total time the sample was in contact with the fluid. This is contrasted with stage contact time which refers to the time the sample is in contact with the fluid in a single stage. Each process trial (PT) in the treatability study consisted of 3 stages.
[3] Metal analyses were of total metal content (i.e., all chemical forms).
[4] Before final wash refers to the treated sample before it undergoes a final treatment with distilled water.
[5] After final wash refers to the treated sample after it undergoes a final wash treatment with distilled water.

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TABLE 1 (continued)
RESULTS OF METALS REMOVAL - KINETICS TRIALS
TREATED SOLIDS ANALYSIS
EXTRACTION WITH 10% HYDROCHLORIC ACID SOLUTION [1]

SCP PROJECT - CARLSTADT, N.J.

RESIDUAL CONCENTRATIONS, SYSTEM CONTACT TIME AND PERCENT REMOVAL

System Contact Time (Min) [2]	Raw Sample	Sample Name	Metals Analyzed [3]	Concentration in Raw Sample (mg/kg)	PT-5 Before Final Wash mg/kg [4]	PT-5 Removal (%)	PT-5 After Final Wash (mg/kg) [5]	PT-5 Removal (%)	PT-6 Before Final Wash mg/kg	PT-6 Removal (%)	PT-6 After Final Wash (mg/kg	PT-6 Removal (%)	PT-7 Before Final Wash mg/kg	PT-7 Removal (%)	PT-7 After Final Wash (mg/kg	PT-7 Removal (%)	PT-8 Before Final Wash mg/kg	PT-8 Removal (%)	PT-8 After Final Wash (mg/kg	PT-8 Removal (%)
45	CET-1	Soil Hot	Chromium																	
		Spot/Lead	Copper																	
			Lead	1,540																
	CET-3	Soil Hot	Chromium	81																
		Spot/	Copper	1,790																
		Composite	Lead	979																
	CET-4	Overall	Chromium	90																
		Soil	Copper	389																
		Composite	Lead	596																
	CET-5	Sludge	Chromium	6,060																
		Tank&Pa	Copper	4,020																
		Composite	Lead	59,700																
90	CET-1	Soil Hot	Chromium																	
		Spot/Lead	Copper																	
			Lead	1,540	312	80	36	98												
	CET-3	Soil Hot	Chromium	81					56	31	40	51								
		Spot/	Copper	1,790					363	80	137	92								
		Composite	Lead	979					259	74	221	77								
	CET-4	Overall	Chromium	90									41	55	34	62				
		Soil	Copper	389									161	60	66	83				
		Composite	Lead	596									54	91	29	95				
	CET-5	Sludge	Chromium	6,060													2,750	55	1,730	71
		Tank&Pa	Copper	4,020													1,350	66	730	82
		Composite	Lead	59,700													25,400	57	15,000	75
180	CET-1	Soil Hot	Chromium																	
		Spot/Lead	Copper																	
			Lead	1,540																
	CET-3	Soil Hot	Chromium	81																
		Spot/	Copper	1,790																
		Composite	Lead	979																
	CET-4	Overall	Chromium	90																
		Soil	Copper	389																
		Composite	Lead	596																
	CET-5	Sludge	Chromium	6,060																
		Tank&Pa	Copper	4,020																
		Composite	Lead	59,700																

Footnotes: [1] The surfactant used was manufactured by Rohm & Haas.
[2] System contact time is the total time the sample was in contact with the fluid. This is contrasted with stage contact time which refers to the time the sample is in contact with the fluid in a single stage. Each *process trial (PT) in the treatability study* consisted of 3 stages.
[3] Metal analyses were of total metal content (i.e., all chemical forms).
[4] *Before final wash refers to the treated sample before it undergoes a final treatment with distilled water.*
[5] After final wash refers to the treated sample after it undergoes a final wash treatment with distilled water.

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TABLE 1 (continued)
RESULTS OF METALS REMOVAL - KINETICS TRIALS
TREATED SOLIDS ANALYSIS
EXTRACTION WITH 10% HYDROCHLORIC ACID SOLUTION [1]

SCP PROJECT - CARLSTADT, N.J.

RESIDUAL CONCENTRATIONS, SYSTEM CONTACT TIME AND PERCENT REMOVAL

System Contact Time (Min) [2]	Raw Sample	Sample Name	Metals Analyzed [3]	Concentration in Raw Sample (mg/kg)	PT-9 Before Final Wash (mg/kg) [4]	PT-9 Removal (%)	PT-9 After Final Wash (mg/kg) [5]	PT-9 Removal (%)	PT-10 Before Final Wash mg/kg	PT-10 Removal (%)	PT-10 After Final Wash (mg/kg	PT-10 Removal (%)	PT-11 Before Final Wash (mg/kg)	PT-11 Removal (%)	PT-11 After Final Wash (mg/kg	PT-11 Removal (%)	PT-12 Before Final Wash mg/kg	PT-12 Removal (%)	PT-12 After Final Wash (mg/kg)	PT-12 Removal (%)
45	CET-1	Sed Hot	Chromium																	
		Spot/Lead	Copper																	
			Lead	1,540																
	CET-3	Sed Hot	Chromium	81																
		Spot/	Copper	1,790																
		Composite	Lead	979																
	CET-4	Overall	Chromium	90																
		Sed	Copper	399																
		Composite	Lead	596																
	CET-5	Sludge	Chromium	6,060																
		Tank&Pit	Copper	4,020																
		Composite	Lead	59,700																
90	CET-1	Sed Hot	Chromium																	
		Spot/Lead	Copper																	
			Lead	1,540																
	CET-3	Sed Hot	Chromium	81																
		Spot/	Copper	1,790																
		Composite	Lead	979																
	CET-4	Overall	Chromium	90																
		Sed	Copper	399																
		Composite	Lead	596																
	CET-5	Sludge	Chromium	6,060																
		Tank&Pit	Copper	4,020																
		Composite	Lead	59,700																
180	CET-1	Sed Hot	Chromium																	
		Spot/Lead	Copper																	
			Lead	1,540	81	95	136	91												
	CET-3	Sed Hot	Chromium	81					68	16	28	66								
		Spot/	Copper	1,790					189	89	87	95								
		Composite	Lead	979					127	87	109	89								
	CET-4	Overall	Chromium	90									40	56	45	50				
		Sed	Copper	399									63	84	124	69				
		Composite	Lead	596									64	89	99	83				
	CET-5	Sludge	Chromium	6,060													5,890	3	3,680	39
		Tank&Pit	Copper	4,020													1,930	52	1,760	56
		Composite	Lead	59,700													36,500	39	32,200	46

Footnotes: [1] The surfactant used was manufactured by Rohm & Haas.
[2] System contact time is the total time the sample was in contact with the fluid. This is contrasted with stage contact time which refers to the time the sample is in contact with the fluid in a single stage. Each process trial (PT) in the treatability study consisted of 3 stages.
[3] Metal analyses were of total metal content (i.e., all chemical forms).
[4] Before final wash refers to the treated sample before it undergoes a final treatment with distilled water.
[5] After final wash refers to the treated sample after it undergoes a final wash treatment with distilled water.

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TABLE 2
RESULTS OF ORGANICS REMOVAL - KINETICS TRIALS
EXTRACTION WITH 5% AQUEOUS SURFACTANT SOLUTION [1]
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

Raw Sample I.D.	Sample Name	Organics Analyzed	Concentration in Raw Sample (ug/kg)	System Contact Time (Min) [2]	PT-14 Before Final Wash (ug/kg) [3]	PT-14 Removal (%)	PT-14 After Final Wash (ug/kg) [4]	PT-14 Removal (%)	PT-18 System Contact Time (Min)	PT-18 Before Final Wash (ug/kg)	PT-18 Removal (%)	PT-18 After Final Wash (ug/kg)	PT-18 Removal (%)	PT-22 System Contact Time (Min)	PT-22 Before Final Wash (ug/kg)	PT-22 Removal (%)	PT-22 After Final Wash (ug/kg)	PT-22 Removal (%)
		TCL Volatiles																
CET-3	Soil - Hot Spot Composite	Chloromethane		45					90					135				
		Bromomethane																
		Methylene Chloride	5,600 J															
		Acetone	64,000															
		Carbon Disulfide																
		1,1-Dichloroethene																
		1,1-Dichloroethane																
		trans-1,2-Dichloroethene	4,700 J															
		Chloroform	140,000		7,200	95	7,300	95		2,600	98	12,000	91		14,000	90	4,800	97
		1,2-Dichloroethane	93,000		6,200	93	5,100	95		2,500	97	8,600	91		7,500	92	2,400	97
		2-Butanone																
		1,1,1-Trichloroethane	47,000				3,200	93				4,600	90		6,500	86	2,400	95
		Carbon Tetrachloride																
		Vinyl Acetate																
		Bromodichloromethane																
		1,2-Dichloropropane																
		Trichloroethene	270,000		17,000	94	11,000	96		7,000	97	21,000	92		34,000	87	8,400	97
		Dibromochloromethane																
		1,1,2-Trichloroethane																
		Benzene																
		trans-1,3-Dichloropropane																
		Bromoform																
		4-Methyl-2-Pentanone	28,000 J															
		2-Hexanone																
		Tetrachloroethene	210,000		26,000	88	11,000	95		12,000		20,000	90		35,000	83	11,000	95
		1,1,2,2-Tetrachloroethane					870											
		Toluene	530,000		30,000	94	2,600	100				3,700	99		3,200	99	4,800	99
		Chlorobenzene	7,300 J												1,100	85		
		Ethylbenzene	88,000		10,000	89	2,700	97		3,500		5,700	94		12,000	86	3,600	96
		Styrene													1,100			
		Xylenes	390,000		40,000	90	7,900	98		8,300		12,000	97		27,000	93	9,600	98
		Semivolatiles																
		Phenol																
		bis (2-chloroethyl) ether																
		2-chlorophenol																
		1,3-dichlorobenzene																
		1,4-dichlorobenzene																
		Benzyl alcohol																
		1,2-dichlorobenzene	17,000 J															
		1-methylphenol																
		bis (2-chloroisopropyl) ether																
		4-methylphenol																
		N-nitrosodi-n-propylamine																
		Naphthalene	31,000 J															
		4 chloro-3-methylphenol																
		Dimethyl phthalate																
		2 Methylnapthalene	15,000 J															
		Acenaphthene																
		2,4 dinitrophenol																
		4-nitrophenol																
		bis(2 Ethylhexyl) phthalate	150,000		41,000	73	37,000	75									48,000	68
		Diethyl phthalate	15,000 J															
		Phenanthrene	19,000 J															
		Di-n-butylphthalate	29,000 J															
		Petroleum Hydrocarbons (mg/kg)			5,500		5,300			3,400		6,400			6,400		9,900	

RESIDUAL CONCENTRATION, SYSTEM CONTACT TIME, AND PERCENT REMOVAL

Footnotes
[1] The surfactant used was Triton x-100 manufactured by Rohm & Haas
[2] System Contact time is the total time the sample was in contact with the fluid
This is contrasted with stage contact time which refers to the time the sample is in contact with the fluid in a single stage. Each process trial (PT) in the geotability study consisted of 3 stages
[3] Before final wash refers to the treated sample before it undergoes a final wash treatment with distilled water
[4] After final wash refers to the treated sample after it undergoes a final wash treatment with distilled water
[5] "J" values mean estimated concentrations

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TABLE 2 (continued)
RESULTS OF ORGANICS REMOVAL - KINETICS TRIALS
EXTRACTION WITH 5% AQUEOUS SURFACTANT SOLUTION [1]
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

RESIDUAL CONCENTRATION, SYSTEM CONTACT TIME, AND PERCENT REMOVAL

Raw Sample I.D.	Sample Name	Organics Analyzed	Concentration in Raw Sample (ug/kg)	PT-15 System Contact Time (Min) [2]	PT-15 Before Final Wash (ug/kg) [3]	PT-15 Removal (%)	PT-15 After Final Wash (ug/kg) [4]	PT-15 Removal (%)	PT-19 System Contact Time (Min)	PT-19 Before Final Wash (ug/kg)	PT-19 Removal (%)	PT-19 After Final Wash (ug/kg)	PT-19 Removal (%)	PT-23 System Contact Time (Min)	PT-23 Before Final Wash ug/kg	PT-23 Removal (%)	PT-23 After Final Wash (ug/kg)	PT-23 Removal (%)
		TCL Volatiles																
CET-4	Overall Soil Composite	Chloromethane		48					80					135				
		Bromomethane																
		Methylene Chloride	1,300															
		Acetone	2,400															
		Carbon Disulfide																
		1,1-Dichloroethene																
		1,1-Dichloroethane	66															
		trans-1,2-Dichloroethene	710															
		Chloroform	3,800															
		1,2-Dichloroethane	130															
		2-Butanone	53J															
		1,1,1-Trichloroethane	150															
		Carbon Tetrachloride																
		Vinyl Acetate																
		Bromodichloromethane																
		1,2-Dichloropropane																
		Trichloroethene	1,800															
		Dibromochloromethane																
		1,1,2-Trichloroethane																
		Benzene	450															
		trans-1,3-Dichloropropene																
		Bromoform																
		4-Methyl-2-Pentanone	160															
		2-Hexanone																
		Tetrachloroethene	7,600				960	87										
		1,1,2,2-Tetrachloroethane																
		Toluene	3,600															
		Chlorobenzene	45															
		Ethylbenzene	1,200															
		Styrene																
		Xylenes	14,000		1,800	87												
		Semivolatiles																
		Phenol																
		bis (2-chloroethyl) ether																
		2-chlorophenol																
		1,3-dichlorobenzene																
		1,4-dichlorobenzene																
		Benzyl alcohol																
		1,2 dichlorobenzene																
		1-methylphenol																
		bis (2-chloroisopropyl) ether																
		4-methylphenol																
		N-nitrosodi-n-propylamine																
		hexachloroethane																
		Nitrobenzene																
		Isophorone																
		2-nitrophenol																
		2,4-dimethylphenol																
		Benzoic acid																
		2,4-dichlorophenol																
		1,2,4-trichlorobenzene																
		Naphthalene																
		4 chloro 3 methylphenol																
		Dimethyl phthalate																
		Acenaphthylene																
		Acenaphthene																
		Diethyl phthalate																
		bis (2-ethylhexyl) phthalate	27,000J		33,000	2				39,000	44				22,000	19	39,000	44
		Petroleum Hydrocarbons (mg/kg)			1,500		560			2,400		336			980		650	

Footnotes
[1] The surfactant used was Triton x 100 manufactured by Rohm & Haas
[2] System Contact time is the total time the sample was in contact with the fluid
This is contrasted with stage contact time which refers to the time the sample is in contact with the fluid in a single stage. Each process trial (PT) in the treatability study consisted of 3 stages
[3] Before final wash refers to the treated sample before it undergoes a final wash treatment with distilled water
[4] After final wash refers to the treated sample after it undergoes a final wash treatment with distilled water
[5] J values mean estimated concentrations

TABLE 2 (continued)
RESULTS OF ORGANICS REMOVAL - KINETICS TRIALS
EXTRACTION WITH 5% AQUEOUS SURFACTANT SOLUTION [1]
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

RESIDUAL CONCENTRATION, SYSTEM CONTACT TIME, AND PERCENT REMOVAL

Raw Sample I.D.	Sample Name	Organics Analyzed	Concentration in Raw Sample (ug/kg)	System Contact Time (Min) [2]	PT-16 Before Final Wash (ug/kg) [3]	PT-16 Removal (%)	PT-16 After Final Wash (ug/kg) [4]	PT-16 Removal (%)	PT-20 System Contact Time (Min)	PT-20 Before Final Wash (ug/kg)	PT-20 Removal (%)	PT-20 After Final Wash (ug/kg)	PT-20 Removal (%)	PT-24 System Contact Time (Min)	PT-24 Before Final Wash (ug/kg)	PT-24 Removal (%)	PT-24 After Final Wash (ug/kg)	PT-24 Removal (%)
		TCL Volatiles																
CET-5	Sludge	Chloromethane		45					90					135				
	Tank & Pi	Bromomethane																
	Composite	Methylene Chloride	970,000															
		Acetone	2,100,000															
		Carbon Disulfide																
		1,1-Dichloroethene																
		1,1-Dichloroethane																
		trans-1,2-Dichloroethene																
		Chloroform	4,800,000															
		1,2-Dichloroethane	1,700,000															
		2-Butanone	5,900,000															
		1,1,1-Trichloroethane	600,000 J															
		Carbon Tetrachloride	11,000,000															
		Vinyl Acetate	2,100,000															
		Bromodichloromethane																
		1,2-Dichloropropane																
		Trichloroethene	1,500,000															
		Dibromochloromethane																
		1,1,2-Trichloroethane																
		Benzene	970,000															
		trans-1,3-Dichloropropene																
		Bromoform																
		4-Methyl-2-Pentanone	2,400,000															
		2-Hexanone																
		Tetrachloroethene	70,000,000 BD		3,700,000	95	8,200,000	88		74,000	100	33,000	100		4,000,000	94	4,800,000	93
		1,1,2,2-Tetrachloroethane																
		Toluene	29,000,000 B		850,000	97	2,300,000	92		16,000	100	6,600	100		1,100,000	96	1,300,000	96
		Chlorobenzene																
		Ethylbenzene	3,000,000		250,000	92	650,000	78							230,000	92	330,000	89
		Styrene																
		Xylenes	12,000,000		1,100,000	91	2,600,000	78		43,000	100	30,000	100		1,100,000	91	1,300,000	89
		Semivolatiles																
		Phenol	4,000,000		722,000	82	480,000	88		347,000	91	780,000	81		601,000	85	530,000	87
		bis (2-chloroethyl) ether	350,000															
		1,2-dichlorobenzene	16,000,000		1,600,000	90	2,000,000	88		337,000	98	1,350,000	92		940,000	94	890,000	94
		2-methylphenol	66,000 J															
		bis (2-chloroisopropyl) ether																
		4-methylphenol	41,000 J															
		N nitrosodi-n-propylamine																
		hexachloroethane																
		Nitrobenzene																
		Isophorone	350,000															
		1,2,4-trichlorobenzene	920,000		165,000	82	196,000	79		76,000	92	350,000	62		157,000	83	130,000	86
		Naphthalene	290,000 J		51,000	82												
		4-chloro-3-methylphenol																
		Dimethyl phthalate	260,000 J															
		2-Methylnaphthalene	140,000 J															
		bis(2-ethylhexyl) phthalate	2,700,000		304,000	89	522,000	81		326,000	88	1,180,000	57		444,000	84	560,000	-79
		Di-n-octylphthalate	59,000 J															
		Butylbenzylphthalate	300,000 J		51,000	83	82,000	72		54,000	82	180,000	40				760,000	-153
		Di-n-butylphthalate	270,000 J									360,000	-33					
		Diethyl phthalate	2,800,000		519,000	81	638,000	77		315,000	89	1,190,000	58		627,000	78	130,000	95
		Anthracene																
		Pyrene																
		Petroleum Hydrocarbons (mg/kg)			31,000		57,000			28,000		36,000			31,000		41,000	

Footnotes
[1] The surfactant used was Triton x-100 manufactured by Rohm & Haas
[2] System Contact time is the total time the sample was in contact with the fluid
This is contrasted with stage contact time which refers to the time the sample is in contact with the fluid in a single stage. Each process trial (PT) in the treatability study consisted of 3 stages
[3] Before final wash refers to the treated sample before it undergoes a final wash treatment with distilled water
[4] After final wash refers to the treated sample after it undergoes a final wash treatment with distilled water
[5] "J" values mean estimated concentrations
"B" values mean detected in the blank
"D" values mean the sample was diluted

TABLE 3
RESULTS OF ORGANICS REMOVAL - KINETICS TRIALS
EXTRACTION WITH 5% AQUEOUS CITRIKLEEN SOLUTION
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

RESIDUAL CONCENTRATION, SYSTEM CONTACT TIME, AND PERCENT REMOVAL

Raw Sample I.D.	Sample Name	Organics Analyzed	Concentration in Raw Sample (ug/kg)	PT-26 System Contact Time (Min)[1]	PT-26 Before Final Wash (ug/kg)[2]	PT-26 Removal (%)	PT-26 After Final Wash (ug/kg)[3]	PT-26 Removal (%)	PT-30 System Contact Time (Min)	PT-30 Before Final Wash ug/kg	PT-30 Removal (%)	PT-30 After Final Wash (ug/kg)	PT-30 Removal (%)	PT-34 System Contact Time (Min)	PT-34 Before Final Wash ug/kg	PT-34 Removal (%)	PT-34 After Final Wash (ug/kg	PT-34 Removal (%)
		TCL Volatiles																
CET-4	Overall Soil Composite	Chloromethane		45					90					135				
		Bromomethane																
		Methylene Chloride	1,300															
		Acetone	2,400															
		Carbon Disulfide																
		1,1-Dichloroethene																
		1,1-Dichloroethane	86															
		trans-1,2-Dichloroethene	710															
		Chloroform	3,800															
		1,2-Dichloroethane	130															
		2-Butanone	53 J															
		1,1,1-Trichloroethane	150															
		Carbon Tetrachloride																
		Vinyl Acetate																
		Bromodichloromethane																
		1,2-Dichloropropane																
		Trichloroethene	1,800															
		Dibromochloromethane																
		1,1,2-Trichloroethane																
		Benzene	450															
		trans-1,3-Dichloropropene																
		Bromoform																
		4-Methyl-2-Pentanone	160															
		2-Hexanone																
		Tetrachloroethene	7,600												2,400	68	1,400	82
		1,1,2,2-Tetrachloroethane																
		Toluene	3,600															
		Chlorobenzene	45															
		Ethylbenzene	1,200															
		Styrene																
		Xylenes	14,000		1,200	91	1,300	91							1,200	91		
		Semivolatiles																
		Phenol			ND													
		bis (2-chloroethyl) ether																
		2-chlorophenol																
		1,3-dichlorobenzene																
		1,4-dichlorobenzene																
		Benzyl alcohol																
		1,2-dichlorobenzene																
		1-methylphenol																
		bis (2-chloroisopropyl) ether																
		4 methylphenol																
		N nitrosodi-n-propylamine																
		hexachloroethane																
		Nitrobenzene																
		Isophorone																
		2 nitrophenol																
		2,4-dimethylphenol																
		Benzoic acid																
		2,4-dichlorophenol																
		1,2,4-trichlorobenzene																
		Naphthalene																
		4 chloro-3 methylphenol																
		Dimethyl phthalate																
		Acenaphthylene																
		Acenaphthene																
		4 nitrophenol																
		bis(2 ethylhexyl) phthalate	27,000 J															
		Diethyl phthalate																
		Petroleum Hydrocarbons(mg/kg)			490		310			3,000		430			1,700		1,700	

Footnotes
[1] System Contact time is the total time the sample was in contact with the fluid
This is contrasted with stage contact time which refers to the time the sample is in contact with the fluid in a single stage. Each process trial (PT) in the treatability study consisted of 3 stages
[2] Before final wash refers to the treated sample before it undergoes a final wash treatment with distilled water
[3] After final wash refers to the treated sample after it undergoes a final wash treatment with distilled water
[4] J values mean estimated concentrations

TABLE 3 (continued)
RESULTS OF ORGANICS REMOVAL - KINETICS TRIALS
EXTRACTION WITH 5% AQUEOUS CITRIKLEEN SOLUTION
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

RESIDUAL CONCENTRATION, SYSTEM CONTACT TIME, AND PERCENT REMOVAL

Raw Sample I.D.	Sample Name	Organics Analyzed	Concentration in Raw Sample (ug/kg)	PT-28 System Contact Time (Min)[1]	PT-28 Before Final Wash (ug/kg)[2]	PT-28 Removal (%)	PT-28 After Final Wash (ug/kg)[3]	PT-28 Removal (%)	PT-32 System Contact Time (Min)	PT-32 Before Final Wash (ug/kg)	PT-32 Removal (%)	PT-32 After Final Wash (ug/kg)	PT-32 Removal (%)	PT-36 System Contact Time (Min)	PT-36 Before Final Wash (ug/kg)	PT-36 Removal (%)	PT-36 After Final Wash (ug/kg)	PT-36 Removal (%)
		TCL Volatiles																
CET-5	Sludge Tank & Pit Composite	Chloromethane		45					90					135				
		Bromomethane																
		Methylene Chloride	970,000				72,000	93				40,000	96					
		Acetone	2,100,000															
		Carbon Disulfide																
		1,1-Dichloroethene																
		1,1-Dichloroethane																
		trans-1,2-Dichloroethene																
		Chloroform	4,800,000															
		1,2-Dichloroethane	1,700,000															
		2-Butanone	5,900,000															
		1,1,1-Trichloroethane	600,000 J															
		Carbon Tetrachloride	11,000,000		38,000	100				70,000	99							
		Vinyl Acetate	2,100,000															
		Bromodichloromethane																
		1,2-Dichloropropane																
		Trichloroethene	1,500,000															
		Dibromochloromethane																
		1,1,2-Trichloroethane																
		Benzene	970,000															
		trans-1,3-Dichloropropene																
		Bromoform																
		4-Methyl-2-Pentanone	2,400,000		38,000	98												
		2-Hexanone																
		Tetrachloroethene	70,000,000 BD		3,400,000	95	1,600,000	98		3,300,000	95	690,000	99		9,700,000	86	7,100,000	90
		1,1,2,2-Tetrachloroethane																
		Toluene	20,000,000 B		780,000	97	320,000	99		1,100,000	96	180,000	99		2,600,000	91	2,000,000	9[illegible]
		Chlorobenzene																
		Ethylbenzene	3,000,000		150,000	95	90,000	97		210,000	93	40,000	99		600,000	80	610,000	80
		Styrene																
		Xylenes	12,000,000		780,000	94	410,000	97		900,000	92	210,000	98		2,700,000	78	2,300,000	81
		Semivolatiles																
		Phenol	4,000,000															
		bis (2-chloroethyl) ether	350,000															
		2-chlorophenol																
		1,3-dichlorobenzene																
		1,4-dichlorobenzene																
		Benzyl alcohol																
		1,2-dichlorobenzene	16,000,000												3,020,000	81	2,430,000	85
		2-methylphenol	68,000 J															
		bis (2-chloroisopropyl) ether																
		4 methylphenol	41,000 J															
		Isophorone	350,000															
		2-nitrophenol																
		1,2,4-trichlorobenzene	920,000															
		Naphthalene	200,000 J															
		4-chloro-3-methylphenol																
		2-Methylnapthalene	140,000 J															
		bis(2-ethylhexyl) phthalate	2,700,000												1,360,000	50	1,060,000	61
		Di-n-octylphthalate	59,000 J															
		4 nitrophenol																
		Butylbenzylphthalate	300,000 J															
		Diethyl phthalate	2,800,000												1,210,000	57	1,220,000	56
		Dimethylphthalate	260,000 J															
		Di-n butylphthalate	270,000 J															
		Petroleum Hydrocarbons (mg/kg)			23,000		6,400			9,600		5,500			110,000		92,000	

[1] System Contact time is the total time the sample was in contact with the fluid
This is contrasted with stage contact time which refers to the time the sample is in contact with the fluid in a single stage. Each process trial (PT) in the treatability study consisted of 3 stages
[2] Before final wash refers to the treated sample before it undergoes a final wash treatment with distilled water
[3] After final wash refers to the treated sample after it undergoes a final wash treatment with distilled water

Footnotes
[4] "J" values mean estimated concentrations
[5] "B" values mean detected in the blank
[6] [illegible] values mean sample was diluted

TABLE 3 (continued)
RESULTS OF ORGANICS REMOVAL - KINETICS TRIALS
EXTRACTION WITH 5% AQUEOUS CITRIKLEEN SOLUTION
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

Raw Sample I.D.	Sample Name	Organics Analyzed	Concentration in Raw Sample (ug/kg)	RESIDUAL CONCENTRATION, SYSTEM CONTACT TIME, AND PERCENT REMOVAL: PT-27 System Contact Time (Min)[1]	PT-27 Before Final Wash (ug/kg)[2]	PT-27 Removal (%)	PT-27 After Final Wash (ug/kg)[3]	PT-27 Removal (%)	PT-31 System Contact Time (Min)	PT-31 Before Final Wash (ug/kg)	PT-31 Removal (%)	PT-31 After Final Wash (ug/kg)	PT-31 Removal (%)	PT-35 System Contact Time (Min)	PT-35 Before Final Wash (ug/kg)	PT-35 Removal (%)	PT-35 After Final Wash (ug/kg)	PT-35 Removal (%)
		TCL Volatiles																
CET-6	Sludge Hot Spot B/N	Chloromethane		45					90					135				
		Bromomethane																
		Methylene Chloride																
		Acetone																
		Carbon Disulfide																
		1,1-Dichloroethene																
		1,1-Dichloroethane																
		trans-1,2-Dichloroethene																
		Chloroform																
		1,2-Dichloroethane																
		2-Butanone																
		1,1,1-Trichloroethane																
		Carbon Tetrachloride																
		Vinyl Acetate																
		Bromodichloromethane																
		1,2-Dichloropropane																
		Trichloroethene																
		Dibromochloromethane																
		1,1,2-Trichloroethane																
		Benzene																
		trans-1,3-Dichloropropene																
		Bromoform																
		4-Methyl-2-Pentanone																
		2-Hexanone																
		Tetrachloroethene																
		1,1,2,2-Tetrachloroethane																
		Toluene																
		Chlorobenzene																
		Ethylbenzene																
		Styrene																
		Xylenes																
		Semivolatiles	ND												ND		ND	
		Phenol																
		bis (2-chloroethyl) ether																
		2-chlorophenol																
		1,3-dichlorobenzene																
		1,4-dichlorobenzene																
		Benzyl alcohol																
		1,2-dichlorobenzene			1,330,000		990,000											
		2-methylphenol																
		bis (2-chloroisopropyl) ether																
		4-methylphenol																
		N-nitrosodi-n-propylamine																
		hexachloroethane																
		Nitrobenzene																
		Isophorone																
		2-nitrophenol																
		2,4-dimethylphenol																
		Naphthalene																
		4-chloro-3-methylphenol																
		Dimethyl phthalate																
		2-Methylnapthalene																
		bis(2-ethylhexyl) phthalate			740,000		490,000											
		Di-n-octylphthalate																
		4-nitrophenol																
		Butylbenzylphthalate																
		Diethyl phthalate			590,000		370,000											
		Dimethylphthalate																
		Petroleum Hydrocarbons (mg/kg)																

Footnotes [1] System Contact time is the total time the sample was in contact with the fluid
This is contrasted with stage contact time which refers to the time the sample is in contact with the fluid in a single stage. Each process trial (PT) in the treatability study consisted of 3 stages
[2] Before final wash refers to the treated sample before it undergoes a final wash treatment with distilled water
[3] After final wash refers to the treated sample after it undergoes a final wash treatment with distilled water
[4] "J" values mean estimated concentrations

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TABLE 4
RESULTS OF ORGANICS REMOVAL - KINETICS TRIALS
EXTRACTION WITH 10% AQUEOUS CITRIKLEEN SOLUTION
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

Raw Sample I.D.	Sample Name	Organics Analyzed	Concentration in Raw Sample (ug/kg)	PT-39 System Contact Time (Min)[1]	PT-39 Before Final Wash (ug/kg)[2]	PT-39 Removal (%)	PT-39 After Final Wash (ug/kg)[3]	PT-39 Removal (%)	PT-42 System Contact Time (Min)	PT-42 Before Final Wash ug/kg	PT-42 Removal (%)	PT-42 After Final Wash (ug/kg)	PT-42 Removal (%)	PT-46 System Contact Time (Min)	PT-46 Before Final Wash ug/kg	PT-46 Removal (%)	PT-46 After Final Wash (ug/kg)	PT-46 Removal (%)
				RESIDUAL CONCENTRATION, SYSTEM CONTACT TIME AND PERCENT REMOVAL														
		TCL Volatiles																
CET-4	Overall Soil Composite	Chloromethane		45					80					135				
		Bromomethane																
		Methylene Chloride	1,300															
		Acetone	2,400									1,200	50					
		Carbon Disulfide																
		1,1-Dichloroethene																
		1,1-Dichloroethane	68															
		trans-1,2-Dichloroethene	710															
		Chloroform	3,600															
		1,2-Dichloroethane	130															
		2-Butanone	63 J															
		1,1,1-Trichloroethane	150															
		Carbon Tetrachloride																
		Vinyl Acetate																
		Bromodichloromethane																
		1,2-Dichloropropane																
		Trichloroethene	1,800															
		Dibromochloromethane																
		1,1,2-Trichloroethane																
		Benzene	450															
		trans-1,3-Dichloropropene																
		Bromoform																
		4-Methyl 2-Pentanone	160															
		2-Hexanone																
		Tetrachloroethene	7,600															
		1,1,2,2-Tetrachloroethane																
		Toluene	3,600															
		Chlorobenzene	45															
		Ethylbenzene	1,200															
		Styrene																
		Xylenes	14,000									1,400	90		3,000	79	1,100	92
		Semivolatiles																
		Phenol																
		bis (2-chloroethyl) ether																
		2-chlorophenol																
		1,3-dichlorobenzene																
		1,4-dichlorobenzene																
		Benzyl alcohol																
		1,2-dichlorobenzene																
		1-methylphenol																
		bis (2-chloroisopropyl) ether																
		4-methylphenol																
		N-nitroso-di-n-propylamine																
		hexachloroethane																
		Nitrobenzene																
		Isophorone																
		2-nitrophenol																
		2,4-dimethylphenol																
		Benzoic acid																
		2,4-dichlorophenol																
		1,2,4-trichlorobenzene																
		Naphthalene																
		4-chloro-3-methylphenol																
		Dimethyl phthalate																
		Diethyl phthalate																
		bis (2-ethylhexyl) phthalate	27,000 J															
		Petroleum Hydrocarbons (mg/kg)			2,200		330			430		1,700			1,400		380	

Footnotes [1] The surfactant used was Triton x 100 manufactured by Rohm & Haas
[2] System Contact time is the total time the sample was in contact with the fluid
This is contrasted with stage contact time which refers to the time the sample is in contact with the fluid in a single stage. Each process trial (PT) in the treatability study consisted of 3 stages
[3] [illegible] final wash refers to the treated sample before it undergoes a final wash treatment with distilled water
[illegible] final wash refers to the treated sample after it undergoes a final wash treatment with distilled water
[illegible] J [illegible] estimated concentrations

TABLE 4 (continued)
RESULTS OF ORGANICS REMOVAL - KINETICS TRIALS
EXTRACTION WITH 10% AQUEOUS CITRIKLEEN SOLUTION
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

Raw Sample I.D.	Sample Name	Organics Analyzed	Concentration in Raw Sample (ug/kg)	RESIDUAL CONCENTRATION, SYSTEM CONTACT TIME AND PERCENT REMOVAL: PT-40 System Contact Time (Min)[1]	PT-40 Before Final Wash (ug/kg)[2]	PT-40 Removal (%)	PT-40 After Final Wash (ug/kg)[3]	PT-40 Removal (%)	PT-44 System Contact Time (Min)	PT-44 Before Final Wash (ug/kg)	PT-44 Removal (%)	PT-44 After Final Wash (ug/kg)	PT-44 Removal (%)	PT-48 System Contact Time (Min)	PT-48 Before Final Wash (ug/kg)	PT-48 Removal (%)	PT-48 After Final Wash (ug/kg)	PT-48 Removal (%)
		TCL Volatiles																
CET-5	Sludge	Chloromethane		45					90					135				
	Tank & Pit	Bromomethane																
	Composite	Methylene Chloride	970,000															
		Acetone	2,100,000															
		Carbon Disulfide																
		1,1 Dichloroethene																
		1,1 Dichloroethane																
		trans-1,2-Dichloroethene																
		Chloroform	4,800,000															
		1,2 Dichloroethane	1,700,000															
		2-Butanone	5,800,000															
		1,1,1-Trichloroethane	600,000 J															
		Carbon Tetrachloride	11,000,000							87,000	99	49,000	100		73,000	99	91,000	99
		Vinyl Acetate	2,100,000															
		Bromodichloromethane																
		1,2 Dichloropropane																
		Trichloroethene	1,500,000															
		Dibromochloromethane																
		1,1,2 Trichloroethane																
		Benzene	870,000															
		trans-1,3-Dichloropropane																
		Bromoform																
		4-Methyl-2 Pentanone	2,400,000															
		2 Hexanone																
		Tetrachloroethene	70,000,000 BD		330,000	100	450,000	99		3,600,000	95	2,800,000	96		4,400,000	94	3,900,000	94
		1,1,2,2-Tetrachloroethane																
		Toluene	29,000,000 B		73,000	100	98,000	100		870,000	97	670,000	98		910,000	97	1,100,000	96
		Chlorobenzene																
		Ethylbenzene	3,000,000		24,000	99	28,000	99		170,000	94	150,000	95		190,000	94	220,000	93
		Styrene																
		Xylenes	12,000,000		130,000	99	150,000	99		810,000	93	700,000	94		920,000	92	1,000,000	92
		Semivolatiles																
		Phenol	4,000,000							360,000	91							
		bis (2-chloroethyl) ether	350,000															
		1,2 dichlorobenzene	16,000,000							1,160,000	93	1,390,000	91		1,900,000	88	1,400,000	91
		2 methylphenol	68,000 J															
		bis (2 chloroisopropyl) ether																
		4 methylphenol	41,000 J															
		N nitrosodi-n-propylamine																
		hexachloroethane																
		Nitrobenzene																
		Isophorone	350,000															
		2 nitrophenol																
		2,4-dimethylphenol																
		1,2,4 trichlorobenzene	920,000							140,000	85							
		Naphthalene	290,000 J															
		4-chloro-3 methylphenol																
		Dimethyl phthalate	260,000 J															
		Di-n butylphthalate	270,000 J															
		Acenaphthene																
		2,4 dinitrophenol																
		Di-n-octylphthalate	59,000 J															
		2 Methylnapthalene	140,000 J															
		Diethyl phthalate	2,800,000							530,000	81							
		bis (2 ethylhexyl) phthalate	2,700,000							480,000	82							
		Butylbenzylphthalate	300,000 J															
		Petroleum Hydrocarbons (mg/kg)			13,000		12,000			20,000		10,000			22,000		34,000	

Footnotes
[1] The surfactant used was Triton x-100 manufactured by Rohm & Haas
[2] System Contact time is the total time the sample was in contact with the fluid
This is contrasted with stage contact time which refers to the time the sample is in contact with the fluid in a single stage. Each process trial (PT) in the treatability study consisted of 3 stages
[3] Before final wash refers to the treated sample before it undergoes a final wash treatment with distilled water
[4] After final wash refers to the treated sample after it undergoes a final wash treatment with distilled water
[5] "J" values mean estimated concentrations

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TABLE 4 (continued)
RESULTS OF ORGANICS REMOVAL - KINETICS TRIALS
EXTRACTION WITH 10% AQUEOUS CITRIKLEEN SOLUTION
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

Raw Sample I.D.	Sample Name	Organics Analyzed	Concentration in Raw Sample (ug/kg)	PT-39 System Contact Time (Min)[1]	PT-39 Before Final Wash (ug/kg)[2]	PT-39 Removal (%)	PT-39 After Final Wash (ug/kg)[3]	PT-39 Removal (%)	PT-43 System Contact Time (Min)	PT-43 Before Final Wash (ug/kg)	PT-43 Removal (%)	PT-43 After Final Wash (ug/kg)	PT-43 Removal (%)	PT-47 System Contact Time (Min)	PT-47 Before Final Wash (ug/kg)	PT-47 Removal (%)	PT-47 After Final Wash (ug/kg)	PT-47 Removal (%)
		RESIDUAL CONCENTRATION, SYSTEM CONTACT TIME AND PERCENT REMOVAL																
CET-6	Sludge Hot Spot B/N	TCL Volatiles																
		Chloromethane		45					90					135				
		Bromomethane																
		Methylene Chloride																
		Acetone																
		Carbon Disulfide																
		1,1-Dichloroethene																
		1,1-Dichloroethane																
		trans-1,2-Dichloroethene																
		Chloroform																
		1,2-Dichloroethane																
		2-Butanone																
		1,1,1-Trichloroethane																
		Carbon Tetrachloride																
		Vinyl Acetate																
		Bromodichloromethane																
		1,2-Dichloropropane																
		Trichloroethene																
		Dibromochloromethane																
		1,1,2-Trichloroethane																
		Benzene																
		trans-1,3-Dichloropropene																
		Bromoform																
		4-Methyl-2-Pentanone																
		2-Hexanone																
		Tetrachloroethene																
		1,1,2,2-Tetrachloroethane																
		Toluene																
		Chlorobenzene																
		Ethylbenzene																
		Styrene																
		Xylenes																
		Semivolatiles	ND		ND		ND								ND		ND	
		Phenol																
		bis (2-chloroethyl) ether																
		2-chlorophenol																
		1,3-dichlorobenzene																
		1,4-dichlorobenzene																
		Benzyl alcohol																
		1,2-dichlorobenzene								69,000		410,000						
		2-methylphenol																
		bis (2-chloroisopropyl) ether																
		4-methylphenol																
		N-nitroso-di-n-propylamine																
		hexachloroethane																
		Nitrobenzene																
		Isophorone																
		2-nitrophenol																
		2,4-dimethylphenol																
		Benzoic acid																
		2,4-dichlorophenol																
		1,2,4-trichlorobenzene																
		Naphthalene																
		4-chloro-3-methylphenol																
		Dimethyl phthalate																
		Diethyl phthalate								83,000								
		bis (2-ethylhexyl) phthalate								83,000								
		Butylbenzylphthalate																

Footnotes
[1] The surfactant used was Triton x-100 manufactured by Rohm & Haas
[2] System Contact time is the total time the sample was in contact with the fluid
This is contrasted with stage contact time which refers to the time the sample is in contact with the fluid in a single stage. Each process trial (PT) in the treatability study consisted of 3 stages
[3] Before final wash refers to the treated sample before it undergoes a final wash treatment with distilled water
[4] After final wash refers to the treated sample after it undergoes a final wash treatment with distilled water
[5] values mean estimated concentrations

TABLE 5
RESULTS OF PCB/PESTICIDES REMOVAL - KINETICS TRIALS
EXTRACTION WITH 5% AQUEOUS SURFACTANT SOLUTION [1]
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

RESIDUAL CONCENTRATIONS, SYSTEM CONTACT TIME AND PERCENT REMOVAL

Raw Sample I.D.	Sample Name	Organics Analyzed	Concentration in Raw Sample (ug/kg)	PT-13 System Contact Time (Min) [2]	PT-13 Before Final Wash (ug/kg)	PT-13 Removal (%)	PT-13 After Final Wash (ug/kg)	PT-13 Removal (%)	PT-17 System Contact Time (Min)	PT-17 Before Final Wash (ug/kg)	PT-17 Removal (%)	PT-17 After Final Wash (ug/kg)	PT-17 Removal (%)	PT-21 System Contact Time (Min)	PT-21 Before Final Wash (ug/kg)	PT-21 Removal (%)	PT-21 After Final Wash (ug/kg)	PT-21 Removal (%)
CET-2	Soil Hot Spot PCBs	Pesticides		48					90					135				
		Alpha BHC																
		Beta BHC																
		Delta BHC																
		Gamma BHC -Lindane																
		Heptachlor																
		Aldrin	580 J		110 J	81	200 J	66		130 J	78	250 J	57		120 J	79	210 J	64
		Heptachlor Epoxide																
		Endosulfan I																
		Dieldrin	590 J		190 J	68	290 J	51							230 J	61	260 J	56
		DDE																
		Endrin																
		Endosulfan II																
		DDD																
		Endosulfan Sulfate																
		DDT																
		Endrin Ketone																
		Methoxychlor																
		Alpha Chlordane																
		Gamma Chlordane																
		Toxaphene																
		PCBs																
		PCB-1016																
		PCB-1221																
		PCB-1232																
		PCB-1242			107,000		149,000			243,000		248,000			160,000		154,000	
		PCB-1248																
		PCB-1254																
		PCB-1260																
		Arochlor 1254								5,200 J		3,800 J						
		Arochlor-1260	5,200 J		1,300 J	75	2,800 J	46							1,400 J	73	1,600 J	69

[1] The surfactant used was manufactured by Rohm & Haas.
[2] System contact time is the total time the sample was in contact with the fluid.
This is contrasted with stage contact time which refers to the time the sample is in contact with the fluid in a single stage. Each process trial (PT) in the treatability study consisted of 3 stages.
[3] "J" values mean estimated concentrations

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TABLE 5 (continued)
RESULTS OF PCB/PESTICIDES REMOVAL - KINETICS TRIALS
EXTRACTION WITH 5% AQUEOUS SURFACTANT SOLUTION [1]
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

RESIDUAL CONCENTRATIONS, SYSTEM CONTACT TIME AND PERCENT REMOVAL

Raw Sample I.D.	Sample Name	Organics Analyzed	Concentration in Raw Sample (ug/kg)	PT-14 System Contact Time (Min) [2]	PT-14 Before Final Wash (ug/kg)	PT-14 Removal (%)	PT-14 After Final Wash (ug/kg)	PT-14 Removal (%)	PT-18 System Contact Time (Min)	PT-18 Before Final Wash (ug/kg)	PT-18 Removal (%)	PT-18 After Final Wash (ug/kg)	PT-18 Removal (%)	PT-22 System Contact Time (Min)	PT-22 Before Final Wash (ug/kg)	PT-22 Removal (%)	PT-22 After Final Wash (ug/kg)	PT-22 Removal (%)
CET-3	Soil Hot Spot Composite	Pesticides		48					90					135				
		Alpha BHC																
		Beta BHC																
		Delta BHC																
		Gamma BHC -Lindane																
		Heptachlor																
		Aldrin			1,300 J		650 J								850 J			
		Heptachlor Epoxide																
		Endosulfan I																
		Dieldrin	780 J		780 J	0	1,300 J	-65				460 J	42		630 J	20	1,500 J	-90
		DDE																
		Endrin																
		Endosulfan II																
		DDD																
		Endosulfan Sulfate																
		DDT																
		Endrin Ketone										980 J						
		Methoxychlor																
		Alpha Chlordane																
		Gamma Chlordane																
		Toxaphene																
		PCBs																
		PCB-1016																
		PCB-1221																
		PCB-1232																
		PCB-1242			119,000		160,000					89,000			72,000		134,000	
		PCB-1248																
		PCB-1254																
		PCB-1260																
		Arochlor-1254	22,000 J		7,400 J	66	12,000 J	45		7,400 J	66	5,200 J	76		4,900 J	78	14,000 J	36
		Arochlor-1242	190,000							52,000 J	73							

[1] The surfactant used was manufactured by Rohm & Haas.
[2] System contact time is the total time the sample was in contact with the fluid.
This is contrasted with stage contact time which refers to the time the sample is in contact with the fluid in a single stage. Each process trial (PT) in the treatability study consisted of 3 stages.
[3] "J" values mean estimated concentrations

TABLE 5 (continued)
RESULTS OF PCB/PESTICIDES REMOVAL - KINETICS TRIALS
EXTRACTION WITH 5% AQUEOUS SURFACTANT SOLUTION [1]
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

RESIDUAL CONCENTRATIONS, SYSTEM CONTACT TIME AND PERCENT REMOVAL

Raw Sample I.D.	Sample Name	Organics Analyzed	Concentration in Raw Sample (ug/kg)	PT-15 System Contact Time (Min) [2]	PT-15 Before Final Wash (ug/kg)	PT-15 Removal (%)	PT-15 After Final Wash (ug/kg)	PT-15 Removal (%)	PT-19 System Contact Time (Min)	PT-19 Before Final Wash (ug/kg)	PT-19 Removal (%)	PT-19 After Final Wash (ug/kg)	PT-19 Removal (%)	PT-23 System Contact Time (Min)	PT-23 Before Final Wash (ug/kg)	PT-23 Removal (%)	PT-23 After Final Wash (ug/kg)	PT-23 Removal (%)
CET-4	Overall Soil Composite	**Pesticides**		45					88					135				
		Alpha BHC																
		Beta BHC																
		Delta BHC																
		Gamma BHC -Lindane																
		Heptachlor																
		Aldrin			310 J		270 J					240 J			310 J		590 J	
		Heptachlor Epoxide																
		Endosulfan I																
		Dieldrin	170 J		180 J	-6	240 J	-41		810 J	-376	230 J	-35		200 J	-18	430 J	-153
		DDE																
		Endrin																
		Endosulfan II																
		DDD																
		Endosulfan Sulfate																
		DDT																
		Endrin Ketone																
		Methoxychlor																
		Alpha Chlordane																
		Gamma Chlordane																
		Toxaphene																
		PCBs																
		PCB-1016																
		PCB-1221																
		PCB-1232																
		PCB-1242					39,000			39,000					28,000			
		PCB-1248																
		PCB-1254																
		PCB-1260																
		Arochlor-1242			9,500 J		2,700 J			5,200 J		8,900 J			2,000 J		1,300 J	
		Arochlor-1254			2,200 J							2,000 J					3,200 J	
		Arochlor-1260																

[1] The surfactant used was manufactured by Rohm & Haas.
[2] System contact time is the total time the sample was in contact with the fluid.
This is contrasted with stage contact time which refers to the time the sample is in contact with the fluid in a single stage. Each process trial (PT) in the treatability study consisted of 3 stages.
[3] "J" values mean estimated concentrations

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TABLE 5 (continued)
RESULTS OF PCB/PESTICIDES REMOVAL - KINETICS TRIALS
EXTRACTION WITH 5% AQUEOUS SURFACTANT SOLUTION [1]
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

RESIDUAL CONCENTRATIONS, SYSTEM CONTACT TIME AND PERCENT REMOVAL

Raw Sample I.D.	Sample Name	Organics Analyzed	Concentration in Raw Sample (ug/kg)	PT-16 System Contact Time (Min) [2]	PT-16 Before Final Wash (ug/kg)	PT-16 Removal (%)	PT-16 After Final Wash (ug/kg)	PT-16 Removal (%)	PT-20 System Contact Time (Min)	PT-20 Before Final Wash (ug/kg)	PT-20 Removal (%)	PT-20 After Final Wash (ug/kg)	PT-20 Removal (%)	PT-24 System Contact Time (Min)	PT-24 Before Final Wash (ug/kg)	PT-24 Removal (%)	PT-24 After Final Wash (ug/kg)	PT-24 Removal (%)
CET-5	Sludge Tank & Pit Composite	*Pesticides*		48					90					135				
		Alpha BHC																
		Beta BHC																
		Delta BHC																
		Gamma BHC -Lindane								3,300 J		3,800 J			3,200 J		3,200 J	
		Heptachlor																
		Aldrin																
		Heptachlor Epoxide																
		Endosulfan I																
		Dieldrin																
		DDE																
		Endrin																
		Endosulfan II																
		DDD																
		Endosulfan Sulfate																
		DDT																
		Endrin Ketone																
		Methoxychlor																
		Alpha Chlordane																
		Gamma Chlordane																
		Toxaphene																
		PCBs																
		PCB-1016																
		PCB-1221																
		PCB-1232																
		PCB-1242			14,400		17,300			33,700		52,800			31,300		41,100	
		PCB-1248																
		PCB-1254			1,580		1,730			3,700		2,810			1,700		3,450	
		PCB-1260																
		Arochlor-1242	130,000,000															
		Arochlor-1254	16,000,000 J															
		Arochlor-1260																

[1] The surfactant used was manufactured by Rohm & Haas.
[2] System contact time is the total time the sample was in contact with the fluid.
This is contrasted with stage contact time which refers to the time the sample is in contact with the fluid in a single stage. Each process trial (PT) in the treatability study consisted of 3 stages.
[3] "J" values mean estimated concentrations

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TABLE 6
RESULTS OF PCB/PESTICIDES REMOVAL - KINETICS TRIALS
EXTRACTION WITH 5% AQUEOUS CITRIKLEEN SOLUTION
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

RESIDUAL CONCENTRATION, SYSTEM CONTACT TIME, AND PERCENT REMOVAL

Raw Sample I.D.	Sample Name	Organics Analyzed	Concentration in Raw Sample (ug/kg)	PT-25 System Contact Time (Min) [1]	PT-25 Before Final Wash (ug/kg)	PT-25 Removal (%)	PT-25 After Final Wash (ug/kg)	PT-25 Removal (%)	PT-29 System Contact Time (Min)	PT-29 Before Final Wash (ug/kg)	PT-29 Removal (%)	PT-29 After Final Wash (ug/kg)	PT-29 Removal (%)	PT-33 System Contact Time (Min)	PT-33 Before Final Wash (ug/kg)	PT-33 Removal (%)	PT-33 After Final Wash (ug/kg)	PT-33 Removal (%)
CET-2	Soil Hot Spot PCBs	Pesticides		45					90					135				
		Alpha BHC															24 J	
		Beta BHC																
		Delta BHC																
		Gamma BHC -Lindane																
		Heptachlor																
		Aldrin	580 J							130 J	78	110 J	81		170 J	71	180 J	69
		Heptachlor Epoxide																
		Endosulfan I																
		Dieldrin	590 J							230 J	61				510 J	14		
		DDE																
		Endrin																
		Endosulfan II																
		DDD																
		Endosulfan Sulfate																
		DDT																
		Endrin Ketone																
		Methoxychlor																
		Alpha Chlordane																
		Gamma Chlordane																
		Toxaphene																
		PCB-1016																
		PCB-1221																
		PCB-1232																
		PCB-1242			93,000		98,000			147,000		112,000					250,000	
		PCB-1248																
		PCB-1254																
		PCB-1260																
		Arochlor 1242													23,000 J			
		Arochlor 1254													4,800 J			
		Arochlor 1260	5,200 J							2,200 J	58	2,600 J	50					

[1] System contact time is the total time the sample was in contact with the fluid. This is contrasted with stage contact time which refers to the time the sample is in contact with the fluid in a single stage. Each process trial (PT) in the treatability study consisted of 3 stages.
[2] "J" values mean estimated concentrations

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TABLE 6 (continued)
RESULTS OF PCB/PESTICIDES REMOVAL - KINETICS TRIALS
EXTRACTION WITH 5% AQUEOUS CITRIKLEEN SOLUTION
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

RESIDUAL CONCENTRATION, SYSTEM CONTACT TIME, AND PERCENT REMOVAL

Raw Sample I.D.	Sample Name	Organics Analyzed	Concentration in Raw Sample (ug/kg)	PT-26 System Contact Time (Min) [1]	PT-26 Before Final Wash (ug/kg)	PT-26 Removal (%)	PT-26 After Final Wash (ug/kg)	PT-26 Removal (%)	PT-30 System Contact Time (Min)	PT-30 Before Final Wash (ug/kg)	PT-30 Removal (%)	PT-30 After Final Wash (ug/kg)	PT-30 Removal (%)	PT-34 System Contact Time (Min)	PT-34 Before Final Wash (ug/kg)	PT-34 Removal (%)	PT-34 After Final Wash (ug/kg)	PT-34 Removal (%)
CET-4	Overall Soil Composite	Pesticides		45					90					135				
		Alpha BHC																
		Beta BHC																
		Delta BHC																
		Gamma BHC -Lindane																
		Heptachlor																
		Aldrin			2,300					35 J								
		Heptachlor Epoxide																
		Endosulfan I																
		Dieldrin	170 J				24,000	-14,018		89 J	48				130 J	24	72 J	58
		DDE																
		Endrin																
		Endosulfan II																
		DDD																
		Endosulfan Sulfate																
		DDT																
		Endrin Ketone																
		Methoxychlor																
		Alpha Chlordane																
		Gamma Chlordane																
		Toxaphene																
		PCBs																
		PCB-1016																
		PCB-1221																
		PCB-1232																
		PCB-1242													26,000		21,000	
		PCB-1248																
		PCB-1254																
		PCB-1260																
		AROCHLOR 1242								5,500 J								
		AROCHLOR 1254																
		AROCHLOR 1260																

(1) System contact time is the total time the sample was in contact with the fluid. This is contrasted with stage contact time which refers to the time the sample is in contact with the fluid in a single stage. Each process trial (PT) in the treatability study consisted of 3 stages.

(2) "J" values mean estimated concentrations

TABLE 6 (continued)
RESULTS OF PCB/PESTICIDES REMOVAL - KINETICS TRIALS
EXTRACTION WITH 5% AQUEOUS CITRIKLEEN SOLUTION
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

				RESIDUAL CONCENTRATION, SYSTEM CONTACT TIME, AND PERCENT REMOVAL														
				PT-28					PT-32					PT-36				
Raw Sample I.D.	Sample Name	Organics Analyzed	Concentration in Raw Sample (ug/kg)	System Contact Time (Min) [1]	Before Final Wash (ug/kg)	Removal (%)	After Final Wash (ug/kg)	Removal (%)	System Contact Time (Min)	Before Final Wash (ug/kg)	Removal (%)	After Final Wash (ug/kg)	Removal (%)	System Contact Time (Min)	Before Final Wash ug/kg	Removal (%)	After Final Wash (ug/kg)	Removal (%)
CET-5	Sludge Tank & Pa Composite	Pesticides		45					90					135				
		Alpha BHC																
		Beta BHC																
		Delta BHC																
		Gamma BHC -Lindane																
		Heptachlor																
		Aldrin																
		Heptachlor Epoxide																
		Endosulfan I																
		Dieldrin																
		DDE																
		Endrin																
		Endosulfan II																
		DDD																
		Endosulfan Sulfate																
		DDT																
		Endrin Ketone																
		Methoxychlor																
		Alpha Chlordane																
		Gamma Chlordane																
		Toxaphene																
		PCBs																
		PCB-1016																
		PCB-1221																
		PCB-1232																
		PCB-1242			7,200		20,200								84,600		56,200	
		PCB-1248																
		PCB-1254			2,750		1,860			28,000		12,800			5,400		4,260	
		PCB-1260																
		Arochlor 1242	130,000,000															
		Arochlor 1254	18,000,000 J							1,500,000 J	91	1,200,000 J	93					

[1] System contact time is the total time the sample was in contact with the fluid.
This is contrasted with stage contact time which refers to the time the sample is in contact with the fluid in a single stage. Each process trial (PT) in the treatability study consisted of 3 stages.
[2] "J" values mean estimated concentrations

TABLE 7
RESULTS OF PCB/PESTICIDES REMOVAL - KINETICS TRIALS
EXTRACTION WITH 10% AQUEOUS SURFACTANT SOLUTION
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

RESIDUAL CONCENTRATION, SYSTEM CONTACT TIME, AND PERCENT REMOVAL

Raw Sample I.D.	Sample Name	Organics Analyzed	Concentration in Raw Sample (ug/kg)	PT-37 System Contact Time (Min) [1]	PT-37 Before Final Wash (ug/kg)	PT-37 Removal (%)	PT-37 After Final Wash (ug/kg)	PT-37 Removal (%)	PT-41 System Contact Time (Min)	PT-41 Before Final Wash ug/kg	PT-41 Removal (%)	PT-41 After Final Wash (ug/kg)	PT-41 Removal (%)	PT-45 System Contact Time (Min)	PT-45 Before Final Wash ug/kg	PT-45 Removal (%)	PT-45 After Final Wash (ug/kg)	PT-45 Removal (%)
CET-2	Soil Hot Spot PCBs	Pesticides		48					98					138				
		Alpha BHC																
		Beta BHC																
		Delta BHC																
		Gamma BHC -Lindane																
		Heptachlor																
		Aldrin	580 J		70 J	88	84 J	86							60 J	90	22 J	96
		Heptachlor Epoxide																
		Endosulfan I																
		Dieldrin	590 J				180 J	69							100 J	83	130 J	78
		DDE																
		Endrin																
		Endosulfan II																
		DDD																
		Endosulfan Sulfate																
		DDT																
		Endrin Ketone																
		Methoxychlor																
		Alpha Chlordane																
		Gamma Chlordane																
		Toxaphene																
		PCBs																
		PCB-1016																
		PCB-1221																
		PCB-1232																
		PCB-1242																
		PCB-1248																
		PCB-1254																
		PCB-1260																
		Arochlor 1260	5,200 J		1,200 J	77	1,500 J	71										

[1] System contact time is the total time the sample was in contact with the fluid. This is contrasted with stage contact time which refers to the time the sample is in contact with the fluid in a single stage. Each process trial (PT) in the treatability study consisted of 3 stages.

[2] "J" values mean estimated concentrations

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TABLE 7 (continued)
RESULTS OF PCB/PESTICIDES REMOVAL - KINETICS TRIALS
EXTRACTION WITH 10% AQUEOUS SURFACTANT SOLUTION
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

RESIDUAL CONCENTRATION, SYSTEM CONTACT TIME, AND PERCENT REMOVAL

Raw Sample I.D.	Sample Name	Organics Analyzed	Concentration in Raw Sample (ug/kg)	PT-38 System Contact Time (Min) [1]	PT-38 Before Final Wash (ug/kg)	PT-38 Removal (%)	PT-38 After Final Wash (ug/kg)	PT-38 Removal (%)	PT-42 System Contact Time (Min)	PT-42 Before Final Wash (ug/kg)	PT-42 Removal (%)	PT-42 After Final Wash (ug/kg)	PT-42 Removal (%)	PT-46 System Contact Time (Min)	PT-46 Before Final Wash (ug/kg)	PT-46 Removal (%)	PT-46 After Final Wash (ug/kg)	PT-46 Removal (%)
CET-4	Overall Soil Composite	Pesticides		45					90					135				
		Alpha BHC																
		Beta BHC																
		Delta BHC																
		Gamma BHC -Lindane																
		Heptachlor																
		Aldrin			490 J		150 J			55 J					190 J		420 J	
		Heptachlor Epoxide																
		Endosulfan I																
		Dieldrin	170 J												150 J	12	240 J	41
		DDE																
		Endrin																
		Endosulfan II																
		DDD																
		Endosulfan Sulfate																
		DDT																
		Endrin Ketone																
		Methoxychlor																
		Alpha Chlordane																
		Gamma Chlordane																
		Toxaphene																
		PCBs																
		PCB-1016																
		PCB-1221																
		PCB-1232																
		PCB-1242			50,000					26,000		5,000					30,000	
		PCB-1248																
		PCB-1254										570,000			1,400 J			
		PCB-1260																
		Arochlor 1254			2,900 J					1,000 J								
		Arochlor 1260																
		Arochlor 1242													7,200 J		28,000 J	

[1] System contact time is the total time the sample was in contact with the fluid. This is contrasted with stage contact time which refers to the time the sample is in contact with the fluid in a single stage. Each process trial (PT) in the treatability study consisted of 3 stages.

[2] "J" values mean estimated concentrations

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TABLE 7 (continued)
RESULTS OF PCB/PESTICIDES REMOVAL - KINETICS TRIALS
EXTRACTION WITH 10% AQUEOUS SURFACTANT SOLUTION
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

RESIDUAL CONCENTRATION, SYSTEM CONTACT TIME, AND PERCENT REMOVAL

Raw Sample I.D.	Sample Name	Organics Analyzed	Concentration in Raw Sample (ug/kg)	PT-40 System Contact Time (Min) [1]	PT-40 Before Final Wash (ug/kg)	PT-40 Removal (%)	PT-40 After Final Wash (ug/kg)	PT-40 Removal (%)	PT-44 System Contact Time (Min)	PT-44 Before Final Wash (ug/kg)	PT-44 Removal (%)	PT-44 After Final Wash (ug/kg)	PT-44 Removal (%)	PT-48 System Contact Time (Min)	PT-48 Before Final Wash (ug/kg)	PT-48 Removal (%)	PT-48 After Final Wash (ug/kg)	PT-48 Removal (%)
CET-5	Sludge Tank & Pb Composite	Pesticides		48					88					135				
		Alpha BHC																
		Beta BHC																
		Delta BHC																
		Gamma BHC -Lindane																
		Heptachlor																
		Aldrin								64,000 J		54 J						
		Heptachlor Epoxide																
		Endosulfan I																
		Dieldrin								56,000 J		100 J						
		DDE																
		Endrin																
		Endosulfan II																
		DDD																
		Endosulfan Sulfate																
		DDT																
		Endrin Ketone																
		Methoxychlor																
		Alpha Chlordane																
		Gamma Chlordane																
		Toxaphene																
		PCBs																
		PCB-1016																
		PCB-1221																
		PCB-1232																
		PCB-1242			12,700		10,200			27,000		12,800			6,300		8,900	
		PCB-1248																
		PCB-1254			1,250,000		1,010,000								610,000			
		PCB-1260																
		Arochlor 1242	130,000,000															
		Arochlor 1254	16,000,000 J									700 J	100					

[1] System contact time is the total time the sample was in contact with the fluid. This is contrasted with stage contact time which refers to the time the sample is in contact with the fluid in a single stage. Each process trial (PT) in the treatability study consisted of 3 stages.

[2] "J" values mean estimated concentrations

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TABLE 8
RESULTS OF METALS REMOVAL - SEQUENTIAL TRIALS
EXTRACTION WITH 5% AQUEOUS SURFACTANT [1], 10% HYDROCHLORIC ACID
AND 10% CITRIKLEEN SOLUTION
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

				RESIDUAL CONCENTRATION, SYSTEM CONTACT TIME, AND PERCENT REMOVAL					
				PT-49 (for CET-151)		PT-50 (for CET-158)		PT-51 (for CET-165)	
Raw Sample I.D.	Sample Name	Metals Analyzed [2]	Concentration in Raw Sample (mg/kg)	After Final Wash (mg/kg)[3]	Removal (%)	After Final Wash (mg/kg)	Removal (%)	After Final Wash (mg/kg)	Removal (%)
CET-3	Soil Hot Spot/ Composite	Antimony	3.9	< 7					
		Arsenic	7.7	2.7	64.9				
		Beryllium	0.6	< 0.7					
		Cadmium	18.6	3.12	83.2				
		Chromium	81.3	39.3	51.7				
		Copper	1,790	417	76.7				
		Lead	979	272	72.2				
		Mercury	6.7	2.33	65.2				
		Nickel	20.8	10.8	48.1				
		Selenium	1.5	< 0.7					
		Zinc	612	314	48.7				
CET-4	Overall Soil Composite	Antimony	3.8			< 7.0			
		Arsenic	14.8			7.0	52.7		
		Beryllium	0.43			< 0.7			
		Cadmium	0.72			3.8	-427.8		
		Chromium	89.8			33.8	62.4		
		Copper	399			148	62.9		
		Lead	596			225	62.2		
		Mercury	8.5			3.16	62.8		
		Nickel	26.4			14.1	46.6		
		Selenium	1.3			< 4.0			
		Zinc	874			796	8.9		
CET-5	Sludge Tank&Pit Composite	Antimony	421.0					102.0	75.8
		Arsenic	33.8					5.7	83.1
		Beryllium	0.1					< 0.9	
		Cadium	361					50.2	86.1
		Chromium	6,060					2,250	62.9
		Copper	4,020					1,070	73.4
		Lead	59,700					16,900	71.7
		Mercury	103					7.7	92.5
		Nickel	35.6					11.4	68.0
		Selenium	11.1					7.6	31.7
		Zinc	2,510					545	78.3

FOOTNOTES:
[1] The surfactant used was Triton-x-100 manufactured by Rohm & Haas.
[2] Metal analyses were of total metal content (i.e., all chemical forms).
[3] After wash refers to the treated sample after it undergoes a final wash treatment with distilled water.

TABLE 9
RESULTS OF PCB/PESTICIDES REMOVAL - SEQUENTIAL TRIALS
EXTRACTION WITH 5% AQUEOUS SURFACTANT [1], 10% HYDROCHLORIC ACID
AND 10 % CITRIKLEEN SOLUTION
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

RESIDUAL CONCENTRATION AND PERCENT REMOVAL

Organics Analyzed	PT-49 [2] for CET-151					PT- 50 CET-158					PT-51 CET-165				
	Raw Sample I.D.	Sample Name	Concentration in Raw Sample (ug/kg)	After Final Wash (ug/kg)[3]	Removal (%)	Raw Sample I.D.	Sample Name	Concentration in Raw Sample (ug/kg)	After Final Wash (ug/kg)	Removal (%)	Raw Sample I.D.	Sample Name	Concentration in Raw Sample (ug/kg)	After Final Wash (ug/kg)	Removal (%)
Pesticides	CET-3	Soil Hot Spot Composite				CET-4	Overall Soil Composite				CET-5	Sludge Tank & Pa Composite			
Alpha BHC															
Beta BHC															
Delta BHC															
Gamma BHC -Lindane															
Heptachlor															
Aldrin				470 J											
Heptachlor Epoxide															
Endosulfan I															
Dieldrin	790 J							170 J							
DDE															
Endrin															
Endosulfan II															
DDD															
Endosulfan Sulfate															
DDT															
Endrin Ketone															
Methoxychlor															
Alpha Chlordane															
Gamma Chlordane															
Toxaphene															
PCBS															
PCB-1016															
PCB-1221															
PCB-1232															
PCB-1242				20,000					204,000					4,000	
PCB-1248															
PCB-1254														400,000	
PCB-1260															
Arochlor 1242	190,000														
Arochlor 1260									8,100 J						
Arochlor 1254	22,000 J			1,900 J	100								18,000,000 J		

Footnotes:

[1] The surfactant used was Triton-x-100 manufactured by Rohm & Haas
[2] PT stand for Process Trial. The applicable I.D. number for the treated sample (i.e., CET 8) is indicated next to the Process Trial.
[3] After final wash refers to the treated sample after it undergoes a final wash treatment with distilled water.

TABLE 10
RESULTS OF ORGANICS REMOVAL - SEQUENTIAL TRIALS
EXTRACTION WITH 5% AQUEOUS SURFACTANT [1], 10% HYDROCHLORIC ACID,
AND 10% CLIRIKLEEN SOLUTION
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N J

RESIDUAL CONCENTRATION, SYSTEM CONTACT TIME
AND PERCENT REMOVAL

Organics Analyzed	Raw Sample I.D.	Sample Name	Concentration in Raw Sample (ug/kg)	PT-48 After Final Wash (ug/kg)[2]	PT-48 Removal (%)	Raw Sample I.D.	Sample Name	Concentration in Raw Sample (ug/kg)	PT-50 After Final Wash (ug/kg)	PT-50 Removal (%)	Raw Sample I.D.	Sample Name	Concentration in Raw Sample (ug/kg)	PT-51 After Final Wash (ug/kg)	PT-51 Removal (%)
TCL Volatiles															
Chloromethane	CET-3	Soil Hot Spot Composite				CET 4	Overall Soil Composite				CET 5	Sludge Tank 6 Pit Composite			
Bromomethane															
Methylene Chloride			5,800 J					1,300					970,000		
Acetone			84,000					2,400					2,100,000		
Carbon Disulfide															
1,1 Dichloroethene															
1,1 Dichloroethane															
trans 1,2 Dichloroethene			4,700 J					86							
Chloroform			140,000	12,000	91			710					4,800,000	380,000	92
1,2 Dichloroethane			93,000	5,400	94			3,800					1,700,000		
2 Butanone								130					5,900,000		
1,1,1 Trichloroethane			47,000	5,800	88			53 J					800,000 J		
Carbon Tetrachloride								150					11,000,000		
Vinyl Acetate													2,100,000	950,000	55
Bromodichloromethane															
1,2 Dichloropropane															
Trichloroethene			270,000	24,000	91			5,000					1,500,000		
Dibromochloromethane															
1,1,2 Trichloroethane															
Benzene								450					970,000		
trans 1,3 Dichloropropene															
Bromoform															
4 Methyl 2 Pentanone			28,000 J					180					2,400,000		
2 Hexanone															
Tetrachloroethene			810,000	35,000	83			7,600	13,000	-71			70,000,000 BL	15,000,000	79
1,1,2,2 Tetrachloroethane															
Toluene			530,000	39,000	93			3,600	4,200	-17			29,000,000 B	4,900,000	83
Chlorobenzene			7,300 J					45							
Ethylbenzene			88,000	9,600	89			1,200					3,000,000	570,000	81
Styrene															
Xylenes			390,000	38,000	90			14,000	2,800	80			12,000,000	2,700,000	78
Semivolatiles															
Phenol													4,000,000	417,000	90
bis (2 chloroethyl) ether													350,000		
2 chlorophenol															
1,3 dichlorobenzene															
1,4 dichlorobenzene															
Benzyl alcohol															
1,2 dichlorobenzene			17,000 J										16,000,000	1,700,000	89
2 methylphenol													68,000 J		
bis (2 chloroisopropyl) ether															
4 methylphenol													41,000 J		
N nitrosodi n propylamine															
hexachloroethane															
Nitrobenzene															
Isophorone													350,000		
2 nitrophenol															
2,4 dimethylphenol															
Benzoic acid															
2,4 dichlorophenol															
1,2,4 trichlorobenzene													920,000	189,000	79
Naphthalene			31,000 J										290,000 J	57,000	80
4 chloro 3 methylphenol															
Dimethyl phthalate													260,000 J		
2 Methylnaphthalene			16,000 J										140,000 J		
Acenaphthene															
Butylbenzylphthalate													300,000 J	57,000	81
Di n octylphthalate													59,000 J		
bis(2 ethylhexyl) phthalate			160,000	81,000	46			27,000 J					2,700,000	492,000	82
Diethyl phthalate			16,000 J										2,000,000	492,000	82
Phenanthrene			19,000 J												
Di n butylphthalate			28,000 J										270,000 J		
Total Petroleum Hydrocarbon (mg/kg)				7,500					1,600					49,000	

Footnotes
[1] The surfactant used was Triton x-100 manufactured by Rohm & Haas
[2] After final wash refers to the treated sample after it undergoes a final wash treatment with distilled water.

TABLE 11
SUMMARY OF PERCENT REMOVALS FOR SEQUENTIAL TRIALS
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

PROCESS TRIALS

Parameter Analyzed	PT-49 Raw Sample I.D.	PT-49 Sample Name	PT-49 Concentration in Raw (mg/kg)	PT-49 Removal (%)	PT-50 Raw Sample I.D.	PT-50 Sample Name	PT-50 Concentration in Raw (mg/kg)	PT-50 Removal (%)	PT-51 Raw Sample I.D.	PT-51 Sample Name	PT-51 Concentration in Raw (mg/kg)	PT-51 Removal (%)
Metals	CET-3	Soil Hot Spot Composite			CET-4	Overall Soil Composite			CET-5	Sludge Tank & Pit Composite		
Antimony			3.9				3.8				421.0	76
Arsenic			7.7	68			14.8	53			33.8	83
Beryllium			0.8				0.4				0.09	
Cadmium			18.6	83			0.7	43			361.0	86
Chromium			81.3	92			89.8	62			6,060.0	63
Copper			1,790.0	77			399.0	63			4,020.0	73
Lead			679.0	72			596.0	62			59,700.0	72
Mercury			6.7	68			8.5	63			103.0	93
Nickel			20.8	48			28.4	47			35.6	62
Selenium			1.5				1.3				11.1	32
Silver												
Zinc			612	49			874	9			2,510	78
VOCL Volatiles												
Chloromethane												
Bromomethane												
Methylene Chloride			5,600 J				1,300				970,000	
Acetone			64,000				2,400				2,100,000	
Carbon Disulfide												
1,1-Dichloroethene												
1,1-Dichloroethane												
trans-1,2-Dichloroethene			4,700				66					
Chloroform			140,000	91			710				4,800,000	92
1,2-Dichloroethane			93,000	94			3,600				1,700,000	
2-Butanone							130				5,900,000	
1,1,1-Trichloroethane			47,000	86			53 J				600,000 J	
Carbon Tetrachloride							150				11,000,000	
Vinyl Acetate											2,100,000	55
Bromodichloromethane												
1,2-Dichloropropane												
Trichloroethene			270,000	91			1,800				1,500,000	
Dibromochloromethane												
1,1,2-Trichloroethane												
Benzene							450				970,000	
trans-1,3-Dichloropropene												
Bromoform												
4-Methyl-2-Pentanone			28,000 J				160				2,400,000	
2-Hexanone												
Tetrachloroethene			210,000	83			7,600	-71			70,000,000 BD	79
1,1,2,2-Tetrachloroethane												
Toluene			530,000	93			3,600	-17			29,000,000 B	83
Chlorobenzene			7,300 J				45					
Ethylbenzene			88,000	89			1,200				3,000,000	81
Styrene												
Xylenes			390,000	90			14,000	80			12,000,000	78
Semivolatiles												
Phenol											4,000,000	90
bis (2-chloroethyl) ether											350,000	
2-chlorophenol												
1,3-dichlorobenzene												
1,4-dichlorobenzene												
Benzyl alcohol												
1,2-dichlorobenzene			17,000 J								18,000,000	89
2-methylphenol											66,000 J	
bis (2-chloroisopropyl) ether												
4-methylphenol											41,000 J	
N-nitroso-n-propylamine												
hexachloroethane												
Nitrobenzene												
Isophorone											350,000	
2-nitrophenol												
2,4-dimethylphenol												
Benzoic acid												
2,4-dichlorophenol												
1,2,4-trichlorobenzene											920,000	79
Naphthalene			31,000 J								290,000 J	80
4-chloro-3-methylphenol												
Dimethyl phthalate											260,000 J	
2-Methylnaphthalene			15,000 J								140,000 J	
Acenaphthene												
Butylbenzylphthalate											300,000 J	81
Di-n-octylphthalate											59,000 J	
bis(2-ethylhexyl) phthalate			150,000	46							2,700,000	82
Diethyl phthalate			15,000 J								2,800,000	82
Phenanthrene			19,000 J									
Di-n-butylphthalate			20,000 J								270,000 J	
Bis(2-ethylhexyl) phthalate							27,000 J					
Total Petroleum Hydrocarbon												
PCB/Pesticides												
Alpha BHC												
Beta BHC												
Delta BHC												

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TABLE 11 (continued)

Parameter Analyzed	PT-49 Raw Sample I.D.	PT-49 Sample Name	PT-49 Concentration in Raw (mg/kg)	PT-49 Removal (%)	PT-50 Raw Sample I.D.	PT-50 Sample Name	PT-50 Concentration in Raw (mg/kg)	PT-50 Removal (%)	PT-51 Raw Sample I.D.	PT-51 Sample Name	PT-51 Concentration in Raw (mg/kg)	PT-51 Removal (%)
PCB/Pesticides (continued)												
Gamma BHC - Lindane												
Heptachlor												
Aldrin												
Heptachlor Epoxide												
Endosulfan I												
Dieldrin			790 J				170 J					
DDE												
Endrin												
Endosulfan II												
DDD												
Endosulfan Sulfate												
DDT												
Endrin Ketone												
Methoxychlor												
Alpha Chlordane												
Gamma Chlordane												
Toxaphene												
PCB-1016												
PCB-1221												
PCB-1232												
PCB-1242												
PCB-1248												
PCB-1254												
PCB-1260												
Aroclor-1242			190,000								130,000,000	
Aroclor-1254			22,000 J	91							16,000,000	

TABLE 12-A
SUMMARY OF PESTICIDE AND PCB REMOVALS FOR KINETICS TRIALS
WITH VARIOUS FLUID TYPES FOR A SYSTEM CONTACT TIME OF 45 MINUTES
A. SOIL HOT SPOT - PCBs (CET-2)
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

	PERCENT REMOVALS (%) WITH VARIOUS FLUID TYPES					
	5% Surfactant		5% Citrikleen		10% Citrikleen	
Organics Analyzed	Before Final Wash[1]	After Final Wash[1]	Before Final Wash	After Final Wash	Before Final Wash	After Final Wash
Pesticides						
Alpha BHC						
Beta BHC						
Delta BHC						
Gamma BHC -Lindane						
Heptachlor						
Aldrin	81	66			88	86
Heptachlor Epoxide						
Endosulfan I						
Dieldrin	68	51				69
DDE						
Endrin						
Endosulfan II						
DDD						
Endosulfan Sulfate						
DDT						
Endrin Ketone						
Methoxychlor						
Alpha Chlordane						
Gamma Chlordane						
Toxaphene						
PCBs						
PCB-1016						
PCB-1221						
PCB-1232						
PCB-1242						
PCB-1248						
PCB-1254						
PCB-1260						
Arochlor 1254						
Arochlor 1260	75	46			77	71

Footnotes:

[1] Treated solids were sampled and analyzed before and after washing them with a final volume of distilled water.

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TABLE 12-B
SUMMARY OF PESTICIDE AND PCB REMOVALS FOR KINETICS TRIALS
WITH VARIOUS FLUID TYPES FOR A SYSTEM CONTACT TIME OF 90 MINUTES
A. SOIL HOT SPOT - PCBs (CET-2)
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

	PERCENT REMOVALS (%) WITH VARIOUS FLUID TYPES					
	5% Surfactant		5% Citrikleen		10% Citrikleen	
Organics Analyzed	Before Final Wash[1]	After Final Wash[1]	Before Final Wash	After Final Wash	Before Final Wash	After Final Wash
Pesticides						
Alpha BHC						
Beta BHC						
Delta BHC						
Gamma BHC -Lindane						
Heptachlor						
Aldrin	78	57	78	81		
Heptachlor Epoxide						
Endosulfan I						
Dieldrin			61			
DDE						
Endrin						
Endosulfan II						
DDD						
Endosulfan Sulfate						
DDT						
Endrin Ketone						
Methoxychlor						
Alpha Chlordane						
Gamma Chlordane						
Toxaphene						
PCBs						
PCB-1016						
PCB-1221						
PCB-1232						
PCB-1242						
PCB-1248						
PCB-1254						
PCB-1260						
Arochlor 1254						
Arochlor 1260			58	50		

Footnotes:

[1] Treated solids were sampled and analyzed before and after washing them with a final volume of distilled water.

TABLE 12-C
SUMMARY OF PESTICIDE AND PCB REMOVALS FOR KINETICS TRIALS
WITH VARIOUS FLUID TYPES FOR A SYSTEM CONTACT TIME OF 180 MINUTES
A. SOIL HOT SPOT - PCBs (CET-2)
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

Organics Analyzed	PERCENT REMOVALS (%) WITH VARIOUS FLUID TYPES					
	5% Surfactant		5% Citrikleen		10% Citrikleen	
	Before Final Wash[1]	After Final Wash[1]	Before Final Wash	After Final Wash	Before Final Wash	After Final Wash
Pesticides						
Alpha BHC						
Beta BHC						
Delta BHC						
Gamma BHC -Lindane						
Heptachlor						
Aldrin	79	64	71	69	90	96
Heptachlor Epoxide						
Endosulfan I						
Dieldrin	61	56	14		83	78
DDE						
Endrin						
Endosulfan II						
DDD						
Endosulfan Sulfate						
DDT						
Endrin Ketone						
Methoxychlor						
Alpha Chlordane						
Gamma Chlordane						
Toxaphene						
PCBs						
PCB-1016						
PCB-1221						
PCB-1232						
PCB-1242						
PCB-1248						
PCB-1254						
PCB-1260						
Arochlor 1254						
Arochlor1260	73	69				

Footnotes:
[1] Treated solids were sampled and analyzed before and after washing them with a final volume of distilled water.

TABLE 12-D
SUMMARY OF PESTICIDE AND PCB REMOVALS FOR KINETICS TRIALS
WITH VARIOUS FLUID TYPES FOR A SYSTEM CONTACT TIME OF 45 MINUTES
B. OVERALL SOIL COMPOSITE (CET-4)
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

	PERCENT REMOVALS (%) WITH VARIOUS FLUID TYPES					
	5% Surfactant		5% Citrikleen		10% Citrikleen	
Organics Analyzed	Before Final Wash[1]	After Final Wash[1]	Before Final Wash	After Final Wash	Before Final Wash	After Final Wash
Pesticides						
Alpha BHC						
Beta BHC						
Delta BHC						
Gamma BHC -Lindane						
Heptachlor						
Aldrin						
Heptachlor Epoxide						
Endosulfan I						
Dieldrin	- 6	- 41		-14018		
DDE						
Endrin						
Endosulfan II						
DDD						
Endosulfan Sulfate						
DDT						
Endrin Ketone						
Methoxychlor						
Alpha Chlordane						
Gamma Chlordane						
Toxaphene						
PCBs						
PCB-1016						
PCB-1221						
PCB-1232						
PCB-1242						
PCB-1248						
PCB-1254						
PCB-1260						
Arochlor 1254						
Arochlor 1260						

Footnotes:

[1] Treated solids were sampled and analyzed before and after washing them with a final volume of distilled water.

TABLE 12-E
SUMMARY OF PESTICIDE AND PCB REMOVALS FOR KINETICS TRIALS
WITH VARIOUS FLUID TYPES FOR A SYSTEM CONTACT TIME OF 90 MINUTES
B. OVERALL SOIL COMPOSITE (CET-4)
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

	PERCENT REMOVALS (%) WITH VARIOUS FLUID TYPES					
	5% Surfactant		5% Citrikleen		10% Citrikleen	
Organics Analyzed	Before Final Wash[1]	After Final Wash[1]	Before Final Wash	After Final Wash	Before Final Wash	After Final Wash
Pesticides						
Alpha BHC						
Beta BHC						
Delta BHC						
Gamma BHC -Lindane						
Heptachlor						
Aldrin						
Heptachlor Epoxide						
Endosulfan I						
Dieldrin	-376	-35	48			
DDE						
Endrin						
Endosulfan II						
DDD						
Endosulfan Sulfate						
DDT						
Endrin Ketone						
Methoxychlor						
Alpha Chlordane						
Gamma Chlordane						
Toxaphene						
PCBs						
PCB-1016						
PCB-1221						
PCB-1232						
PCB-1242						
PCB-1248						
PCB-1254						
PCB-1260						
Arochlor 1254						
Arochlor 1260						

Footnotes:

[1] Treated solids were sampled and analyzed before and after washing them with a final volume of distilled water.

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TABLE 12-F
SUMMARY OF PESTICIDE AND PCB REMOVALS FOR KINETICS TRIALS
WITH VARIOUS FLUID TYPES FOR A SYSTEM CONTACT TIME OF 180 MINUTES
B. OVERALL SOIL COMPOSITE (CET-4)
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

	PERCENT REMOVALS (%) WITH VARIOUS FLUID TYPES					
	5% Surfactant		5% Citrikleen		10% Citrikleen	
Organics Analyzed	Before Final Wash[1]	After Final Wash[1]	Before Final Wash	After Final Wash	Before Final Wash	After Final Wash
Pesticides						
Alpha BHC						
Beta BHC						
Delta BHC						
Gamma BHC -Lindane						
Heptachlor						
Aldrin						
Heptachlor Epoxide						
Endosulfan I						
Dieldrin	-18	-153	24	58	12	-41
DDE						
Endrin						
Endosulfan II						
DDD						
Endosulfan Sulfate						
DDT						
Endrin Ketone						
Methoxychlor						
Alpha Chlordane						
Gamma Chlordane						
Toxaphene						
PCBs						
PCB-1016						
PCB-1221						
PCB-1232						
PCB-1242						
PCB-1248						
PCB-1254						
PCB-1260						
Arochlor 1254						
Arochlor1260						

Footnotes:
[1] Treated solids were sampled and analyzed before and after washing them with a final volume of distilled water.

TABLE 12-G
SUMMARY OF PESTICIDE AND PCB REMOVALS FOR KINETICS TRIALS
WITH VARIOUS FLUID TYPES FOR A SYSTEM CONTACT TIME OF 45 MINUTES
C. SLUDGE TANK & PIT COMPOSITE (CET-5)
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

	PERCENT REMOVALS (%) WITH VARIOUS FLUID TYPES					
	5% Surfactant		5% Citrikleen		10% Citrikleen	
Organics Analyzed	Before Final Wash[1]	After Final Wash[1]	Before Final Wash	After Final Wash	Before Final Wash	After Final Wash
Pesticides						
Alpha BHC						
Beta BHC						
Delta BHC						
Gamma BHC -Lindane						
Heptachlor						
Aldrin						
Heptachlor Epoxide						
Endosulfan I						
Dieldrin						
DDE						
Endrin						
Endosulfan II						
DDD						
Endosulfan Sulfate						
DDT						
Endrin Ketone						
Methoxychlor						
Alpha Chlordane						
Gamma Chlordane						
Toxaphene						
PCBs						
PCB-1016						
PCB-1221						
PCB-1232						
PCB-1242						
PCB-1248						
PCB-1254						
PCB-1260						
Arochlor 1254						
Arochlor 1260						

Footnotes:

[1] Treated solids were sampled and analyzed before and after washing them with a final volume of distilled water.

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TABLE 12-H
SUMMARY OF PESTICIDE AND PCB REMOVALS FOR KINETICS TRIALS
WITH VARIOUS FLUID TYPES FOR A SYSTEM CONTACT TIME OF 90 MINUTES
C. SLUDGE TANK & PIT COMPOSITE (CET-5)
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

	PERCENT REMOVALS (%) WITH VARIOUS FLUID TYPES					
	5% Surfactant		*5% Citrikleen*		*10% Citrikleen*	
Organics Analyzed	Before Final Wash[1]	After Final Wash[1]	Before Final Wash	After Final Wash	Before Final Wash	After Final Wash
Pesticides						
Alpha BHC						
Beta BHC						
Delta BHC						
Gamma BHC -Lindane						
Heptachlor						
Aldrin						
Heptachlor Epoxide						
Endosulfan I						
Dieldrin						
DDE						
Endrin						
Endosulfan II						
DDD						
Endosulfan Sulfate						
DDT						
Endrin Ketone						
Methoxychlor						
Alpha Chlordane						
Gamma Chlordane						
Toxaphene						
PCBs						
PCB-1016						
PCB-1221						
PCB-1232						
PCB-1242						
PCB-1248						
PCB-1254						
PCB-1260						
Arochlor 1254			91	93		99.9
Arochlor 1260						

Footnotes:
[1] Treated solids were sampled and analyzed before and after washing them with a final volume of distilled water.

TABLE 12-I
SUMMARY OF PESTICIDE AND PCB REMOVALS FOR KINETICS TRIALS
WITH VARIOUS FLUID TYPES FOR A SYSTEM CONTACT TIME OF 180 MINUTES
C. SLUDGE TANK & PIT COMPOSITE (CET-5)
TREATED SOLIDS ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

	PERCENT REMOVALS (%) WITH VARIOUS FLUID TYPES					
	5% Surfactant		5% Citrikleen		10% Citrikleen	
Organics Analyzed	Before Final Wash[1]	After Final Wash[1]	Before Final Wash	After Final Wash	Before Final Wash	After Final Wash
Pesticides						
Alpha BHC						
Beta BHC						
Delta BHC						
Gamma BHC -Lindane						
Heptachlor						
Aldrin						
Heptachlor Epoxide						
Endosulfan I						
Dieldrin						
DDE						
Endrin						
Endosulfan II						
DDD						
Endosulfan Sulfate						
DDT						
Endrin Ketone						
Methoxychlor						
Alpha Chlordane						
Gamma Chlordane						
Toxaphene						
PCBs						
PCB-1016						
PCB-1221						
PCB-1232						
PCB-1242						
PCB-1248						
PCB-1254						
PCB-1260						
Arochlor 1254						
Arochlor1260						

Footnotes:
[1] Treated solids were sampled and analyzed before and after washing them with a final volume of distilled water.

TABLE 13-A
SUMMARY OF ORGANICS REMOVALS FOR KINETICS TRIALS
FOR VARIOUS FLUID TYPES AND A SYSTEM CONTACT TIME OF 45 MINUTES
A. OVERALL SOIL COMPOSITES (CET-4)

SCP PROJECT - CARLSTADT, N.J.

Organics Analyzed	PERCENT REMOVALS (%) WITH VARIOUS FLUID TYPES					
	5% Surfactant		5% Citrikleen		10% Citrikleen	
	Before Final Wash[1] CET-49	After Final Wash[1] CET-50	Before Final Wash CET-82	After Final Wash CET-83	Before Final Wash CET-118	After Final Wash CET-119
TCL Volatiles						
Chloromethane						
Bromomethane						
Methylene Chloride						
Acetone						
Carbon Disulfide						
1,1-Dichloroethene						
1,1-Dichloroethane						
trans-1,2-Dichloroethene						
Chloroform						
1,2-Dichloroethane						
2-Butanone						
1,1,1-Trichloroethane						
Carbon Tetrachloride						
Vinyl Acetate						
Bromodichloromethane						
1,2-Dichloropropane						
Trichloroethene						
Dibromochloromethane						
1,1,2-Trichloroethane						
Benzene						
trans-1,3-Dichloropropane						
Bromoform						
4-Methyl-2-Pentanone						
2-Hexanone						
Tetrachloroethene		87				
1,1,2,2-Tetrachloroethane						
Toluene						
Chlorobenzene						
Ethylbenzene						
Styrene						
Xylenes	87		91	91		
Semivolatiles						
Phenol						
bis (2-chloroethyl) ether						
2-chlorophenol						
1,3-dichlorobenzene						
1,4-dichlorobenzene						
Benzyl alcohol						
1,2-dichlorobenzene						
1-methylphenol						
bis (2-chloroisopropyl) ether						
4-methylphenol						
N-nitrosodi-n-propylamine						

TABLE 13A (continued)

Organics Analyzed	PERCENT REMOVALS (%) WITH VARIOUS FLUID TYPES					
	5% Surfactant		5% Citrikleen		10% Citrikleen	
	Before Final Wash[1] CET-49	After Final Wash[1] CET-50	Before Final Wash CET-82	After Final Wash CET-83	Before Final Wash CET-118	After Final Wash CET-119
Semivolatiles (continued)						
hexachloroethane						
Nitrobenzene						
Isophorone						
2-nitrophenol						
2,4-dimethylphenol						
Benzoic acid						
2,4-dichlorophenol						
1,2,4-trichlorobenzene						
Naphthalene						
4-chloro-3-methylphenol						
Dimethyl phthalate						
Acenaphthylene						
Acenaphthene						
2,4-dinitrophenol						
4-nitrophenol						
Dibenzofuran						
Diethyl phthalate						
Anthracene						
bis (2-ethylhexyl) phthalate	-22					
Total Petroleum Hydrocarbon						

Footnotes:

[1] Treated solids were sampled and analyzed before and after washing them with a final volume of distilled water.

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TABLE 13-B
SUMMARY OF ORGANICS REMOVALS FOR KINETICS TRIALS
FOR VARIOUS FLUID TYPES AND A SYSTEM CONTACT TIME OF 90 MINUTES
A. OVERALL SOIL COMPOSITES (CET-4)

SCP PROJECT - CARLSTADT, N.J.

PERCENT REMOVALS (%) WITH VARIOUS FLUID TYPES

Organics Analyzed	5% Surfactant		5% Citrikleen		10% Citrikleen	
	Before Final Wash[1] CET-61	After Final Wash[1] CET-62	Before Final Wash CET-94	After Final Wash CET-95	Before Final Wash CET-130	After Final Wash CET-131
TCL Volatiles						
Chloromethane						
Bromomethane						
Methylene Chloride						
Acetone						50
Carbon Disulfide						
1,1-Dichloroethene						
1,1-Dichloroethane						
trans-1,2-Dichloroethene						
Chloroform						
1,2-Dichloroethane						
2-Butanone						
1,1,1-Trichloroethane						
Carbon Tetrachloride						
Vinyl Acetate						
Bromodichloromethane						
1,2-Dichloropropane						
Trichloroethene						
Dibromochloromethane						
1,1,2-Trichloroethane						
Benzene						
trans-1,3-Dichloropropane						
Bromoform						
4-Methyl-2-Pentanone						
2-Hexanone						
Tetrachloroethene						
1,1,2,2-Tetrachloroethane						
Toluene						
Chlorobenzene						
Ethylbenzene						
Styrene						
Xylenes						90
Semivolatiles						
Phenol						
bis (2-chloroethyl) ether						
2-chlorophenol						
1,3-dichlorobenzene						
1,4-dichlorobenzene						
Benzyl alcohol						
1,2-dichlorobenzene						
1-methylphenol						
bis (2-chloroisopropyl) ether						
4-methylphenol						
N-nitrosodi-n-propylamine						

TABLE 13B (continued)

Organics Analyzed	PERCENT REMOVALS (%) WITH VARIOUS FLUID TYPES					
	5% Surfactant		5% Citrikleen		10% Citrikleen	
	Before Final Wash[1] CET-61	After Final Wash[1] CET-62	Before Final Wash CET-94	After Final Wash CET-95	Before Final Wash CET-130	After Final Wash CET-131
Semivolatiles (continued)						
hexachloroethane						
Nitrobenzene						
Isophorone						
2-nitrophenol						
2,4-dimethylphenol						
Benzoic acid						
2,4-dichlorophenol						
1,2,4-trichlorobenzene						
Naphthalene						
4-chloro-3-methylphenol						
Dimethyl phthalate						
Acenaphthylene						
Acenaphthene						
2,4-dinitrophenol						
4-nitrophenol						
Dibenzofuran						
Diethyl phthalate						
Anthracene						
bis (2-ethylhexyl) phthalate	-44					
Total Petroleum Hydrocarbon						

Footnotes:

[1] Treated solids were sampled and analyzed before and after washing them with a final volume of distilled water.

TABLE 13-C
SUMMARY OF ORGANICS REMOVALS FOR KINETICS TRIALS
FOR VARIOUS FLUID TYPES AND A SYSTEM CONTACT TIME OF 180 MINUTES
A. OVERALL SOIL COMPOSITES (CET-4)

SCP PROJECT - CARLSTADT, N.J.

PERCENT REMOVALS (%) WITH VARIOUS FLUID TYPES

Organics Analyzed	5% Surfactant		5% Citrikleen		10% Citrikleen	
	Before Final Wash CET-73	After Final Wash CET-74	Before Final Wash CET-106	After Final Wash CET-107	Before Final Wash CET-142	After Final Wash CET-143
TCL Volatiles						
Chloromethane						
Bromomethane						
Methylene Chloride						
Acetone						
Carbon Disulfide						
1,1-Dichloroethene						
1,1-Dichloroethane						
trans-1,2-Dichloroethene						
Chloroform						
1,2-Dichloroethane						
2-Butanone						
1,1,1-Trichloroethane						
Carbon Tetrachloride						
Vinyl Acetate						
Bromodichloromethane						
1,2-Dichloropropane						
Trichloroethene						
Dibromochloromethane						
1,1,2-Trichloroethane						
Benzene						
trans-1,3-Dichloropropane						
Bromoform						
4-Methyl-2-Pentanone						
2-Hexanone						
Tetrachloroethene			68	82		
1,1,2,2-Tetrachloroethane						
Toluene						
Chlorobenzene						
Ethylbenzene						
Styrene						
Xylenes			91		79	92
Semivolatiles						
Phenol						
bis (2-chloroethyl) ether						
2-chlorophenol						
1,3-dichlorobenzene						
1,4-dichlorobenzene						
Benzyl alcohol						
1,2-dichlorobenzene						
1-methylphenol						
bis (2-chloroisopropyl) ether						
4-methylphenol						
N-nitrosodi-n-propylamine						

TABLE 13C (continued)

Organics Analyzed	PERCENT REMOVALS (%) WITH VARIOUS FLUID TYPES					
	5% Surfactant		5% Citrikleen		10% Citrikleen	
	Before Final Wash CET-73	After Final Wash CET-74	Before Final Wash CET-106	After Final Wash CET-107	Before Final Wash CET-142	After Final Wash CET-143
Semivolatiles (continued)						
hexachloroethane						
Nitrobenzene						
Isophorone						
2-nitrophenol						
2,4-dimethylphenol						
Benzoic acid						
2,4-dichlorophenol						
1,2,4-trichlorobenzene						
Naphthalene						
4-chloro-3-methylphenol						
Dimethyl phthalate						
Acenaphthylene						
Acenaphthene						
2,4-dinitrophenol						
4-nitrophenol						
Dibenzofuran						
Diethyl phthalate						
Anthracene						
bis (2-ethylhexyl) phthalate	19	-44				
Total Petroleum Hydrocarbon						

Footnotes:

[1] Treated solids were sampled and analyzed before and after washing them with a final volume of distilled water.

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TABLE 14-A
SUMMARY OF ORGANICS REMOVALS FOR KINETICS TRIALS
FOR VARIOUS FLUID TYPES AND A SYSTEM CONTACT TIME OF 45 MINUTES
B. SLUDGE TANK & PIT COMPOSITES (CET-5)

SCP PROJECT - CARLSTADT, N.J.

Organics Analyzed	PERCENT REMOVALS (%) WITH VARIOUS FLUID TYPES					
	5% Surfactant		5% Citrikleen		10% Citrikleen	
	Before Final Wash[1] CET-52	After Final Wash[1] CET-53	Before Final Wash CET-88	After Final Wash CET-89	Before Final Wash CET-124	After Final Wash CET-125
TCL Volatiles						
Chloromethane						
Bromomethane						
Methylene Chloride				93		
Acetone						
Carbon Disulfide						
1,1-Dichloroethene						
1,1-Dichloroethane						
trans-1,2-Dichloroethene						
Chloroform						
1,2-Dichloroethane						
2-Butanone						
1,1,1-Trichloroethane						
Carbon Tetrachloride			100			
Vinyl Acetate						
Bromodichloromethane						
1,2-Dichloropropane						
Trichloroethene						
Dibromochloromethane						
1,1,2-Trichloroethane						
Benzene						
trans-1,3-Dichloropropane						
Bromoform						
4-Methyl-2-Pentanone			98			
2-Hexanone						
Tetrachloroethene	95	88	95	98	100	99
1,1,2,2-Tetrachloroethane						
Toluene	97	92	97	99	100	100
Chlorobenzene						
Ethylbenzene	92	78	95	97	99	99
Styrene						
Xylenes	91	78	94	97	99	99
Semivolatiles						
Phenol	82	88				
bis (2-chloroethyl) ether						
2-chlorophenol						
1,3-dichlorobenzene						
1,4-dichlorobenzene						
Benzyl alcohol						
1,2-dichlorobenzene	90	88				
1-methylphenol						
bis (2-chloroisopropyl) ether						
4-methylphenol						
N-nitrosodi-n-propylamine						

TABLE 14A (continued)

Organics Analyzed	PERCENT REMOVALS (%) WITH VARIOUS FLUID TYPES					
	5% Surfactant		5% Citrikleen		10% Citrikleen	
	Before Final Wash[1] CET-52	After Final Wash[1] CET-53	Before Final Wash CET-88	After Final Wash CET-89	Before Final Wash CET-124	After Final Wash CET-125
Semivolatiles (continued)						
hexachloroethane						
Nitrobenzene						
Isophorone						
2-nitrophenol						
2,4-dimethylphenol						
Benzoic acid						
2,4-dichlorophenol						
1,2,4-trichlorobenzene	82	79				
Naphthalene	82					
4-chloro-3-methylphenol						
Dimethyl phthalate						
Acenaphthylene						
Acenaphthene						
2,4-dinitrophenol						
4-nitrophenol						
Dibenzofuran						
Diethyl phthalate	81	77				
bis (2-ethylhexyl) phthalate	89	81				
butylbenzylphthalate	83	73				
Total Petroleum Hydrocarbon						

Footnotes:

[1] Treated solids were sampled and analyzed before and after washing them with a final volume of distilled water.

TABLE 14-8
SUMMARY OF ORGANICS REMOVALS FOR KINETICS TRIALS
FOR VARIOUS FLUID TYPES AND A SYSTEM CONTACT TIME OF 90 MINUTES
B. SLUDGE TANK & PIT COMPOSITES (CET-5)

SCP PROJECT - CARLSTADT, N.J.

PERCENT REMOVALS (%) WITH VARIOUS FLUID TYPES

Organics Analyzed	5% Surfactant		5% Citrikleen		10% Citrikleen	
	Before Final Wash[1] CET-64	After Final Wash[1] CET-65	Before Final Wash CET-100	After Final Wash CET-101	Before Final Wash CET-136	After Final Wash CET-137
TCL Volatiles						
Chloromethane						
Bromomethane						
Methylene Chloride				96		
Acetone						
Carbon Disulfide						
1,1-Dichloroethene						
1,1-Dichloroethane						
trans-1,2-Dichloroethene						
Chloroform						
1,2-Dichloroethane						
2-Butanone						
1,1,1-Trichloroethane						
Carbon Tetrachloride			99		99	100
Vinyl Acetate						
Bromodichloromethane						
1,2-Dichloropropane						
Trichloroethene						
Dibromochloromethane						
1,1,2-Trichloroethane						
Benzene						
trans-1,3-Dichloropropane						
Bromoform						
4-Methyl-2-Pentanone						
2-Hexanone						
Tetrachloroethene	100	100	95	99	95	96
1,1,2,2-Tetrachloroethane						
Toluene	100	100	96	99	97	98
Chlorobenzene						
Ethylbenzene			93	99	94	95
Styrene						
Xylenes	100	100	92	98	93	94
Semivolatiles						
Phenol	91	81			91	
bis (2-chloroethyl) ether						
2-chlorophenol						
1,3-dichlorobenzene						
1,4-dichlorobenzene						
Benzyl alcohol						
1,2-dichlorobenzene	98	92			93	91
1-methylphenol						
bis (2-chloroisopropyl) ether						
4-methylphenol						
N-nitrosodi-n-propylamine						

TABLE 14B (continued)

Organics Analyzed	PERCENT REMOVALS (%) WITH VARIOUS FLUID TYPES					
	5% Surfactant		5% Citrikleen		10% Citrikleen	
	Before Final Wash[1] CET-64	After Final Wash[1] CET-65	Before Final Wash CET-100	After Final Wash CET-101	Before Final Wash CET-136	After Final Wash CET-137
Semivolatiles (continued)						
hexachloroethane						
Nitrobenzene						
Isophorone						
2-nitrophenol						
2,4-dimethylphenol						
Benzoic acid						
2,4-dichlorophenol						
1,2,4-trichlorobenzene	92	62			85	
Naphthalene						
4-chloro-3-methylphenol						
Dimethyl phthalate						
Acenaphthylene						
Acenaphthene						
2,4-dinitrophenol						
4-nitrophenol						
Di-n-butylphthalate		-33				
Diethyl phthalate	89	58			81	
bis (2-ethylhexyl) phthalate	88	57			82	
butylbenzylphthalate	82	40				
Total Petroleum Hydrocarbon						

Footnotes:

[1] Treated solids were sampled and analyzed before and after washing them with a final volume of distilled water.

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TABLE 14-C
SUMMARY OF ORGANICS REMOVALS FOR KINETICS TRIALS
FOR VARIOUS FLUID TYPES AND A SYSTEM CONTACT TIME OF 180 MINUTES
B. SLUDGE TANK & PIT COMPOSITES (CET-5)

SCP PROJECT - CARLSTADT, N.J.

PERCENT REMOVALS (%) WITH VARIOUS FLUID TYPES

Organics Analyzed	5% Surfactant		5% Citrikleen		10% Citrikleen	
	Before Final Wash CET-76	After Final Wash CET-77	Before Final Wash CET-112	After Final Wash CET-113	Before Final Wash CET-148	After Final Wash CET-149
TCL Volatiles						
Chloromethane						
Bromomethane						
Methylene Chloride						
Acetone						
Carbon Disulfide						
1,1-Dichloroethene						
1,1-Dichloroethane						
trans-1,2-Dichloroethene						
Chloroform						
1,2-Dichloroethane						
2-Butanone						
1,1,1-Trichloroethane						
Carbon Tetrachloride					99	99
Vinyl Acetate						
Bromodichloromethane						
1,2-Dichloropropane						
Trichloroethene						
Dibromochloromethane						
1,1,2-Trichloroethane						
Benzene						
trans-1,3-Dichloropropane						
Bromoform						
4-Methyl-2-Pentanone						
2-Hexanone						
Tetrachloroethene	94	93	86	90	94	94
1,1,2,2-Tetrachloroethane						
Toluene	96	96	91	93	97	96
Chlorobenzene						
Ethylbenzene	92	89	80	80	94	93
Styrene						
Xylenes	91	89	78	81	92	92
Semivolatiles						
Phenol	85	87				
bis (2-chloroethyl) ether						
2-chlorophenol						
1,3-dichlorobenzene						
1,4-dichlorobenzene						
Benzyl alcohol						
1,2-dichlorobenzene	94	94	81	85	88	91
1-methylphenol						
bis (2-chloroisopropyl) ether						
4-methylphenol						
N-nitrosodi-n-propylamine						

TABLE 14C (continued)

PERCENT REMOVALS (%) WITH VARIOUS FLUID TYPES

Organics Analyzed	5% Surfactant		5% Citrikleen		10% Citrikleen	
	Before Final Wash	After Final Wash	Before Final Wash	After Final Wash	Before Final Wash	After Final Wash
	CET-76	CET-77	CET-112	CET-113	CET-148	CET-149
Semivolatiles (continued)						
hexachloroethane						
Nitrobenzene						
Isophorone						
2-nitrophenol						
2,4-dimethylphenol						
Benzoic acid						
2,4-dichlorophenol						
1,2,4-trichlorobenzene	83	86				
Naphthalene						
4-chloro-3-methylphenol						
Dimethyl phthalate						
Acenaphthylene						
Acenaphthene						
2,4-dinitrophenol						
4-nitrophenol						
Dibenzofuran						
Diethyl phthalate	78	95	57	56		
bis (2-ethylhexyl) phthalate	84	79	50	61		
butylbenzylphthalate		-153				
Total Petroleum Hydrocarbon						

Footnotes:

[1] Treated solids were sampled and analyzed before and after washing them with a final volume of distilled water.

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TABLE 15
SUMMARY OF PERCENT REMOVALS FOR KINETICS TRIALS
FOR VARIOUS FLUID TYPES AND SYSTEM CONTACT TIMES
C. SLUDGE HOT SPOT B/N

SCP PROJECT - CARLSTADT, N.J.

Note: No Semivolatiles were detected in the raw sample.

Organics Analyzed	PERCENT REMOVALS (%)				PERCENT REMOVALS (%)				PERCENT REMOVALS (%)			
	5% Citrikleen SYSTEM CONTACT TIME OF 45 MIN		10% Citrikleen		5% Citrikleen SYSTEM CONTACT TIME OF 90 MIN		10% Citrikleen		5% Citrikleen SYSTEM CONTACT TIME OF 180 MIN		10% Citrikleen	
	Before Final Wash[1] CET-85	After Final Wash[1] CET-86	Before Final Wash CET-121	After Final Wash CET-122	Before Final Wash CET-97	After Final Wash CET-98	Before Final Wash CET-133	After Final Wash CET-134	Before Final Wash CET-108	After Final Wash CET-109	Before Final Wash CET-145	After Final Wash CET-146
Semivolatiles												
Phenol												
bis (2-chloroethyl) ether												
2-chlorophenol												
1,3-dichlorobenzene												
1,4-dichlorobenzene												
Benzyl alcohol												
1,2-dichlorobenzene												
1-methylphenol												
bis (2-chloroisopropyl) ether												
4-methylphenol												
N-nitrosodi-n-propylamine												
hexachloroethane												
Nitrobenzene												
Isophorone												
2-nitrophenol												
2,4-dimethylphenol												
Benzoic acid												
2,4-dichlorophenol												
1,2,4-trichlorobenzene												
Naphthalene												
4-chloro-3-methylphenol												
Dimethyl phthalate												
Acenaphthylene												
Acenaphthene												
2,4-dinitrophenol												
4-nitrophenol												
Dibenzofuran												
Diethyl phthalate												
Anthracene												
Pyrene												

Footnotes:
[1] Treated solids were sampled and analyzed before and after washing them with a final volume of distilled water.

C002735 A

ATTACHMENT D-3

COMPLETE CHEMICAL ANALYSES FOR USED FLUIDS AND WASH LIQUIDS

TABLE 16
RESULTS OF METALS REMOVAL - KINETICS TRIALS
EXTRACTION WITH 10% HYDROCHLORIC ACID
USED EXTRACTION FLUID ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

System Contact Time [1] (Min)	Sample Name	Raw Sample I.D.	Soils/ Sludges Metals Analyzed [2]	CONCENTRATION IN USED EXTRACTION FLUID (ug/l) PT-1	PT-2	PT-3	PT-4	PT-5	PT-6	PT-7	PT-8	PT-9	PT-10	PT-11	PT-12
45	Soil Hot Spot/Lead	CET-1	Chromium												
			Copper												
			Lead	30,400											
	Soil Hot Spot/ Composite	CET-3	Chromium		1,410										
			Copper		22,100										
			Lead		37,100										
	Overall Soil Composite	CET-4	Chromium			1,560									
			Copper			55,900									
			Lead			33,700									
	Sludge Tank&Pit Composite	CET-5	Chromium				48,600								
			Copper				29,900								
			Lead				229,000								
90	Soil Hot Spot/Lead	CET-1	Chromium					1,290							
			Copper					10,800							
			Lead					55,400							
	Soil Hot Spot/ Composite	CET-3	Chromium						2,150						
			Copper						128,000						
			Lead						23,500						
	Overall Soil Composite	CET-4	Chromium							2,020					
			Copper							13,700					
			Lead							25,100					
	Sludge Tank&Pit Composite	CET-5	Chromium												
			Copper												
			Lead												
180	Soil Hot Spot/Lead	CET-1	Chromium								633,000				
			Copper								346,000				
			Lead								650,000	55,300			
	Soil Hot Spot/ Composite	CET-3	Chromium										2,810		
			Copper										160,000		
			Lead										25,400		
	Overall Soil Composite	CET-4	Chromium											2,120	
			Copper											16,900	
			Lead											77,800	
	Sludge Tank&Pit Composite	CET-5	Chromium												252,000
			Copper												220,000
			Lead												601,000

Footnotes :

[1] System contact time is the total time the sample was in contact with the fluid. This is contrasted with the stage contact time which refers to the time the sample is in contact with the fluid in a single stage. Each process trial in the treatability study consisted of 3 stages.

[2] Metal analyses were of total metal content (i.e. all chemical forms).

TABLE 17
RESULTS OF ORGANICS REMOVAL - KINETICS TRIALS
EXTRACTION WITH 5% AQUEOUS SURFACTANT SOLUTION [1]
USED EXTRACTION FLUID ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

CONTAMINANT CONCENTRATION IN USED EXTRACTION FLUID SAMPLES
(WITHIN THE RANGE CET-15 TO CET-24)
(ug/l)

Organics Analyzed	Soil/Sludge Sample Name Overall Soil Composite			Soil/Sludge Sample Name Sludge Tank&Pit Composite			Soil/Sludge Sample Name Soil Hot Spot Composite		
	PT-15 CET-51	PT-19 CET-63	PT-23 CET-75	PT-16 CET-54	PT-20 CET-66	PT-24 CET-78	PT-14 CET-48	PT-18 CET-60	PT-22 CET-72
TCL Volatiles									
Chloromethane									
Bromomethane									
Methylene Chloride									
Acetone				29.000					
Carbon Disulfide									
1,1-Dichloroethene									
1,1-Dichloroethane									
trans-1,2-Dichloroethene			280.000						
Chloroform				26.000					
1,2-Dichloroethane									
2-Butanone						37.000			
1,1,1-Trichloroethane									
Carbon Tetrachloride				55.000		16.000			
Vinyl Acetate									
Bromodichloromethane									
1,2-Dichloropropane									
Trichloroethene			260.000						
Dibromochloromethane									
1,1,2-Trichloroethane									
Benzene			280.000						
trans-1,3-Dichloropropane									
Bromoform									
4-Methyl-2-Pentanone									
2-Hexanone									
Tetrachloroethene				870.000	110.000	600.000			
1,1,2,2-Tetrachloroethane									
Toluene			270.000	270.000	19.000	160.000			
Chlorobenzene			280.000						
Ethylbenzene				31.000		31.000			
Styrene									
Xylenes				140.000	32.000	130.000			
Semivolatiles									
Phenol		ND		32.000		40.000			
bis (2-chloroethyl) ether				5.000					
2-chlorophenol			3.000						
1,3-dichlorobenzene									
1,4-dichlorobenzene			2.000	1.000					
Benzyl alcohol									
1,2-dichlorobenzene				160.000		120.000			
1-methylphenol									
bis (2-chloroisopropyl) ether									
4-methylphenol									
N-nitrosodi-n-propylamine			2.000						
hexachloroethane									
Nitrobenzene									
Isophorone				7.000					
2-nitrophenol									
2,4-dimethylphenol									
Benzoic acid									
2,4-dichlorophenol									
1,2,4-trichlorobenzene			2.000	13.000		10.000			
Naphthalene				4.000					
4-chloro-3-methylphenol			3.000						
2-methylnaphthalene				2.000					
Dimethyl phthalate				3.000					
Acenaphthylene									
Acenaphthene			3.000						
2,4-dinitrophenol			1.000						
4-nitrophenol									
Dibenzofuran									
Bis(2-ethylhexyl)phthalate	1.000		4.000	24.000		40.000	2.000	10.000	2.000
Diethyl phthalate				50.000		50.000			
Anthracene									
Pyrene			4.000						
Di-n-butyl phthalate				1.000					
Butyl benzyl phthalate				3.000					
Petroleum Hydrocarbons	39.000		19.000	300.000	240.000	370.000	52.000	190.000	43.000

[1] The surfactant used was Triton - X - 100 manufactured by Ronm & Haas.

TABLE 18
RESULTS OF ORGANICS REMOVAL - KINETICS TRIALS
EXTRACTION WITH 5% AQUEOUS CITRIKLEEN SOLUTION
USED EXTRACTION FLUID ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

CONTAMINANT CONCENTRATION IN USED EXTRACTION FLUID SAMPLES
(WITHIN THE RANGE CET-26 TO CET-36)
(ug/l)

	Soil/Sludge Sample Name Overall Soil Composite			Soil/Sludge Sample Name Sludge Tank & Pit Composite			Soil/Sludge Sample Name Sludge Hot Spot B/N		
Organics Analyzed	PT-26 CET-84	PT-30 CET-96	PT-34 CET-108	PT-28 CET-90	PT-32 CET-102	PT-36 CET-114	PT-27 CET-87	PT-31 CET-99	PT-35 CET-111
TCL Volatiles						ND			ND
Chloromethane									
Bromomethane									
Methylene Chloride									
Acetone									
Carbon Disulfide									
1,1-Dichloroethene									
1,1-Dichloroethane									
trans-1,2-Dichloroethene									
Chloroform									
1,2-Dichloroethane									
2-Butanone									
1,1,1-Trichloroethane									
Carbon Tetrachloride				34,000					
Vinyl Acetate									
Bromodichloromethane									
1,2-Dichloropropane									
Trichloroethene									
Dibromochloromethane									
1,1,2-Trichloroethane									
Benzene									
trans-1,3-Dichloropropane									
Bromoform									
4-Methyl-2-Pentanone									
2-Hexanone									
Tetrachloroethene				340,000	420,000				
1,1,2,2-Tetrachloroethane									
Toluene				150,000	130,000				
Chlorobenzene									
Ethylbenzene				20,000	21,000				
Styrene									
Xylenes				92,000	95,000				
Semivolatiles								ND	
Phenol				16,000					
bis (2-chloroethyl) ether					2,000				
2-chlorophenol									
1,3-dichlorobenzene									
1,4-dichlorobenzene									
Benzyl alcohol									
1,2-dichlorobenzene				42,000	23,000		55,000		
1-methylphenol									
bis (2-chloroisopropyl) ether									
4-methylphenol									
N-nitrosodi-n-propylamine									
hexachloroethane									
Nitrobenzene									
Isophorone					6,000				
2-nitrophenol									
2,4-dimethylphenol									
Benzoic acid									
2,4-dichlorophenol									
1,2,4-trichlorobenzene					12,000				
Naphthalene					2,000				
4-chloro-3-methylphenol									
Dimethyl phthalate									
Acenaphthylene									
Acenaphthene									
2,4-dinitrophenol									
4-nitrophenol									
Dibenzofuran									
Diethyl phthalate				18,000	33,000		22,000		
Di-n-butyl phthalate				26,000					
Bis(2-ethylhexyl)phthalate		5,000	3,000	128,000	60,000		36,000		
Anthracene									
Pyrene									
Butyl benzyl phthalate					5,000				
Petroleum Hydrocarbons		5,400,000	4,600,000		5,900,000	920,000			

TABLE 19
RESULTS OF ORGANICS REMOVAL - KINETICS TRIALS
EXTRACTION WITH 10% AQUEOUS CITRIKLEEN SOLUTION
USED EXTRACTION FLUID ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

CONTAMINANT CONCENTRATION IN USED EXTRACTION FLUID SAMPLES
(WITHIN THE RANGE CET-38 TO CET-48)
(ug/l)

Organics Analyzed	Soil/Sludge Sample Name Overall Soil Composite			Soil/Sludge Sample Name Sludge Tank & Pit Composite			Soil/Sludge Sample Name Sludge Hot Spot B/N		
	PT-38 CET-120	PT-42 CET-132	PT-46 CET-144	PT-40 CET-126	PT-44 CET-138	PT-48 CET-150	PT-39 CET-123	PT-43 CET-135	PT-47 CET-147
TCL Volatiles									
Chloromethane									
Bromomethane									
Methylene Chloride									
Acetone									
Carbon Disulfide									
1,1-Dichloroethene									
1,1-Dichloroethane									
trans-1,2-Dichloroethene									
Chloroform				58,000					
1,2-Dichloroethane				27,000					
2-Butanone				140,000					
1,1,1-Trichloroethane									
Carbon Tetrachloride				140,000		46,000			
Vinyl Acetate									
Bromodichloromethane									
1,2-Dichloropropane									
Trichloroethene				25,000					
Dibromochloromethane									
1,1,2-Trichloroethane									
Benzene									
trans-1,3-Dichloropropane									
Bromoform									
4-Methyl-2-Pentanone				70,000					
2-Hexanone									
Tetrachloroethene				2,200,000		900,000			
1,1,2,2-Tetrachloroethane									
Toluene				760,000		260,000			
Chlorobenzene									
Ethylbenzene				94,000		36,000			
Styrene									
Xylenes				470,000		170,000			
Semivolatiles									
Phenol	5,000			9,000	23,000	12,400		18,000	
bis (2-chloroethyl) ether									
2-chlorophenol									
1,3-dichlorobenzene									
1,4-dichlorobenzene									
Benzyl alcohol									
1,2-dichlorobenzene					96,000	72,000			
1-methylphenol									
bis (2-chloroisopropyl) ether									
4-methylphenol									
N-nitrosodi-n-propylamine									
hexachloroethane									
Nitrobenzene									
Isophorone									
2-nitrophenol									
2,4-dimethylphenol									
Benzoic acid									
2,4-dichlorophenol									
1,2,4-trichlorobenzene									
Naphthalene									
4-chloro-3-methylphenol									
Dimethyl phthalate									
Acenaphthylene									
Acenaphthene									
2,4-dinitrophenol									
4-nitrophenol									
Dibenzofuran									
2,6- dinitrotoluene						13,000	8,000		
Diethyl phthalate				18,000	36,000	33,000		30,000	
Bis(2-ethylhexyl)phthalate				7,000	14,000	13,000		12,000	
Anthracene									
Pyrene									
Petroleum Hydrocarbons	9,600,000	9,400,000	8,600,000	9,200,000	9,400,000	9,000,000			

TABLE 20
RESULTS OF PESTICIDES REMOVAL - KINETICS TRIALS
EXTRACTION WITH 5% AQUEOUS SURFACTANT SOLUTION [1]
USED EXTRACTION FLUID ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

CONTAMINANT CONCENTRATION IN USED EXTRACTION FLUID SAMPLES
(WITHIN THE RANGE CET-15 TO CET-24)
(ug/l)

Organics Analyzed	Soil/Sludge Sample Name Overall Soil Composite			Soil/Sludge Sample Name Sludge Tank&Pit Composite			Soil/Sludge Sample Name Soil Hot Spot Composite			Soil/Sludge Sample Name Soil Hot Spot PCB's		
	PT-15 CET-51	PT-19 CET-63	PT-23 CET-75	PT-16 CET-54	PT-20 CET-66	PT-24 CET-78	PT-14 CET-48	PT-18 CET-60	PT-22 CET-72	PT-13 CET-45	PT-17 CET-57	PT-21 CET-69
Pesticides										ND		ND
Alpha BHC												
Beta BHC												
Delta BHC												
Gamma BHC - Lindane												
Heptachlor												
Aldrin												
Heptachlor Epoxide												
Endosulfan I												
Dieldrin												
DDE												
Endrin												
Endosulfan II												
DDD												
Endosulfan II												
DDD												
Endosulfan Sulfate												
DDT												
Endrin Ketone												
Methoxychlor												
Alpha Chlordane												
Gamma Chlordane												
Toxaphene												
PCB-1016												
PCB-1221												
PCB-1232												
PCB-1242	600	1,300	800		80,000	160,000	4,100	3,000	5,600			
PCB-1248												
PCB-1254									800			
PCB-1260												
AROCHLOR 1254		220 J		4,100								
AROCHLOR 1242				85,000							4000 J	

[1] The surfactant used was Triton - X - 100 manufactored by Rohm & Haas.

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TABLE 21
RESULTS OF PESTICIDES REMOVAL - KINETICS TRIALS
EXTRACTION WITH 5% AQUEOUS CITRIKLEEN SOLUTION
USED EXTRACTION FLUID ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

CONTAMINANT CONCENTRATION IN USED EXTRACTION FLUID SAMPLES
(WITHIN THE RANGE CET-26 TO CET-36)
(ug/l)

Organics Analyzed	Soil/Sludge Sample Name Overall Soil Composite			Soil/Sludge Sample Name Sludge Tank & Pit Composite			Soil/Sludge Sample Name Soil Hot Spot PCB's		
	PT-26 CET-84	PT-30 CET-96	PT-34 CET-108	PT-28 CET-90	PT-32 CET-102	PT-36 CET-114	PT-25 CET-81	PT-29 CET-93	PT-33 CET-105
Pesticides			ND			ND	ND		
Alpha BHC									
Beta BHC									
Delta BHC									
Gamma BHC - Lindane									
Heptachlor									
Aldrin								1.2 J	
Heptachlor Epoxide									
Endosulfan 1									
Dieldrin								1.4 J	
DDE									
Endrin									
Endosulfan II									
DDD									
Endosulfan Sulfate									
DDT									
Endrin Ketone									
Methoxychlor									
Alpha Chlordane									
Gamma Chlordane									
Toxaphene									
PCB-1016									
PCB-1221									
PCB-1232									
PCB-1242	300	500		26000	420000				200000
PCB-1248									
PCB-1254		200			40000				
PCB 1260									

TABLE 22
RESULTS OF PESTICIDES REMOVAL - KINETICS TRIALS
EXTRACTION WITH 10% AQUEOUS CITRIKLEEN SOLUTION
USED EXTRACTION FLUID ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

CONTAMINANT CONCENTRATION IN USED EXTRACTION FLUID SAMPLES
(WITHIN THE RANGE CET-38 TO CET-48)
(ug/l)

Organics Analyzed	Soil/Sludge Sample Name Overall Soil Composite			Soil/Sludge Sample Name Sludge Tank & Pit Composite			Soil/Sludge Sample Name Soil Hot Spot PCB's		
	PT-38 CET-120	PT-42 CET-132	PT-46 CET-144	PT-40 CET-126	PT-44 CET-138	PT-48 CET-150	PT-37 CET-117	PT-41 CET-129	PT-45 CET-141
Pesticides							ND	ND	ND
Alpha BHC									
Beta BHC									
Delta BHC									
Gamma BHC - Lindane									
Heptachlor									
Aldrin									
Heptachlor Epoxide									
Endosulfan I									
Dieldrin									
DDE									
Endrin									
Endosulfan II									
DDD									
Endosulfan Sulfate									
DDT									
Endrin Ketone									
Methoxychlor									
Alpha Chlordane									
Gamma Chlordane									
Toxaphene									
PCB-1016									
PCB-1221									
PCB-1232									
PCB-1242	200	500	210	32000	44000	36000			
PCB-1248									
PCB 1254									
PCB 1260									

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TABLE 23
RESULTS OF METALS REMOVAL - SEQUENTIAL TRIALS
EXTRACTION WITH 5% AQUEOUS SURFACTANT, 5%
HYDROCHLORIC ACID, AND 10% CITRIKLEEN SOLUTION
USED EXTRACTION FLUID ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

				CONTAMINANT CONCENTRATION IN USED EXTRACTION FLUID [2] (ug/l)					
Process Trial	Raw Sample I.D.	Soils/ Sludges Sample Name	Metals Analyzed [1]	Aqueous Surfactant CET - 152	Hydrochloric Acid CET - 154	Water Wash CET - 153	Sodium Carbonate CET - 155	Citrikleen CET - 156	Wash Water CET - 157
PT-49	CET-3	Soil Hot Spot Composite	**Metals**						
			Antimony			260		70	
			Arsenic	60		190	20	60	
			Beryllium			7			
			Cadmium	91	72	802		41	5
			Chromium	310	140	2,020	70	320	40
			Copper	16,200	3,640	146,000	120	1,340	120
			Lead	2,550	1,740	44,400	155	2,730	648
			Mercury	13	1	58	3	24	1
			Nickel	80		550		50	
			Selenium	20					
			Silver			20			
			Zinc	1,700	1,450	16,400	50	1,410	190

[1] Metals analyses were of total metal content (i.e. all chemical forms).
[2] Refer to Figure II-7 for a detailed description of process steps in the sequential trials.

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TABLE 23
RESULTS OF METALS REMOVAL - SEQUENTIAL TRIALS
EXTRACTION WITH 5% AQUEOUS SURFACTANT, 5%
HYDROCHLORIC ACID, AND 10 % CITRIKLEEN SOLUTION
USED EXTRACTION FLUID ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

Process Trial	Raw Sample I.D.	Soils/ Sludges Sample Name	Metals Analyzed [1]	CONTAMINANT CONCENTRATION IN USED EXTRACTION FLUID [2] (ug/l) Aqueous Surfactant CET - 159	Hydrochloric Acid CET - 161	Water Wash CET - 160	Sodium Carbonate CET - 162	Citrikleen CET - 163	Wash Water CET - 164
PT-50	CET-4	Overall Soil Composite	**Metals**						
			Antimony			380		70	
			Arsenic	60	40	440	210	120	
			Beryllium			7			
			Cadmium	16	9	223		21	
			Chromium	300	140	4,290	510	480	60
			Copper	1,390	480	17,200	390	620	70
			Lead	1,580	991	73,800	370	902	651
			Mercury	19	0	137	26	44	4
			Nickel	60		470	60	70	
			Selenium						
			Silver			70			
			Zinc	1,290	1,210	30,400	590	810	120

[1] Metals analyses were of total metal content (i.e. all chemical forms).

[2] Refer to Figure II-7 for a detailed description of process steps in the sequential trials.

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TABLE 23
RESULTS OF METALS REMOVAL - SEQUENTIAL TRIALS
EXTRACTION WITH 5% AQUEOUS SURFACTANT, 5%
HYDROCHLORIC ACID, AND 10 % CITRIKLEEN SOLUTION
USED EXTRACTION FLUID ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

				CONTAMINANT CONCENTRATION IN USED EXTRACTION FLUID [2] (ug/l)					
Process Trial	Raw Sample I.D.	Soils/ Sludges Sample Name	Metals Analyzed [1]	Aqueous Surfactant CET - 166	Hydrochloric Acid CET - 168	Water Wash CET - 167	Sodium Carbonate CET - 169	Citrikleen CET - 170	Wash Water CET - 171
PT-51	CET-6	Sludge Tank & Pit Composite	**Metals**						
			Antimony	170	140	7,310	340	940	50
			Arsenic		20	500	30	50	
			Beryllium						
			Cadmium	1,140	324	4,930		444	17
			Chromium	5,130	3,600	115,000	1,190	5,650	260
			Copper	1,140	1,690	48,700	140	3,640	200
			Lead	10,500	93,500	1,190,000	2,090	30,300	9,270
			Mercury	9	1	303	3	155	6
			Nickel	160	50	600		60	
			Selenium	46				65	6
			Silver			110			
			Zinc	6,620	2,720	43,700	40	1,380	110

[1] Metal analyses were of total metal content (i.e. all chemical forms).

[2] Refer to Figure II-7 for a detailed description of process steps in the sequential trials.

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TABLE 24
RESULTS OF ORGANICS REMOVAL - SEQUENTIAL TRIALS
EXTRACTION WITH 5% AQUEOUS SURFACTANT, 5% HYDROCHLORIC ACID, AND 10% CITRIKLEEN SOLUTION
USED EXTRACTION FLUID ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

				CONTAMINANT CONCENTRATION IN USED EXTRACTION FLUID [2] (ug/l)					
Process Trial	Soils/ Sludges Sample Name	Raw Sample I.D.	Organics Analyzed	Aqueous Surfactant CET-159	Hydrochloric Acid CET-161	Water Wash CET-160	Sodium Carbonate CET-162	Citrikleen CET-163	Wash Water CET-164
			TCL Volatiles						
PT-50	Overall Soil Composite	CET-4	Chloromethane						
			Bromomethane						
			Methylene Chloride						
			Acetone		200		200		
			Carbon Disulfide						
			1,1-Dichloroethene						
			1,1-Dichloroethane						
			trans-1,2-Dichloroethene						
			Chloroform						
			1,2-Dichloroethane						
			2-Butanone						
			1,1,1-Trichloroethane						
			Carbon Tetrachloride						
			Vinyl Acetate						
			Bromodichloromethane						
			1,2-Dichloropropane						
			Trichloroethene						
			Dibromochloromethane						
			1,1,2-Trichloroethane						
			Benzene						
			trans-1,3-Dichloropropane						
			Bromoform						
			4-Methyl-2-Pentanone						
			2-Hexanone						
			Tetrachloroethene		200				
			1,1,2,2-Tetrachloroethane						
			Toluene						
			Chlorobenzene						
			Ethylbenzene						
			Styrene						
			Xylenes						
			Semivolatiles						
			Phenol						
			bis (2-chloroethyl) ether						
			2-chlorophenol						
			1,3-dichlorobenzene						
			1,4-dichlorobenzene						
			Benzyl alcohol						
			1,2-dichlorobenzene	2,000					
			1-methylphenol						
			bis (2-chloroisopropyl) ether						
			4-methylphenol						
			N-nitrosodi-n-propylamine						
			hexachloroethane						
			Nitrobenzene						
			Isophorone						
			2-nitrophenol						
			2,4-dimethylphenol						
			Benzoic acid						
			2,4-dichlorophenol						
			1,2,4-trichlorobenzene						
			Naphthalene						
			4-chloro-3-methylphenol						
			Dimethyl phthalate						
			Acenaphthylene						
			Acenaphthene						
			2,4-dinitrophenol						
			4-nitrophenol	4					
			Dibenzofuran						
			Diethyl phthalate			300			
			Anthracene						
			Pyrene						
			Bis (2-ethylhexyl) phthalate	5,000			200		200
			Di-n-butyl phthalate		200				300
			Petroleum Hydrocarbons	24,000		19,000	3,000	6,400,000	100,000

[2] Refer to Figure II-7 for a detailed description of process steps in the sequential trials.

TABLE 24
RESULTS OF ORGANICS REMOVAL - SEQUENTIAL TRIALS
EXTRACTION WITH 5% AQUEOUS SIRFACTANT, 5%
HYDROCHLORIC ACID, AND 10% CITRIKLEEN SOLUTION
USED EXTRACTION FLUID ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

				CONTAMINANT CONCENTRATION IN USED EXTRACTION FLUID [2] (ug/l)					
Process Trial	Soils/ Sludges Sample Name	Raw Sample I.D.	Organics Analyzed	Aqueous Surfactant CET-152	Hydrochloric Acid CET-154	Water Wash CET-153	Sodium Carbonate CET-155	Citrikleen CET-156	Wash Water CET-157
			TCL Volatiles						
PT-49	Soil Hot Spot Composite	CET-3	Chloromethane						
			Bromomethane						
			Methylene Chloride						
			Acetone						
			Carbon Disulfide						
			1,1-Dichloroethene						
			1,1-Dichloroethane						
			trans-1,2-Dichloroethene						
			Chloroform						
			1,2-Dichloroethane						
			2-Butanone						
			1,1,1-Trichloroethane						
			Carbon Tetrachloride						
			Vinyl Acetate						
			Bromodichloromethane						
			1,2-Dichloropropane						
			Trichloroethene						
			Dibromochloromethane						
			1,1,2-Trichloroethane						
			Benzene						
			trans-1,3-Dichloropropane						
			Bromoform						
			4-Methyl-2-Pentanone						
			2-Hexanone						
			Tetrachloroethene		100				
			1,1,2,2-Tetrachloroethane						
			Toluene						
			Chlorobenzene						
			Ethylbenzene						
			Styrene						
			Xylenes		100				
			Semivolatiles						
			Phenol						
			bis (2-chloroethyl) ether						
			2-chlorophenol						
			1,3-dichlorobenzene						
			1,4-dichlorobenzene						
			Benzyl alcohol						
			1,2-dichlorobenzene	700					
			1-methylphenol						
			bis (2-chloroisopropyl) ether						
			4-methylphenol						
			N-nitrosodi-n-propylamine						
			hexachloroethane						
			Nitrobenzene						
			Isophorone						
			2-nitrophenol						
			2,4-dimethylphenol						
			Benzoic acid						
			2,4-dichlorophenol						
			1,2,4-trichlorobenzene						
			Naphthalene	600					
			4-chloro-3-methylphenol						
			Dimethyl phthalate						
			Acenaphthylene						
			Acenaphthene						
			2,4-dinitrophenol						
			4-nitrophenol						
			Dibenzofuran						
			Diethyl phthalate						
			Anthracene						
			Di-n-butyl phthalate	400					600
			Pyrene						
			Phenanthrene	400					
			Bis(2-ethylhexyl)phthalat	3,300		300	200		
			Petroleum Hydrocarbon	52,000	900	21,000	15,000	6,000,000	290,000

[2] Refer to Figure II-7 for a detailed description of process steps in the sequential trials.

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TABLE 24
RESULTS OF ORGANICS REMOVAL - SEQUENTIAL TRIALS
EXTRACTION WITH 5% AQUEOUS SURFACTANT, 5% HYDROCHLORIC ACID, AND 10% CITRIKLEEN SOLUTION
USED EXTRACTION FLUID ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

				CONTAMINANT CONCENTRATION IN USED EXTRACTION FLUID [2] (ug/l)					
Process Trial	Soils/ Sludges Sample Name	Raw Sample I.D.	Organics Analyzed	Aqueous Surfactant CET-166	Hydrochloric Acid CET-168	Water Wash CET-167	Sodium Carbonate CET-169	Citrikleen CET-170	Wash Water CET-171
			TCL Volatiles						
PT-51	Sludge Tank & Pit Composite	CET-6	Chloromethane						
			Bromomethane						
			Methylene Chloride						
			Acetone	55,000		6,000			
			Carbon Disulfide						
			1,1-Dichloroethene						
			1,1-Dichloroethane						
			trans-1,2-Dichloroethene						
			Chloroform	36,000					
			1,2-Dichloroethane	21,000					
			2-Butanone	79,000		10,000			
			1,1,1-Trichloroethane						
			Carbon Tetrachloride		270				
			Vinyl Acetate						
			Bromodichloromethane						
			1,2-Dichloropropane						
			Trichloroethene	21,000					
			Dibromochloromethane						
			1,1,2-Trichloroethane						
			Benzene						
			trans-1,3-Dichloropropane						
			Bromoform						
			4-Methyl-2-Pentanone	60,000	700	8,000			
			2-Hexanone						
			Tetrachloroethene	1,700,000	6,900	62,000	3,000	62,000	830
			1,1,2,2-Tetrachloroethane						
			Toluene	490,000	5,000	18,000	1,500		
			Chlorobenzene						
			Ethylbenzene	78,000	500	3,500	200		
			Styrene						
			Xylenes	360,000	2,400	18,000	1,100		380
			Semivolatiles						
			Phenol	52,000	1,200	8,000	400		
			bis (2-chloroethyl) ether	8,000		1,000			
			2-chlorophenol						
			1,3-dichlorobenzene						
			1,4-dichlorobenzene						
			Benzyl alcohol						
			1,2-dichlorobenzene	154,000	1,100	12,000	900	30,000	300
			1-methylphenol						
			bis (2-chloroisopropyl) ether						
			4-methylphenol						
			N-nitrosodi-n-propylamine						
			hexachloroethane						
			Nitrobenzene						
			Isophorone	10,000	300	2,000			
			2-nitrophenol						
			2,4-dimethylphenol						
			Benzoic acid						
			2,4-dichlorophenol						
			1,2,4-trichlorobenzene	24,000		1,000			
			Naphthalene	7,000					
			4-chloro-3-methylphenol						
			Dimethyl phthalate						
			Acenaphthylene						
			Acenaphthene						
			2,4-dinitrophenol						
			4-nitrophenol						
			Dibenzofuran						
			Diethyl phthalate	60,000	2,000	8,000	300		400
			Anthracene						
			Pyrene						
			Bis(2-ethylhexyl)phthalate	42,000		4,000			300
			Di-n-butyl phthalate						300
			Petroleum Hydrocarbon	700,000	2,100	150,000	7,900	4,400,000	82,000

[2] Refer to Figure II-7 for a detailed description of process steps in the sequential trials.

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TABLE 25
RESULTS OF PCB/PESTICIDES REMOVAL - SEQUENTIAL TRIALS
EXTRACTION WITH 5% AQUEOUS SURFACTANT, 5%
HYDROCHLORIC ACID, AND 10% CITRIKLEEN SOLUTION
USED EXTRACTION FLUID ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

				CONTAMINANT CONCENTRATION IN USED EXTRACTION FLUID [2] (ug/l)					
Process Trial	Raw Sample I.D.	Soils/ Sludges Sample Name	PCB/Pesticides Analyzed	Aqueous Surfactant CET - 152	Hydrochloric Acid CET - 154	Water Wash CET - 153	Sodium Carbonate CET - 155	Citrikleen CET - 156	Wash Water CET - 157
PT-49	CET-3	Soil Hot Spot Composite	Pesticides						
			Alpha BHC						
			Beta BHC						
			Delta BHC						
			Gamma BHC -Lindane						
			Heptachlor						
			Aldrin						
			Heptachlor Epoxide						
			Endosulfan I						
			Dieldrin						
			DDE						
			Endrin						
			Endosulfan II						
			DDD						
			Endosulfan Sulfate						
			DDT						
			Endrin Ketone						
			Methoxychlor						
			Alpha Chlordane						
			Gamma Chlordane						
			Toxaphene						
			PCB-1016						
			PCB-1221						
			PCB-1232						
			PCB-1242	6,000	100	700	700	2,100	280
			PCB-1248						
			PCB-1254	1,000				300	
			PCB-1260						

[2] Refer to Figure II-7 for a detailed description of process steps in the sequential trials.

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TABLE 25
RESULTS OF PCB/PESTICIDES REMOVAL - SEQUENTIAL TRIALS
EXTRACTION WITH 5% AQUEOUS SURFACTANT, 5%
HYDROCHLORIC ACID, AND 10% CITRIKLEEN SOLUTION
USED EXTRACTION FLUID ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

				CONTAMINANT CONCENTRATION IN USED EXTRACTION FLUID [2] (ug/l)					
Process Trial	Raw Sample I.D.	Soils/ Sludges Sample Name	PCB/Pesticides Analyzed	Aqueous Surfactant CET - 159	Hydrochloric Acid CET - 161	Water Wash CET - 160	Sodium Carbonate CET - 162	Citrikleen CET - 163	Wash Water CET - 164
PT-50	CET-4	Overall Soil Composite	Pesticides						
			Alpha BHC						
			Beta BHC						
			Delta BHC						
			Gamma BHC -Lindane						
			Heptachlor						
			Aldrin						
			Heptachlor Epoxide						
			Endosulfan I						
			Dieldrin						
			DDE						
			Endrin						
			Endosulfan II						
			DDD						
			Endosulfan Sulfate						
			DDT						
			Endrin Ketone						
			Methoxychlor						
			Alpha Chlordane						
			Gamma Chlordane						
			Toxaphene						
			PCB-1016						
			PCB-1221						
			PCB-1232		40				
			PCB-1242	13,000		8,000	2,200	1,000	1,600
			PCB-1248						
			PCB-1254	1,700		600	300		
			PCB-1260						

[2] Refer to Figure II-7 for a detailed description of process steps in the sequential trials.

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TABLE 25
RESULTS OF PCB/PESTICIDES REMOVAL - SEQUENTIAL TRIALS
EXTRACTION WITH 5% AQUEOUS SURFACTANT, 5%
HYDROCHLORIC ACID, AND 10% CITRIKLEEN SOLUTION
USED EXTRACTION FLUID ANALYSIS

SCP PROJECT - CARLSTADT, N.J.

				CONTAMINANT CONCENTRATION IN USED EXTRACTION FLUID [2] (ug/l)					
Process Trial	Raw Sample I.D.	Soils/ Sludges Sample Name	PCB/Pesticides Analyzed	Aqueous Surfactant CET - 166	Hydrochloric Acid CET - 168	Water Wash CET - 167	Sodium Carbonate CET - 169	Citrikleen CET - 170	Wash Water CET - 171
PT-51	CET-6	Sludge Tank & Pit Composite	Pesticides						
			Alpha BHC						
			Beta BHC						
			Delta BHC						
			Gamma BHC -Lindane						
			Heptachlor						
			Aldrin						
			Heptachlor Epoxide						
			Endosulfan I						
			Dieldrin						
			DDE						
			Endrin						
			Endosulfan II						
			DDD						
			Endosulfan Sulfate						
			DDT						
			Endrin Ketone						
			Methoxychlor						
			Alpha Chlordane						
			Gamma Chlordane						
			Toxaphene						
			PCB-1016						
			PCB-1221						
			PCB-1232						
			PCB-1242	82,000		23,000	10,000	39,000	8,000
			PCB-1248						
			PCB-1254				900	5,000	700
			PCB-1260						

[2] Refer to Figure II-7 for a detailed description of process steps in the sequential trials.

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Appendix E
Solidification and Stabilization Testing

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APPENDIX E

SOLIDIFICATION AND STABILIZATION TESTING FOR SOILS AND SLUDGES

Summary of the work done by Enreco Laboratories and HAZCON Engineering, Inc.

Table E-1 Summary of the physical testing of the final stabilized mixes developed by Enreco Laboratories

Table E-2 Summary of the physical testing of the final stabilized mixes developed by HAZCON Engineering, Inc.

Table E-3 Summary of the analytical results for the Enreco treatability study

Table E-4 Summary of the analytical results for the HAZCON treatability study

Attachment E1 Enreco Laboratories' Preliminary and Final reports on the stabilization/solidification of the SCP site soil/sludges

Attachment E2 Final Report Treatability Study of the HAZCON Engineering, Inc. Stabilization/Solidification Process

APPENDIX E

Objectives

A series of laboratory scale bench studies were performed by two independent stabilization/solidification contractors to assess the feasibility of stabilization of the materials in the FOU. The objective of the study is to evaluate the effectiveness of stabilization/solidification for reducing the toxicity or mobility of constituents in the soil and sludges. The specific objectives of the treatability testing include the following:

1. To determine the applicability of the solidification/stabilization process to the site soil and sludges;
2. To determine the effectiveness of the process for remediation of the site soil and sludges, in terms of strength, permeability and leaching;
3. To evaluate potential chemical process conditions; and
4. To provide preliminary estimate of unit costs.

The treatability study was performed as outlined in the Scope of Treatability Studies for the FS/FOU. Both contractors evaluated a number of different mixes based on cementitious and pozzolanic bonding process, with/without the addition of proprietary additives. The evaluation of the mixes was based on strength values (unconfined compressive strength [UCS]), leaching parameters, and permeability.

Discussion of Results

The results of the physical testing for Round III are attached in Table E-1 and Table E-2 which summarizes the results for Enreco and HAZCON, respectively. The analytical data for the raw sample and Round III stabilized material are attached in Table E-3 and Table E-4 which consolidates the results to date for Enreco and HAZCON respectively. Following is a discussion of the results for each of the major parameters and a general interpretation of trends and results. Excerpts from the final

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reports from the contractors are included in Attachment E1 and Attachment E2 for Enreco and HAZCON respectively.

According to the Scope of Treatability Studies, the actual analysis performed by HAZCON was correct for the initial and TCLP analysis, as HAZCON performed total analysis on the raw material and leached testing on the stabilized material. Compounds in the final TCLP testing indicated as NAF (Not Analyzed For) are so because the list of compounds that are analyzed for in a total constituent analysis differ from the list of compounds for TCLP testing.

Enreco testing differs from the Scope of Treatability Studies because the raw analysis was performed through TCLP analysis and not as specified total constituents. Enreco requested EP-Tox leaching analysis for most of the metals analysis and one of the organic analysis in the raw sample characterization.

The majority of the material on site does not require stabilization for structural purposes, therefore the ultimate strength values are not the driving factor for this stabilization. All of the stabilization mixes exceeded the 50 psi guidelines for strength of stabilized materials after curing for 14 days.

The mix design by HAZCON exceeded the 50 psi guidance by 1 to 2 orders of magnitude. This high strength indicates that the mix may be leaned out to produce a more cost effective mix while meeting the strength guidance. Both contractors experienced a general lower ultimate strength for the Soil Hot Spot Base/Neutrals and the Sludge Tank and Pit Composite, indicating that there is potentially an interference with elevated levels of some constituents and the cementitious or pozzolanic bonding.

The range of permeabilities found for the stabilized materials was between 10^{-5} to 10^{-8} cm/sec. This range would be expected for a similar soil cement mix. The dry unit weight of the stabilized mixes was found to be in the range of 75 to 100 pounds per cubic foot.

The mix moisture content was approximately 17 to 27 percent for Enreco while HAZCON utilized a mix moisture content of 18 to 31 percent. This difference is attributed to the addition of site water for workability by HAZCON. Enreco did not add any additional water to the stabilized mix.

The analytical results in Table E-3 and Table E-4 are generated from the data provided by Compuchem Labs. None of the data has undergone a QA/QC review for completeness or correctness, therefore the data may need reevaluation upon completion of the data QA/QC review.

The general interpretation of the analytical results indicates that a significant reduction in leachability was achieved by stabilization. The stabilized mixes appear to bind up metals, volatiles, semi-volatiles, and PCB's into the structural matrix.

Some samples showed an increase in contaminant levels. This may be attributed to variability in the sample.

Summary

In conclusion the stabilization/solidification of the material in the FOU is an applicable technology. The application of this technology is limited to the use in an on-site environment where the material is excavated and then stabilized. In-situ stabilization would be difficult to impossible on this site due to the presence of quantities of large pieces of rubble. The presence of the rubble would limit the mixing potential; therefore the quality and homogeneity of the material would be in question.

HAZCON's estimate of full scale costs for the mix developed would be approximately $65 to $80 per cubic yard of treated waste. This price includes excavation, additive, blending, and emplacement of the treated material. Enreco has provided an estimate of full scale costs inthe $20 to $40 per cubic yard range, although they note the price could be higher depending on the site locaion, availability of reagent, and potential transportation costs.

If stabilization is chosen as a final remedy for the SCP FOU, further testing of mix designs would be recommended to optimize a cost performance ratio. Also a pilot scale test on-site should be done to evaluate the effect of the rubble content on mixing and the control of volatilization during excavation and mixing.

Three permeability samples from Enreco broke during preparation for testing at the lab. These specimens were re-

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mixed at the same ratios and tested. Both contractors have submitted final reports which are attached.

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Table E-1
Summary of the physical testing of the final stabilized mixes developed by Enreco

Design Mix	Unconfined Compressive Strength (psi) 3 Day Cure	7 Day Cure	14 Day Cure	Permeability [1] (cm/sec)	Moisture Content [1] [2] (%)	Dry Unit Weight [1] (lb/ft-3)
Overall Soil Composite .2 Portland Cement + 5% B-27	>125	>125	>125	4E-07	17.3	100.0
Hot Spot Soil Composite .3 Portland Cement	78.8	89.3	113.5	3E-07	20.8	94.6
Soil Hot Spot - Volatiles .2 Portland Cement + 5% B-27	84.0	110.7	>125	4E-08	14.9	107.9
Sludge Hot Spot - Base/Neutrals .3 Portland Cement	20.5	76.0	88.25	6E-05	17.6	85.0
Sludge Tank and Pit Composite .2 Lime Kiln Dust	24.1	44.1	>62.5	1E-06	27.3	89.1
Soil Hot Spot - Lead .2 Portland Cement + 5% B-27	>125	>125	>125	2E-05	18.5	95.9

Notes:

[1] - Analysis on 14-day cured samples

[2] - Enreco did not add any additional water to the stabilization mixes

Table E-2
Summary of the physical testing of the final stabilized mixes
developed by Hazcon

Design Mix	Unconfined Compressive Strength (psi) 3 Day Cure	7 Day Cure	14 Day Cure	Permeability [1] (cm/sec)	Moisture Content [1] [2] (%)	Dry Unit Weight [1] (lb/ft-3)
Overall Soil Composite .5 Portland Cement + 15% Chloranan	1678	2028, 2115	2422	2E-08	17.9	100.5
Hot Spot Soil Composite .5 Portland Cement + 15% Chloranan	798	1138, 1029	1194	9E-08	25.6	87.6
Soil Hot Spot - Volatiles .5 Portland Cement + 15% Chloranan	1456	1864, 1786	1977	3E-08	17.8	97.2
Sludge Hot Spot - Base/Neutrals .5 Portland Cement + 15% Chloranan	12	179, 162	753	1E-07	24.2	91.7
Sludge Tank and Pit Composite .5 Portland Cement + 15% Chloranan	393	522, 575	701	3E-06	31.0	78.9
Soil Hot Spot - Lead .5 Portland Cement + 15% Chloranan	2552	2941, 2951	3598	4E-08	18.8	100.1

Notes:

[1] - Analysis on 14-day cured samples

[2] - Between 15-25% water added to mix for workability (water added came from site water collected).

Table E-3
Summary of the analytical results for the Enreco Treatability Study

COMPOUND	TCLP leaching raw sample ug/l	Notes	TCLP leaching stab. sample ug/l	Notes
Overall Soil Composite				
METALS				
Arsenic, total	373	[2]	9.3	B
Barium, total	289	[2]	572	
Cadmium, total	29	[2]	4	U
Chromium, total	34	[2]	13.9	
Lead, total	242	[2]	50.3	
Mercury, total	0.22	[2]	1.7	
Selenium, total	30	[2]	1.4	U
Silver, total	5.5	U [2]	5.5	U
VOLATILES				
Benzene	100		38	
Chloroform	450		BDL	
1,2-Dichloroethane	24	J	BDL	
Methylene chloride	260	B	80	B
Tetrachloroethene	33	J	8	J
Toluene	390		200	
1,1,1-Trichloroethane	18	J	BDL	
Trichloroethene	150		38	
Vinyl Chloride	BDL		60	
SEMI-VOLITILES				
1,2-Dichlorobenzene	10		22	
3-Methylphenol	BDL		37	[1]
4-Methylphenol	BDL		37	[1]
Nitrobenzene	16		4	J
Phenol	BDL		30	
HERBICIDES	BDL		BDL	
PESTICIDES	BDL		BDL	

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Table E-3
Summary of the analytical results for the Enreco Treatability Study

COMPOUND	TCLP leaching raw sample ug/l	Notes	TCLP leaching stab. sample ug/l	Notes
Hot Spot Soil Composite				
METALS				
Arsenic, total	18	[2]	8.6	B
Barium, total	352	[2]	257	
Cadmium, total	57	[2]	4	U
Chromium, total	33	[2]	44.1	
Lead, total	1080	[2]	2	B
Mercury, total	0.2	U [2]	0.2	U
Selenium, total	7	U [2]	1.4	U
Silver, total	5.5	U [2]	5.5	U
VOLATILES				
Benzene	330	J	BDL	
2-Butanone	6900		BDL	
Chlorobenzene	420	J	40	
Chloroform	31000		22	J
1,2-Dichloroethane	20000		16	J
Methylene Chloride	1300	B	26	JB
Tetrachloroethene	5500		560	
Toluene	34000		750	
1,1,1-Trichloroethane	6800		10	J
1,1,2-Trichloroethane	230	J	BDL	
Trichloroethene	22000		95	
SEMI-VOLATILES				
1,2-Dichlorobenzene	BDL		51	
1,4-Dichlorobenzene	2	J	BDL	
2-Methylphenol	51		8	J
3-Methylphenol	BDL		91	[1]
4-Methylphenol	BDL		91	[1]
Nitrobenzene	5800		1400	+
Phenol	280	J	390	+
Pyridine	BDL		5	J
HERBICIDES	BDL		BDL	
PESTICIDES	BDL		BDL	

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Table E-3
Summary of the analytical results for the Enreco Treatability Study

COMPOUND	TCLP leaching raw sample ug/l	Notes	TCLP leaching stab. sample ug/l	Notes
Soil Hot Spot Volatiles				
VOLATILES				
Acetone	480	B	NAF	
Benzene	4	J	1	J
Chloroform	9	J	BDL	
1,1-Dichloroethane	6	J	NAF	
1,2-Dichloroethane	260		47	
1,2-Dichloroethene, total	21		NAF	
Ethylbenzene	5	J	NAF	
4-Methyl-2-Pentanone	49		NAF	
Methylene Chloride	23	B	12	B
1,1,2,2-Tetrachloroethane	58		BDL	
Tetrachloroethene	46		4	J
Toluene	14		64	
1,1,1-Trichloroethane	29		BDL	
Trichloroethene	12	J	2	J
Total Xylenes	27		NAF	
Sludge Hot Spot Base/Neutrals				
SEMI-VOLATILES				
Acetophenone	110	[2]	NAF	
Aniline	4	J [2]	NAF	
Benzyl Alcohol	4	J [2]	NAF	
Benzyl Chloride	2	J [2]	NAF	
1,2-Dichlorobenzene	2	J [2]	3	J
Isophorone	7	J [2]	NAF	
1-Methylnaphthalene	32	[2]	NAF	
2-Methylphenol	BDL		12	
3-Methylphenol	BDL		12	[1]
4-Methylphenol	BDL		12	[1]
Naphthalene	12	[2]	NAF	
Nitrobenzene	32	[2]	BDL	
Phenol	38	[2]	45	
Pyridine	2	J [2]	3	J

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Table E-3
Summary of the analytical results for the Enreco Treatability Study

COMPOUND	TCLP leaching raw sample ug/l	Notes	TCLP leaching stab. sample ug/l	Notes
Sludge Tank and Pit Composite				
PCB's				
PCB-1232	BDL	[2]	310	
PCB-1242	810	[2]	BDL	
METALS				
Arsenic, total	3.4		44.9	
Barium, total	120		1040	
Cadmium, total	3400		4	U
Chromium, total	14200		29000	
Lead, total	65900		44800	
Mercury, total	6.9		0.51	
Selenium, total	14	U	1.4	U
Silver, total	5.5	U	5.5	U
Soil Hot Spot Lead				
METALS				
Lead	21	[2]	3700	

Notes:

[1] - Indistinguishable Isomers

[2] - Leached utilizing EP-Tox leaching technique

J - Estimated concentration of analite which is present but at a concentration less than stated detection limit

B - Analite is found in the associated blank as well as in the sample

BDL- Below Detection Limit

NAF - Compound was not analyzed for

U - Compound was analyzed for but was not detected. Total reported is the instrument detection limit

+ - These values were obtained from a higher dilution factor of sample extract

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Table E-4
Summary of the analytical results for the Hazcon Treatability Study

COMPOUND	Total Constituent raw sample mg/kg	Notes	TCLP leaching stab. sample ug/l	Notes
Overall Soil Composite				
METALS				
Aluminum, total	15200		NAF	
Antimony, total	8.2	U	NAF	
Arsenic, total	53		18.3	B
Barium, total	297		1400	
Beryllium, total	0.9		NAF	
Cadmium, total	13		4	U
Calcium, total	4900		NAF	
Chromium, total	320		27.1	
Cobalt, total	6.5		NAF	
Copper, total	374		NAF	
Iron, total	19400		NAF	
Lead, total	322		3.5	B
Magnesium, total	5090		NAF	
Manganese, total	339		NAF	
Mercury, total	19		0.21	
Nickel, total	40		NAF	
Potassium, total	1880		NAF	
Selenium, total	5.2	U	14	U
Silver, total	2.2		5.5	U
Sodium, total	558	U	NAF	
Thallium, total	0.95		NAF	
Vanadium, total	29		NAF	
Zinc, total	646		NAF	
VOLATILES				
Acetone	2900	B	NAF	
Benzene	410	J	2	J
Chloroform	2200		1	J
Chlorobenzene	BDL		1	J
1,1-Dichloroethane	500	J	NAF	
1,2-Dichloroethene, total	380	J	NAF	
Ethylbenzene	2500		NAF	
Methylene Chloride	2100	JB	20	B
Tetrachloroethene	960	J	4	J
Toluene	1800		12	
Trichloroethene	1000	J	3	J
1,1,2-Trichloro-1,2,2-Trifluoroethane	340	JB	NAF	
Vinyl Chloride	BDL		2	J
Total Xylenes	21000		NAF	

Table E-4
Summary of the analytical results for the Hazcon Treatability Study

COMPOUND	Total Constituent raw sample mg/kg	Notes	TCLP leaching stab. sample ug/l	Notes
Overall Soil Composite				
SEMI-VOLATILES				
Acenaphthylene	840	J	NAF	
Anthracene	790	J	NAF	
Benzo(A)Anthracene	3400		NAF	
Benzo(A)Pyrene	3900		NAF	
Benzo(B)Fluoranthene	4300		NAF	
Benzo(G,H,I)Perylene	1700	J	NAF	
Benzo(K)Fluoranthene	4000		NAF	
Chrysene	4050		NAF	
Dibenzofuran	740	J	NAF	
1,2-Dichlorobenzene	1600	J	34	
Fluoranthene	7300		NAF	
Fluorene	1300	J	NAF	
Indeno(1,2,3-C,D)Pyrene	1500	J	NAF	
1-Methylnaphthalene	2200	J	NAF	
2-Methylnaphthalene	1000	J	NAF	
2-Methylphenol	BDL		1	J
3-Methylphenol	BDL		5	J
4-Methylphenol	BDL		5	J
Naphthalene	610	J	NAF	
Phenanthrene	6200		NAF	
Phenol	BDL		38	
Bis(2-Ethylhexyl)Phthalate	30000		NAF	
Pyrene	7050		NAF	
HERBICIDES	BDL		BDL	
PESTICIDES	BDL		BDL	
PCB'S	BDL		NAF	

Table E-4
Summary of the analytical results for the Hazcon Treatability Study

COMPOUND	Total Constituent raw sample mg/kg	Notes	TCLP leaching stab. sample ug/l	Notes
Hot Spot Soil Composite				
METALS				
Aluminum, total	8740		NAF	
Antimony, total	16		NAF	
Arsenic, total	2.6		19.2	B
Barium, total	736		1670	
Beryllium, total	0.38		NAF	
Cadmium, total	38		4	U
Calcium, total	25100		NAF	
Chromium, total	300		83.3	
Cobalt, total	12		NAF	
Copper, total	3160		NAF	
Iron, total	14000		NAF	
Lead, total	2760		15.2	B
Magnesium, total	5510		NAF	
Manganese, total	249		NAF	
Mercury, total	1.4		0.2	U
Nickel, total	18		NAF	
Potassium, total	1210		NAF	
Selenium, total	3.4	U	14	U
Silver, total	0.68	U	5.5	U
Sodium, total	363	U	NAF	
Thallium, total	0.23		NAF	
Vanadium, total	29		NAF	
Zinc, total	2300		NAF	
VOLATILES				
Acetone	63000	B	NAF	
Chlorobenzene	14000	J	46	J
Chloroform	310000		280	
1,2-Dichloroethane	140000		230	
1,2-Dichloroethene, total	14000	J	NAF	
Ethylbenzene	160000		NAF	
4-Methyl-2-Pentanone	45000	J	NAF	
Methylene Chloride	9000	JB	52	B
Tetrachloroethene	400000	B	630	
Toluene	900000	B	1700	
1,1,1-Trichloroethane	120000		110	
Trichloroethene	580000	B	920	
Total Xylenes	580000	B	NAF	

Table E-4
Summary of the analytical results for the Hazcon Treatability Study

COMPOUND	Total Constituent raw sample mg/kg	Notes	TCLP leaching stab. sample ug/l	Notes
Hot Spot Soil Composite				
SEMI-VOLATILES				
Acenaphthene	7400		NAF	
Acenaphthylene	1400		NAF	
Anthracene	8800		NAF	
Benzo(A)Anthracene	14000		NAF	
Benzo(A)Pyrene	8800		NAF	
Benzo(B)Fluoranthene	14000	+	NAF	
Benzo(G,H,I)Perylene	2600		NAF	
Benzo(K)Fluoranthene	11000	+	NAF	
Butylbenzyl Phthalate	1300		NAF	
1-Chloronaphthalene	8100		NAF	
Chrysene	14000		NAF	
Di-N-Butyl Phthalate	40000	+	NAF	
Dibenzo(A,H)Anthracene	940	J	NAF	
Dibenzofuran	8200		NAF	
1,2-Dichlorobenzene	19000		45	
1,3-Dichlorobenzene	BDL		1	J
2,4-Dichlorophenol	2800		NAF	
Diethyl Phthalate	40000	+	NAF	
1,2-Diphenylhydrazine (Azobenzene)	3200		NAF	
Bis(2-Ethylhexyl)Phthalate	180000	+	NAF	
Fluoranthene	32000	+	NAF	
Fluorene	10000		NAF	
Indeno(1,2,3-C,D)Pyrene	2400		NAF	
Isophorone	9400		NAF	
1-Methylnaphthalene	32000	+	NAF	
2-Methylnaphthalene	26000	+	NAF	
2-Methylphenol	BDL		9	J
3-Methylphenol	BDL		31	[1]
4-Methylphenol	BDL		31	[1]
Naphthalene	79000	+	NAF	
Nitrobenzene	67000	+	14	
Phenanthrene	54000	+	NAF	
Phenol	7400		150	
Pyrene	28000	+	NAF	
Pyridine	BDL		4	J
1,2,3-Trichlorobenzene	200	J	NAF	
HERBICIDES	BDL		BDL	
PESTICIDES				
Heptachlor	BDL		0.06	
PCB'S				
PCB-1242	20000		NAF	

Table E-4
Summary of the analytical results for the Hazcon Treatability Study

COMPOUND	Total Constituent raw sample mg/kg	Notes	TCLP leaching stab. sample ug/l	Notes
PCB-1254	2600		NAF	
Soil Hot Spot Volatiles				
VOLATILES				
Acetone	8300	B	NAF	
Benzene	230	J	2	J
Chloroform	440	J	1	J
1,1-Dichloroethane	280	J	NAF	
1,2-Dichloroethane	12000		27	
1,2-Dichloroethene, total	940		NAF	
Ethylbenzene	260	J	NAF	
Methylene Chloride	1300	JB	14	B
1,1,2,2-Tetrachloroethane	2300		BDL	
Tetrachloroethene	5100		12	
Toluene	3200		20	
1,1,1-Trichloroethane	2900		9	
Trichloroethene	1100		8	
1,1,2-Trichloro-1,2,2-Trifluoroethane	190	JB	NAF	
Total Xylenes	3900		NAF	
Soil Hot Spot Base/Neutrals				
SEMI-VOLATILES				
Acetophenone	2600	J	NAF	
Benzo(A)Anthracene	1200	J	NAF	
Benzo(A)Pyrene	900	J	NAF	
Benzo(B)Fluoranthene.	1000	J	NAF	
Benzo(K)Fluoranthene.	1200	J	NAF	
Chrysene	1200	J	NAF	
1,2-Dichlorobenzene	BDL		5	J
Di-N-Butyl Pthalate	1000	J	NAF	
Di-N-Octyl Phthalate	550	J	NAF	
Dibenzofuran	2000	J	NAF	
Bis(2-Ethylhexyl)Pthalate	17000		NAF	
Fluoranthene	2300	J	NAF	
Fluorene	680	J	NAF	
1-Methylnaphthalene	14000		NAF	
2-Methylnaphthalene	610	J	NAF	
2-Methylphenol	BDL		6	J
3-Methylphenol	BDL		4	J
4-Methylphenol	BDL		4	J
Naphthalene	2300	J	NAF	
Phenanthrene	2600	J	NAF	
Phenol	1800	J	130	
Pyrene	2800	J	NAF	

Table E-4
Summary of the analytical results for the Hazcon Treatability Study

COMPOUND	Total Constituent raw sample mg/kg	Notes	TCLP leaching stab. sample ug/l	Notes
Sludge Tank and Pit Composite				
PCB'S				
PCB-1242	13000000		BDL	
METALS				
Aluminum, total	3220		NAF	
Antimony, total	127		NAF	
Arsenic, total	21		18	B
Barium, total	2240		1400	
Beryllium, total	0.97		NAF	
Cadmium, total	190		4	U
Calcium, total	8040		NAF	
Chromium, total	6300		2480	
Cobalt, total	8.7		NAF	
Copper, total	2100		NAF	
Iron, total	20500		NAF	
Lead, total	26000		229	
Magnesium, total	978		NAF	
Manganese, total	144		NAF	
Mercury, total	5		0.28	
Nickel, total	24		NAF	
Potassium, total	873	U	NAF	
Selenium, total	2.4	U	7	U
Silver, total	2.4		5.5	U
Sodium, total	2780		NAF	
Thallium, total	1.8		NAF	
Vanadium, total	19		NAF	
Zinc, total	1180		NAF	
Soil Hot Spot Lead				
METALS				
Lead, total	740		44.6	

Notes:
[1] - Indistinguishable Isomers
J - Estimated concentration of analite which is present but at a concentration less than stated detection limit
B - Analite is found in the associated balnk as well as in the sample
BDL- Below Detection Limit
NAF - Compound was not analized for
U - Compound was analized for but was not detected. Total reported is the instrument detection limit
+ - These values were obtained from a higher dilution factor of sample extract

ATTACHMENT E1

ENRECO LABORATORY
PRELIMINARY AND FINAL REPORT ON THE STABILIZATION/SOLIDIFICATION OF THE SCP SITE SOIL/SLUDGES

002754 A

ENRECO
LABORATORIES

March 29, 1989

Edward Van Keuren
ERM - Exton
855 Springdale
Exton, PA 19341
FAX NO. 215-524-7335

Edward,

Please find enclosed data pertaining to the Carlstadt New Jersey super-fund site. We have recommended the mixes in this report because of their U.C.C.S. of 50 psi or greater. I have broken down each sample into a fairly self explanatory data flow. One thing I would like to add is that these mix ratios can be changed to facilitate greater metal chelation or higher strength. We did use some of our own mixes that were approved because of our experience with similar wastes. Because of the project being a "feasibility" study to show that in-situ fixation is a viable method, we did not "fine-tune" our mixes thru leachate testing as extensively as we do when bidding a job. We feel that in-situ fixation is an extremely viable method of clean-up. If you have any questions or comments please feel free to call me any time you need. We look forward to doing more work with you in the future.

Best Regards,
ENRECO Laboratories

Lisa Davis
Accounts Manager

P.S. Final Copy to Follow

002755

Sample Identification: Hot Spot Composite - 14896

Design Mix Chosen: Portland cement ratio

Unconfined compressive strength by ASTM methods:

3 Day	7 Day	14 Day
78.8 P.S.I.	89.3 P.S.I.	113.5 P.S.I.

Triaxial Flexwall Permeability - EPA method 9100:

This sample also broke at the engineering lab and was unsuitable for permeability testing. It has been remixed with the others and will be rerun with a report to follow.

Inorganics/metals

Untreated Sample Results	mg/l	Treated Sample Results	mg/l
Arsenic	[18]		.0086
Barium	.352		.257
Cadmium	.057		U
Chromium	.033		.044
Lead	1.08		.0002
Selenium	U		U
Silver	U		U
Mercury	U		U

[ ] = total is greater than instrument detection limit but less than EPA requirements.

U = compound was analyzed for but not detected

Results: Please See Attached

Comments:

All reports were not in as of 3/29/89 so there will be reports to follow. Also it assumed by us but not stated anywhere in CompuChem's second report that these samples were extracted by TCLP or not (for metal analysis).

002755 A

Sample Identification: Sludge Hot Spot - B/N - 14916

Design Mix Chosen: Portland cement ratio

Unconfined compressive strength by ASTM methods:

3 Day	7 Day	14 Day
20.5 P.S.I.	76.0 P.S.I.	88.25

Triaxial Flexwall Permeability - EPA Method 9100:

Moisture content: 17.6%
Unit weight dry: 85.0 (pcf)
Permeability: 6×10^{-5} (cm/sec)

An EP Toxicity for Base neutrals was the request on the untreated sample. The treated sample had a TCLP performed. The treated sample results have not arrived as of 3/28/89. An ammended report will follow.

Results: Please See Attached

Sample Identification: Sludge tank and Pit Composite = 14917

Design Mix Chosen: lime kiln dust ratio

Unconfined compressive strength by ASTM methods:

3 Day	7 Day	14 Day
15.8 P.S.I.	28.3 P.S.I.	62.5 P.S.I.

Triaxial Flexwall Permeability - Method 9100:

This sample broke at the testing facility and was unsuitable for testing. It has been remixed and will be sent ASAP post 14 day cure to the Engineering lab. We will then send an ammended report.

Testing Requested: EP-Tox - 8 metals + PCBs

Untreated sample	mg/l	Treated sample	mg/l
Arsenic	[ ]		.045
Barium	[ ]		1.040
Cadmium	3.40		[ ]
Chromium	14.2		29.0
Lead	55.9		44.8
Mercury	.007		.0005
Selenium	[ ]		[ ]
Silver	[ ]		[ ]

[ ] = Element tested for but not detected.

Comments:

The lime kiln dust seemed to bring down the levels of cadmium, chromium and lead. In the case of the latter two not in any real significance.

SEE ATTACHED PCB REPORT

Special Comments:

Again the original method of extraction is differenct in the first sample than in the second. This could account for some of the differences in the results.

002756 A

Sludge Hot Spot B/N
Mix - Portland cement = B-27 - U.C.C.S. - 37.8

Arsenic: To follow
Barium: To follow
Cadmium: None detected
Chromium: None detected
Lead: None detected
Selenium: None detected
Silver: None detected
Mercury: To follow

Sludge Hot Spot B/N
Mix - Portland cement - U.C.C.S. - 88.25 P.S.I.

Arsenic: To follow
Barium: To follow
Cadmium: None detected
Chromium: None detected
Lead: None detected
Selenium: None detected
Silver: None detected
Mercury: To follow

Sludge Tank and Pit Composite
Mix - Lime kiln dust - U.C.C.S. - 62.5 P.S.I.

Arsenic: To follow
Barium: To follow
Cadmium: .3 mg/l
Chromium: 2.3 mg/l
Lead: 0.4 mg/l
Selenium: None detected
Silver: None detected
Mercury: To follow

Sludge Tank and Pit Composite
Mix - .2 Portland cement = 5 grams B-27 - U.C.C.S. - 24.8 P.S.I.

Arsenic: To follow
Barum: To follow
Cadmium: None detected
Chromium: 16.6 mg/l
Lead: .5 mg/l
Selenium: None detected
Silver: None detectec
Mercury: To follow

ENRECO LABORATORIES

May 8, 1989

Edward Van Keuren
ERM-Exton PA
855 Springdale
Exton, PA 19341

Dear Ed:

Please find the enclosed final report as per your outline. I would like to say that regarding cost, we have historically run between $25.00 and $40.00 a cubic yard. The price could however be higher or lower depending on the site location, availability of reagent and potential transportation costs.

Thanks for your work, we appreciate the business.

Best Regards,
ENRECO LABORATORIES

Lisa Davis
Manager, Business Development
and Quality Assurance

LD/can

Enclosure

cc: Lisa Davis
Frank Robinson
Larry Graybill
File

002757 A

6661-A Canyon E-Way • Amarillo, Texas 79110 • (806) 353-4425

April 30 1989

Edward Van Keuren
ERM - Exton PA
855 Springdale
Exton, PA 19341

Edward:
Pursuant to the treatability study for the Carlstadt NJ site Enreco INC. has received the final test results that we were waiting for and respectfully submitt the following final report.

The samples that Enreco received from ERM were identified in the following manner

HOT SPOT VOC'S
HOT SPOT COMPOSITE
OVERALL SOIL COMPOSITION
SOIL HOT SPOT LEAD
SLUDGE HOT SPOT B/N
SLUDGE TANK AND PIT COMPOSITE

SUMMARY OF PROCEDURES:

The procedures that were employed consisted of taking a quantity of waste sample and mixing it with a ratio of different reagents that were specified by the work order. These consisted of; Portland cement, Lime kiln dust, Quick lime and Cement kiln dust. The samples were mixed in 150ml cylinders that are made of an inert material and allowed to cure for the requested times. A strength test was then measured at 3,7 and 14 days. The 3 day strength was taken by pocket pentrometer and the 7 and 14 were by unconfined compressive strength as per ASTM method 1633.

In the preliminary report of the visual analysis the samples were mixed with the above additives and placed in 6oz insulated cups and assesed at the first day for their visible water,consistency,volume and density increases.

HOT SPOT VOC'S, HOT SPOT COMPOSITE, OVERALL SOIL COMPOSITE, SOIL HOT SPOT LEAD: All mixes looked good with the exception of the higher ratio of Quicklime. It got too hot and made a sand-like material out of the samples. There were no free liquids present.

Hot Spot B/N: All Portland Cement mixes looked the same as the above samples. The higher ratios of Quicklime are too hot. The lower ratios of Quicklime and the Cement Kiln Dusts dissolved the cups. The Lime Kiln Dusts are expanding and are breaking the cups open. The volume increase and Densities were too high to go further with this reagent. There are no free liquids present.

SLUDGE TANK AND PIT COMPOSITE: All samples, including the raw, dissolved the cups almost completely and formed a sticky mass.

There are no free liquids present. All mixtures for the sample were remixed.

PERFORMANCE DATA

The first reagents to be evaualated will be the Quick lime, Cement kiln dusts and the Lime.Klin dusts. In the initial mixing with Cement Kiln dust as the pozzolanic reagent and the Quick lime, kiln dust and Portland cement as the cementitious reagent. The strenths and mixes were then evaluated at 3 and 7 days to get a overall idea on how to proceed with round II.
They are as follows: ROUND I **THE INITIAL MIXES**

HOT SPOT VOC'S

ADDITIVE	U.C.C.S.	3 DAY	7 DAY	14 DAY
.2 PC		>62.5	>62.5	------
.3 PC		>62.5	>62.5	------
.4 PC		>62.5	>62.5	------
.2 QL	TOO HOT			
.3 QL	TOO HOT			
.1 QL		>62.5	>62.5	------
.4 CKD		>62.5	>62.5	------
.6 CKD		>62.5	>62.5	------
.4 LKD		>62.5	>62.5	------
.6 LKD		48.7	59.1	------

HOT SPOT COMPOSITE

.2 PC		>62.5	>62.5	------
.3 PC		>62.5	>62.5	------
.4 PC		>62.5	>62.5	------
.1 QL		31.3	31.3	59.1
.2 QL	TOO HOT			
.4 CKD		48.7	34.8	52.1
.6 CKD		>62.5	>62.5	------
.4 LKD		31.3	31.3	27.8
.6 LKD		<1.4	<1.4	<1.4

OVERALL SOIL COMPOSITE

.2 PC		>62.5	>62.5	------
.3 PC		>62.5	>62.5	------
.4 PC		>62.5	>62.5	------
.1 QL		>62.5	>62.5	------
.2 QL	TOO HOT			
.4 CKD		>62.5	>62.5	------
.6 CKD		>62.5	>62.5	------
.4 LKD		>62.5	>62.5	------
.6 LKD		24.3	24.3	52.1

SOIL HOT SPOT LEAD

.2 PC	>62.5	>62.5	------
.3 PC	>62.5	>62.5	------
.4 PC	>62.5	>62.5	------
.1 QL	>62.5	>62.5	------
.2 QL	>62.5	>62.5	------
.4 CKD	>62.5	>62.5	------
.6 CKD	>62.5	>62.5	------
.4 LKD	>62.5	>62.5	------
.6 LKD	24.3	24.3	34.8

SLUDGE HOT SPOT B/N

.2 PC	>62.5	>62.5	------
.3 PC	>62.5	>62.5	------
.4 PC	>62.5	>62.5	------
.1 QL	27.8	27.8	31.3
.2 QL	TOO HOT		
.4 CKD	20.8	20.8	20.8
.6 CKD	20.8	20.8	20.8
.4 LKD	<1.4	<1.4	<1.4
.6 LKD	<1.4	<1.4	<1.4

SLUDGE TANK AND PIT COMPOSITE

.2 PC	7.0	34.8	45.2
.3 PC	>62.5	>62.5	------
.4 PC	>62.5	>62.5	------
.1 QL	52.1	>62.5	------
.15 QL	52.1	>62.5	------
.2 QL	>62.5	>62.5	------
.2 CKD	10.4	10.4	27.8
.4 CKD	20.9	34.8	62.5
.6 CKD	41.7	>62.5	------
.2 LKD	20.9	27.8	>62.5
.4 LKD	13.9	13.9	<1.4
.6 LKD	<1.4	<1.4	<1.4

Round II was then begun and the mixes were then remixed and the strengths were recorded. At this point the main reagents that were being looked at were the Portland cement and Lime kiln dust. The preceeding two were the best choices based on strength and required reagents. ** ROUND II **

REAGENT	3 DAY	7 DAY	14 DAY
HOT SPOT VOC'S			
.3 PC	>125	>125	>125
.4 LKD	26.3	72	84.25
.2 PC + 5GRAM B-27	84.0	110.7	>125

HOT SPOT COMPOSITE

.3 PC	78.8	89.3	113.5
.4 LKD	21.3	18.3	42.5
.2 PC + 5GRAM B-27	53.2	58.8	----

OVERALL SOIL COMPOSITE

.3 PC	>125	>125	>125
.4 LKD	23.5	58.8	80.25
.2 PC + 5GRAM B-27	>125	>125	>125

SOIL HOT SPOT LEAD

.3 PC	>125	>125	>125
.4 LKD	24.8	40.5	61.75
.2 PC + 5GRAM B-27	>125	>125	>125

SLUDGE HOT SPOT B/N

.3 PC	20.5	76.0	88.25
.4 LKD	<12	35.5	36.75
.2 PC + 5GRAM B-27	<12	37.8	52.3

SLUDGE TANK AND PIT COMPOSITE

.3 PC	14.3	122.8	12.25
.2 LKD	24.1	44.1	>62.5
.2 PC + 5GRAM B-27	<12	12.8	<12.

At this point the final 6 design mixes were chosen and they were sent out for the TCLP analysis and method 9100 triaxial flexwall permeability. The 6 chosen for round III are as follows:

HOT SPOT VOC'S .2 PC + 5 GRAMS B-27

HOT SPOT COMPOSITE .3 PC

OVERALL SOIL COMPOSITE .2 PC + 5 GRAM B-27

SOIL HOT SPOT PB .2 PC + 5 GRAM B-27

SLUDGE HOT SPOT B/N .3 PC

SLUDGE TANK AND PIT COMPOSITE .2 LKD

The permeability results are as follows:

HOT SPOT VOC'S
- MOISTURE 14.9%
- DENSITY 107.9
- PERM (CM/SEC) 4 X 10-8

HOT SPOT COMPOSITE
- MOISTURE 20.8%
- DENSITY 94.6
- PERM (CM/SEC) 3 X 10-7

OVERALL SOIL COMPOSITE
- MOISTURE CONTENT 17.3%
- DENSITY 100.0
- PERM (CM/SEC) 4 X 10 -7

SOIL HOT SPOT LEAD
- MOISTURE CONTENT 18.5%
- DENSITY 95.9
- PERM (CM/SEC) 2 X 10 -5

SLUDGE HOT SPOT B/N
- MOISTURE 17.6%
- DENSITY 85.0
- PERM (CM/SEC) 6 X 10 -5

SLUDGE TANK AND PIT COMPOSITE
- MOISTURE 27.3%
- DENSITY 89.1
- PERM (CM/SEC) 1 X 10 -6

As far as the evaluation of the implementability of stabilization for this particular waste stream, it would be next to impossible to make such a prediction without first examining the site. The information on the site being such that it is, states that it is a very dense and well-compacted area of approximately 95k yards. If stabilization were to be viable method of remediation it would most certainly be with our stiff injector unit. It could be a very possible method of cleanup, whether in-situ or for excavation and disposal in an approved land-fill. The approximate cost would run between 30 and 40 dollars a cubic yard depending on the reagents and the transportation costs. It would appear that de-watering would not be needed because of the low moisture content of the treated sludge.

Volatilization would depend on the reagent used, but with the portland cement mixes and the additives it would be minimal. Enreco Inc. also has a pneumatic delivery system that would make the emissions minimal.

The special mixes that were employed are so chosen because of the field record of tying up heavy metals and yielding low TCLP extraction levels. There were previous data sheets comparing the design mixes with the design mixes with the additives for you information.

ATTACHMENT E2

FINAL REPORT
TREATABILITY STUDY OF THE
HAZCON ENGINEERING, INC.
STABILIZATION/SOLIDIFICATION PROCESS

Final Report

Treatability Study of the HAZCON Engineering, Inc. Stabilization / Solidification Process

April 26, 1989

Prepared For: ERM, Inc.

Prepared By:

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INTRODUCTION:

The following data, lab notes, and attachments are the preliminary findings and conclusions made by HAZCON. Pending the results of chemical analysis being accomplished by Comp-u-Chem laboratory in Research Triangle, NC a final report and final summary will be submitted. However, in an attempt to assist ERM Inc. to meet its tight schedule, this report is submitted at this time.

1. SAMPLE DELIVERY:

All samples arrived intact and in a prompt manner. Chain of Custody forms and sample tracking documents were checked and found to be acceptable. Precautionary measures to prevent volatilization of samples included double bagging of sample material and insertion of frozen blue ice. Also, sample containers were shipped via overnight courier. (see appendix A).

1.1 SAMPLE STORAGE:

Prior to receipt of sample containers HAZCON purchased approximately 50 pounds of blue ice packages. All packages were frozen and immediately upon receipt of sample containers 1/2 of the frozen blue ice was packed in the containers in an attempt to keep the samples cool. Also the sample containers were stored in our laboratory holding area, where temperatures were, on the average, 55° F. From the date of receipt until after blending of round 3, samples were kept cool using the above described method.

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1.2 SAMPLE HANDLING:

All HAZCON field and lab personnel have been formally trained IAW 29CFR 1910.120. Other training has been accomplished as well. Several precautions were taken in order to reduce any health and safety risks involved with the waste samples. Specifically, prior to opening any of the sample containers, lab technicians wore Wilson full face respirators with new organic cartridges. Protective clothing and double gloves were also worn. The containers were opened in a well ventilated area. Sensidyne indicator tubes for Benzene and Toluene were used. Containers were kept open only for minimal amounts of time.

2. SELECTION OF ADDITIVES:

Since ERM's work plan indicated that the waste at the site is in contact with ground waters, HAZCON decided that permeability of the treated waste was critical. Our experience has been that in order to obtain low permeabilities, a high compressive strength must be obtained. This has been the philosophy of our firm since we started business. In order to reach high compressive strengths and low permeability we decided to use Type I Portland Cement (PC). Also we used a Portland Cement and Chloranan (PCch) additive. Chloranan is HAZCON's proprietary chemical additive. (see appendix B and G). However since ERM's client wanted low psi as well (50 psi to be the target) HAZCON considered using a coal flyash. Flyash was eliminated as a likely candidate because the only type available in the East Coast is an inferior ASTM Class "F" flyash. Previous studies have shown us that very high ratios of Class F are needed to achieve stabilization / solidification. There are two concerns with using high ratios. One is that waste volume is increased. HAZCON

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doesn't promote volume increase but instead, tries to practice waste minimization. Secondly, most Class F flyash is moderately laden with various concentrations of heavy metals.

Of the other additives made available to choose from by ERM Inc., HAZCON decided to test Cement Kiln Dust (CKD). CKD is relatively inexpensive, doesn't require any type of custom blending to make it a viable additive, and it is readily available. Therefore, in summary the additives selected by HAZCON for testing were, PC, PCch and CKD. (see appendix C for CKD analysis).

3. ROUND I BLENDING:

HAZCON identified Round I blending as dual purpose. First, it was to be an exercise to familiarize ourselves with the physical characteristics of the waste and secondly to see how the chemical make up of the waste affected the selected additives' ability to solidify it.

HAZCON decided to blend 72 different ratios of additives to waste. That is 3 ratios of each of 4 additives applied to each of 6 types of waste. For a description of how the additive was applied to the waste see Appendix D, and for pocket penetrometer psi results see appendix E. Blending information not included in the appendix material follows.

Seventy two, 12 oz clear plastic cups were labeled indicting sample ID number and additive ratios. One hundred grams of waste was placed in each cup. The additives were placed next. The contents of each cup were blended via a small, low speed, hand held mixer. Water was added until a homogenized workable slurry appeared. The cups were sealed with a plastic film to prevent the escape of moisture. Then all blends were stored at 55° F. Pocket Penetrometer

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readings were taken at 24, 48, & 72 hours (see appendix E). It was determined that due to various inconsistent psi readings, a "1 part waste" to "1 part additive" ratio would be used on all samples in Round II. Lower ratios could have been used on some samples but in order to generate clear, comparative, data, the 1:1 ratio was selected to be carried into Round II.

4. ROUND II BLENDING:

The purpose of Round II blending was to try to plot how compressive strength grew over a period of 14 days. After all results were compiled, a decision would be made by HAZCON and ERM which would result in a blend design for Round III testing. No proprietary additives were applied in Round II. Tap water was used in Round II. A discussion on water additive follows.

5. ADDITIONAL MOISTURE:

Since this treatability study looks at 6 different waste types from one site, HAZCON decided to use additional moisture until such a point that the resultant slurry reached a certain "workability". The amount of additional moisture added is divided by the amount of waste in the batch to calculate the percentage of moisture added. This method is very simple, and therefore easily reproduced in the field. Other benefits include the homogeneous blend that results from a highly moist slurry. In the presence of moisture waste particles tend to be reduced in size, therefore more surface area can come into contact with the additives used for treatment. Some wastes that are high in organic content react differently than soils containing no organics in the presence of moisture. In conclusion,

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moisture was not added at a set percentage but instead added so as to generate a workable, homogenized slurry.

6. ROUND III:

The purpose of Round III was to incorporate the data that was generated in Rounds I and II, and to develop a design mix that would be submitted to Unconfined Compressive Strength (UCS), Permeability, and Leachate extraction tests. Since ERM's client wanted low UCS, the percentage of CKD was reduced. Since ERM wanted low permeability and reduced toxicity, HAZCON's proprietary additives were used with a lower ratio of PC. See lab blending notes in appendix D and the data spread sheet, appendix F.

7. CHEMICAL ANALYSIS OF ROUND III:

Upon review of initial analysis compared to analysis of treated samples, it is evident that the HAZCON treatment process was effective at stabilizing and immobilizing various contaminants. Although initial concentrations were low, all concentrations were reduced below detectable limits after treatment. PCB's, Metals, and Organics were all reduced in toxicity. If HAZCON is offered the opportunity to further optimize the waste streams we feel sure that ratios of additives can be reduced and costs can be even lower than projected for this study. Since initial concentrations of metals were low, the thoroughness of the HAZCON process was not fully demonstrated. Perhaps it would be fair to compare results of metal toxicity reduction that HAZCON achieved at the Douglassville, PA Superfund site. (See appendix G).

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If in fact further bench scale testing was to be accomplished, HAZCON would lower our admix ratios even further. Probably additive would be applied at 10, 20, 30 and 40 percent to 100 percent waste. We would also experiment with such additives as lime and flyash or a combination of the two.

On a full scale remediation level HAZCON would have on site a mobil laboratory in which technicians could do bench scale testing and analysis on a continuous basis. This approach is beneficial since most sites have "hot spots" throughout. Each hot spot could be identified prior to field blending and optimum ratios could be determined readily thus ensuring maximum quality control. After field blending, core samples from the various areas would be analyzed to assure that the targeted treatment specifications have been met.

If further bench scale testing or a pilot scale demonstration is required, HAZCON remains ready to respond, assured that our process can achieve effective stabilization no matter what the scale.

8. PHYSICAL ANALYSIS OF ROUND III:

UCS results indicate that the CKD group approaches the desired 50 psi that ERM's client requests. No permeability data is available for the CKD group, analysis was not run. We are confident that all 6 waste samples treated can be blended and reach 50 psi. The PCch samples have much higher UCS results and all but 2 of the samples have very low permeabilities. It should also be noted that HAZCON can make adjustments in its additive ratios to achieve lower permeabilities in all of the samples.

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9. DESIGN MIX RECOMMENDED FOR FURTHER EVALUATION:

In order to better compare CKD to PCch we recommend that the Round III CKD series be submitted to the same analysis as the PCch. This includes a 14 day Permeability and TCLP. HAZCON recommends samples be allowed to cure 28 days before final analyses are run, however, we can appreciate the deadlines involved with this study. After 7 days of curing time, samples should have reached approximately 85% of their maximum potential strength, therefore the 14 day results are fairly representative of a fully cured sample. Upon receipt of results of chemical analysis, HAZCON will be able to suggest additive adjustments. Possible other additives to be tested would be a mixture of Class "F" flyash and lime.

10. AIR QUALITY CONTROL:

It was noted that the CKD additive was very fine and therefore became air borne easily and stayed longer than did PC. All sample material was moist and did not create a dust problem. The key issue under this heading is VOC emissions. Normally VOC's will be released during excavation at sites that are contaminated with organics. VOC emissions can become a problem also when organic wastes are blended in a batch mixer or in-situ. Also, since additives usually generate exothermic heat, VOC emissions are again present. HAZCON has engineering concepts whereby VOC's can be controlled to the point that emissions are minimal. One of the most simple approaches would be to remediate the site in the winter time. Cooler ambient temperatures would keep VOC's down. HAZCON also uses totally enclosed blenders and pressurizes the head space with nitrogen gas to keep VOC's down. Enclosed, air inflatable structures can cover the entire excavation and blending areas to control VOC's. Emissions from the inflatable structure are then filtered.

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By applying a few or all of these techniques, stabilization/solidification of organic compounds can be accomplished at any site and is a viable treatment alternative.

11. FULL SCALE COSTS:

Based on ratios of additives used in this study, and without having the opportunity to visit the site, HAZCON estimates that the PC Chloranan blend as tested in Round III would cost approximately $65 to $80 per cubic yard of waste treated and the CKD would cost approximately $50 to $65 per cubic yard of waste treated. These prices include excavation, additive, blending and emplacement of treated material. Prices probably, would be reduced pending a Round of final optimization with only one specific additive. HAZCON remains ready to accomplish any additional testing that ERM or its client may need.

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ERM Inc.
Treatability Study
Lab, Notes

Friday 1-27-89

Samples arrived 1-27-89 1400 hrs. Phoned Rob Morris. Informed me final revised work plan not yet complete, Feb. 10, no longer deadline. Instructed to keep samples cool to prevent volitalization of sample material. Action taken: Ambient temps in lab reduced to 55 ^{o} F. Coolers stored over night. B.N.S.

Saturday 1-28-89

1730 hrs. Level C respiratory protection (full face) worn. Lab temp 52° F. Photo doc. began. All coolers opened. Waste samples temp. 48° F. Blue ice (frozen) appeared to hold waste temps. down. Sensidyne hand held manual pump used with indicator tubes for:

Benzene at source 7 ppm
Toluene at source >300 ppm
Benzene avg. in room ND
Toluene avg. in room ND

Coolers had been packed w/ vermiculite, plastic bag w/ cold H_2O (had been ice). All samples appear to be intact. <u>ERM Traffic report</u> found in :"Hot Spot for VOC's" B-3 cooler. All sample OK. Repacked @ 1900 hrs. w/ Frozen Blue Ice. B.N.S.

Sunday 1-29-89

1810 hrs. changed blue ice, temp. inside cooler 43° F. Ambient temp in lab 55° F. B.N.S.

Monday 1-30-89

0942 Reviewed FAX from Rob Morse Temp in lab 55° F. B.N.S.

1047 10 more coolers arrived Fed Ex. B.N.S.

1255 Inventory of Samples in:

Monday 1-30-89 Continued

Friday: Hot Spot for VOC X 3
Hot Spot Composite X 3

Monday: Sludge Tank & Pit Comp X 1
Soil Hot SPot for Lead
Sludge Hot SPot B/N
Overall Soil Compqsite

Monday's shipment not opened as per instructions Rob Morse. (telephone conversation 0900). B.N.S.

Tuesday 1-31-89

1000 hrs. New samples opened, level "C" protection .5 ppm Benzene @ source, ND in background. 10 new coolers had "blue ice" packs within. Temp 52° F in cooler. Fresh Blue ice installed. ERM Chain of Custody completed to be returned to ERM. New prices to be quoted. B.N.S.

1100 Large container w/ five 2L Amber bottles of site H_2O arrived B.N.S.

Friday 2-3-89

1150 Prepared samples for shipment to Comp-u-Chem Lab for initial analysis.

Sludge Tank & Pit Composite = STPC
Soil Hot Spot - Lead = SHS-Pb
Overall Soil Composite = OSC
Sludge Hot Spot - B/N = SHS-B/N
Soil Hot Spot VOCs = SHS-VOC
Hot Spot Soil Composite = HSSC

P.O.C. @ Comp-u-Chem is Kaye Roberts. Faxed ERM's analytical requirments. Recommened that Kaye Roberts contact Rob Morse to coordinate schedule and analyses.

Friday 2-3-89 cont.

Samples packed in sterile lab bottles in the following proportions

STPC - 337 g
SHS-Pb - 355 g
OSC - 286 g
SHS-B/N - 353 g
SHS-VOC - 359 g
HSSC - 325 g

All lids tight and custody taped closed.

All coolers of sample moved to warehouse area. Ambient temp. 41° F. Sample Temp. 43° F. Ambient temps. expected to drop even further tonight.

Chain of Custody - Analysis Request completed. Package ready to go. Samples packed in an igloo cooler with 4 packs of frozen blue ice. B.N.S.

Tuesday 2-7-89

1000 hrs. Ambient temps 30° F all weekend. Sample material has been stored @ <30° F. Sample material temp 33° F. Preparing for round 1 today. Cement Kiln dust and Portland C to be used w/ and w/o Chloranan. Called Comp-u-Chem. Samples received intact Saturday 2-4-89. Analysis has begun. In order to simplify sample # the following key has been developed:

CKD = Cement Kiln Dust
CKD ch = Cement Kiln Dust w/ Chloranan
PC = Portland Cement
PC ch = Portland Cement Chloranan

1) = Sludge Tank & Pit Composite = STPC
2) = Soil Hot Spot for Lead = SHS Pb
3) = Overall Soil Composite = OSC
4) = Sludge Hot Spot B/N = SHS B/N
5) = Soil Hot Spot VOC = SHS VOC
6) = Hot Spot Soil Composite = HSSC

1 = 1 to 1 ratio = waste to pozzolan
3 = 3 to 1 ratio = waste to pozzolan
5 = 5 to 1 ratio = waste to pozzolan

eg: "PCch 6-1" = Portland Cement Chloranan-Hot Spot Soil Comp-1:1 ratio of waste to pozzolan.

Tuesday 2-7-89 Cont.

	(waste : additive)		
Samples will be mixed with a	1:1 /	3:1 /	5:1
	100g : 100g/	100g : 33.3g/	100g : 20g

Chloranan will be used at a 20 : 1
(waste : Chl)

72 labels prepared. B.N.S.

Wednesday 2-8-89

0937 hrs. Waste temp 38° F, Round I begins.

Sample Descriptions:

#1 Wet, soil sludge, fairly homog., black, VOC indications.
#2 Moist, Sandy soil
#3 Clay like, moist
#4 Moist, soil like, sandy, black.
#5 Clay like, shingle material, globs, free liquids, black, VOC indications.
#6 Moist, soil like, some shingles, black, free liquids

1350 Blending notes:

#1&2 easy to homogenize
#3 clay like material requires > additional H_2O to make slurry
#4 easy to homogenize
#5 shingles in way, may need to grind
#6 difficult, may need to grind first

All round 1 blending done @ 1350. level "C". B.N.S.

Monday 2-13-89

1520 hrs. Compressive Strengths have been monitored @ 24 48 & 72 hours. (See log sheet). Round II selectees are Portland cement (PC) and Cement Kiln Dust (CKD) at a 1:1 ratio. Probably could have used lower ratios, will wait for round III to reduce. will show Chloranan affect. Will fill 5 tubes of each blend (4 for UCS, 1 for spare) H_2O is the only variable to be recorded.
B.N.S.

Tuesday 2-28-89

0941 Preped lab for Round III. Reviewed UCS results from Round II. Have determined that moisture contents are too high. Will reduce % H_2O added. CKD ratios will be reduced ie. Ratios reduced to .7:1 across board. PC series has high UCS, w/ exception of 4-1 @ 3 and 7 days. PC and Chloranan will be used in Round III. PCch will be .5:1 across board. (see blending notes for specific additive ratios) Temp in lab reduced to 50° F. Outside ambient temp 52° F. Temp of waste 43° F. Used site water for blending in all samples. B.N.S.

Wednesday 3-1-89

Sample ID's for Round III. Number 1-6 follow same code as Round II.

Portland Cement & Chloranan-Code # for Sample ID

Last # or letter in code, eg. 3, 7, 14, P, T, S, D =

3	3 day UCS
7	7 day UCS
14	14 day UCS
P	Permeability
T	TCLP
S	Spare
D	Document

Tuesday 3-14-89

Called Comp-u-Chem today. Samples were received in tact and TCLP's will begin today as per schedule. Solidified samples also delivered to McCelland Engineers today to run UCS and permeability tests. Everything is on schedule. B.N.S.

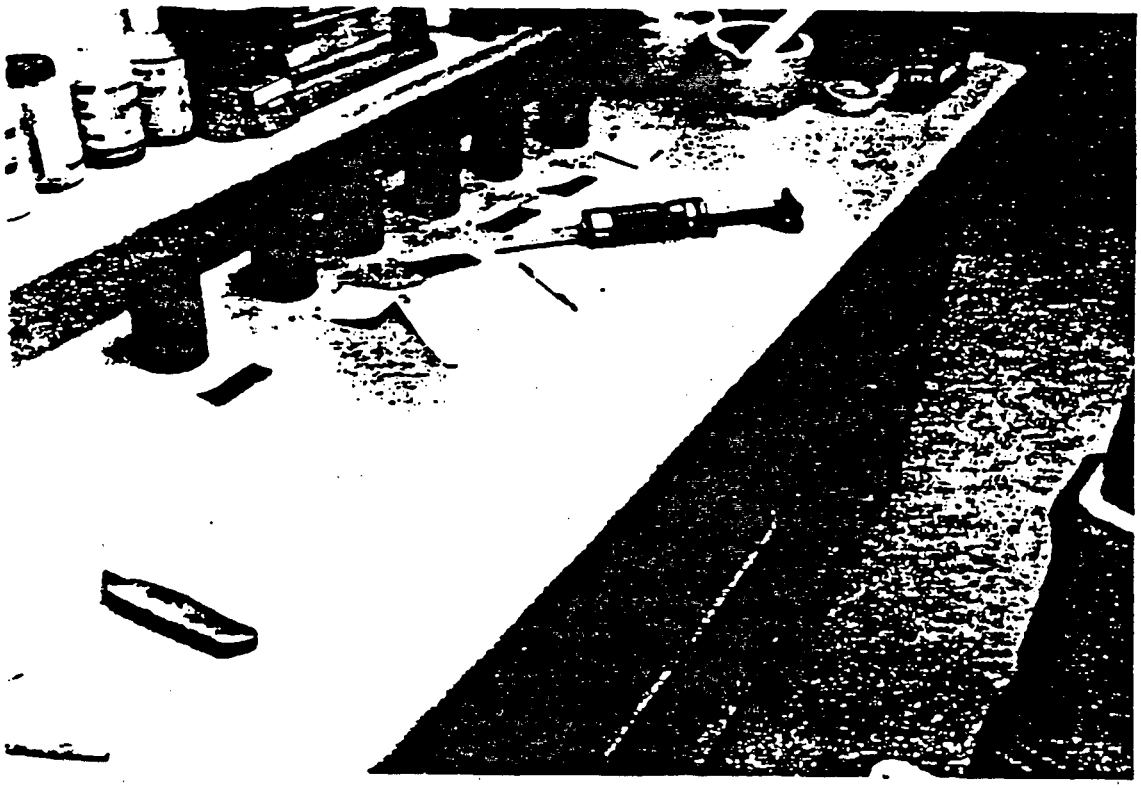
ERM Inc., Treatability Study; Round II & III Data

Additive ID Code	Waste Type Code	% of Waste	% of Cement Kiln Dust	% of Portland Cement	% of Proprietary Additive	% of H_2O to Blend	Round 2 Blend Moisture Content	Round 2, Blend lbs. per $ft.^3$	Round 2, 3 day UCS (psi)	Round 2, 7 day UCS (psi)	Round 2, 7 day UCS (psi)	Round 2, 14 day UCS (psi)	Round 3 Blend Moisture Content	Round 3, Blend lbs. per $ft.^3$	Round 3, 3 day UCS (psi)	Round 3, 7 day UCS (psi)	Round 3, 7 day UCS (psi)	Round 3, 14 day UCS (psi)	Round 3, Permeability (cm/sec)
CKD	1	1.	1.	N/A	N/A	39	34.2	81.5	7	11	10	18	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CKD	2	1.	1.	N/A	N/A	49	31.7	88.5	8	27	31	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CKD	3	1.	1.	N/A	N/A	52	39.2	80.6	3	6	6	12	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CKD	4	1.	1.	N/A	N/A	49	22	93.7	141	273	210	459	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CKD	5	1.	1.	N/A	N/A	29	24.2	88.6	83	114	154	209	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CKD	6	1.	1.	N/A	N/A	39	27.4	86.7	71	69	82	144	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PC	1	1.	N/A	1.	N/A	28	24.6	91	1078	1411	1769	2083	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PC	2	1.	N/A	1.	N/A	30	16.9	107	3745	4213	3714	4229	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PC	3	1.	N/A	1.	N/A	28	33.5	82.6	976	1170	1065	1396	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PC	4	1.	N/A	1.	N/A	25	29.3	108	10	23	23	1262	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PC	5	1.	N/A	1.	N/A	29	18.9	96.4	620	13299	1400	2300	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PC	6	1.	N/A	1.	N/A	34	28	88.6	1	938	1067	1321	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CKD	1	1.	.7	N/A	N/A	19	N/A	N/A	N/A	N/A	N/A	N/A	40.9	74.5	3	5	5	6	N/A
CKD	2	1.	.7	N/A	N/A	25	N/A	N/A	N/A	N/A	N/A	N/A	26.4	88.8	10	26	35	60	N/A
CKD	3	1.	.7	N/A	N/A	43	N/A	N/A	N/A	N/A	N/A	N/A	28.2	90.3	689	79	66	132	N/A
CKD	4	1.	.7	N/A	N/A	49	N/A	N/A	N/A	N/A	N/A	N/A	29.3	98.4	3	4	5	6	N/A
CKD	5	1.	.7	N/A	N/A	33	N/A	N/A	N/A	N/A	N/A	N/A	24.4	91.5	45	59	35	96	N/A
CKD	6	1.	.7	N/A	N/A	34	N/A	N/A	N/A	N/A	N/A	N/A	34.3	81.4	11	19	21	34	N/A
PCch	1	1.	N/A	.5	15	20	N/A	N/A	N/A	N/A	N/A	N/A	36	74.4	393	522	575	701	3.0×10^{-6}
PCch	2	1.	N/A	.5	15	19	N/A	N/A	N/A	N/A	N/A	N/A	22	97	2552	9241	2951	3738	4.0×10^{-8}
PCch	3	1.	N/A	.5	15	20	N/A	N/A	N/A	N/A	N/A	N/A	22.1	95.9	1678	2028	2115	2422	2.0×10^{-8}
PCch	4	1.	N/A	.5	15	19	N/A	N/A	N/A	N/A	N/A	N/A	31.1	89	12	179	162	753	1.0×10^{-7}
PCch	5	1.	N/A	.5	15	19	N/A	N/A	N/A	N/A	N/A	N/A	20.2	95.2	1456	1864	1786	1977	3.0×10^{-9}
PCch	6	1.	N/A	.5	15	25	N/A	N/A	N/A	N/A	N/A	N/A	30.6	84.3	798	1138	1023	1134	3.0×10^{-8}

Our Facility In Brookshire, Texas

0027699 Outside temperatures below freezing

Samples stored in unheated warehouse



Raw samples prepared for shipment to Comp-u-Chem

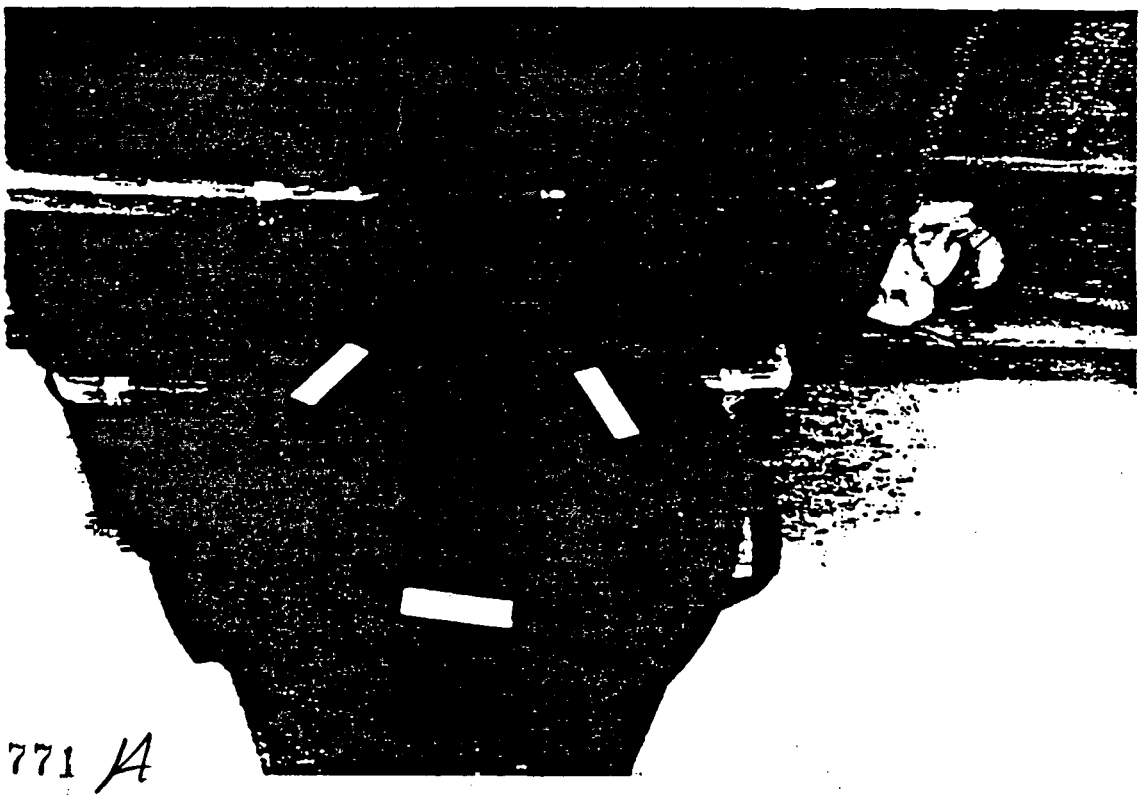
Blue Ice changed daily, temperature observed

Samples in lab to prepare for Round I

72 cup samples curing during Round I

Round II samples prepared for UCS

Blending area during Round III



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All E.R.M. samples "Hazardous Trash" contained

Appendix F
Thermal Treatment/ Incineration Testing

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APPENDIX F

INCINERATOR FEASIBILITY TESTS

Screening tests were conducted on one soil sample and one sludge tank and pit composite to determine incineration feasibility. A batch incinerator, using less than ten pounds of sample, was used for the test. The test program included evaluation of the following:

- 30 and 60 minute residence times
- Combustion temperatures of 1500, 1800 and 2100 degrees F
- After burner temperature of approximately 2100 degrees F

The test was conducted to determine:

- Temperature and time to remove organics from the samples
- Residue quality and leachability
- Metal emissions
- Destruction of PCBs
- Acid gas emissions
- Particulate emissions

The conclusions from the test were as follows:

- Efficient PCB destruction can be obtained at 1500 and 1800 ^{o}F for 30 and 60 minute burn times
- Temperatures above 1800 ^{o}F result in vitrification of the soil
- Control of products of incomplete combustion will require further evaluation and consideration in selection of an on site incinerator
- Arsenic, cadmium, chromium, lead and mercury emissions are of concern due to high volatility and concentrations

- Based on the EPA Guideline, removal efficiencies greater than 99 percent would be required for these metals; with 99.999 percent required for chromium
- Although 99.9999 percent PCB destruction was not demonstrated for all samples because of analytical detection limits, EER is confident that commercial units can be operated to achieve this performance
- A 99.4 percent HCl removal would be required to meet allowable limits of acid gas emission
- The ash generated from the combustion tests yields EP TOX leachate concentrations below RCRA standards for all metals

Details of the tests are discussed in the report entitled "The Characterization of the Incinerability of Contaminated Soil Samples."

The original scope of work included ultimate analysis for C, H, N, S, Cl in the feed and ash samples. These tests could not be run on the ash samples because there was not enough sample available. These tests were run on the two feed samples, but the results were not available at the time the report was issued. These results will be forwarded by EER when available, but they will not alter the results of the study.

Discussion of Results

EER provides a discussion of results in the Executive Summary of the attached report. However, this summary provides inconclusive analysis for the fate of chromium in the test burn. This condition warrants evaluation which is not provided in the EER report.

The test burn by EER indicates that the metals arsenic, cadmium, chromium, lead and mercury will experience significant emissions as fly ash and/or metal vapor. A summary of the test burn results for these metals, excluding mercury, is presented in Table F-1. An analysis of these data are presented in Tables F-2 and F-3 These results indicate that most of the metals present in the sample are removed from the incinerator ash and emitted with the flue gas.

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The fate of these metals is somewhat ambiguous because a material balance could not be calculated between the starting mass and the products of incineration (ash and particulate). This problem with the metals fate determination is due primarily to innacuracies in estimating initial concentrations in the feed to the incinerator. Six sample bags containing "Hot Spot" (HS) soils, and six sample bags containing "Sludge Tank and Pit" (STP) solids, were obtained from the SCP site and submitted to EER for thermal testing. Only one HS sample and one STP sample were analyzed for initial metals concentration. These samples were not well-mixed composites but represented a grab from one of the six sample bags sent for thermal testing. During the actual burn, each sample bag was emptied sequentially for testing. Due to sample variability, the concentration of metals in each bag varied from test to test.

In addition, problems were encountered in the chemical analysis of the feed and incinerated samples (Table F-1). All of the cadmium concentrations reported for the incinerator residual (ash) are qualified based on spiked sample recovery limitations. All of the arsenic feed sample concentrations and 11 of 12 incinerator ash sample concentrations are qualified based on spiked sample recovery limitations. Seven of 12 incinerator ash samples for lead concentration are qualified based on duplicate analysis limitations.

Only the particulate samples are reported with total quality assurance for these metals. The particulate collection mechanism consists of an EPA Method 5 train. This train includes a glass fiber filter followed by a series of impingers maintained in an ice-water bath. The capture efficiency of this system is estimated at better than 98 percent by EER personnel. This capture efficiency, along with the high concentrations of metals observed, imply a high degree of confidence in the observations for the particulate fraction.

Regardless of the analytical problems, the total mass of all metals in the particulate generally exceeds that estimated in the incinerator residual by an order of magnitude (Table F-2). This observation applies to all metals considered here, including chromium. The presence of high percentages of chromium in the particulate (fly ash) is not an anomaly. All 12 tests yield high

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percentages of chromium in the particulate, indicating that this occurrence is common for the particular conditions at hand.

Chromium is not usually expected to appear in the particulate because of its high vaporization temperature, however, this temperature varies with the Chromium species under consideration. The Handbook of Physics and Chemistry (CRC Press, 61st Edition) lists boiling points for various Chromium species as:

Chromium Species	Boiling Point (C)
Chromium (metal)	2,482
Chromium trichloride	1,300
Chromium Carbonyl	151
Chromium Oxychloride	117

As is apparent from the table above, vaporization temperature is highly dependent upon the chromium compound present.

High particulate concentration of chromium is not totally dependent upon vaporization temperature, because dissolved species of chromium, which crystallize as the combustion process proceeds, will adhere to other particulates formed at this time. The tendency is for this crystallization to occur on small particulates which may eventually wind up as fly ash. The results presented by EER did not distinguish between metallic vapor (captured by the impingers) and fly ash emission (captured by the glass fiber filter) of metals, therefore the specific mechanism by which chromium was reduced in the feed is not known.

As indicated previously, a mass balance between the incinerator feed and combustion residuals (soil ash and flue gas emissions) cannot be closed due to innacuracies in the determination of the feed concentration. However, a comparison of the relative amounts of metal in the ash and flue gas emission (particulate) provides insight into the fate of these constituents. The results indicate that greater than 90 percent of these metals are emitted with the particulate fraction (Table F-3), independent of burn temperature.

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Table F-1
EER Incinerator Testing
Analytical Data for Arsenic

Test Number	Sample Weight (lbs)	Sample Concentration (mg/kg)	+/- 20% Ash Recovered (lbs)	Ash Conc. (mg/kg)	Fly Ash (grams/lb)	Fly Ash Conc. (mg/kg)
HS-15-30-1	10.0	13 N		18.0 N		
HS-15-30-2	10.0	13 N		39.7 N	4.5	53,500
HS-15-60-1	7.0	13 N	3.3	37.4 N	4.5	44,300
HS-18-30-1	5.0	13 N		35.2 N	6.0	57,800
HS-18-30-2	7.25	13 N	2.1	9.7 N	4.3	20,400
HS-18-60-1	7.0	13 N	2.8	8.9 N	3.7	68,200
HS-21-30-1	7.0	13 N			4.2	20,000
STP-15-30-1	10.0	8.4 N		9.1 N	9.0	21,500
STP-15-30-2	4.25	8.4 N	1.8	4.8 N	4.8	6,235
STP-15-60-1	7.0	8.4 N	3.0	5.9 N	13.1	16,200
STP-18-30-1	7.0	8.4 N		8.5 N		
STP-18-30-2	7.0	8.4 N	1.6	10.0 N	8.1	62,200
STP-18-30-3	4.0	8.4 N	0.9		9.3	16,500
STP-18-60-1	7.0	8.4 N	2.1	3.5	27.4	17,300

EER Incinerator Testing
Analytical Data for Cadmium

Test Number	Sample Weight (lbs)	Sample Concentration (mg/kg)	+/- 20% Ash Recovered (lbs)	Ash Conc. (mg/kg)	Fly Ash (grams/lb)	Fly Ash Conc. (mg/kg)
HS-15-30-1	10.0	3.6		0.76 N		
HS-15-30-2	10.0	3.6		1.3 N	4.5	207
HS-15-60-1	7.0	3.6	3.3	0.77 N	4.5	377
HS-18-30-1	5.0	3.6		0.8 N	6.0	254
HS-18-30-2	7.25	3.6	2.1	0.75 N	4.3	99
HS-18-60-1	7.0	3.6	2.8	0.79 N	3.7	337
HS-21-30-1	7.0	3.6			4.2	358
STP-15-30-1	10.0	59		8.3 N	9.0	658
STP-15-30-2	4.25	59	1.8	1.0 N	4.8	266
STP-15-60-1	7.0	59	3.0	2.5 N	13.1	342
STP-18-30-1	7.0	59		0.76 N		
STP-18-30-2	7.0	59	1.6	2.1 N	8.1	814
STP-18-30-3	4.0	59	0.9		9.3	312
STP-18-60-1	7.0	59	2.1	0.80 N	27.4	262

Table F-1(continued)
EER Incinerator Testing
Analytical Data for Chromium

Test Number	Sample Weight (lbs)	Sample Conc. (mg/kg)	+/- 20% Ash Recovered (lbs)	Ash Conc. (mg/kg)	Fly Ash (grams/lb)	Fly Ash Conc. (mg/kg)
HS-15-30-1	10.0	23		12.3		
HS-15-30-2	10.0	23		27.9	4.5	567
HS-15-60-1	7.0	23	3.3	102	4.5	2,770
HS-18-30-1	5.0	23		36.3	6.0	11,116
HS-18-30-2	7.25	23	2.1	8.9	4.3	24,600
HS-18-60-1	7.0	23	2.8	12.9	3.7	6,320
HS-21-30-1	7.0	23			4.2	9,880
STP-15-30-1	10.0	2050		176	9.0	186
STP-15-30-2	4.25	2050	1.8	72	4.8	25,500
STP-15-60-1	7.0	2050	3.0	73.8	13.1	5,835
STP-18-30-1	7.0	2050		59.6		
STP-18-30-2	7.0	2050	1.6	56.4	8.1	4,232
STP-18-30-3	4.0	2050	0.9		9.3	23,253
STP-18-60-1	7.0	2050	2.1	95.8	27.4	2,421

EER Incinerator Testing
Analytical Data for Lead

Test Number	Sample Weight (lbs)	Sample Concentration (mg/kg)	+/- 20% Ash Recovered (lbs)	Ash Conc. (mg/kg)	Fly Ash (grams/lb)	Fly Ash Conc. (mg/kg)
HS-15-30-1	10.0	122		6.2		
HS-15-30-2	10.0	122		8.6	4.5	3,670
HS-15-60-1	7.0	122	3.3	46.7 D	4.5	26,700
HS-18-30-1	5.0	122		34.9	6.0	11,100
HS-18-30-2	7.25	122	2.1	19.2	4.3	34,200
HS-18-60-1	7.0	122	2.8	10.3	3.7	19,700
HS-21-30-1	7.0	122			4.2	5,757
STP-15-30-1	10.0	9710		402 D	9.0	87,700
STP-15-30-2	4.25	9710	1.8	296 D	4.8	42,100
STP-15-60-1	7.0	9710	3.0	300 D	13.1	34,300
STP-18-30-1	7.0	9710		59.9 D		
STP-18-30-2	7.0	9710	1.6	108 D	8.1	95,800
STP-18-30-3	4.0	9710	0.9		9.3	40,780
STP-18-60-1	7.0	9710	2.1	126 D	27.4	32,100

Table F-2
EER Incinerator Testing
Mass Analysis for Arsenic

Test Number	Initial Mass (mg)	Ash Metals (mg)	Particulate Metals (mg)	Total Metals Residuals (mg)	Estimated Initial Feed Concentration (mg/kg)
HS-15-30-1	59.0	N/A	N/A	N/A	N/A
HS-15-30-2	59.0	N/A	2,407.5	N/A	N/A
HS-15-60-1	41.3	56.0	1,395.5	1,451.4	457
HS-18-30-1	29.5	N/A	1,734.0	N/A	N/A
HS-18-30-2	42.8	9.2	636.0	645.2	196
HS-18-60-1	41.3	11.3	1,766.4	1,777.7	560
HS-21-30-1	41.3	N/A	588.0	N/A	N/A
STP-15-30-1	38.1	N/A	1,935.0	N/A	N/A
STP-15-30-2	16.2	3.9	127.2	131.1	68
STP-15-60-1	26.7	8.0	1,485.5	1,493.6	470
STP-18-30-1	26.7	N/A	N/A	N/A	N/A
STP-18-30-2	26.7	7.3	3,526.7	3,534.0	1,113
STP-18-30-3	15.2	0.0	613.8	613.8	338
STP-18-60-1	26.7	3.3	3,318.1	3,321.5	1,046

EER Incinerator Testing
Mass Analysis for Cadmium

Test Number	Initial Mass (mg)	Ash Metals (mg)	Particulate Metals (mg)	Total Metals Residuals (mg)	Estimated Initial Feed Concentration (mg/kg)
HS-15-30-1	16.3	N/A	N/A	N/A	N/A
HS-15-30-2	16.3	N/A	9.3	N/A	N/A
HS-15-60-1	11.4	1.2	11.9	13.0	4.1
HS-18-30-1	8.2	N/A	7.6	N/A	N/A
HS-18-30-2	11.8	0.7	3.1	3.8	1.2
HS-18-60-1	11.4	1.0	8.7	9.7	3.1
HS-21-30-1	11.4	N/A	10.5	N/A	N/A
STP-15-30-1	267.6	N/A	59.2	N/A	N/A
STP-15-30-2	113.7	0.8	5.4	6.2	3.2
STP-15-60-1	187.3	3.4	31.4	34.8	10.9
STP-18-30-1	187.3	N/A	N/A	N/A	N/A
STP-18-30-2	187.3	1.5	46.2	47.7	15.0
STP-18-30-3	107.0	0.0	11.6	11.6	6.4
STP-18-60-1	187.3	0.8	50.3	51.0	16.1

Table F-2(continued)
EER Incinerator Testing
Mass Analysis for Chromium

Test Number	Initial Mass (mg)	Ash Metals (mg)	Particulate Metals (mg)	Total Metals Residuals (mg)	Estimated Initial Feed Concentration (mg/kg)
HS-15-30-1	104.3	N/A	N/A	N/A	N/A
HS-15-30-2	104.3	N/A	25.5	N/A	N/A
HS-15-60-1	73.0	152.7	87.3	239.9	76
HS-18-30-1	52.2	N/A	333.5	N/A	N/A
HS-18-30-2	75.6	8.5	766.9	775.4	236
HS-18-60-1	73.0	16.4	163.7	180.1	57
HS-21-30-1	73.0	N/A	290.5	N/A	N/A
STP-15-30-1	9,298.6	N/A	16.7	N/A	N/A
STP-15-30-2	3,951.9	58.8	520.2	579.0	300
STP-15-60-1	6,509.0	100.4	535.1	635.5	200
STP-18-30-1	6,509.0	N/A	N/A	N/A	N/A
STP-18-30-2	6,509.0	40.9	240.0	280.9	88
STP-18-30-3	3,719.4	0.0	865.0	865.0	477
STP-18-60-1	6,509.0	91.3	464.3	555.6	175

EER Incinerator Testing
Mass Analysis for Lead

Test Number	Initial Mass (mg)	Ash Metals (mg)	Particulate Metals (mg)	Total Metals Residuals (mg)	Estimated Initial Feed Concentration (mg/kg)
HS-15-30-1	553.4	N/A	N/A	N/A	N/A
HS-15-30-2	553.4	N/A	165.2	N/A	N/A
HS-15-60-1	387.4	69.9	841.1	911.0	287
HS-18-30-1	276.7	N/A	333.0	N/A	N/A
HS-18-30-2	401.2	18.3	1,066.2	1,084.5	330
HS-18-60-1	387.4	13.1	510.2	523.3	165
HS-21-30-1	387.4	N/A	169.3	N/A	N/A
STP-15-30-1	44,043.6	N/A	7,893.0	N/A	N/A
STP-15-30-2	18,718.5	241.7	858.8	1,100.5	571
STP-15-60-1	30,830.5	408.2	3,145.3	3,553.5	1,119
STP-18-30-1	30,830.5	N/A	N/A	N/A	N/A
STP-18-30-2	30,830.5	78.4	5,431.9	5,510.2	1,735
STP-18-30-3	17,617.4	0.0	1,517.0	1,517.0	836
STP-18-60-1	30,830.5	120.0	6,156.8	6,276.8	1,977

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Table F-3
EER Incinerator Testing
Fate Analysis for Arsenic

Test Number	Metals Liberation (mg/lb)	Fate of Arsenic in Test Burn Samples Ash (Percent)	Fly Ash (Percent)
HS-15-30-1	N/A	N/A	N/A
HS-15-30-2	240.75	N/A	N/A
HS-15-60-1	199.35	3.86%	96.14%
HS-18-30-1	346.80	N/A	N/A
HS-18-30-2	87.72	1.43%	98.57%
HS-18-60-1	252.34	0.64%	99.36%
HS-21-30-1	84.00	N/A	N/A
STP-15-30-1	193.50	N/A	N/A
STP-15-30-2	29.93	2.99%	97.01%
STP-15-60-1	212.22	0.54%	99.46%
STP-18-30-1	N/A	N/A	N/A
STP-18-30-2	503.82	0.21%	99.79%
STP-18-30-3	153.45	0.00%	100.00%
STP-18-60-1	474.02	0.10%	99.90%

EER Incinerator Testing
Fate Analysis for Cadmium

Test Number	Metals Liberation (mg/lb)	Fate of Cadmium in Test Burn Samples Ash (Percent)	Fly Ash (Percent)
HS-15-30-1	N/A	N/A	N/A
HS-15-30-2	0.93	N/A	N/A
HS-15-60-1	1.70	8.85%	91.15%
HS-18-30-1	1.52	N/A	N/A
HS-18-30-2	0.43	18.80%	81.20%
HS-18-60-1	1.25	10.31%	89.69%
HS-21-30-1	1.50	N/A	N/A
STP-15-30-1	5.92	N/A	N/A
STP-15-30-2	1.28	13.08%	86.92%
STP-15-60-1	4.48	9.79%	90.21%
STP-18-30-1	N/A	N/A	N/A
STP-18-30-2	6.59	3.20%	96.80%
STP-18-30-3	2.90	0.00%	100.00%
STP-18-60-1	7.18	1.49%	98.51%

Table F-3(continued)
EER Incinerator Testing
Fate Analysis for Chromium

Test Number	Metals Liberation (mg/lb)	Fate of Chromium in Test Burn Samples Ash (Percent)	Fly Ash (Percent)
HS-15-30-1	N/A	N/A	N/A
HS-15-30-2	2.55	N/A	N/A
HS-15-60-1	12.47	63.63%	36.37%
HS-18-30-1	66.70	N/A	N/A
HS-18-30-2	105.78	1.09%	98.91%
HS-18-60-1	23.38	9.10%	90.90%
HS-21-30-1	41.50	N/A	N/A
STP-15-30-1	1.67	N/A	N/A
STP-15-30-2	122.40	10.15%	89.85%
STP-15-60-1	76.44	15.80%	84.20%
STP-18-30-1	N/A	N/A	N/A
STP-18-30-2	34.28	14.57%	85.43%
STP-18-30-3	216.25	0.00%	100.00%
STP-18-60-1	66.34	16.42%	83.58%

EER Incinerator Testing
Fate Analysis for Lead

Test Number	Metals Liberation (mg/lb)	Fate of Lead in Test Burn Samples Ash (Percent)	Fly Ash (Percent)
HS-15-30-1	N/A	N/A	N/A
HS-15-30-2	16.52	N/A	N/A
HS-15-60-1	120.15	7.67%	92.33%
HS-18-30-1	66.60	N/A	N/A
HS-18-30-2	147.06	1.69%	98.31%
HS-18-60-1	72.89	2.50%	97.50%
HS-21-30-1	24.18	N/A	N/A
STP-15-30-1	789.30	N/A	N/A
STP-15-30-2	202.08	21.96%	78.04%
STP-15-60-1	449.33	11.49%	88.51%
STP-18-30-1	N/A	N/A	N/A
STP-18-30-2	775.98	1.42%	98.58%
STP-18-30-3	379.25	0.00%	100.00%
STP-18-60-1	879.54	1.91%	98.09%

Energy and
Environmental
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THE CHARACTERIZATION OF THE INCINERABILITY OF CONTAMINATED SOIL SAMPLES

Prepared for:

Environmental Resource Management, Inc.
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EXECUTIVE SUMMARY

1.0 STUDY APPROACH AND OBJECTIVE

The objective of this rapid response screening study was to evaluate the feasibility of thermally treating materials from the SCP/Carlstadt site and to indicate the appropriate conditions for thermal treatment. Two different materials were investigated including composites from hot spots, and sludge tanks and pits. The thermal treatability of these samples were investigated in a pilot scale rotary kiln simulator. The focus of the study was directed at the following:

- Time at temperature to remove organics from the samples
- Residue quality
- Metal emissions
- Destruction of PCBs
- Acid gas emissions
- Particulate emissions

The materials were separately thermally treated for different temperatures and different residence times in the rotary kiln. Temperatures were varied in three series, nominally 1500, 1800 and 2100°F and residence times were either 30 or 60 minutes.

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2.0 TEST RESULTS

2.1 Treated Materials

Materials treated at 1800°F were partially vitrified while whose treated at 2100°F completely slagged. At 1500°F treatment the residue remained dry. Thus, the upper temperature limit allowed for dry kilns is between 1500 and 1800°F.

Only one treated sample, from a 30 minute incineration of a sludge tanks and pits composite sample had detectable levels of PCBs. No hot spots composite (HS) or sludge tanks and pits composite (STP) ash samples had detectable PCB concentrations. This one exception suggests that 30 minutes at 1500°F may be a lower time at temperature requirement for the STP materials. The leachate concentrations from the treated residues were below RCRA standards for all metals for each treated residue at any treatment temperature.

Thus, the low PCB levels and low metal leachability of the treated residue indicates thermal treatment is suitable for cleaning the site materials if the composite samples are representative of the range of materials from the site. Excessively high temperatures (1800°F) must be avoided to prevent slagging and short residence times at lower temperatures (ca. 30 minutes at 1500°F) must be avoided to ensure complete removal of PCBs from the sludge tanks and pits materials.

2.2 DRE of PCBs

The afterburner used in this study was operated at nominal conditions of 1800-2050°F. At these conditions, the emissions levels of the principle PCB determined to be in the sample were always below detection limits for all test runs. This corresponds to a demonstrated destruction and removal efficiency of PCBs of greater than 7 nines in some cases of sludge tank and pit composite materials treatment. For the hot spots composite, due to the relatively low levels of the principle PCB in the waste stream, only 98.9 to

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99.94 percent DRE could be demonstrated. However there was evidence of PCBs with lower chlorination than the principle species in the exhaust of the rotary kiln simulator at detectable levels. Further testing is recommended to examine the afterburner parameters required to achieve 6 nines DRE of the POHC without generating PICs.

2.3 Fate of Metals

Analyses of treatment residues and incinerator exhaust fly ash suggest there is substantial volatilization of certain hazardous metals in the composite samples that accompanies thermal treatment of these materials. In particular, for the STP composite which contains substantial levels of antimony, arsenic, cadmium, chromium, lead, and mercury, the control of emissions of these metals will be important to consider for regulatory compliance. Chromium is not normally volatilized at treatment temperatures. It may be present in the sample in a volatile form such as an organo chromium compound. Further testing is necessary to determine why chromium has such a high volatility when these soil samples are incinerated.

2.4 HCl Emissions

Analyses of flue gas samples show that significant amounts of chlorine are released during PCB combustion and converted to hydrochloric acid. Incineration of these soils will require some type of acid gas air pollution control, such as a spray dryer.

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3.0 SUITABILITY OF THERMAL TREATMENT

In this study, no observations were made which would suggest that thermal treatment is not suitable for use on the two samples tested. Based upon the data and interpretation of the results, it is fully expected that a thermal treatment process could be developed which could successfully treat the materials in a manner consistent with environmental regulations. However there is a number of design issues and concerns that must be resolved before an optimized cost effective thermal treatment technology can be specified. These include the following:

- The control of emissions of products of incomplete combustion, specifically mono and dichlorinated biphenyls, will require more careful evaluation and design of afterburners than the one used in this study.

- Slagging of materials at high temperatures (1800°F) can occur and can result in operational difficulties if the thermal treatment system is not designed properly.

- High efficiency acid gas control will be required.

- High efficiency fine particle control will be required due to the high concentration and volatility of many of the metals in the composites associated with the sludge tanks and pits.

These issues must be resolved before an engineering specification can be made for an optimized thermal treatment system suitable for vendor bid preparation.

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1.0 INTRODUCTION

The purpose of this screening study was to characterize the ability of rotary kiln incinerators to thermally treat contaminated soils from the SCP/Carlstadt superfund site. The soil samples were suspected to contain significant concentrations of hazardous organic compounds, most notably PCBs, and toxic metals. The experimental matrix and samples analyses addressed five topics:

1. What are the temperature/time requirements for removal of organic compounds from the materials? Samples taken before and after thermal treatment were analyzed for PCBs and carbon content. Continuous monitoring of gaseous species at the afterburner region exit indicated when detectable levels of combustible compounds were being evolved from the soils.

2. Are the organics volatilized during thermal treatment destroyed in the kiln or afterburner regions of the incinerator, or do they escape the system? Exhaust gases were sampled using an EPA Modified Method 5 (US EPA SW-846 Method 10) train and analyzed for PCBs and pesticides. Exhaust total hydrocarbon (THC) levels were continuously monitored.

3. What is the fate of toxic metals in the site materials when the soils are thermally treated? Of specific interest is the trade off between the temperature requirements for removal of organics from the soil and the temperature dependent vaporization of volatile metals such as As, Cd, Hg and Pb which will form a fine fume that is difficult to capture in particulate control devices. Treated and untreated soil samples as well as samples taken from the incinerator exhaust with EPA Method 5 sampling trains modified to capture volatile metals were analyzed for toxic metals.

4. What are the leachability characteristics of the metals remaining in thermally treated soils? E.P. Toxic leachability analyses were run on both treated and untreated site material samples.

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5. What are combustion products of the soils incineration? Standard combustion products were continuously monitored by instrumentation and samples for hydrochloric acid analysis were taken with an impinger train.

The testing was performed in the Solid Fuels Test Facility (SFTF) at the EER El Toro test site. This facility is designed to allow the time at temperature requirements necessary to decontaminate solids to be defined under realistic incinerator conditions. Specifically, the facility simulates the conditions that exist within full scale rotary kilns, including the contacting of gases and solids, the mixing of the bed solids, the time at temperatures, and the gas phase conditions. This facility is described in Section 2.

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2.0 EXPERIMENTAL FACILITY

2.1 Rotary Kiln Simulator

The experimental tests were conducted in the rotary kiln portion of EER Solid Fuels Test Facility (SFTF), shown in Figure 2-1. A view of the main combustion chamber is shown in Figure 2-2. The refractory-lined facility consists of a horizontal barrel, an elbow section with an afterburner, a vertical controlled temperature tower (CTT), cooling sections, and a baghouse. The horizontal barrel, with rotational speeds of 0 to 5 rpm, houses the main burner. This burner, which has a load capability of $5x10^5$ Btu/hr, is inserted into the front end of the barrel section and can be moved in and out to give the desired flame configuration over the bed. Natural gas was the primary fuel. The secondary burner, or afterburner, is located in the upper region of the elbow section for destruction of waste gases that escape the main combustion zone. This burner, which also fired natural gas, has a load capability of $1.5x10^5$ Btu/hr. The SFTF may also be used to simulate a solid waste incinerator by feeding solid fuels/wastes onto an aerated grate in the bottom of the elbow section.

The CTT portion of the kiln was designed to study the destruction efficiency of partially burned hazardous gases and contains two backfire chambers that supply heat through the refractory wall to the main furnace duct. The backfired sections are completely isolated from the main duct and are exhausted through the two side stacks shown in the figure. The main exhaust is pulled from the kiln with an induced-draft fan and then directed to a baghouse to collect the fines entrained in the flue.

A removable door in the kiln barrel allows access to the bed for cleaning and residual solids removal. A sample port in this door allows solid or gas phase samples to be obtained in the barrel. Other sample ports are located immediately upstream of the afterburner, and in the exhaust duct. K-type thermocouples are embedded in the kiln refractory wall to measure the bed temperature. Rotary seals are employed on both the stationary main burner and between the barrel and elbow section to minimize air leakage into the kiln.

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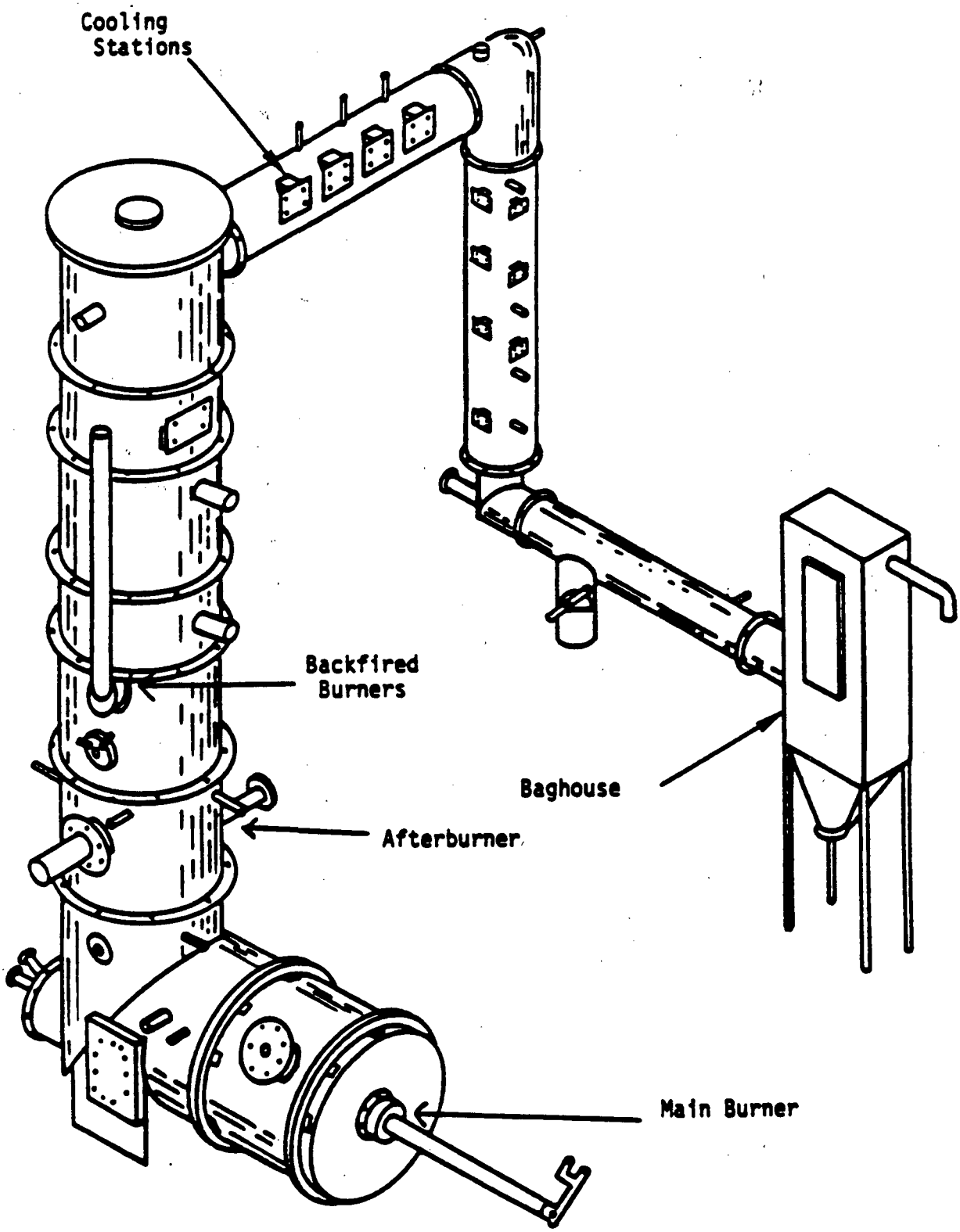

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Figure 2-1. Solid Fuels Test Facility.

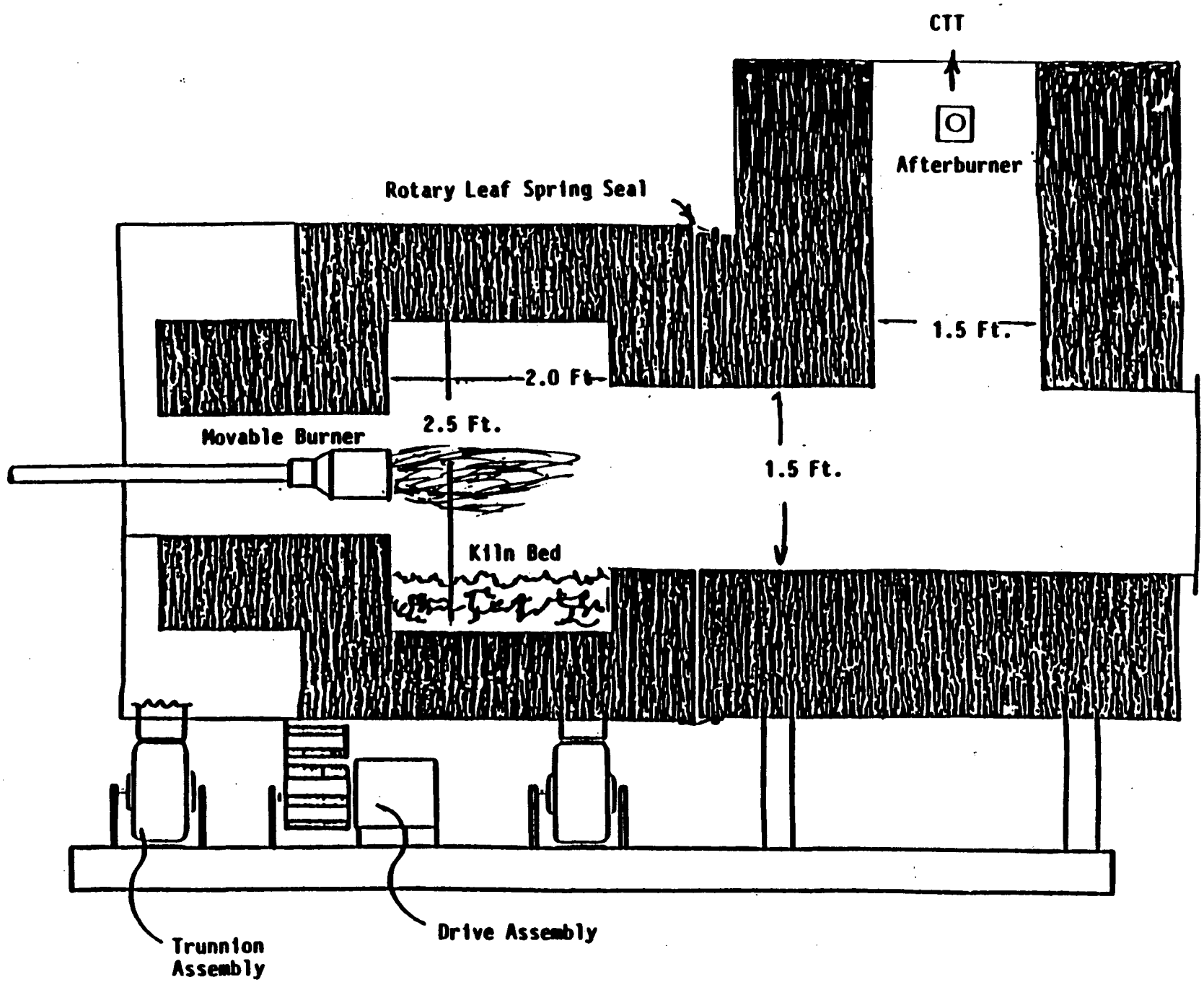

Figure 2-2. Schematic of rotary kiln.

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A schematic of the flow control panel for the kiln is shown in Figure 2-3. The highly accurate Waukee flowmeters are used to monitor natural gas and air to the main and afterburner. Standard flowmeters are used for natural gas and air to the backfired burners where less accuracy is required.

Figure 2-4 illustrates the charging system that was used to introduce the sample in to the kiln bed. During normal operation the refractory gate was closed. When the furnace conditions were stable, the loading chamber door was then opened and the charge placed in the bucket. The loading chamber door was then pushed into the kiln as desired and rotated 180^{0} to empty the contents onto the bed. The bucket was then pulled out and the gate closed. This procedure was usually carried out in about 15-20 seconds.

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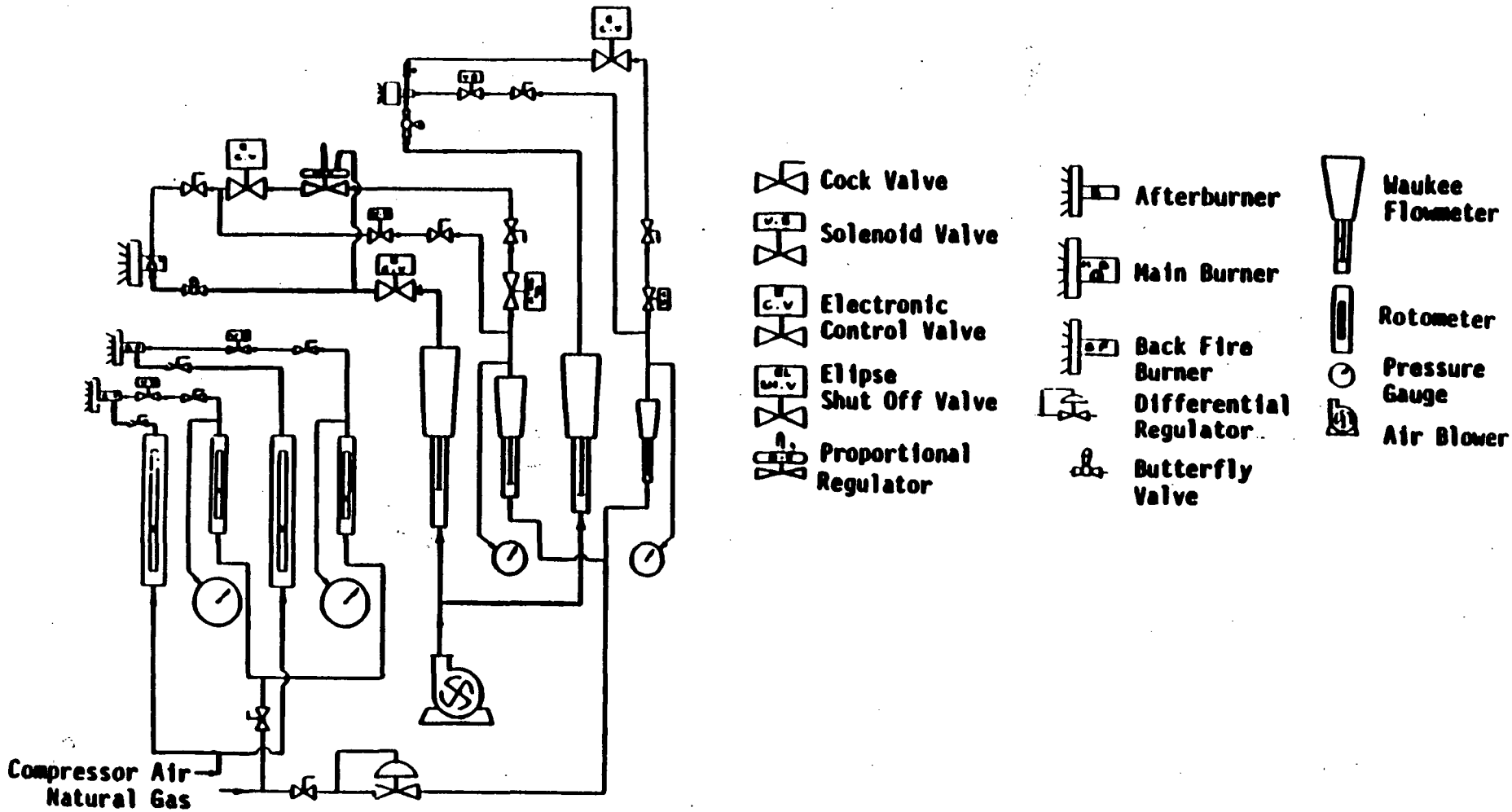

Figure 2-3. SFTF flow control.

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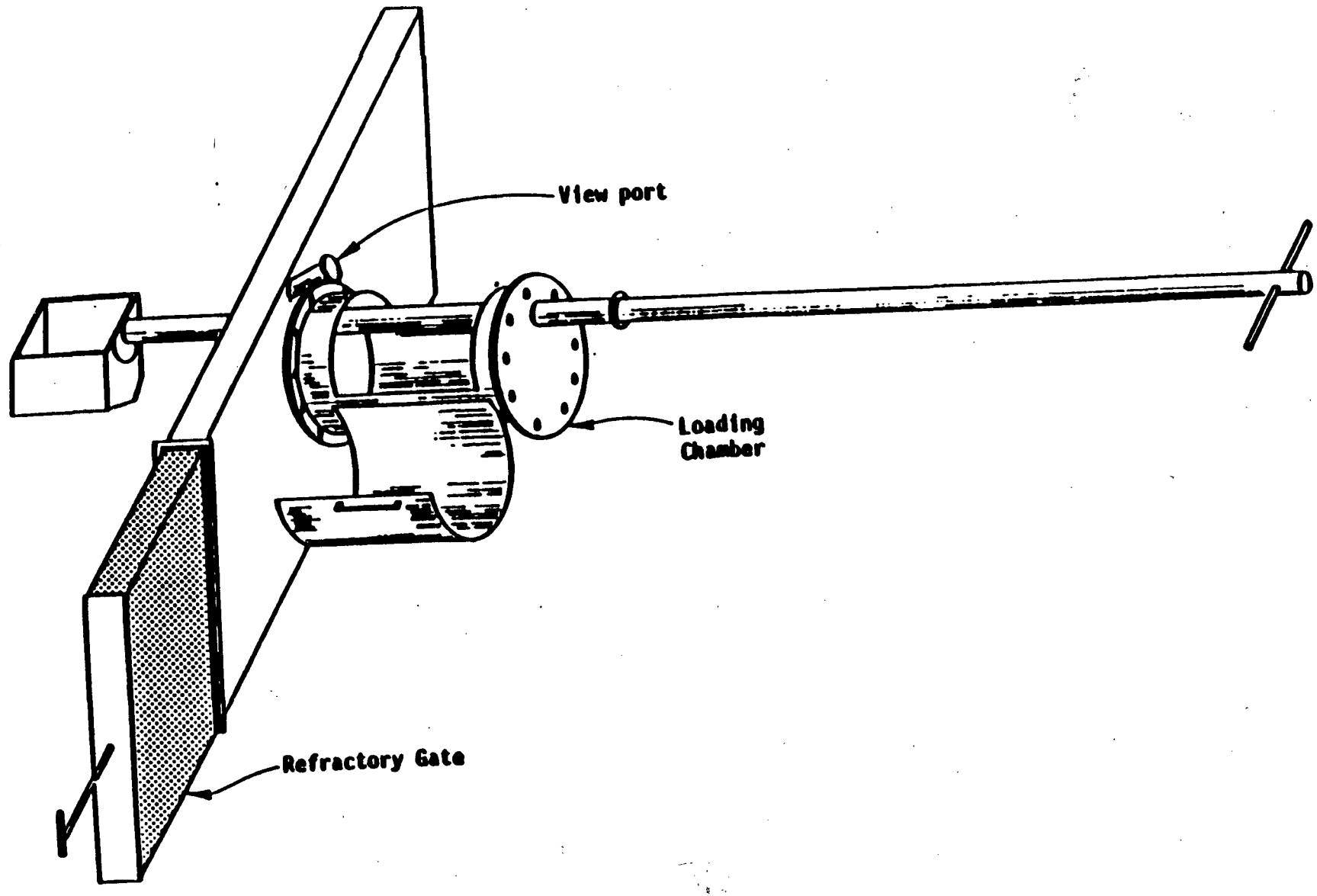

Figure 2-4. Charging system.

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3.0 MEASUREMENT METHODS

Measurements performed for incinerability tests included:

- gas phase species concentrations,
- kiln bed solids and afterburner gas phase temperatures,
- solids composition.

The measurements performed and analytical methods are outlined in Table 3-1. For analyses performed outside of EER, the analytical lab is shown in the table.

3.1 Gas Phase Sampling

The exhaust gas was analyzed for fly ash particulate, hydrochloric acid, PCBs, total hydrocarbons (THC), volatile metals, and combustion products. All constituents were continuously monitored for the duration of the run.

The continuous monitoring system (CMS) is shown in Figures 3-1 and 3-2. A phase discrimination probe, originally designed for sorbent-SO_2 systems, was used for O_2, CO, CO_2, NO_x and SO_2 sampling. The probe was stainless steel and water jacketed and split the sample into two streams. The high flowrate side passed through condensers and was then pumped to the CMS instrumentation, as shown in Figure 3-1. SO_2 system is shown in Figure 3-2. The strip charts for these species are provided in the appendix. The THC sample was withdrawn from the flue through a separate sample probe and heated line with direct feed to the instrument.

Particulate samples from the exhaust gas were obtained with a Method 5 sampling train (U.S. EPA Method 5). Samples were taken at the top of the controlled temperature tower. The sample train, shown in Figure 3-2, draws gas samples through a glass nozzle and probe and collects solid particulate on a glass fiber filter. The gas stream is then passed through an impinger train and flow measurement instrumentation. Impinger solutions were modified to capture highly volatile metals such as mercury, arsenic, and selenium that would not be captured by standard impinger solutions. The filter catch, and probe and

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TABLE 3-1. MEASUREMENT

Measurement		Analytical Method/Instrument	Analytical Lab
Gases			
O_2		Paramagnetism (Beckman 755)	--
CO_2	Continuous	Non-Dispersive IR (Infrared 7300)	--
CO	Monitoring	Non-Dispersive IR (Horiba 2000)	--
NOx	System	Chemiluminescence (TECO 10)	--
SO_2		Non-Dispersive IR (Anarad AR-50)	--
THC		Flame Ionization (Beckman 402)	--
Temperature			
Barrel Bed		K-type Thermocouple	--
Gas		Suction Pyrometry; B-Type TC	--
Solid			
Carbon			Northeastern
Hydrogen			Northeastern
Nitrogen		Elemental analyzers	Northeastern
Sulfur			Northeastern
Chlorine			Northeastern
PCBs		EPA/CLP Protocols, GC/MS	Compuchem
Metals		EPA SW-846 Methods, graphite furnace, cold vapor, ICP	Compuchem
Leachability		EPA Toxicity Characteristic Leaching Procedure	Compuchem
Exhaust Samples			
MM5 Train, PCBs		Method 680, GC/MS	Enseco
M5 Train, particulate		EPA Method 5	EER
M5 Train, Metals		EPA SW-846 Methods, graphite furnace, cold vapor, ICP	Enseco
HCl Impingers		Mercuric nitrate titration	EER

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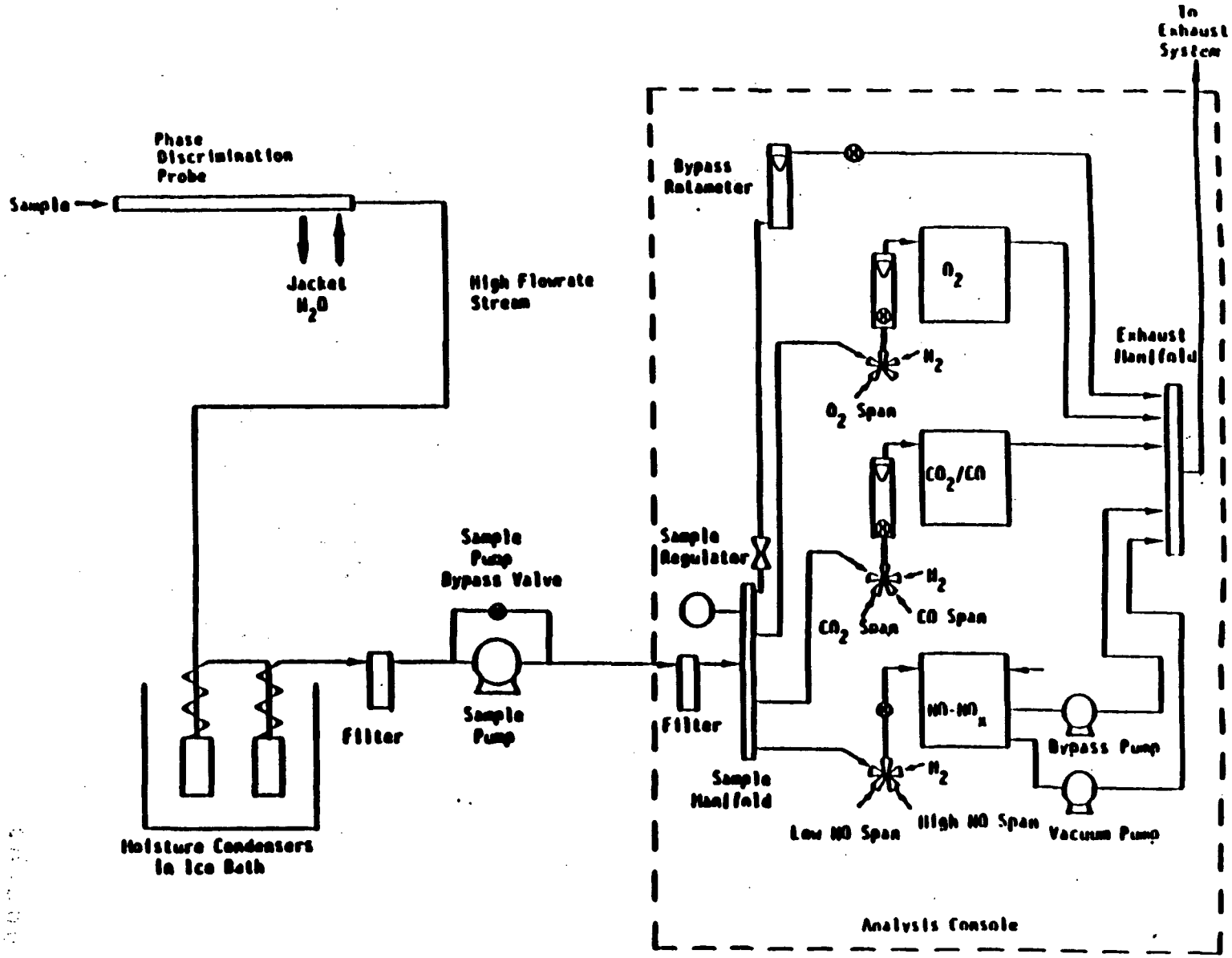

Figure 3-1. Continuous monitoring sampling system.

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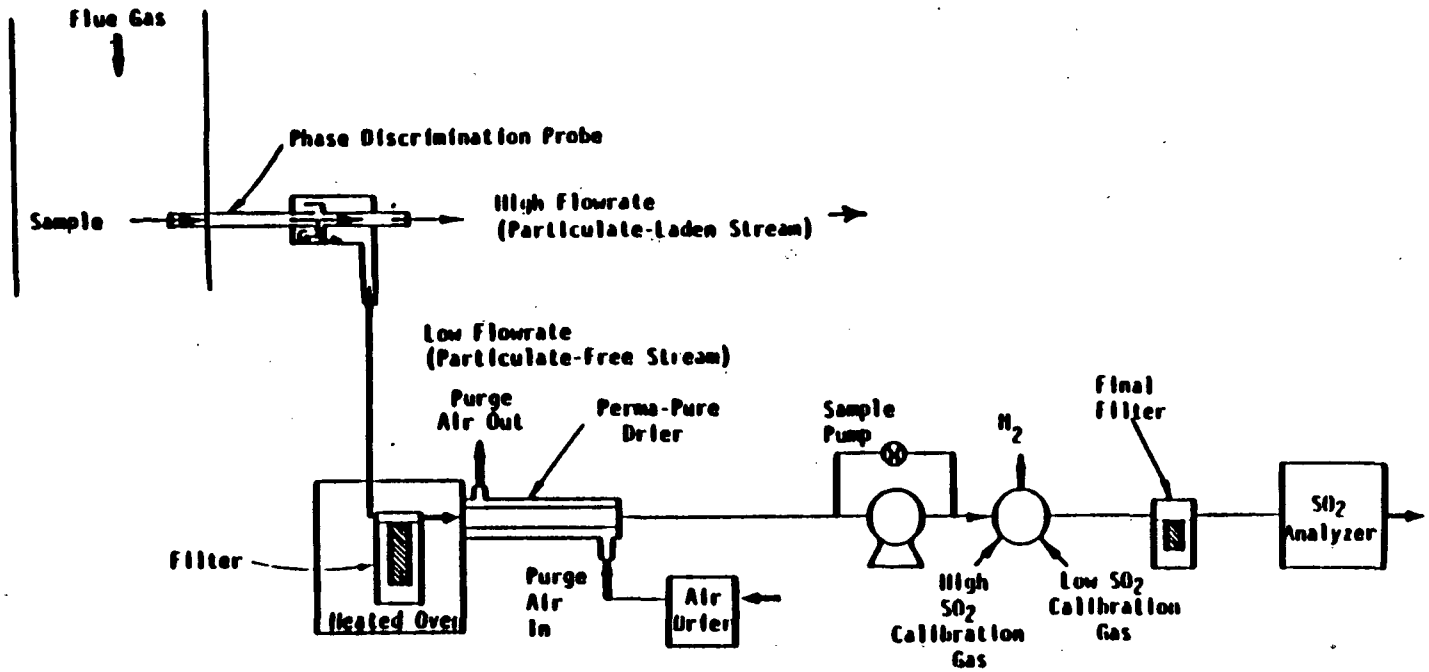

Figure 3-2. SO_2 continuous monitoring system.

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filter holder washes were analyzed for metals and particulate. Impinger solutions were analyzed for metals. Analyses for metals were performed by Enseco Cal Labs of Sacramento, California in accordance with US EPA SW-846. Enseco is a CLP certified laboratory.

Semi-volatile organics samples were obtained with a Modified Method 5 sampling train (US EPA SW-846 Method 10). The sample train, shown in Figure 3-4, collects solid particulate on a glass fiber filter, then absorbs semi-volatile organic species with a porous polymeric resin (XAD-2).

Gas samples were drawn through a glass probe to an oven which maintained the filter at 250°F. The sample then passed through a condenser coil and a sorbent module which contained the XAD-2 resin. The gas stream then passed through an impinger train and flow measurement instrumentation. Extraction and analysis of the semi-volatile organics was performed by Enseco Cal Labs in accordance with US EPA SW-846.

Acid gas (HCl) in the exhaust was also measured. An exhaust sample was bubbled through an alkaline solution to absorb the acid gas, and the gas flowrate was measured. A titration procedure using $Hg(NO_3)_2$ as the titrant quantified the HCl concentration.

3.2 Temperature

The kiln bed solid samples temperatures were measured with a K-type thermocouple embedded in the wall. Gas phase temperatures were measured with a single shield suction pyrometer which contained a B-type thermocouple, as shown in Figure 3-5. The thermocouples were manufactured according to ASTM standards. The error limits are $\pm 2.2^{o}$C or $\pm$ 0.75 percent of the reading (whichever is greater), and $\pm$ 1.5^{o}C or $\pm$ 2.5 percent of the reading for K and B type thermocouples respectively.

3.3 Solid Samples

Solid samples were removed from the bed via a port in the kiln barrel door. Samples were kept cool until analysis began. Solid samples were analyzed

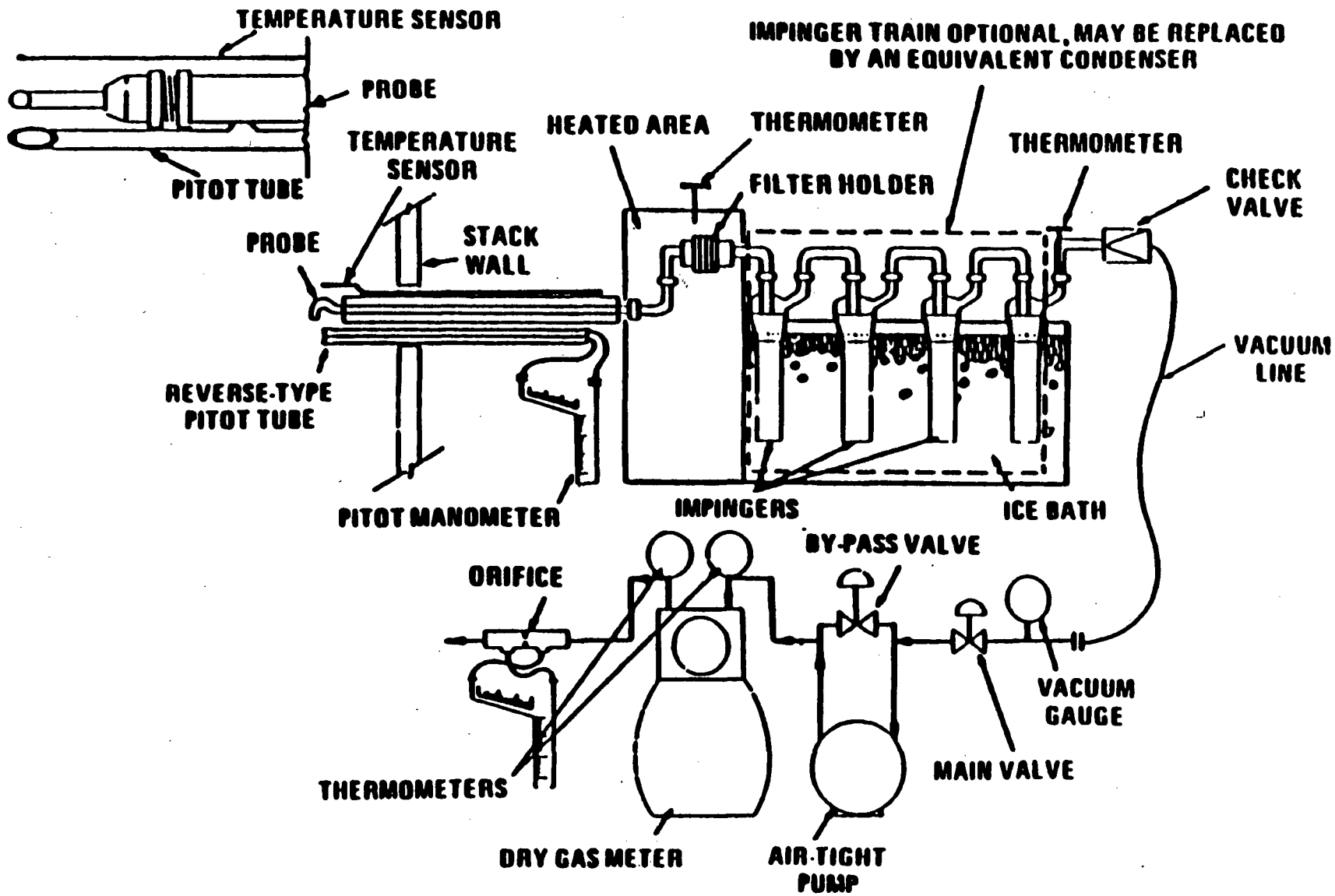

Figure 3-3. Method 5 sampling train.

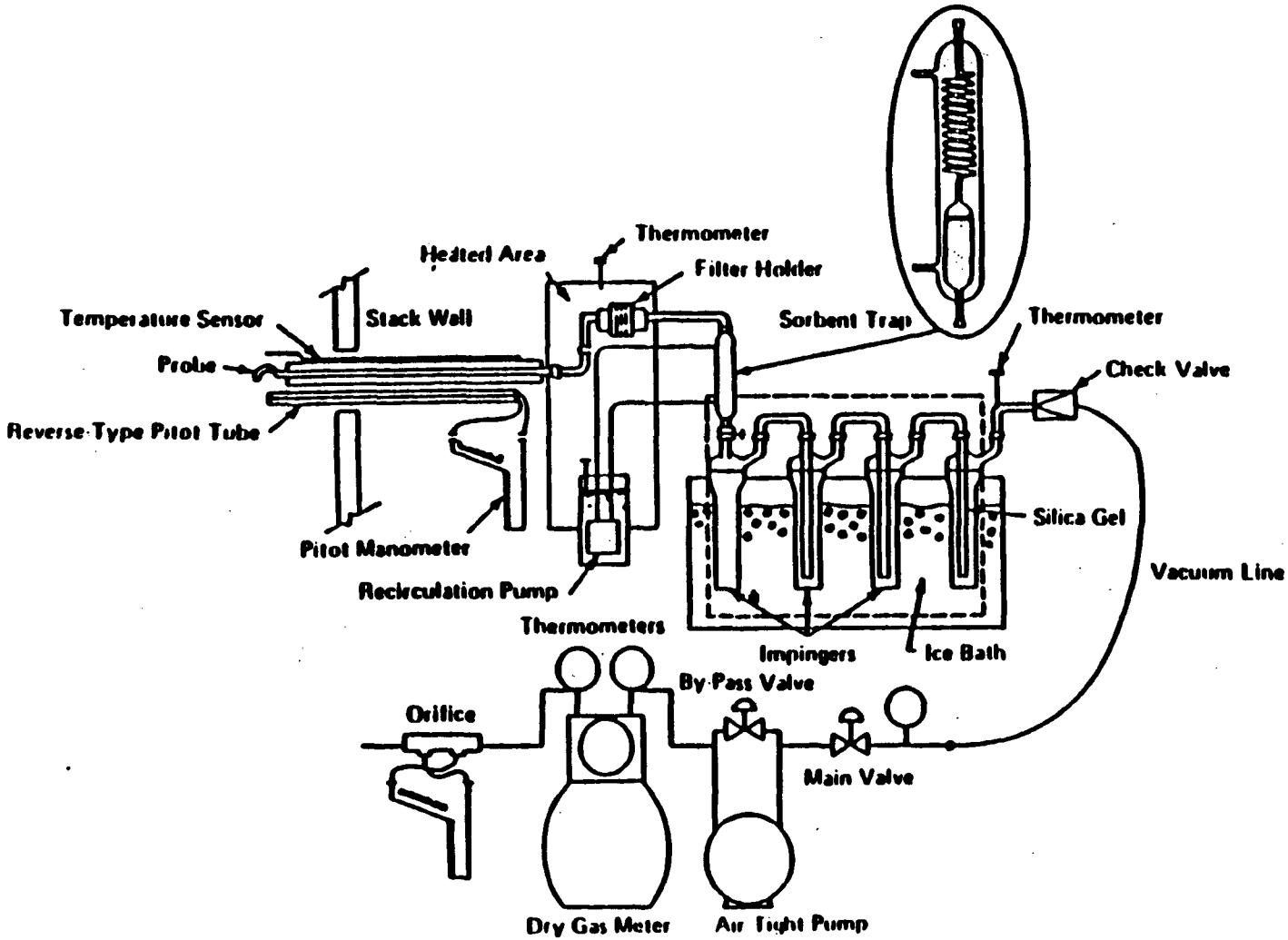

Figure 3-4. Modified Method 5 sampling train.

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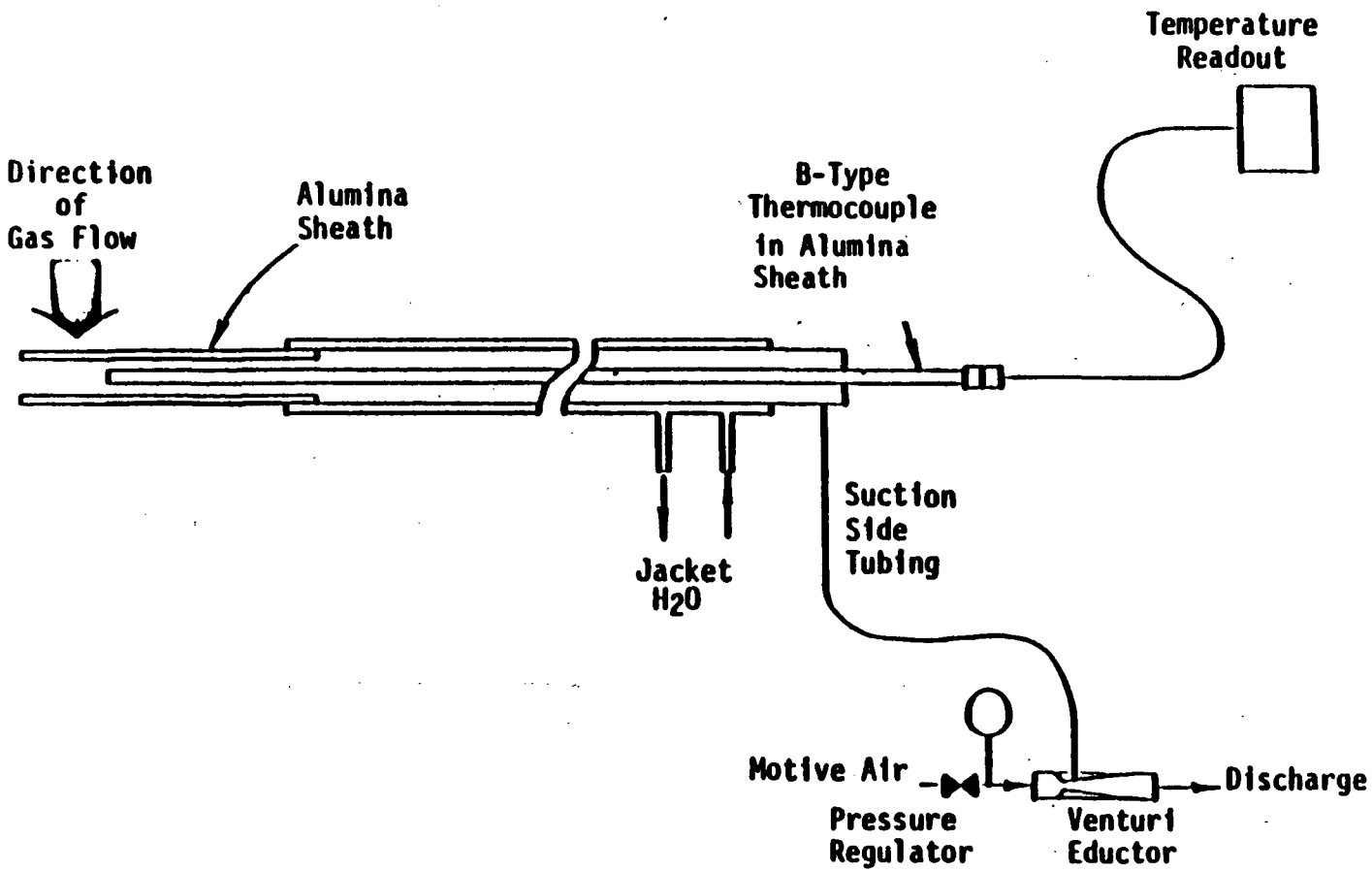

Figure 3-5. Gas temperature measurement system.

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by Compuchem Laboratories, a CLP certified laboratory in Research Triangle Park, North Carolina. Representative feedstock samples and kiln bed residue samples were sent to Compuchem for PCBs, metals and EP Toxic metals leachability analyses. Ultimate elemental analyses were run for carbon, hydrogen, nitrogen, sulfur, and chlorine content. The ultimate elemental analyses were performed by Northeastern Labs, a subcontractor to Compuchem.

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4.0 EXPERIMENTAL

Thermal treatment studies of two soils samples from the SCP/Carlstadt superfund site were required. These samples were referred to as Sludge Tank and Pit Composite (STP) and Hot Spot Composite (HS). Target incineration temperatures were 1500°F, 1800°F and 2100°F, 30 and 60 minutes were the treatment durations.

Beginning tests conditions were chosen based upon data from previous incineration testing of contaminated soils. Soil samples of 10 pounds were taken and incinerator conditions were set. Following charge of the soil samples, incinerator exhaust oxygen levels fell to zero and carbon monoxide levels were very high (>2500 ppm). Soil samples for current tests had larger quantities of volatile organic compounds than soil samples from previous tests.

Adjustments of soils sample charge size and incinerator excess oxygen levels were necessary to produce optimum combustion conditions, multiple tests were necessary at some incinerator temperatures. Tests which had periods of operation under oxygen depletion had very high emissions of carbonaceous particulate, carbon monoxide (CO), and soot. During tests in which oxygen levels were sufficient for complete combustion, CO concentrations remained near baseline levels and significant levels of carbonaceous particulate and soot were not observed. Kiln operation under oxygen depletion results in higher particulate emissions than normal. DREs of PCBs and emissions of metals and HCl may also be influenced by incinerator oxygen availability. Tests which had significant periods of high CO emissions are denoted with a *.

Labeling of tests was based upon soils sample type, target soils temperature, treatment duration and repetition number. For example, test HS-1800-30-2, refers to a Hot Spot sample, treated at 1800°F for 30 minutes, second test at these conditions.

4.1 Procedures

The test sequence on the kiln was preceded by a thorough cleaning of the bed to ensure a contaminant free system. The kiln was run with sand as the charge to scrub the bed of any residuals.

Main and afterburner firing rates were set to achieve desired temperatures. Oxygen enhancement was often used to boost oxygen to levels necessary for complete combustion. Baseline incinerator conditions were set and kiln bed temperatures were allowed to come to steady state. Soils were stored in the original shipping coolers. Each cooler contained two or three plastic bags containing composite soil samples. Shipping and storage of bags allowed water in soils to settle, therefore contents of each bag were mixed before sampling or treatment to ensure homogeneous moisture content. Soils from separate bags cooler were not necessarily mixed as soil samples were sent as a composite. The charge was added to the kiln barrel via the system previously described. The bed thermocouple was closely monitored to determine soil sample temperature. Observations of main gas flame color, flames emitting from soils, and smoke/soot in the kiln were noted. Continuously monitored exhaust species downstream of the afterburner at the CCT exit were O_2, CO_2, CO, SO_2, NO_x and total hydrocarbons (THC). Exhaust samples were taken for particulate, metals, hydrochloric acid, and PCBs using appropriate sampling trains. These samples were taken at the CCT exit. Sampling temperature ranged from 1435-1746°F (Table 4-1). Incinerator exhaust samples were taken using sampling systems maximum flow rates to collect sufficient sample to obtain analytically detectable quantities of trace species and to ensure demonstration of high organic compounds destruction efficiencies. The sampling rates were generally greater than the calculated isokinetic sampling rates.

When the test run was completed, burners and air flows were shut down. The recovery batch was then opened and the spend solids were removed from the bed. Condition of ash, such as evidence of glassification, was noted and weight of residual ash was estimated.

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TABLE 4-1. SFTF OPERATING CONDITIONS

TEST NUMBER	HS-1500-30-1	HS-1500-30-2*	HS-1500-60-1	HS-1800-30-1
Exhaust Flow, Dry (SCFH)	4930	4930	5353	5006
Exhaust Flow, Wet (SCFH)	5762	5712	6088	5869
Soil Sample Wt. (lbs)	10	10	7	5
Kiln Solids T (^oF) High	1502	1570	1585	1737
Kiln Solids T (^oF) Baseline	1488	1540	1530	1704
Afterburner T (^oF) Wall	1744	1744	N/D	2020
Afterburner T (^oF) Centerline	1908	1908	N/D	2050
CTT Exit Temp (^oF)	1515	1476	1452	1611
Kiln Pressure (inches H_2O)	-.08	-.08	-.19	-.18
Kiln Rotation (rev/min)	1	1	1	1
Baseline O_2 (%) Dry	6.0	6.5	10.1	7.1
Main Flame Coloration/min	green/17	green/20	green/18	green/21
Ash Recovered (lbs) $\pm$20%	N/D	N/D	3.3	N/D

N/D - Not Determined

* - High CO

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TABLE 4-1. SFTF OPERATING CONDITIONS (continued)

TEST NUMBER	HS-1800-30-2	HS-1800-60-1	HS-2100-30-1*	STP-1500-30-1*
Exhaust Flow, Dry (SCFH)	6706	6526	6370	4390
Exhaust Flow, Wet (SCFH)	7718	7548	7499	5110
Soil Sample Wt. (lbs)	7.25	7	7	10
Kiln Solids T (^oF) High	1777	1712	2158	1626
Kiln Solids T (^oF) Baseline	1750	1704	2130	1521
Afterburner T (^oF) Wall	1929	1850	N/D	1926
Afterburner T (^oF) Centerline	2040	1946	N/D	2016
CTT Exit Temp (^oF)	1542	1470	1746	1533
Kiln Pressure (inches H_2O)	-.19	-.185	-.18	-.09
Kiln Rotation (rev/min)	1	1	1	1
Baseline O_2 (%) Dry	8.6	9.1	7.3	6.0
Main Flame Coloration/min	green/7	green/7	green/7	green/22
Ash Recovered (lbs) $\pm$20%	2.1	2.8	None	N/D

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TABLE 4-1. SFTF OPERATING CONDITIONS (continued)

TEST NUMBER	STP-1500-30-2	STP-1500-60-1	STP-1800-30-1*	STP-1800-30-2*
Exhaust Flow, Dry (SCFH)	6346	5148	4882	6706
Exhaust Flow, Wet (SCFH)	7087	5925	5745	7718
Soil Sample Wt. (lbs)	4.25	7	7	7
Kiln Solids T (^{o}F) High	1551	1562	1786	1830
Kiln Solids T (^{o}F) Baseline	1535	1520	1750	1809
Afterburner T (^{o}F) Wall	1892	1825	2020	1903
Afterburner T (^{o}F) Centerline	1909	1929	2050	2060
CTT Exit Temp (^{o}F)	1492	1472	1640	1614
Kiln Pressure (inches H_2O)	-.19	-.18	-.16	-.19
Kiln Rotation (rev/min)	1	1	1	1
Baseline O_2 (%) Dry	11.25	8.9	6.8	9.6
Main Flame Coloration/min	green/13	green/14	Light Yellow/13	None
Ash Recovered (lbs) $\pm$20%	1.8	3.0	N/D	1.6

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TABLE 4-1. SFTF OPERATING CONDITIONS (continued)

TEST NUMBER	STP-1800-30-3	STP-1800-60-1*	HS-1500-FID	HS-1800-FID
Exhaust Flow, Dry (SCFH)	6096	6142	6246	6706
Exhaust Flow, Wet (SCFH)	7108	7132	7087	7718
Soil Sample Wt. (lbs)	4	7	7	7
Kiln Solids T (^{o}F) High	1784	1823	1526	1722
Kiln Solids T (^{o}F) Baseline	1780	1760	1522	1714
Afterburner T (^{o}F) Wall	1863	1998	N/D	N/D
Afterburner T (^{o}F) Centerline	2053	2034	N/D	N/D
CTT Exit Temp (^{o}F)	1564	1584	1548	1548
Kiln Pressure (inches H_2O)	-.19	-.18	-.19	-.19
Kiln Rotation (rev/min)	1	1	1	1
Baseline O_2 (%) Dry	8.5	8.9	11.5	8.6
Main Flame Coloration/min	None	green/7	green/7	green/6
Ash Recovered (lbs) $\pm$20%	0.9	2.1	N/D	N/D

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TABLE 4-1. SFTF OPERATING CONDITIONS (continued)

TEST NUMBER	STP-1500-FID
Exhaust Flow, Dry (SCFH)	6246
Exhaust Flow, Wet (SCFH)	7087
Soil Sample Wt. (lbs)	3.5
Kiln Solids T (^{o}F) High	1541
Kiln Solids T (^{o}F) Baseline	1525
Afterburner T (^{o}F) Wall	N/D
Afterburner T (^{o}F) Centerline	N/D
CTT Exit Temp (^{o}F)	1548
Kiln Pressure (inches H_2O)	-.19
Kiln Rotation (rev/min)	1
Baseline O_2 (%) Dry	11.5
Main Flame Coloration/min	green/4
Ash Recovered (lbs) $\pm$20%	N/D

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4.2 Operating Conditions and Observations

Operating conditions and observations for tests are presented in Table 4-1. Test HS-1500-30-1 was scratched due to a power failure to instruments and sampling equipment, test HS-2100-30-1 was interrupted at the 12-minute mark by a power failure to the entire system. Strip chart recordings of exhaust gas species are presented in the appendix.

During some tests insufficient oxygen was available to completely combust all organics volatilized from from the soils. Strip charts from these test show periods of very high carbon monoxide (CO emissions and near zero oxygen (O_2) levels in the exhaust gas.

The total hydrocarbons analyzer was not available for all tests. A post-leak in the total hydrocarbons sample system was noted following tests STP-1500-30-2 and STP-1800-30-3. Enough STP sample remained at the conclusion of regular testing to repeat STP-1500-30-2, only THC, CO, NO_x, CO_2 and O_2 were monitored. Tests with the HS sample at 1800°F and 1500°F were also run in this manner. These three tests were labeled STP-1500-FID, HS-1800-FID and HS-1500-FID, respectively. THC strip chart recordings are presented in the appendix.

The main burner gas flame often had some coloration caused by emissions from the soils. Usually a greenish hue was exhibited. This may have been caused by the volatilization of metal species, such as copper. Tests run with samples from the Hot Spot Composite usually displayed more intense colorations for longer durations than Sludge Tank and Pit Composite tests.

Flames were observed emitting from the soils in the barrel during most tests. STP samples usually burned for longer time periods than HS samples, all other factors being equal. Large quantities of smoke and soot were produced during tests which had severe oxygen depletion. Test run with sufficient oxygen for complete combustion did not have noticeable smoke or soot production.

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Ash samples were recovered from the kiln after each test to be analyzed. Residuals from 1500°F tests closely resembled the original samples in both color and grain size, they looked like regular soil. No evidence of glassification was seen. Ash samples taken from 1800°F tests were noticeably lacking in normal soil size granules. The majority of recovered material was small stones, with diameters of 5 mm and larger. It was evident that some glassification of kiln solids had occurred. There was no recovery of solids from test HS-2100-30-1. All material had glassified and slagged to the wall of the kiln. Weights of recovered ash are based upon recovered sample weights and estimating loose solids removed from the kiln barrel during between-test cleaning.

4.3 Results

4.3.1 Treatment Residue Quality

A key residue quality issue is associated with slagging. Materials treated at 2100°F were completely vitrified while 1800°F treatment produced partial slagging. At 1500°F runs the residue remained a dry residue. Thus, the upper temperature limit allowed for dry kilns is between 1500 and 1800°F. The specific level or variability of this temperature limit for different materials from the site were not examined in this study.

Concentrations of PCBs and pesticides in the composite samples and residual ash are presented in Table A-2. The PCBs present in the samples were efficiently removed via thermal treatment at either 1500 or 1800°F for 60 minutes. The initial concentration of Arochlor 1242 in the sludge tank and pits was 15,000,000 µg/kg and was less than 80 µg/kg for all treated residues, except for one sample from test STP-1500-30-2. This one exception suggests that 30 minutes at 1500°F may be a lower time at temperature requirement for the sludge tanks and pits materials. The exception had 120 µg/kg of Arochlor 1242. For the hot spots composite which had 2200 µg/kg of Arochlor 1260, no runs were made, even at 1500°F, which had detectable limits of PCBs (detection limit at 80-160 µg/kg).

Soil and ash leachate concentrations as determined by EP Toxic metals leachability analysis are presented in Table A-5. The leachability of metals from the treated residue were found to be low for all samples. The leachate concentrations were below RCRA standards for all metals for each treated residue at any treatment temperature.

Thus, the low PCB levels and low metal leachability of the treated residue indicates thermal treatment is suitable for cleaning the site materials if the composite samples are representative of the range of materials from the site. Excessively high temperatures (1800°F) must be avoided to prevent slagging and short residence times at lower temperatures (ea. 30 minutes at 1500°F) must be avoided to ensure complete removal of PCBs from the sludge tanks and pits materials.

4.3.2 Destruction Efficiency of PCBs

Destruction and removal efficiencies of PCBs are presented in Table A-6. The afterburner used in this study was operated at nominal conditions of 1800-2050°F. At these conditions, the emissions levels of the principle PCB determined to be in the sample were always below detection limits for all test runs. This corresponds to a demonstrated destruction and removal efficiency of PCB of greater than 7 nines in some cases. For example, for the sludge tanks and pits composite samples the concentration of Arochlor 1242 was always below detectable levels and the demonstrated DRE of Arochlor 1242 ranged from 99.99985 to 99.99999% for individual runs due to differences in sample size, flue gas flow rate and exhaust sample flow rate. For the hot spot composite, the major PCB specie in the sample was Arochlor 1260 which was not detected in the exhaust of the runs. However, because of the relatively low levels of these PCBs in the waste stream, only 98.9 to 99.94% could be demonstrated. In order to demonstrate higher DREs, the sample must be spiked with higher levels of principle PCBs.

There was evidence of monochlorinated and dichlorinated biphenyls in the exhaust of the rotary kiln simulator at detectable levels. However, field blanks had measurable quantities of the species as well which precluded a

complete characterization of emission factors. Nonetheless, it is clear that the production of products of incomplete combustion of lower chlorinated PCBs could be a limitation of thermal treatment systems without an optimized afterburner. Further testing is recommended to examine the afterburner parameters required to achieve 6 nines DRE of the POHC without generating PICs. This afterburner optimization was beyond the scope of the current study.

4.3.3 Fate of Metals

Metals concentrations in soil and residual ash samples are presented in Table A-4. The data can be interpreted to suggest that there is substantial volatilization of certain hazardous metals in the composite samples that accompanies thermal treatment of the materials. In particular, for the sludge tank and pit composite which contains substantial levels of antimony, arsenic, cadmium, chromium, lead and mercury, the control of these emissions of these metals will be important to consider for regulatory compliance. Metal species which are known not to volatilize at these conditions, such as magnesium and aluminum, were found to be concentrated in the treated residues from 135 to 200% over the untreated materials due to losses of moisture, carbon and hydrogen from the samples upon thermal treatment. Species such as arsenic, zinc and barium were somewhat preferentially released from the residue being reduced between 20-70% from levels in the raw samples. Metals such as antimony, cadmium, lead and chromium were found to be highly volatilized from the residue at levels ranging from 80 to 97% reduced from raw samples. Mercury levels were reduced by levels exceeding 98% of the raw samples.

In Table 4-2 are provided data on the expected volatilization temperature of metals for chlorinated and non-chlorinated waste. These analyses compare favorably with the results of this study except for two metals, i.e., arsenic and chromium. Arsenic is expected to be highly volatile at these conditions and was found not be to too volatile. The analysis of arsenic is expected to be in error due to difficulties to duplicate the analysis of the raw samples. The samples are expected to have

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TABLE 4-2. VOLATILITY OF TOXIC METALS

Metal	Volatility Temperature*, °F	Principal Vapor Species	With 10% Chlorine	
			Volatility Temperature*, °F	Principal Vapor Species
Chromium	2940	CrO_2/CrO_3	2930	CrO_2/CrO_3
Nickel	2210	$Ni(OH)_2$	1280	$NiCl_2$
Beryllium	1930	$Be(OH)_2$	1930	$Be(OH)_2$
Silver	1660	Ag	1160	AgCl
Barium	1560	$Ba(OH)_2$	1660	$BaCl_2$
Thallium	1330	Tl_2O_3	280	TlOH
Antimony	1220	Sb_2O_3	1220	Sb_2O_3
Lead	1160	Pb	10	$PbCl_4$
Selenium	610	SeO_2	610	SeO_2
Cadmium	420	Cd	420	Cd
Arsenic	90	As_2O_3	90	As_2O_3
Mercury	60	Hg	60	Hg

*Temperature at which vapor pressure is 1×10^{-6} atm.

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higher levels of arsenic than determined. On the other extreme is chromium, which is not expected to be volatile but is 95-97% removed from the residue.

The chromium may have been present in the composite samples in a volatile form such as an organo-chromium compound. Analyses of incinerator exhaust fly ash (Table A-8) show the fly ash chromium concentration to be highly enriched compared to residual ash from most tests.

Fly ash samples were taken using a Method 5 sampling train (U.S. EPA Method 5) with impinger solutions modified for volatile metals capture. Mass of particulate captured in the probe and on the filter was determined (Table A-7) and then all sampling train components were analyzed for metals.

The incinerator emissions data demonstrated that arsenic, cadmium, chromium, lead and mercury were highly enriched in the fly ash suggesting volatilization of these metals. Antimony, barium, beryllium and silver were either too low to consider or were not enriched in the fly ash. Selenium levels were extraordinarily high in fly ash relative to feed material, likely due to interferences in the analysis.

Table A-8 presents metals emissions per pound of soil incinerated. This data is a means of comparing results from tests which had different soil charge sizes and particulate emissions. Any inaccuracies in analysis or bias in sampling are magnified when a small sample is expanded to represent a total emission, especially for tests of short duration, such as these batch mode studies. These values are useful on a comparison basis, however application of this data to a detailed system metals mass balance is not recommended.

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Thus, from both the analysis of the treated residue and enrichment in the fly ash, it is clear that

- Arsenic
- Cadmium
- Chromium
- Lead
- Mercury

emissions are of concern due to high volatility and concentrations. The emission levels of concern can be indicated by considering a hypothetical transportable facility burning 10,000 lbs/hr in a rural non-complex terrain with a 10-meter stack. The emissions factors dictated by EPA omnibus guidance for these metals are provided in Table 4-3. Assuming complete volatilization of these metals, the control efficiency required for these metals for this hypothetical facility are also provided in Table 4-3.

The required removal efficiencies for metals of consideration are quite high, especially for chromium. Further testing is necessary to determine why chromium, normally a non-volatile metal, has such high volatility when these soil samples are incinerated. The efficiencies of commonly available APCDs for toxic metals are listed in Table 4-4. When considering which APCD or APCDs train will be required for emissions control, it must be stressed that listed efficiencies are very conservative. It is expected that they can produce higher removal efficiencies.

4.3.4 Hydrochloric Acid Emissions

Combustion of PCBs is accompanied by the release of chlorine. Analyses of flue gas samples show that significant amounts of this chlorine is converted to hydrochloric acid (Table A-7), as much as .026 pound of HCl was produced per pound of STP soil incinerated. Some type of acid gas air pollution control, such as a spray dryer, will be required. For the hypothetical incinerator previously considered, emissions of 0.37 lb/hr HCl

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TABLE 4-3. EMISSION LIMITS AND REMOVAL EFFICIENCIES REQUIRED FOR VOLATILE METALS FOR HYPOTHETICAL INCINERATOR

Metal	Emission Limit (gm/sec)*	Required Removal Efficiency for Sludge Tank & Pit Composite
Arsenic	.0001	99.0%
Cadmium	.0002	99.7%
Chromium	.00004	99.999%
Lead	.004	99.97%
Mercury	.09	None

*For incinerator located in rural non-complex terrain with 10 m stack

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TABLE 4-4

Air Pollution Control Devices (APCDs) and Their Conservatively Estimated Efficiencies for Controlling Toxic Metals

APCD	POLLUTANT				
	Ba, Be	Ag	Cr	As, Sb, Cd, Pb, Tl	Hg
*WS	50	50	50	40	30
*VS-20	90	90	90	85	60
*VS-60	98	98	98	97	90
ESP-1	95	95	95	80	10
ESP-2	97	97	97	85	10
ESP-4	99	99	99	90	10
*WESP	97	97	96	95	60
*FF	95	95	95	90	50
*PS	95	95	95	95	80
SD/FF; SD/C/FF	99	99	99	95	90
DS/FF	98	98	98	98	90
*FF/WS	95	95	95	90	50
ESP-1/WS; ESP-1/PS	96	96	96	90	80
ESP-4/WS; ESP-4/PS	99	99	99	95	85
*VS-20/WS	97	97	97	96	80
**WS/IWS	95	95	95	95	85
*WESP/VS-20/IWS	99	99	98	97	90
C/DS/ESP/FF; C/DS/C/ESP/FF	99	99	99	99	98
SD/C/ESP-1	99	99	98	95	85

* It is assumed that flue gases have been precooled in a quench. If gases are not cooled adequately, mercury recoveries will diminish, as will cadmium and arsenic to a lesser extent.
** An IWS is nearly always used with an upstream quench and packed horizontal scrubber.

C = Cyclone
WS = Wet Scrubber including: Sieve Tray Tower
Packed Tower
Bubble Cap Tower
PS = Proprietary Wet Scrubber Design
(A number of proprietary wet scrubbers have come on the market in recent years that are highly efficient on both particulates and corrosive gases. Two such units are offered by Calvert Environmental Equipment Co. and by Hydro-Sonic Systems, Inc.).
VS-20 = Venturi Scrubber, ca. 20-30 in W. G. Δp
VS-60 = Venturi Scrubber, ca. > 60 in W. G. Δp
ESP-1 = Electrostatic Precipitator; 1 stage
ESP-2 = Electrostatic Precipitator; 2 stages
ESP-4 = Electrostatic Precipitator; 4 stages
IWS = Ionizing Wet Scrubber
DS = Dry Scrubber
FF = Fabric Filter (Baghouse)
SD = Spray Dryer (Wet/Dry Scrubber)

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are allowed. If all the chlorine in STP soil PCBs is converted to HCl, a removal efficiency of 99.4% would be necessary.

4.4 Conclusions

Based upon the results of these feasibility tests of thermal treatment for materials from the SCP/Carlsdadt site, it is fully expected that a thermal treatment process could be developed which could successfully treat the materials in a manner consistent with environmental regulations. High DREs of POHCs have been demonstrated. Residual ashes have non-detectable PCB concentrations and metals leachability levels well below RCRA standards. However, a number of design issues and concerns must be resolved before an optimized cost effective thermal treatment technology can be specified. These include the following:

- The control of emissions of products of incomplete combustion, specifically mono and dichlorinated biphenyls, will require more careful evaluation and design of afterburners than the one used in this study.

- Slagging of materials at high temperatures (1800°F) can occur and can result in operational difficulties if the thermal treatment system is not designed properly.

- High efficiency acid gas control will be required.

- High efficiency fine particle control will be required due to the high concentration and volatility of many of the metals in the composites associated with the sludge tanks and pits.

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TABLE A4. SOIL AND ASH METALS CONCENTRATIONS

Analyte	Metal Concentration (mg/Kg)					
	Hot Spot Composite Sample		Sludge Tank and Pit Composite Sample		Ash From HS-1500-30-1	
Aluminum	5390		4150		4620	
Antimony	11	BN	75	N	<8.3	N
Arsenic	13	ND	8.4	ND	18.0	BN
Barium	145		1420		27.3	B
Beryllium	.34	B	<.410		<.23	
Cadmium	3.6		59		<.76	N
Calcium	52100	D	37500	D	14800	
Chromium	23		2050		12.3	
Cobalt	4.9	B	7.2	B	4.3	B
Copper	18500	D	1750	D	5970	D
Iron	13200		18400		8370	
Lead	122		9710		6.2	
Magnesium	5630	E	3460	E	3760	E
Manganese	210		178		130	ND
Mercury	1.6	N	5.1	N	<.10	
Nickel	14		26		<6.8	
Potassium	<12200		<1620		<940	D
Selenium	<1.70	EN	<4.6	N	<2.7	WN
Silver	<1.40		<1.8		<1.1	
Sodium	1000	B	1990		609	B
Thallium	5.0	N	4.7	N	<.34	
Vanadium	14		19		16.9	
Zinc	147		1190		49.4	D

TABLE A4. SOIL AND ASH METALS CONCENTRATIONS (CONTINUED)

Analyte	Metal Concentration (mg/Kg)					
	HS-1500-30-2		HS-1500-60-1		HS-1800-30-1	
Aluminum	6440		6120		6110	
Antimony	<8.2	N	<8.3	N	<8.6	N
Arsenic	39.7	N	37.4	N	35.2	N
Barium	94.3		139		71.7	
Beryllium	.31	B	<.23		<.24	
Cadmium	1.3	N	<.77	N	<.80	N
Calcium	45600		31200		33900	
Chromium	27.9		102		36.3	
Cobalt	6.3	B	5.3	B	4.2	B
Copper	20100	D	20500	D	6660	D
Iron	15200		12300		6000	
Lead	8.6		46.7	D	34.9	
Magnesium	6500	E	5530	E	4780	E
Manganese	283	ND	196	ND	103	ND
Mercury	<.10		<.10		<.10	
Nickel	12.5		8.6		<7.1	
Potassium	1890	D	<945	D	2470	D
Selenium	<2.8	WN	<2.7	WN	<2.7	WN
Silver	<1.0		<1.1		<1.1	
Sodium	1550		1160		1180	
Thallium	<.35		<.34		<.34	W
Vanadium	16.8		16.0		11.4	
Zinc	97.1	D	95.4	D	33.8	D

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TABLE A4. SOIL AND ASH METALS CONCENTRATIONS (CONTINUED)

Analyte	Metal Concentration (mg/Kg)					
	HS-1800-30-2		HS-1800-60-1		STP-1500-30-1	
Aluminum	5580		5750		8330	
Antimony	<8.1	N	<8.6	N	12.7	N
Arsenic	9.7	BN	<8.9	N	9.1	BN
Barium	24.5	B	34.0	B	2330	
Beryllium	<.22		<.24		.29	B
Cadmium	<.75	N	<.79	N	8.3	N
Calcium	20500		41800		28800	
Chromium	8.9		12.9		176	
Cobalt	2.8	B	3.0	B	5.1	B
Copper	1800	D	2890	D	3200	D
Iron	4320		4710		5920	
Lead	19.2		10.3		402	D
Magnesium	2880	E	5610	E	3420	E
Manganese	101	ND	155	ND	105	ND
Mercury	<.10		<.10		<.10	
Nickel	<6.6		<7.0		11.6	
Potassium	2040	D	1800	D	<929	D
Selenium	<1.4	EN	<1.3	WN	<1.4	WN
Silver	<1.0		<1.1		<1.0	
Sodium	1060		985	B	1260	
Thallium	<.35		<.35		<.35	
Vanadium	11.0		11.3		24.3	
Zinc	31.9	D	57.4	D	467	D

TABLE A4. SOIL AND ASH METALS CONCENTRATIONS (CONTINUED)

Analyte	Metal Concentration (mg/Kg)					
	STP-1500-30-2		STP-1500-60-1		STP-1800-30-1	
Aluminum	6350		6280		14400	
Antimony	8.6	BN	8.6	BN	<8.2	N
Arsenic	4.8	N	5.9	N	8.5	BN
Barium	727		356		1060	
Beryllium	<.23		<.24		.68	B
Cadmium	1.0	N	2.5	N	<.76	N
Calcium	39200		37400		60900	
Chromium	72.0		73.8		59.6	
Cobalt	4.1	B	4.0	B	7.7	B
Copper	595	D	1810	D	276	D
Iron	6670		5800		9950	
Lead	296	D	300	D	59.9	D
Magnesium	4960	E	5570	E	7000	E
Manganese	230	ND	551	ND	116	ND
Mercury	<.10		<.10		<.10	
Nickel	12.4		7.1	B	23.4	
Potassium	<936	D	<964	D	<938	D
Selenium	<2.7	N	<.28	WN	<1.4	WN
Silver	<1.0		<1.1		<1.0	
Sodium	743	B	793	B	728	B
Thallium	<.35		<.36		<.36	
Vanadium	14.1		16.7		20.2	
Zinc	261	D	188	D	52.1	D

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TABLE A4. SOIL AND ASH METALS CONCENTRATIONS

Analyte	Metal Concentration (mg/Kg)					
	STP-1800-30-2		STP-1800-30-3	STP-1800-60-1		
Aluminum	7410			6980		
Antimony	9.0	BN		<8.6	N	
Arsenic	10.0	N	LAR	3.5		
Barium	432			683		
Beryllium	.34	B		<.24		
Cadmium	2.1	N		<.80	N	
Calcium	87500			39800		
Chromium	56.4			95.8		
Cobalt	3.4	B		4.5	B	
Copper	459	D		527	D	
Iron	6180			5010		
Lead	108	D		126	D	
Magnesium	25000	E		6930	E	
Manganese	999	ND		127	ND	
Mercury	<.10			<.10		
Nickel	<6.9			18.1		
Potassium	<954	D		1080	D	
Selenium	<1.4	WN		<1.4	WN	
Silver	<1.1			<1.1		
Sodium	1140			946	B	
Thallium	<.36			<.36		
Vanadium	11.3			14.0		
Zinc	1060	D		84.9	D	

LAR - no analyses due to low ash recovery

TABLE A5. SOIL AND ASH LEACHATE CONCENTRATIONS

Analyte	Leachate Concentration (μg/liter)					
	Hot Spot Composite Sample		Sludge Tank and Pit Composite Sample		Ash From HS-1500-30-1	
Aluminum	502		472		28800	
Antimony	<43		<43		48.2	B
Arsenic	14		2.7	B	57.9	N
Barium	98	B	324		296	
Beryllium	<1.2		<1.2		1.6	B
Cadmium	4.9	B	28		<4.0	
Calcium	88500	B	175000		567000	
Chromium	<6.3		462		14.0	
Cobalt	<5.1		7.3	B	8.2	B
Copper	1520		242		23100	
Iron	782		1210		5900	
Lead	13		497		9.5	
Magnesium	4520	B	12500	E	70900	
Manganese	190		421		604	
Mercury	<.20		<.20		<.209	
Nickel	<35		<35		<35	
Potassium	<4910		<4910		<4910	
Selenium	<14	N	<14	EN	<7.0	EN
Silver	<5.5		<5.5		<5.5	
Sodium	12800		42800		<2950	
Thallium	<1.8		<1.8		<1.8	W
Vanadium	<4.4		<4.4		37.6	B
Zinc	97	ND	432	ND	649	

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TABLE A5. SOIL AND ASH LEACHATE CONCENTRATIONS (CONTINUED)

Analyte	Leachate Concentration (μg/liter)					
	HS-1500-30-2		HS-1500-60-1		HS-1800-30-1	
Aluminum	<30.9		653		58.6	B
Antimony	49.0	B	54.2	B	45.0	B
Arsenic	31.0	BN	19.0	W	<2.4	WN
Barium	511		295		452	
Beryllium	<1.2		<1.2		<1.2	
Cadmium	<4.0		<4.4	B	<4.0	
Calcium	1650000		948000		700000	
Chromium	35.6		13.0		132	
Cobalt	<5.1		12.8	B	<5.1	
Copper	11.3	B	29500		9.4	B
Iron	6.5	B	96.1	B	5.5	B
Lead	1.7	BE	5.8		<.40	W
Magnesium	176000		169000		2450	B
Manganese	10.0	B	593		1.5	B
Mercury	<.20		<.20		<.20	
Nickel	<35.3		36.8	B	<35.3	
Potassium	<49.0		<4910		<4910	
Selenium	<7.0	EN	<7.0	EN	<7.0	EN
Silver	<5.5		<5.5		<5.5	
Sodium	6360		3160	B	6620	
Thallium	<1.8	W	<1.8	W	<1.8	
Vanadium	38.3	B	46.1	B	9.6	B
Zinc	<1.7		845		73.8	

TABLE A5. SOIL AND ASH LEACHATE CONCENTRATIONS (CONCENTRATION)

Analyte	Leachate Concentration (μg/liter)					
	HS-1800-30-2		HS-1800-60-1		HS-1500-30-1	
Aluminum	12800		48600		13100	
Antimony	<43.2		<43.2		74.1	
Arsenic	13.9	N	251		<12.0	WN
Barium	613		866		810	
Beryllium	1.6	B	6.2		2.7	B
Cadmium	<4.0		<4.0		7.8	
Calcium	502000		631000		1080000	
Chromium	36.2		42.8		581	
Cobalt	12.2	B	28.5	B	27.3	B
Copper	8100		106000		10500	
Iron	2680		21500		2830	
Lead	28.0		71.0		96.8	
Magnesium	46200		56100		147000	
Manganese	509		868		687	
Mercury	<.20		<.20		<.20	
Nickel	<35.3		<35.3		75.1	
Potassium	<4910		<4910		<4910	
Selenium	18.9	BEN	<7.0	EN	<7.0	EN
Silver	<5.5		<5.5		<5.5	
Sodium	5690		9140		7820	
Thallium	<1.8		<1.8	W	<1.8	W
Vanadium	19.4	B	115		35.7	B
Zinc	480		768		4190	

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TABLE A5. SOIL AND ASH LEACHATE CONCENTRATIONS (CONTINUED)

Analyte	Leachate Concentration (μg/liter)					
	STP-1500-30-2		STP-1500-60-1		STP-1800-30-1	
Aluminum	52.3	B	96.6	B	58.4	B
Antimony	51.2	B	61.2		45.0	B
Arsenic	<2.4	WN	<2.4	WN	<2.4	WN
Barium	1140		809		452	
Beryllium	<1.2		<1.2		<1.2	
Cadmium	<4.0		<4.0		<4.0	
Calcium	229000		1830000		700000	
Chromium	268		577		132	
Cobalt	12.7	B	<5.1		<5.1	
Copper	<1.6		5.7	B	9.4	B
Iron	<3.5		<3.5		5.5	B
Lead	2.80	BW	<.40	W	<.40	W
Magnesium	4710	B	4410	B	2450	B
Manganese	3.6	B	<1.3	B	1.5	B
Mercury	<.20		<.20		<.20	
Nickel	<35.3		<35.3		<35.3	
Potassium	<4910		<4910		<4910	
Selenium	<7.0	EN	<7.0	EN	<7.0	EN
Silver	<5.5		<5.5		<5.5	
Sodium	10800		6010		6620	
Thallium	<1.8	W	<1.8	W	<1.8	
Vanadium	16.9	B	<10.0	B	9.6	B
Zinc	30.5		<18.7	B	73.8	

TABLE A5. SOIL AND ASH LEACHATE CONCENTRATIONS (CONTINUED)

Analyte	Leachate Concentration (μg/liter)					
	STP-1800-30-2		STP-1800-30-3		STP-1800-60-1	
Aluminum	282		1810		512	
Antimony	<43.2		44.6	B	59.0	B
Arsenic	8.0	BN	<2.4	WN	<2.4	WN
Barium	434		721		509	
Beryllium	<1.2		<1.2		<1.2	
Cadmium	<4.0		<4.0		<4.0	
Calcium	972000		942000		982000	
Chromium	56.5		110		315	
Cobalt	6.8	B	6.3	B	<5.1	
Copper	12.5	B	10.7	B	148	
Iron	16.5	B	6.8	B	34.1	B
Lead	<.40		<.40		<.40	
Magnesium	3110	B	2860	B	2970	B
Manganese	2.6	B	2.1	B	4.0	B
Mercury	<.20		<.20		<.20	
Nickel	<35.3		<35.3		<35.3	
Potassium	<4910		<4910		<4910	
Selenium	<7.0	EN	<7.0	EN	<7.0	EN
Silver	<5.5		<5.5		<5.5	
Sodium	5690		15100		5180	
Thallium	<1.8	W	<1.8	W	<1.8	W
Vanadium	31.4	B	23.3	B	19.9	B
Zinc	13.7	B	20.2		15.3	B

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TABLE A6. PCBs DESTRUCTION AND REMOVAL EFFICIENCIES

Test No.	DRE of Arochlor 1242	DRE of Arochlor 1260
HS-1500-30-2*	Chemical Interference - Unable to Analyze	
HS-1500-60-1	--	>.9987
HS-1800-30-1	Chemical Interference - Unable to Analyze	
HS-1800-30-2	--	>.9994
HS-1800-60-1	--	>.998
HS-2100-30-1*	--	>.989
STP-1500-30-1*	Sample System Failure	
STP-1500-30-2	>.9999999	--
STP-1500-60-1	>.9999994	--
STP-1800-30-1*	Chemical Interference - Unable to Analyze	
STP-1800-30-2*	>.9999995	--
STP-1800-30-3	>.9999997	--
STP-1800-60-1*	>.9999985	--

*High CO

TABLE A7. PARTICULATE AND HCl EMISSIONS

Test No.	Particulate gr/lb of Incinerated Soil	HCl lb/lb of Incinerated Soil
HS-1500-30-2*	4.5	.00029
HS-1500-60-1	4.5	.0020
HS-1800-30-1	6.0	.013
HS-1800-30-2	4.3	.0059
HS-1800-60-1	3.7	.0045
HS-2100-30-1*	4.2	.0037
STP-1500-30-1*	9.0	.024
STP-1500-30-2	4.8	.0092
STP-1500-60-1	13.1	.0105
STP-1800-30-1*	Probe Plugged	.026
STP-1800-30-2*	8.1	.023
STP-1800-30-3	9.3	.0049
STP-1800-60-1*	27.4	.012

*High CO

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TABLE A8. METALS IN INCINERATOR EXHAUST

METAL	Test Number HS-1500-30-2* mg/Kg of Flyash	HS-1500-30-2* mg/lb Soil Incinerated		HS-1500-60-1 mg/Kg of Flyash	HS-1500-60-1 mg/lb Soil Incinerated		HS-1800-30-1* mg/Kg of Flyash	HS-1800-30-1* mg/lb Soil Incinerated	
Aluminum	14589	65.4		11424	51.1		2015	12.2	
Antimony	<62	<.28		<69	<.31		91	<.55	
Arsenic	53500	240		44300	198		57800	348	
Barium	268	1.2	B	164	.74	B	98	.590	B
Beryllium	22	.098	B	1.6	.0070	B	11	.066	B
Cadmium	207	.93		377	1.7		254	1.5	
Calcium	22924	102.7		22642	101.2		5982	36.0	B
Chromium	567	2.5		2770	12.3		11116	66.9	
Cobalt	20	.091		63	.28	B	107	.64	B
Copper	75268	337.2		65587	293.3		41790	251.6	
Iron	15446	69.2		22849	102.2		48706	293.2	
Lead	3670	16.5		26700	119.2		11100	66.7	
Magnesium	2623	11.8		2567	11.5	B	725	4.3	B
Manganese	406	1.8		926	4.1		10734	64.6	
Mercury	52	.23		112	.50		5.6	.033	
Nickel	1436	6.4		4559	20.4		5464	32.9	
Potassium	14344	64.3	B	15726	70.3	B	22317	134.3	B
Selenium	5413	24.3		3649	16.3		25964	156.3	+
Silver	15	.066	B	17	.077		21	.13	
Sodium	44397	199.0		71403	319.3		66099	397.9	
Thallium	3705	16.6		4032	18.0		2762	16.6	B
Vanadium	28	.12	B	41	.18	B	34	.20	B
Zinc	37701	168.9		37714	168.6		45906	276.4	

*High CO

TABLE A8. METALS IN INCINERATOR EXHAUST (continued)

METAL	Test Number HS-1800-30-2 mg/Kg of Flyash	HS-1800-30-2 mg/lb Soil Incinerated		HS-1800-60-1 mg/Kg of Flyash	HS-1800-60-1 mg/lb Soil Incinerated		HS-2100-30-1* mg/Kg of Flyash	HS-2100-30-1* mg/lb Soil Incinerated	
Aluminum	3394	14.6		7088	21.3		2260	9.6	
Antimony	92	.39		90	.33		<77	<.33	
Arsenic	20400	87.3		68200	254		20000	841	
Barium	111	.48	B	137	.51	B	39	1.63	B
Beryllium	1.5	.0065	B	2.0	.0070	B	2.4	.01	
Cadmium	99	.42		337	1.3		358	1.5	
Calcium	6704	28.8	B	14694	154.8	B	5629	23.8	B
Chromium	24600	105.5		6320	23.6		9880	41.9	
Cobalt	121	.52		114	.42	B	153	.65	B
Copper	13780	59.1		73966	275.8		53452	226.4	
Iron	83502	358.2		54939	204.8		60413	255.9	
Lead	34200	147.5		19700	73.5		5757	24.4	
Magnesium	1025	4.4	B	1952	7.3	B	726	3.1	B
Manganese	1230	5.3		1046	3.9		1891	8.0	
Mercury	14	.06		211	.78		66	.28	
Nickel	7410	31.8		5011	18.7		890	37.7	
Potassium	4088	17.6	B	1108	4.1	B	25480	108.0	B
Selenium	2315	9.93		3287	12.3		10189	43.2	S
Silver	10	.044	B	22	.082		7.8	.023	
Sodium	32154	137.9		63008	234.9		110428	467.7	
Thallium	1636	7.0	B	4537	16.9		3229	13.7	
Vanadium	84	.36	B	41	.15	B	38	.16	B
Zinc	10766	46.2		51004	190.2		49628	210.2	

*High CO

0028044

TABLE A8. METALS IN INCINERATOR EXHAUST (continued)

METAL	Test Number STP-1500-30-1* mg/Kg of Flyash	STP-1500-30-1* mg/lb Soil Incinerated	STP-1500-30-2 mg/Kg of Flyash	STP-1500-30-2 mg/lb Soil Incinerated	STP-1500-60-1 mg/Kg of Flyash	STP-1500-60-1 mg/lb Soil Incinerated
Aluminum	1516	13.7	5993	28.8	17632	230.7
Antimony	218	1.97	<59	<.28	67	.88 B
Arsenic	21500	194.5	6235	29.9	16200	212
Barium	132	1.19 B	304	1.5 B	1192	15.6 B
Beryllium	<1.0	<.0038	<1.3	<.0061	<1	.0011B
Cadmium	658	5.9	266	1.3	342	4.5
Calcium	3393	30.6 B	17403	83.5	18607	243.5
Chromium	186	1.7	25500	121.8	5835	76.4
Cobalt	9	.077 B	201	.96	60	.78 B
Copper	21420	193.4	10642	51.1	10683	139.8
Iron	4910	44.3	107000	513.5	24619	322.2
Lead	87700	792	42100	202.2	34300	448.9
Magnesium	385	3.5 B	2565	12.3 B	1459	19.1 B
Manganese	114	10.3	2061	9.9	685	8.9
Mercury	66	0.60	41	.20	94	1.2
Nickel	239	2.16	11484	55.1	3721	48.7
Potassium	8363	75.5 B	3515	16.9 B	4911	64.3 B
Selenium	28760	259.7 EN	358	1.7 +	5114	66.9 +
Silver	8	.073 B	24	.127	4.0	.053 B
Sodium	25752	232.5	46537	223.4	20252	165.0
Thallium	1132	10.2	963	4.6	1458	19.1
Vanadium	4	.037 B	79	.39 B	36	.48 B
Zinc	3470	31.3	27870	133.8	4291	56.2

*High CO

002805A

TABLE A8. METALS IN INCINERATOR EXHAUST

METAL	Test Number STP-1800-30-2* mg/Kg of Flyash	STP-1800-30-2* mg/lb Soil Incinerated	STP-1800-30-3 mg/Kg of Flyash	STP-1800-30-3 mg/lb Soil Incinerated	STP-1800-60* mg/Kg of Flyash	STP-1800-60* mg/lb Soil Incinerated
Aluminum	1151	9.4	48014	446.5	16455	450.6
Antimony	291	2.48	119	7.1	62	1.7
Arsenic	62200	506	16500	153	17300	475
Barium	65	.53 B	72	.67 B	65	1.80
Beryllium	1.3	.01	2.7	.026	<1	.0082
Cadmium	814	6.6	312	2.9	262	7.2
Calcium	3813	31.0 B	3859	35.9	1022	275.1
Chromium	4232	35.5	23253	216	2421	66.3
Cobalt	92	.751	359	3.3	22	.60
Copper	38434	313.0	17723	164.8	5672	155.3
Iron	33249	270.7	135610	1261.2	8722	238.9
Lead	95800	780	40780	379	32100	879
Magnesium	416	3.4 B	597	5.5 B	385	10.6 B
Manganese	1007	8.2	3996	37.2	242	6.6
Mercury	29	.23	107	1.0	7.6	.21
Nickel	5313	43.3	21612	200.1	1190	32.6
Potassium	17833	145.2	10064	93.6	4676	128.0
Selenium	17228	140	5806	54.0	5869	160.6
Silver	8.8	.07 B	14	.13 B	2.7	.073
Sodium	89051	725.1	63917	594.4	18916	518.0
Thallium	1515	12.3	2111	19.6	643	17.6
Vanadium	22	.18	66	.62	16	.44 B
Zinc	13951	113.6	26648	242.1	7458	204.2

*High CO

CONTINUOUS EMISSIONS MONITORING SYSTEM STRIP CHARTS

O_2 - 25% full scale, .25%/division

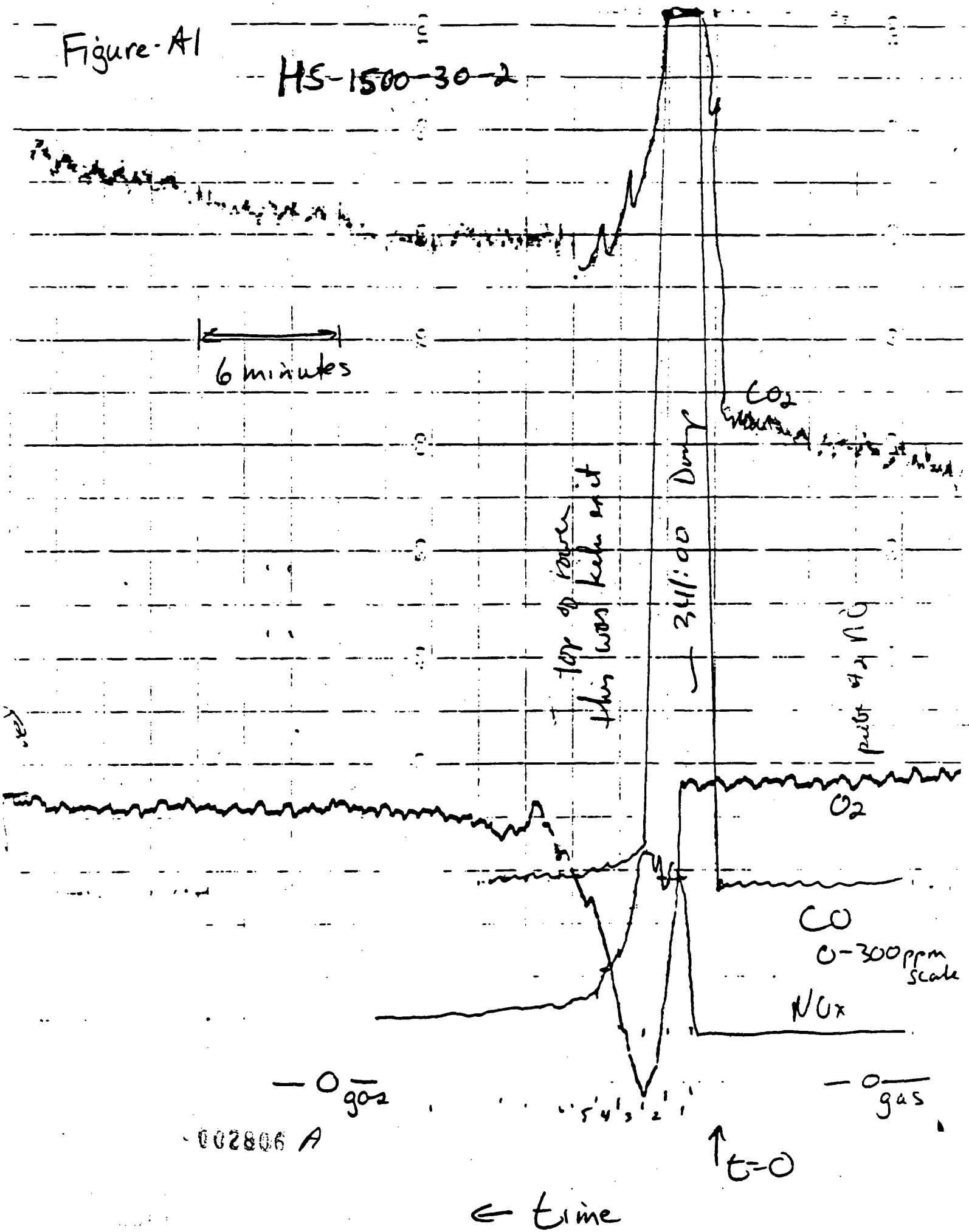
CO_2 - 20% full scale, .20%/division

NO_x - 1000 ppm full scale, 10 ppm/division

CO - Variable scale, noted on charts

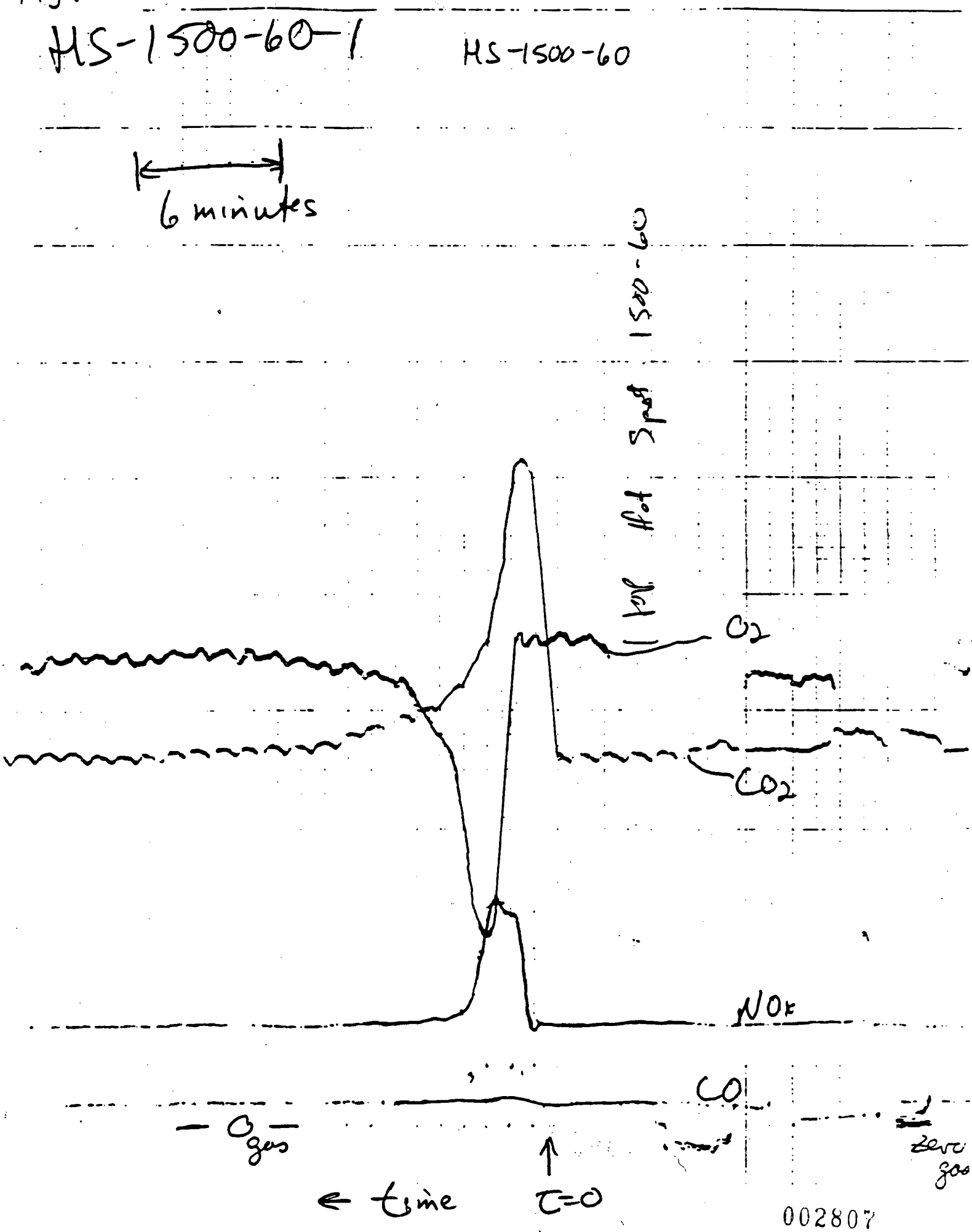
Figure-A1

HS-1500-30-2



002806 A

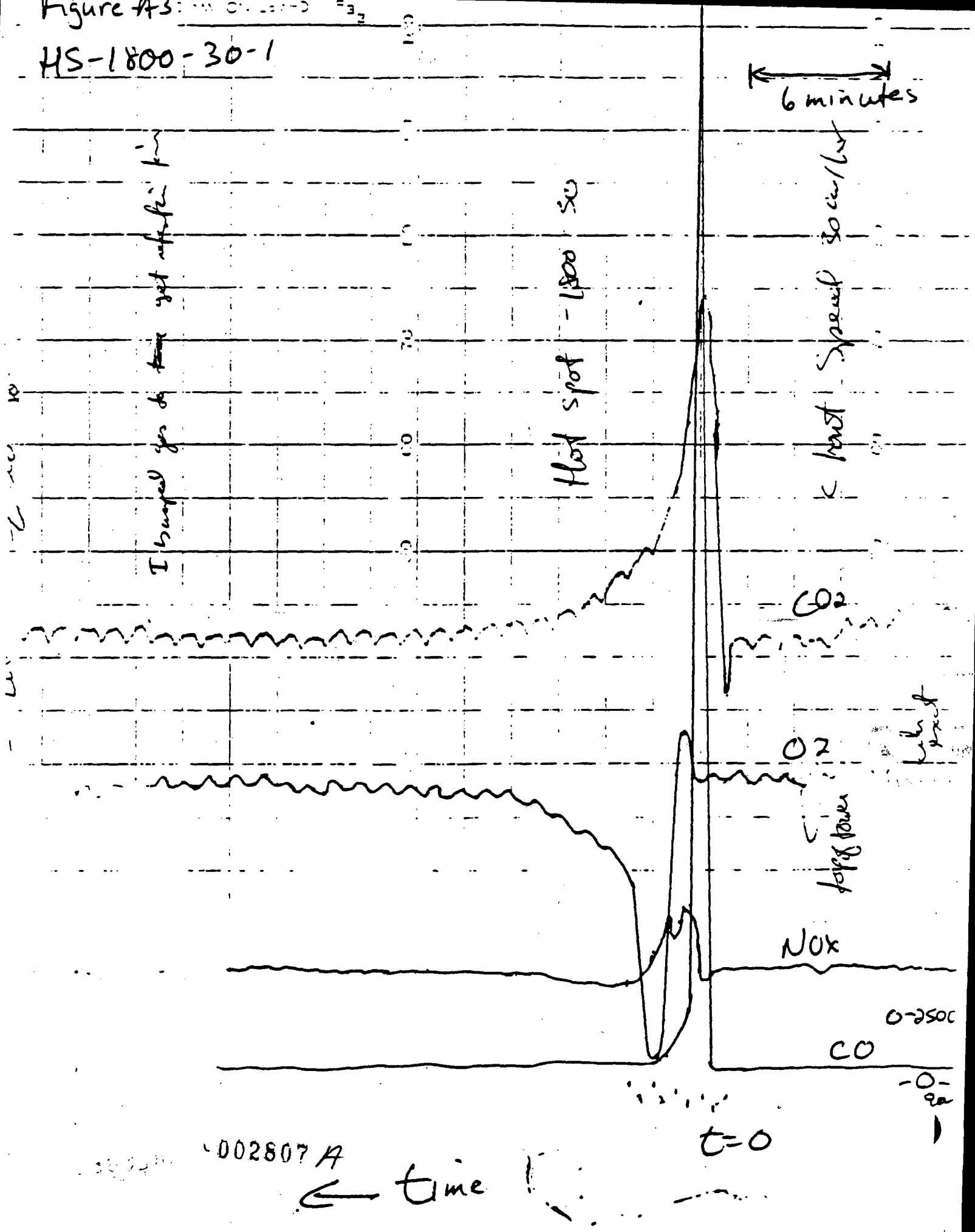
Figure-A2



002807

Figure #3:

HS-1800-30-1



002807 A

Figure-A4

HS-1800-30-2

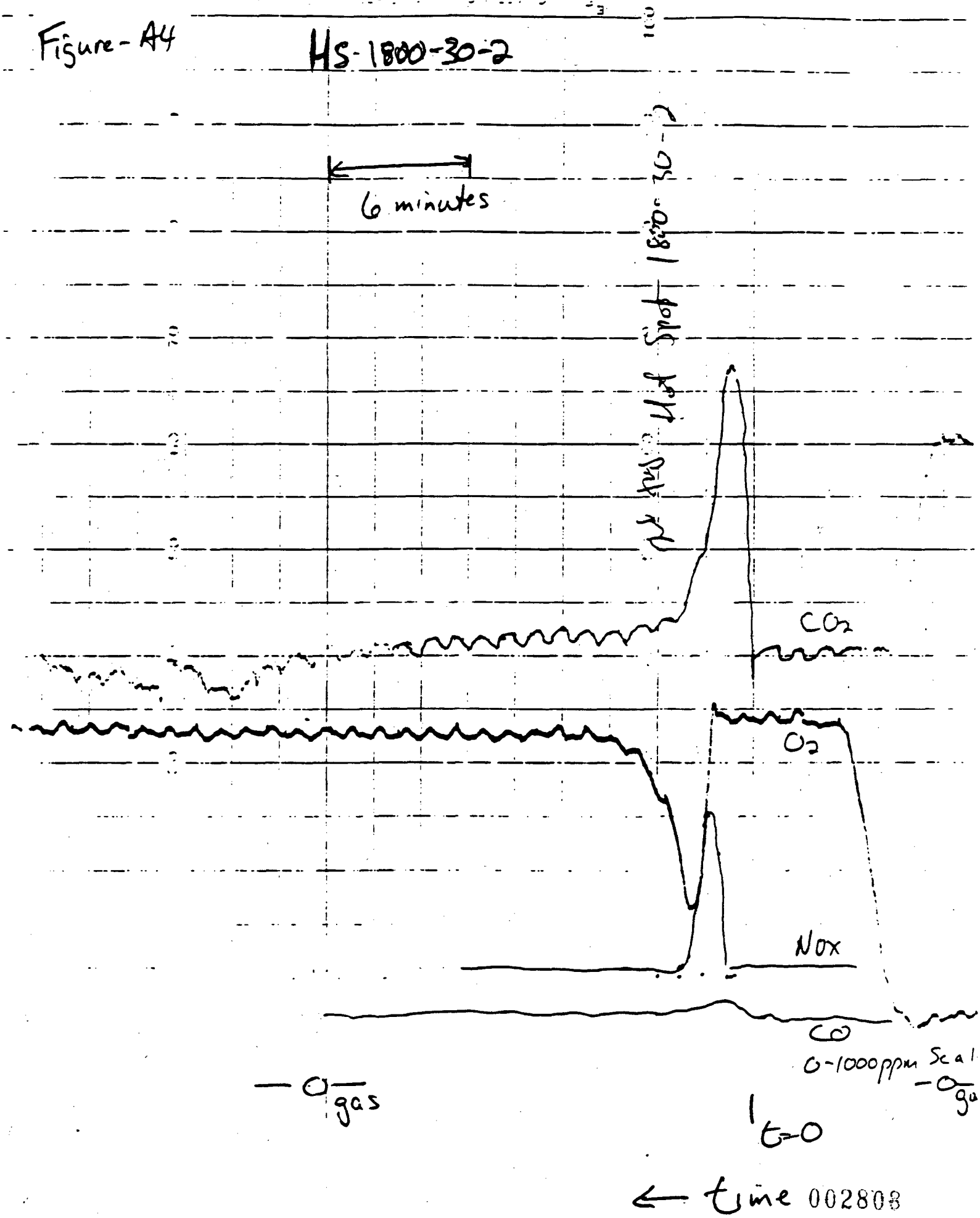


Figure A5

HS-1800-60-1

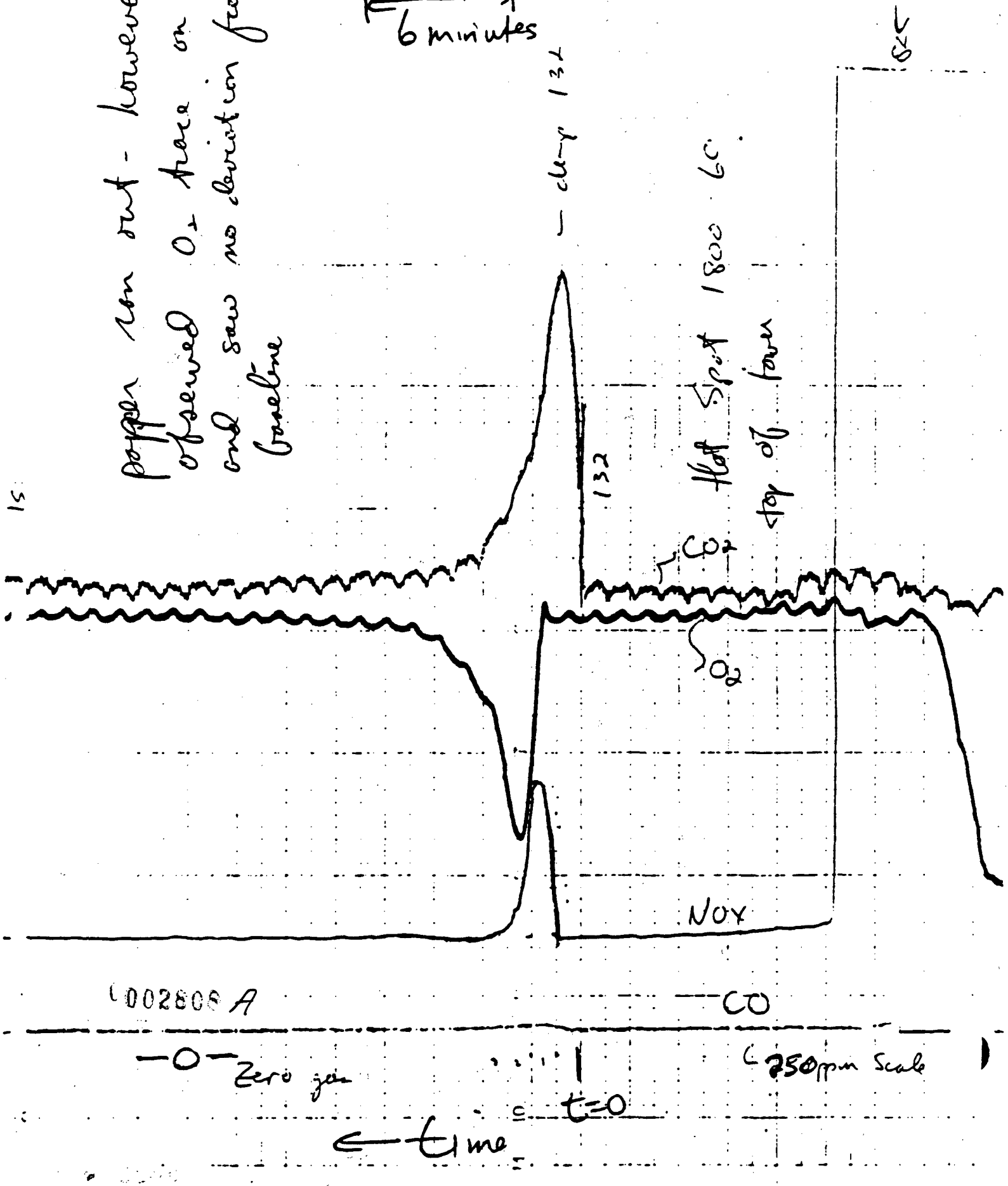
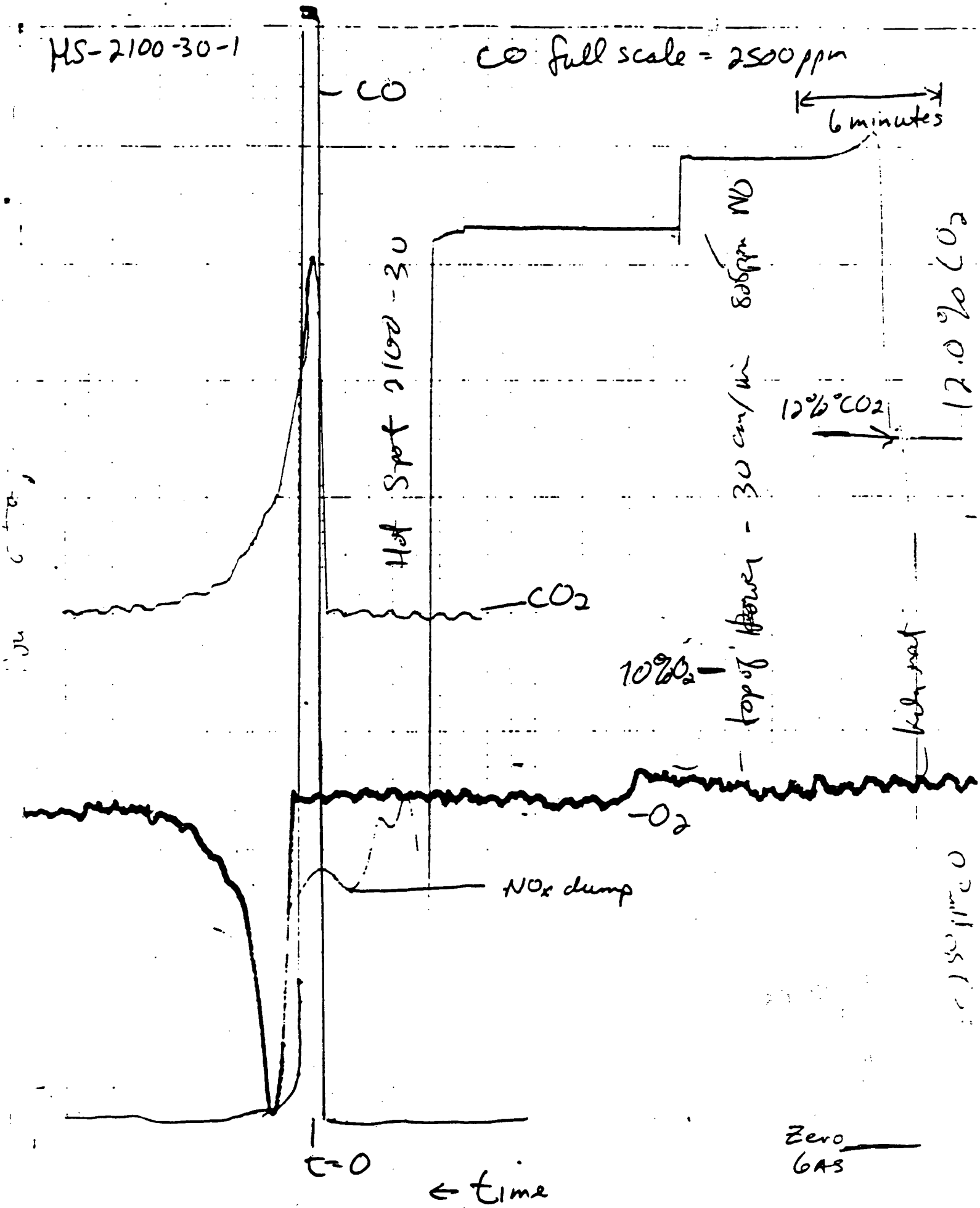


Figure 110


HS-2100-30-1
CO full scale = 2500 ppm
CO
6 minutes
Hot Spot 2100-30
800 ppm NO
12.0 % CO2
12% CO2
CO2
10% O2
top of burner - 30 cm/in
O2
NOx dump
Zero GAS
t=0
← time

Figure

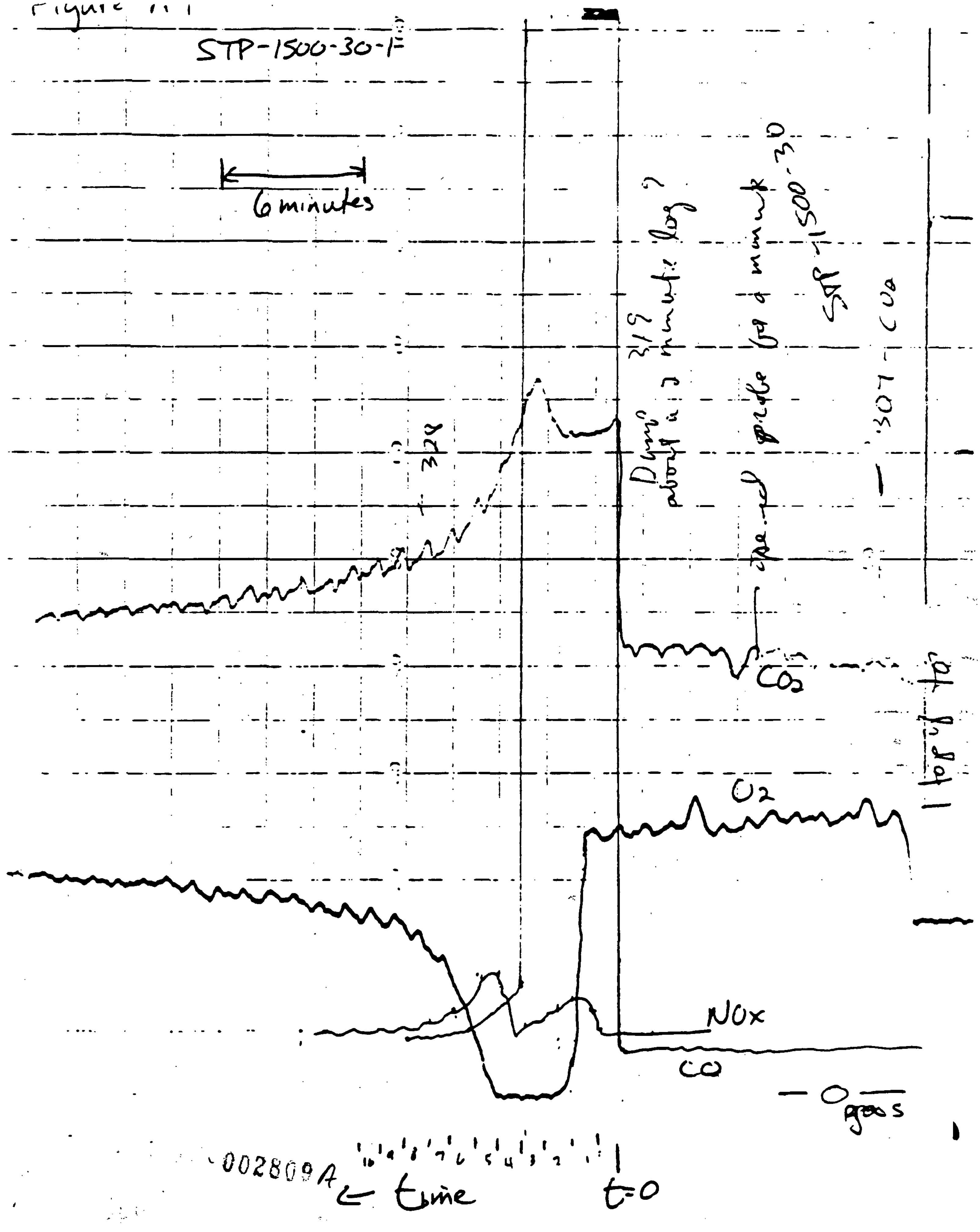
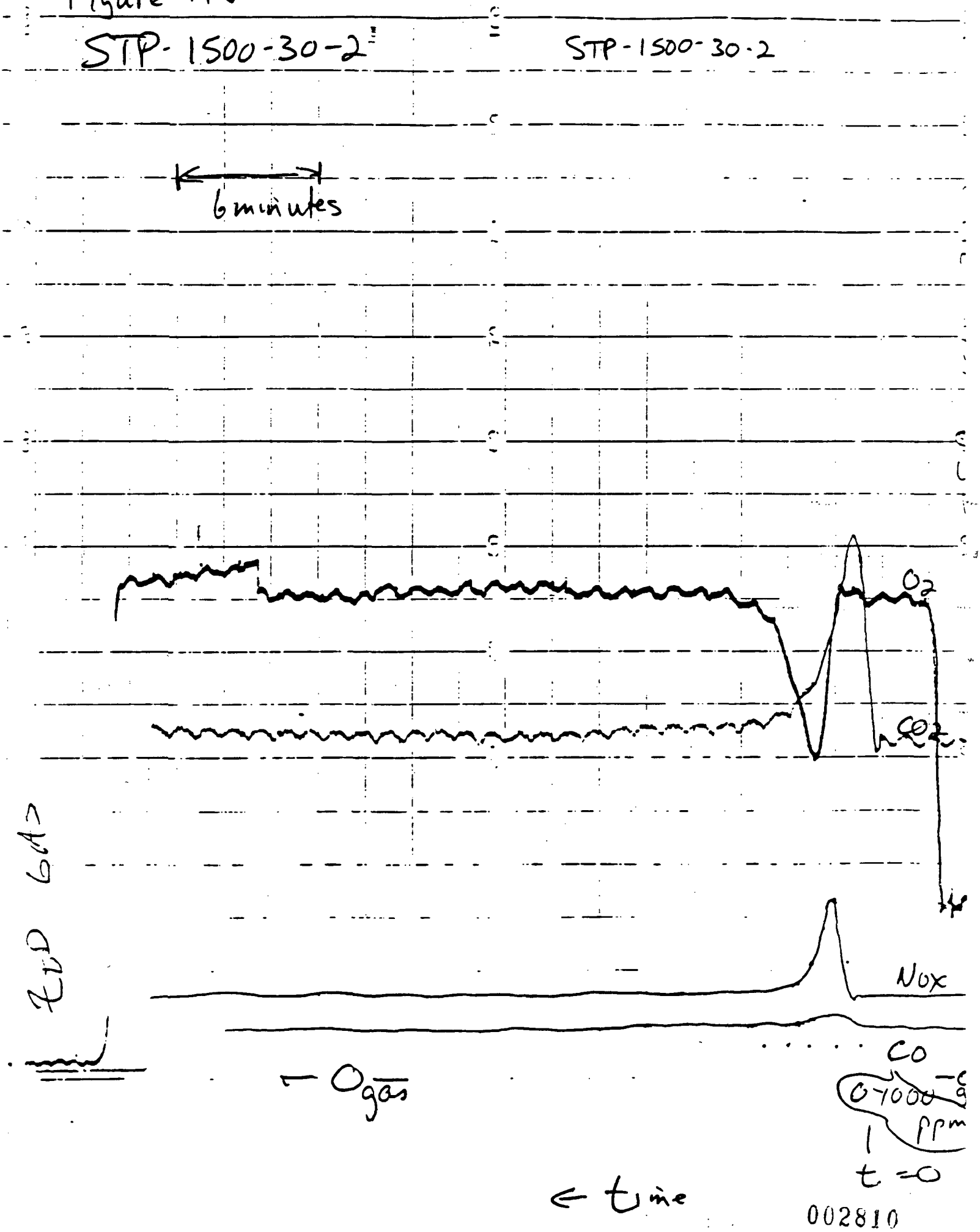


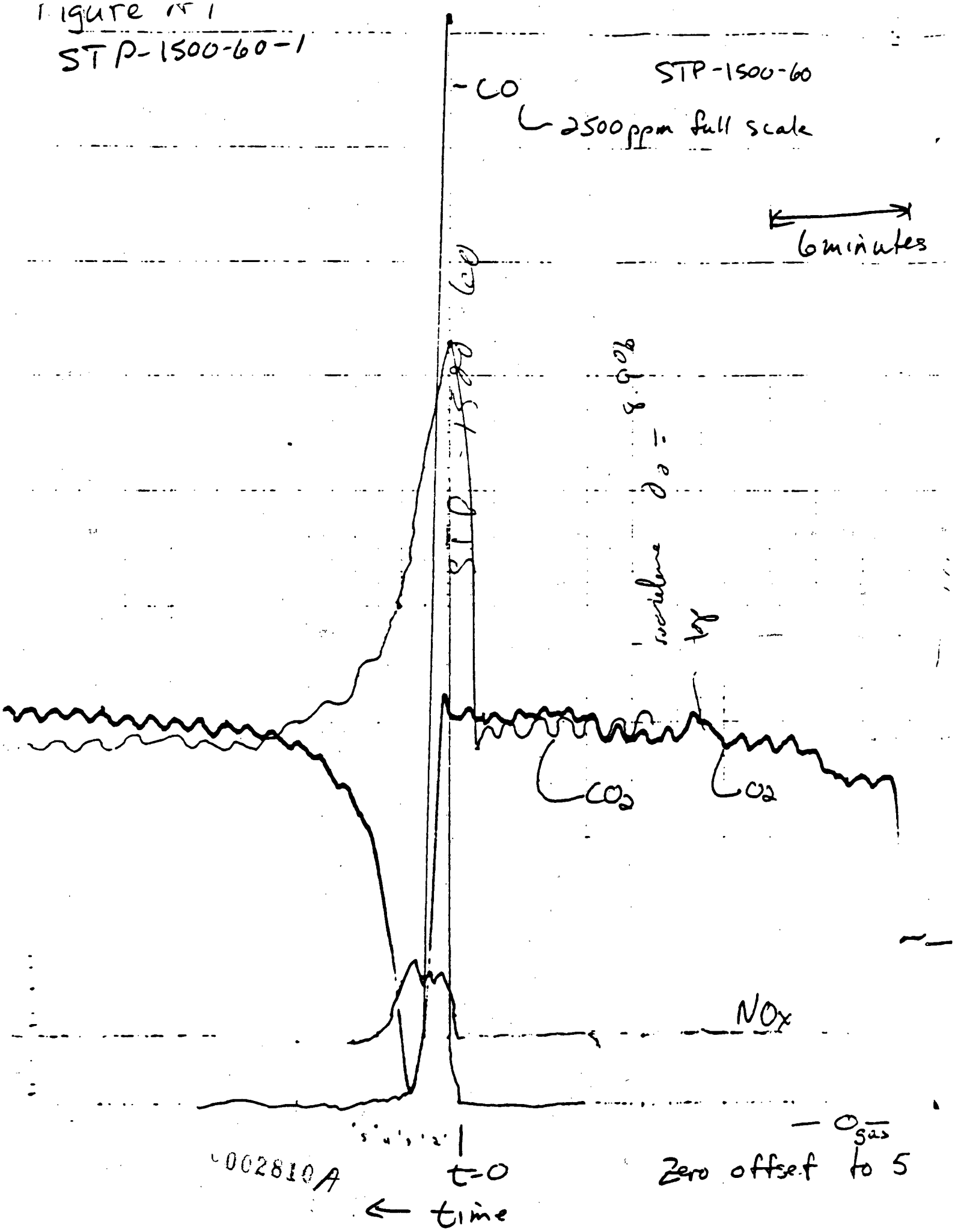
Figure - 40



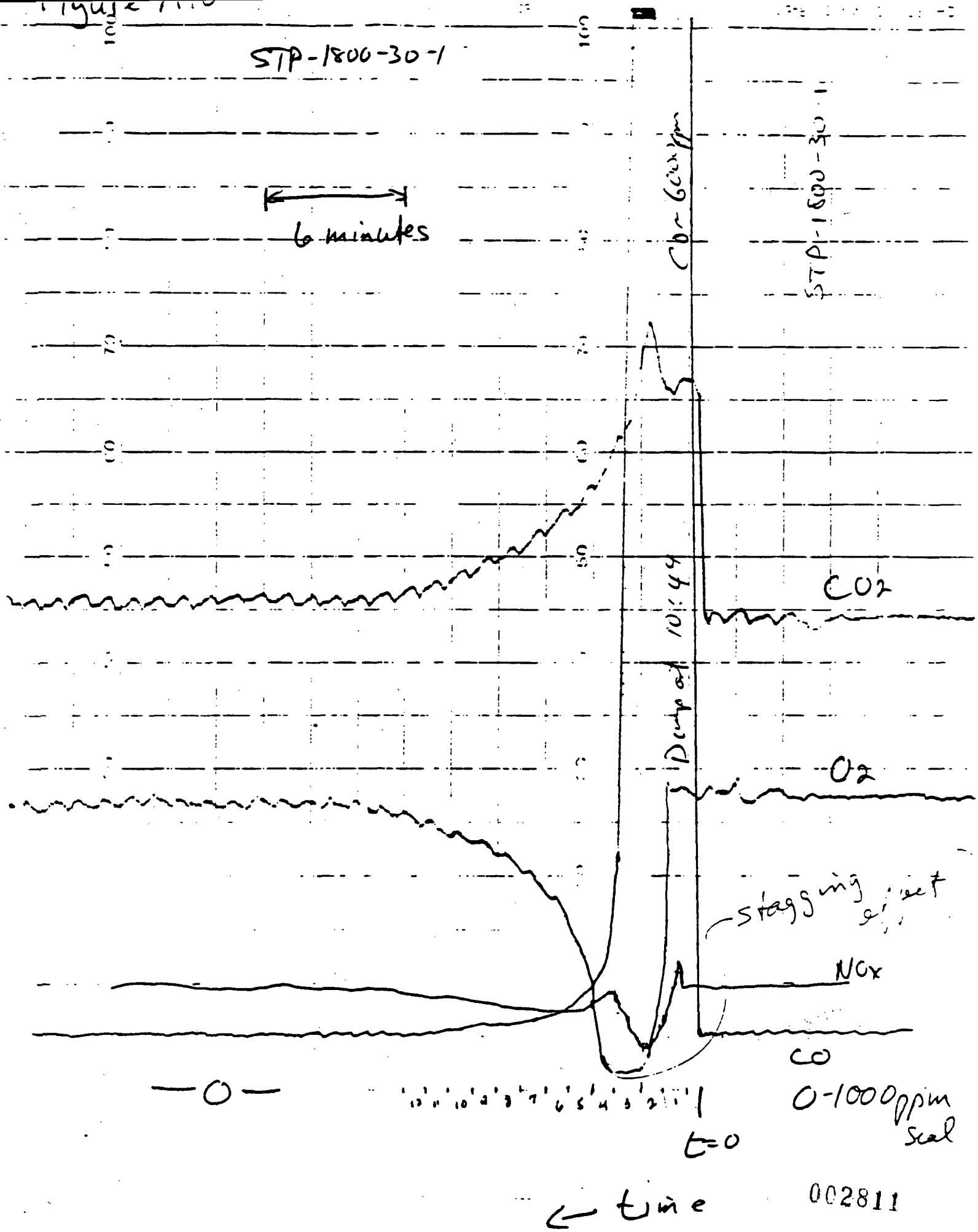
002810

Figure #1

STP-1500-60-1



002810A


STP-1800-30-1
6 minutes
Cbr 6000 ppm
STP-1800-30-1
Dump at 10:44
CO2
O2
stagging offset
NOx
CO
0-1000 ppm scal
t=0
time

002811

Figure. T11

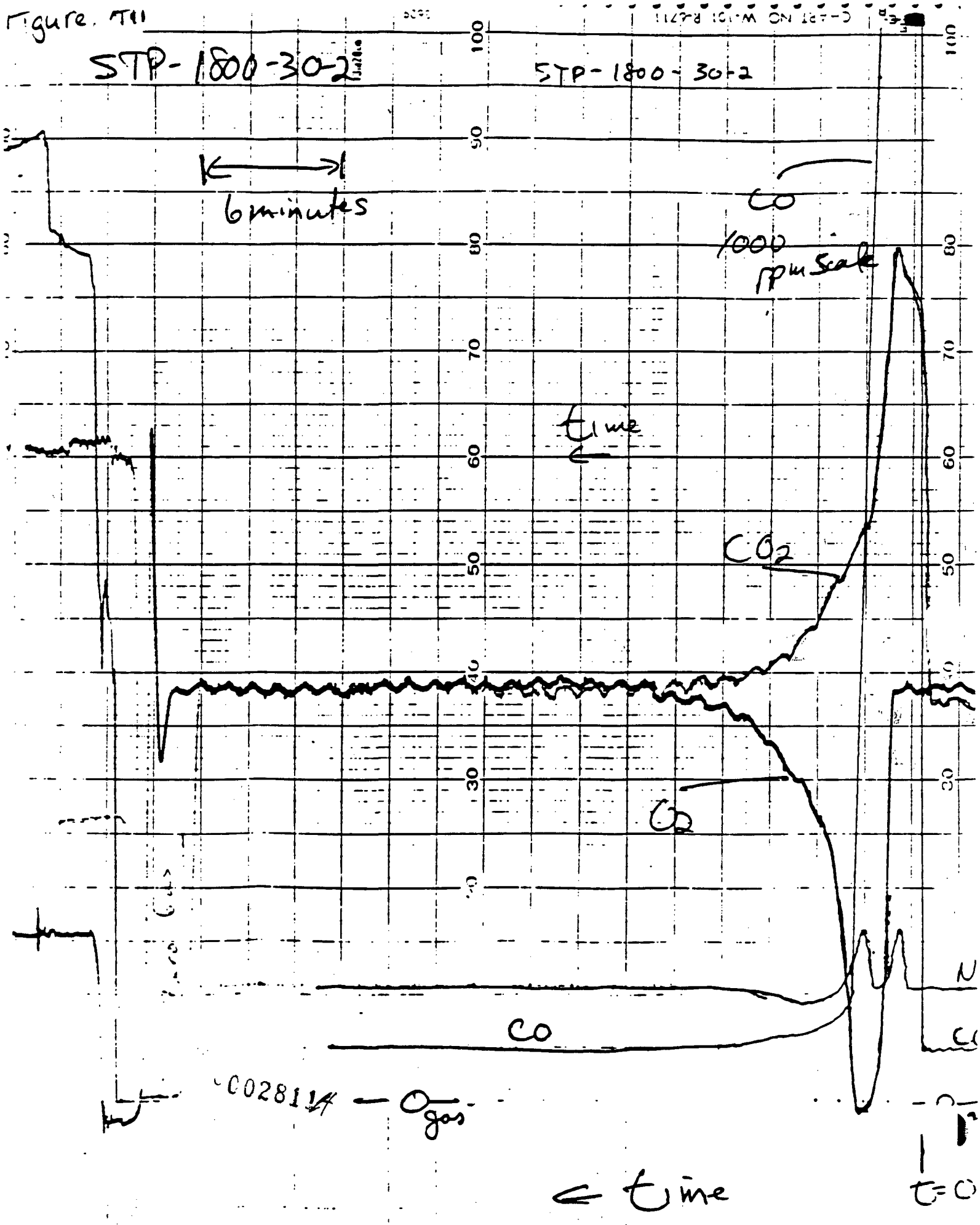
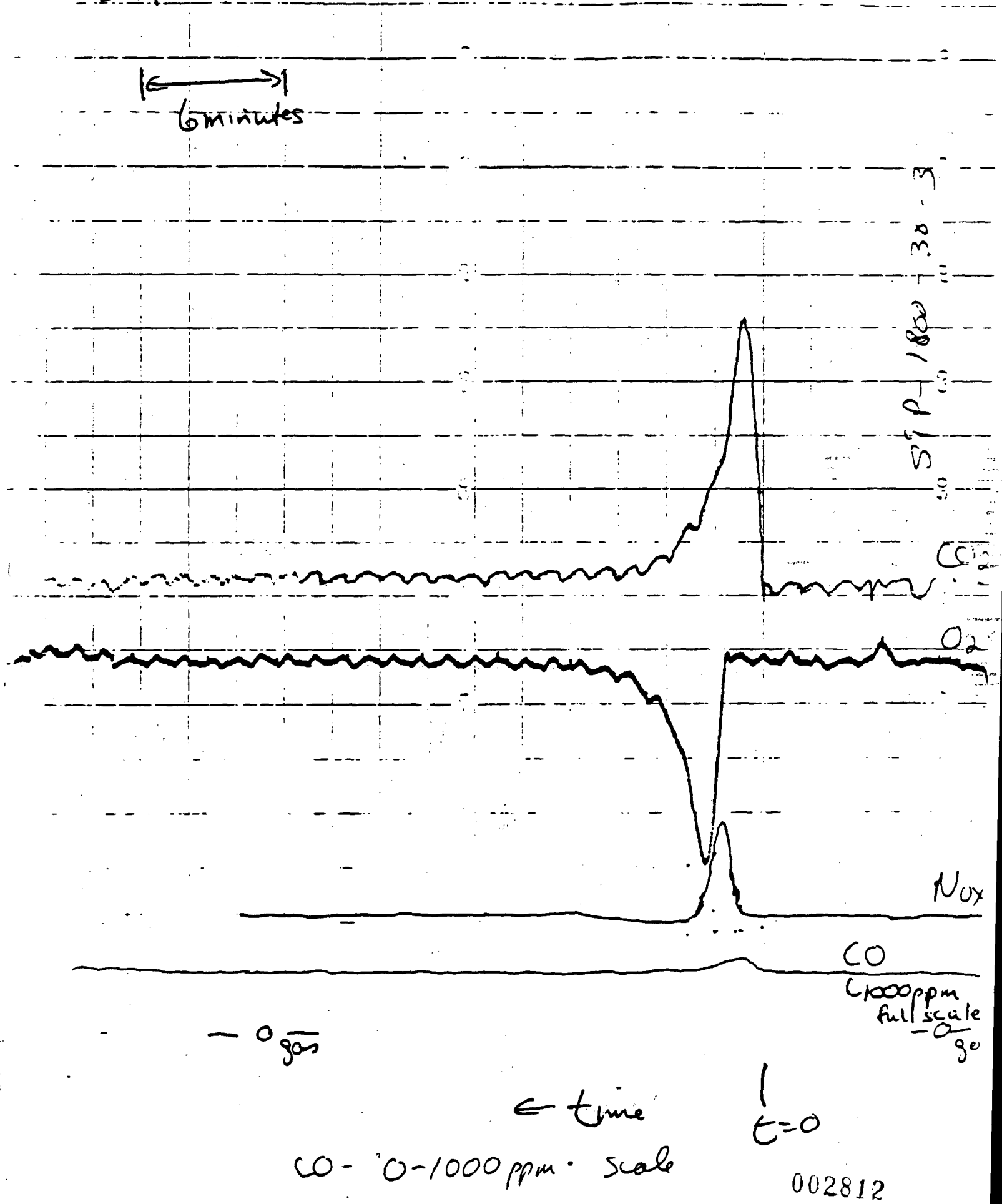

STP-1800-30-2
STP-1800-30-2
6 minutes
CO
1000 ppm Scale
time
CO2
O2
N
CO
O gas
time
t=0

Figure A10

STP- 1800-30-3 STP -1800-30-3



002812

Figure A13

STP-1800-60-1

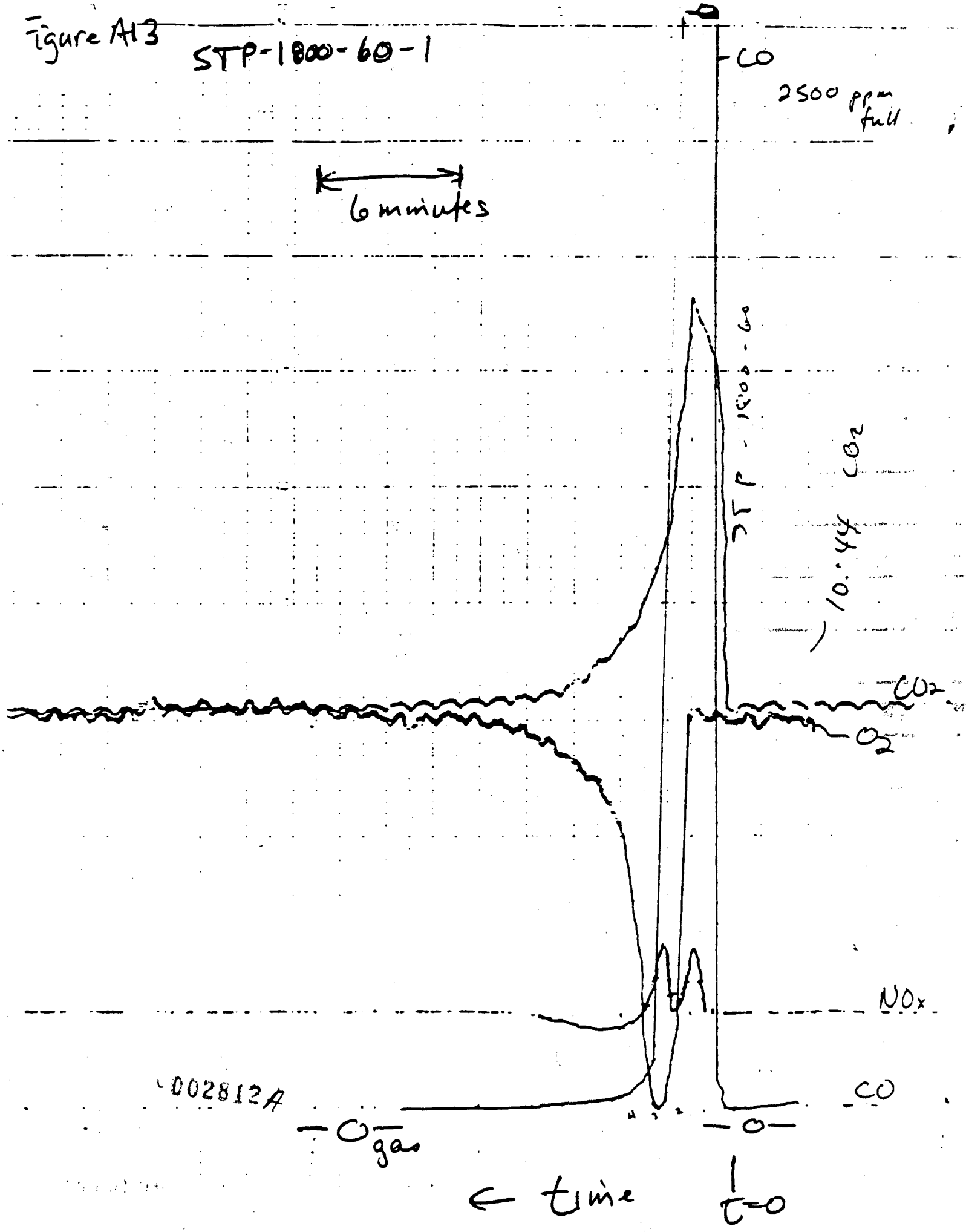


Figure A17

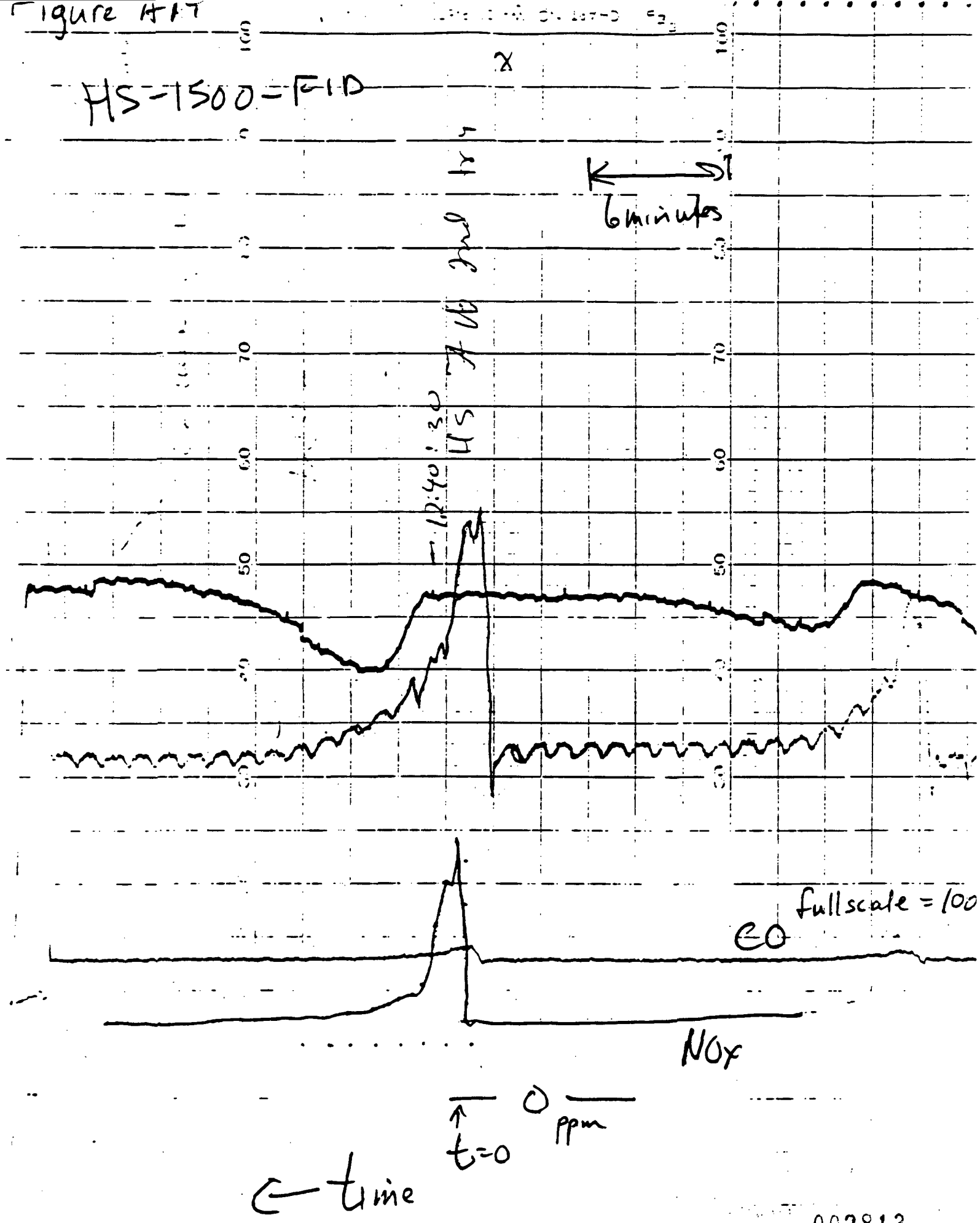
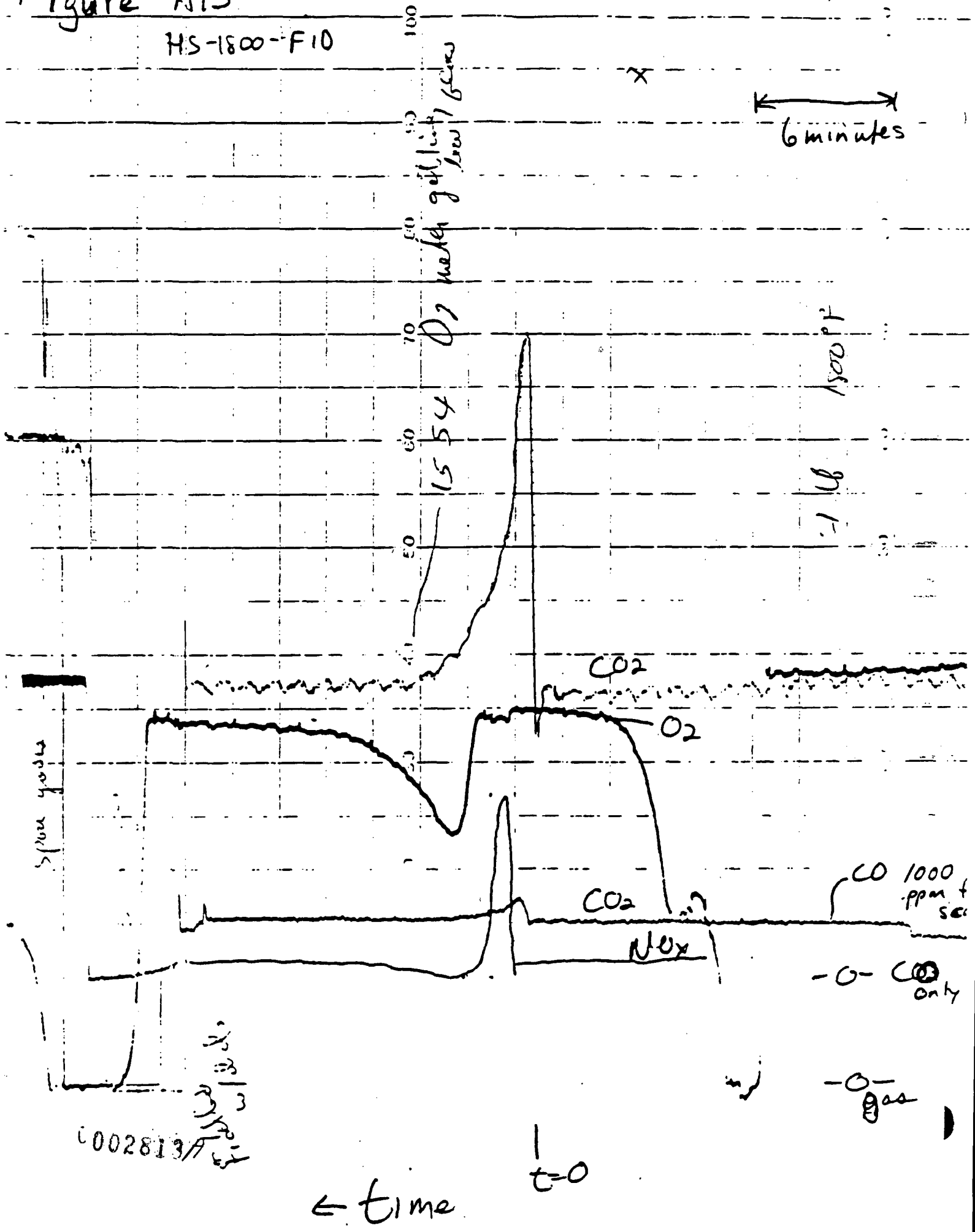

HS-1500-FID
6 minutes
HS 7 Hz 2nd
F 12:40:30
fullscale = 100
CO
NOx
0 ppm
t=0
time

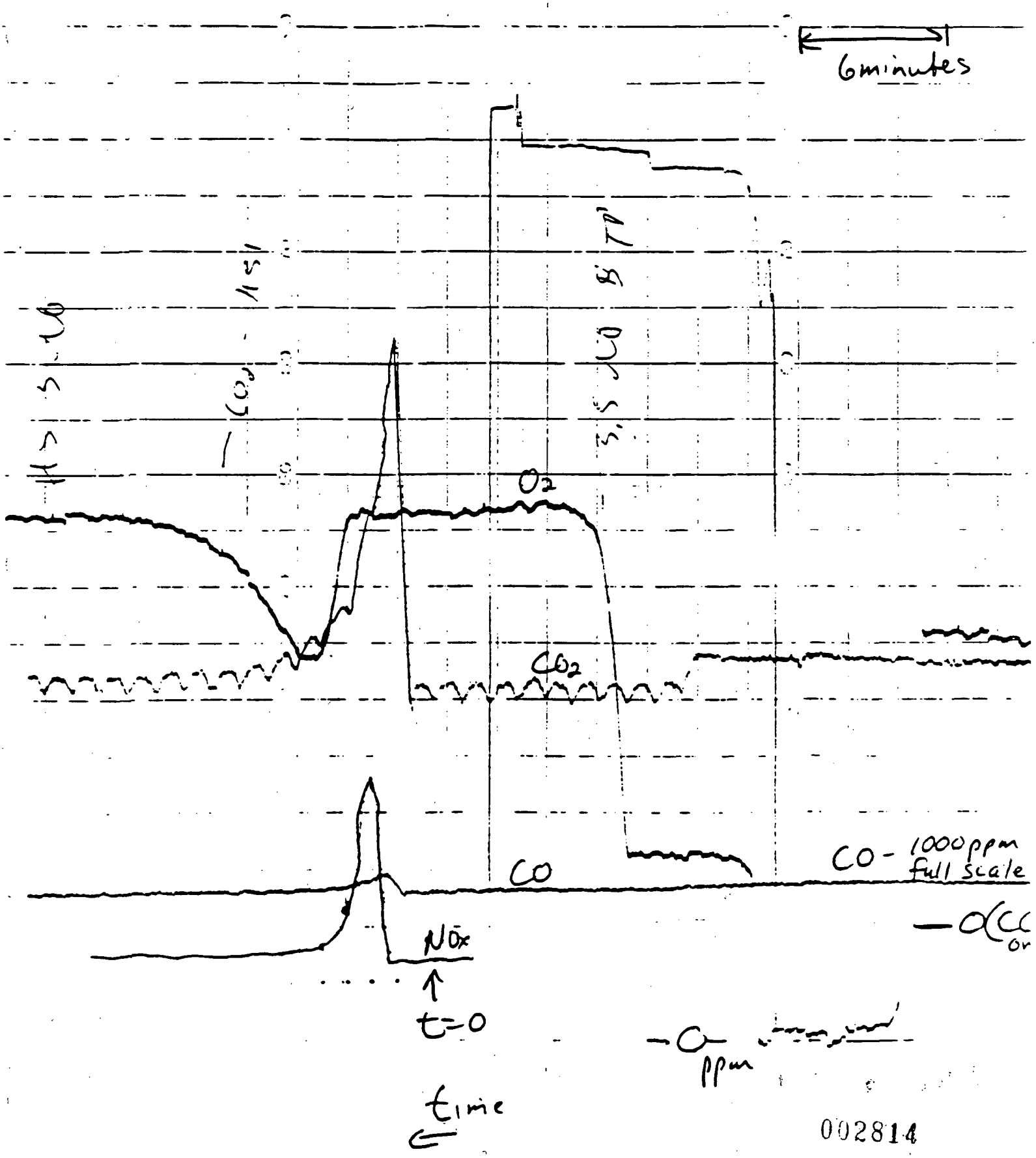
Figure FID

HS-1800-F10



C002813/A

Figure A-16
STP-1500-FID



002814

SO_2 ANALYZER STRIP CHARTS

SO_2 - 1000 PPM Full Scale
- 10 ppm/Division

002814A

Figure A17

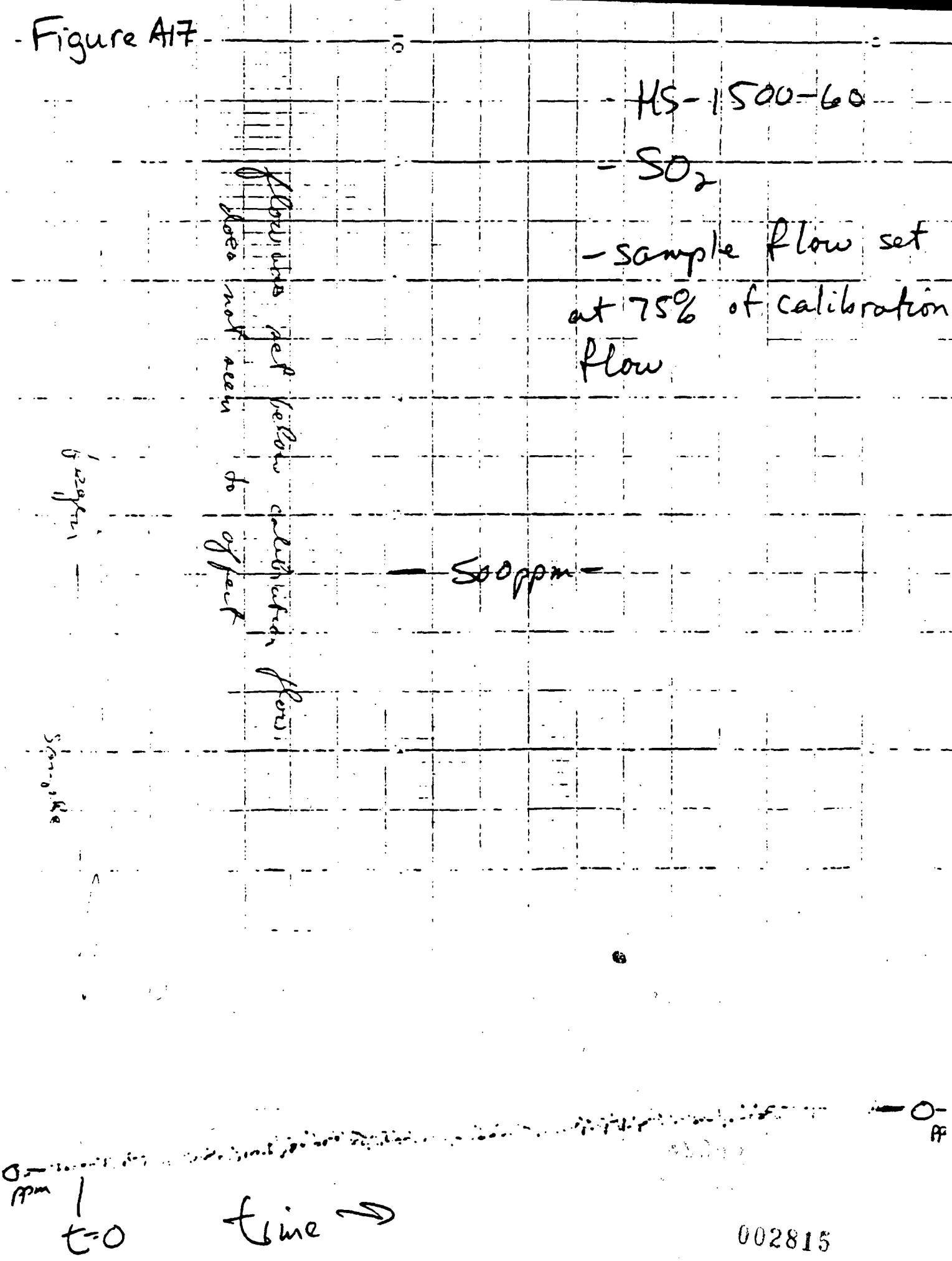

HS-1500-60
SO_2
- sample flow set at 75% of calibration flow
500ppm
flow was set below calibrated flow, does not seem to affect
span-0 like
0 ppm
0 pp
t=0
time

Figure A18

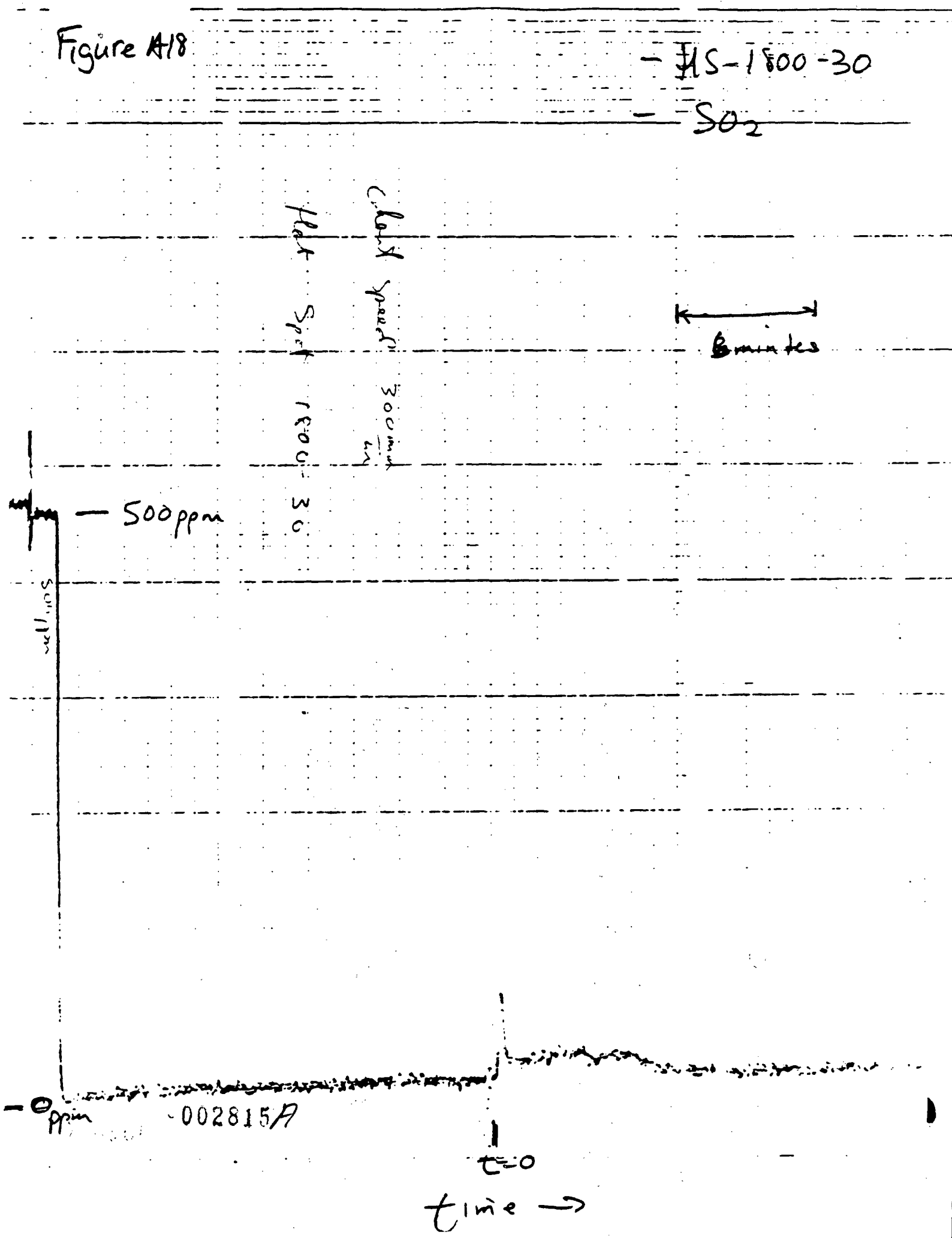
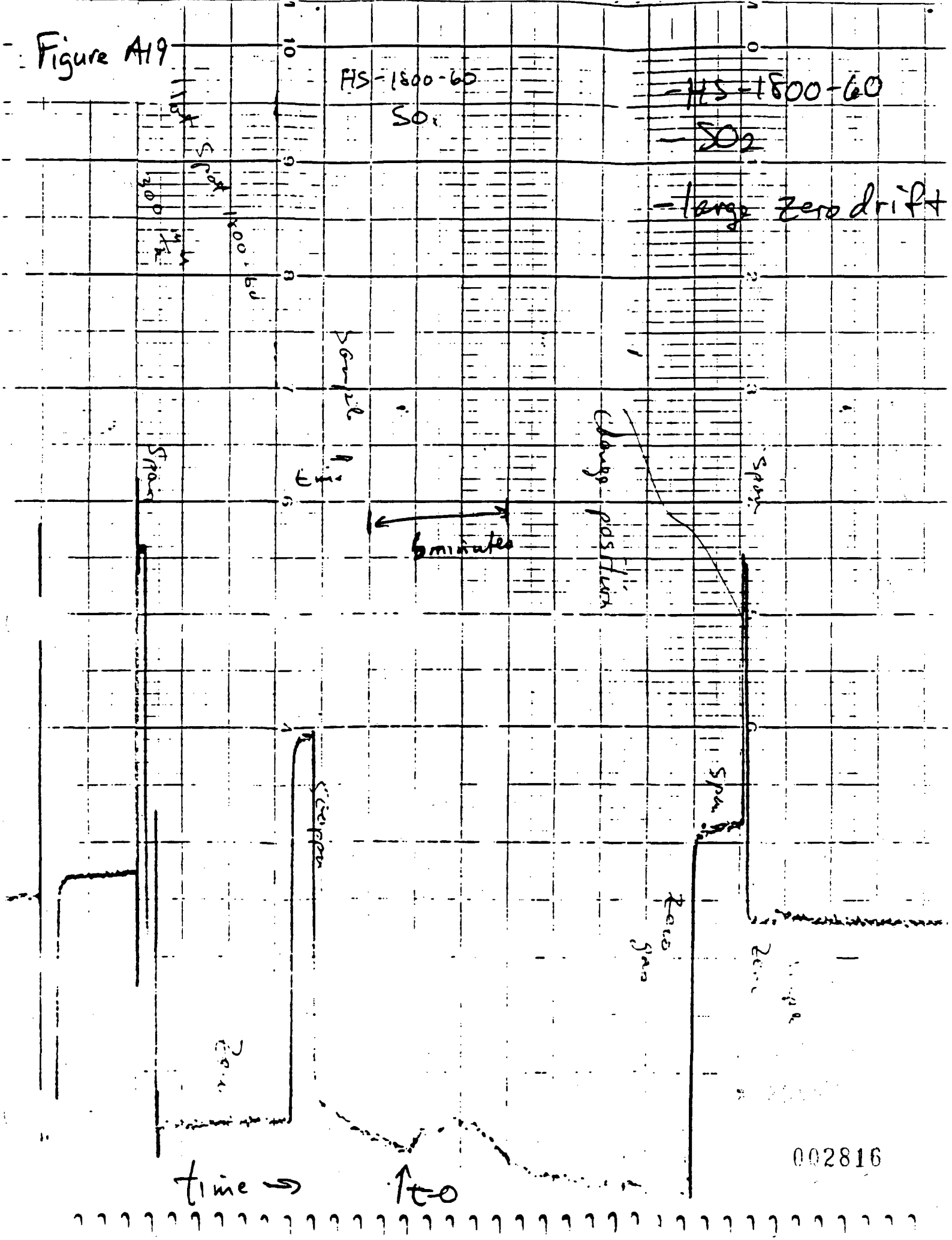

HS-1800-30
SO2
Chart speed 300 mm/hr
Start 1800-30
500 ppm
8 minutes
0 ppm
002815A
t=0
time

Figure A19



002816

Figure A20

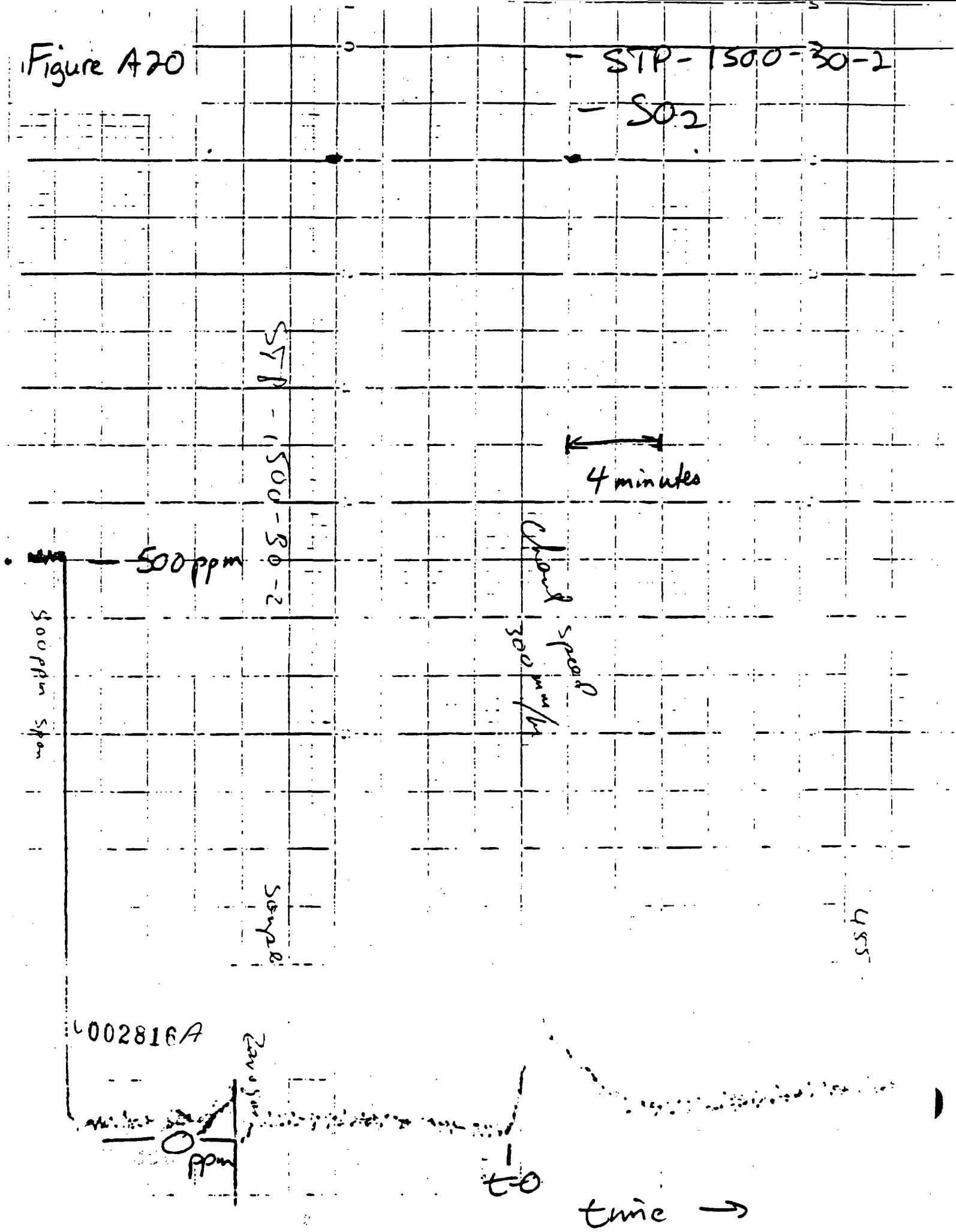

STP-1500-30-2
SO2
STP-1500-30-2
4 minutes
500ppm
Chart speed 300 mm/hr
500ppm span
Sample
455
002816A
Zero span
0 ppm
t=0
time →

Figure A21

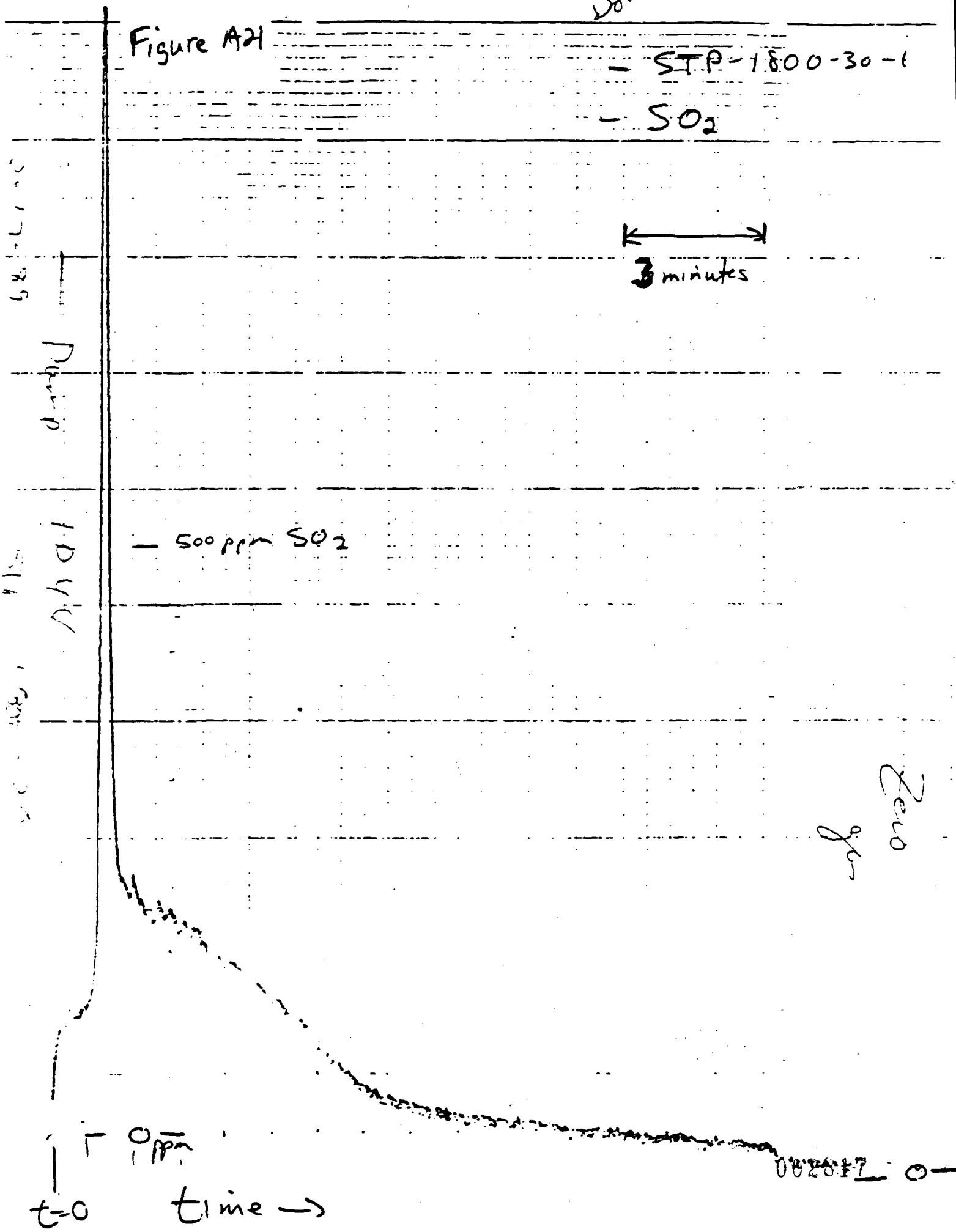


Figure A23

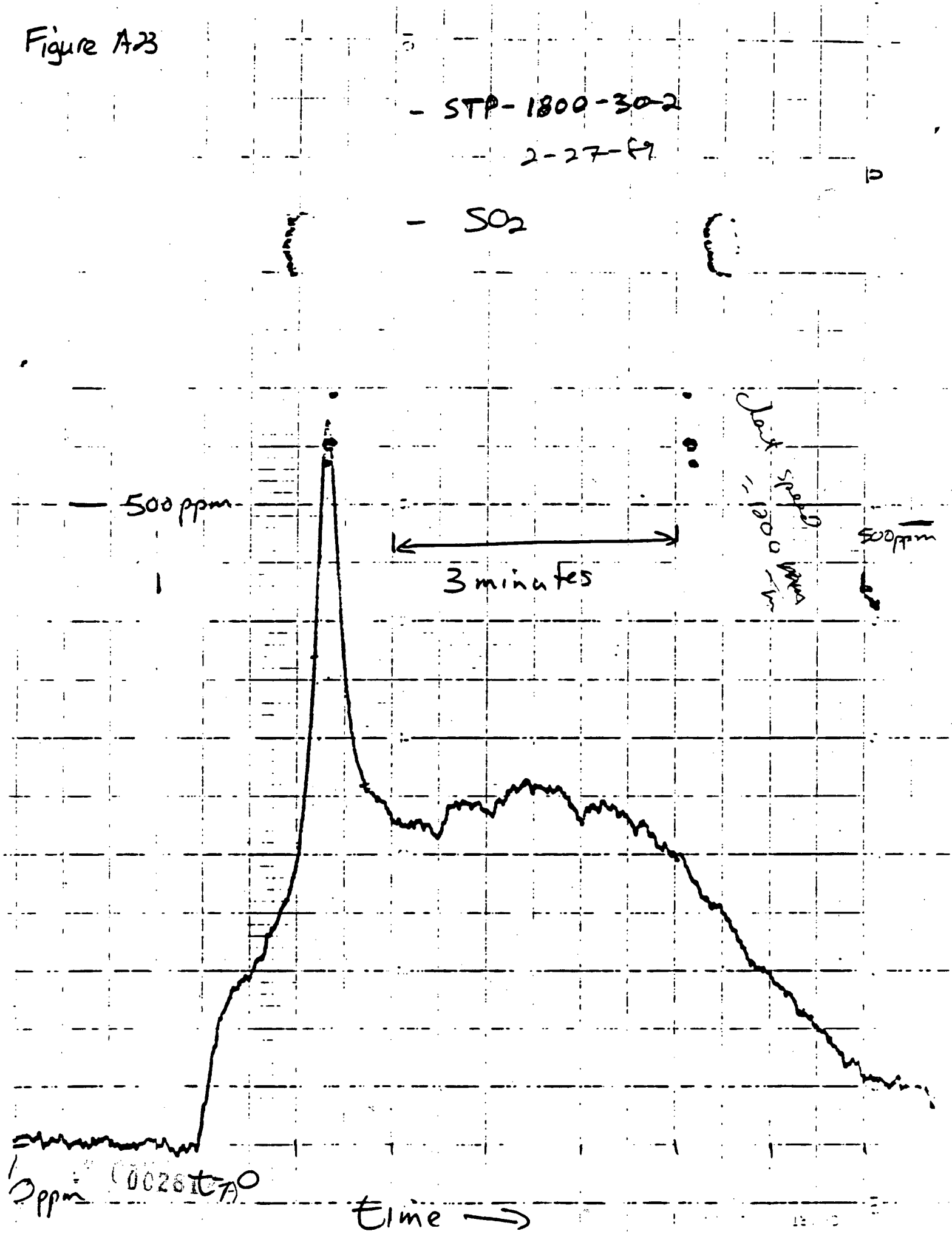
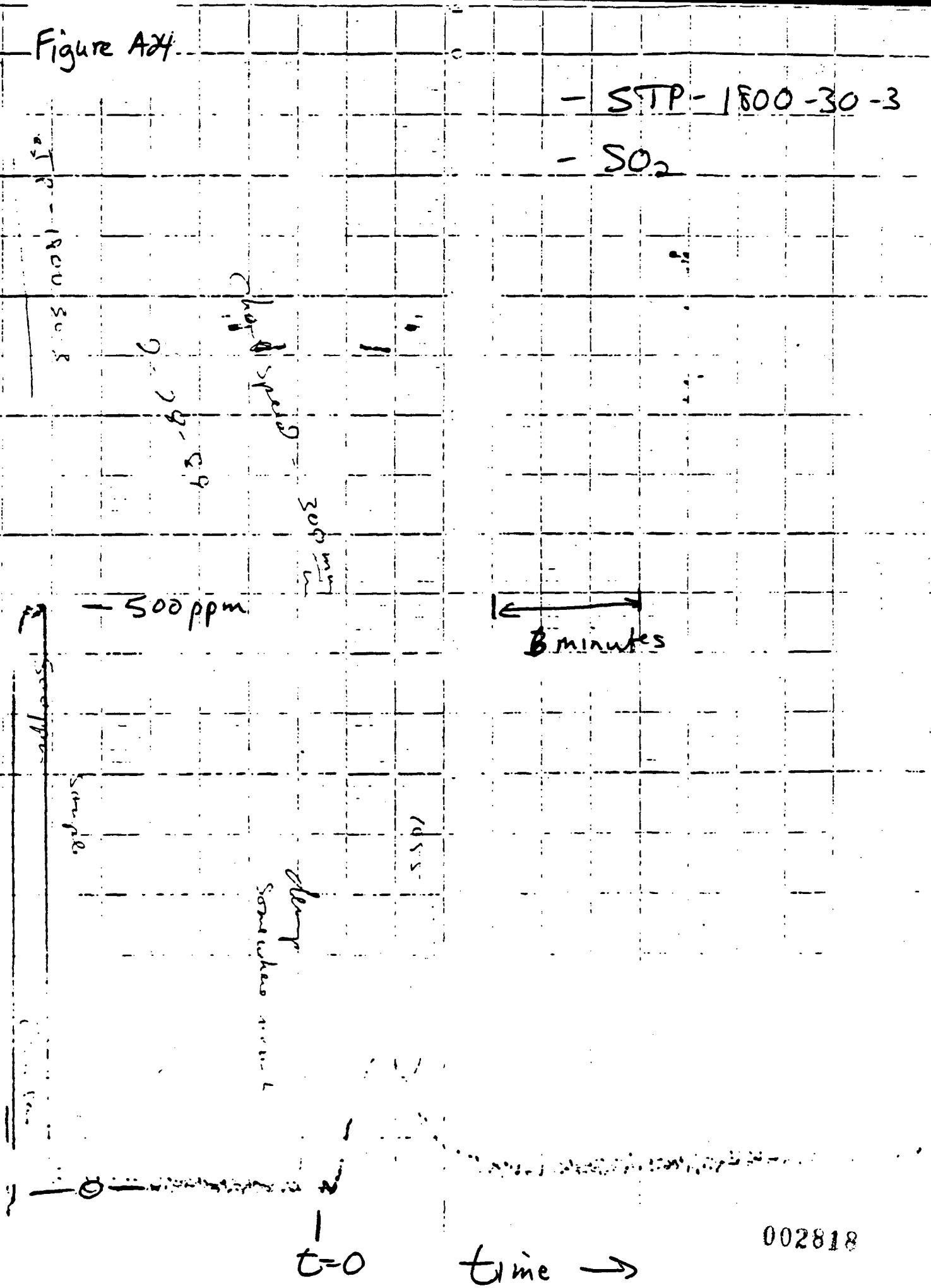

STP-1800-302
2-27-79
SO_2
500 ppm
3 minutes
Chart speed ~120 mm/min
500 ppm
0 ppm
Time

Figure A24

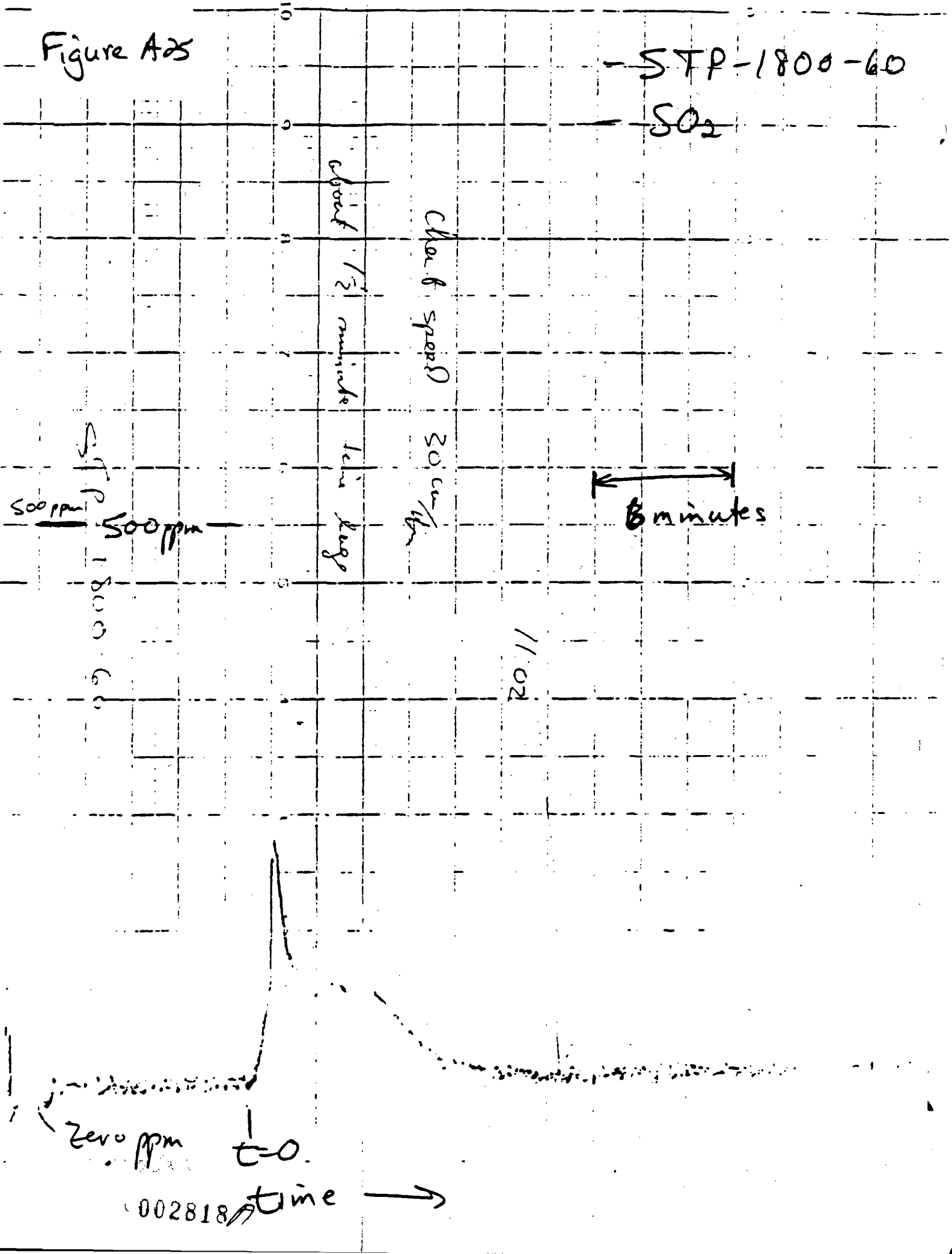


002818

Figure A25

STP-1800-60

SO_2



002818

TOTAL HYDROCARBON ANALYZER STRIP CHARTS

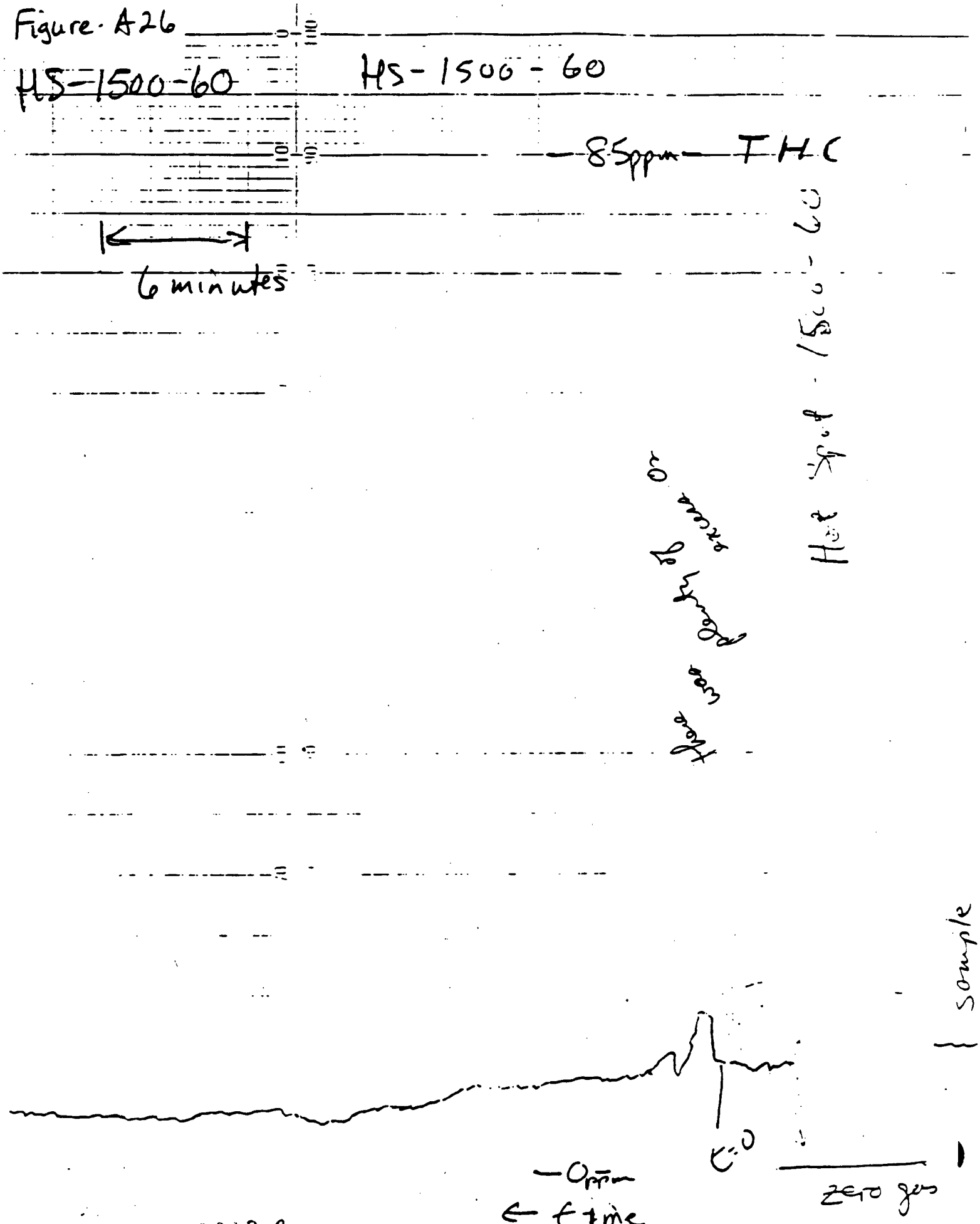
THC - 100 ppm Full Scale at RM=5
- 1 ppm/Division

Note: Full scale changes with range multiplier (RM)

$$\text{Full Scale} = \frac{RM}{5} * 100$$

-RM=5 Unless Indicated

Figure A26



002819A

Figure 1-4

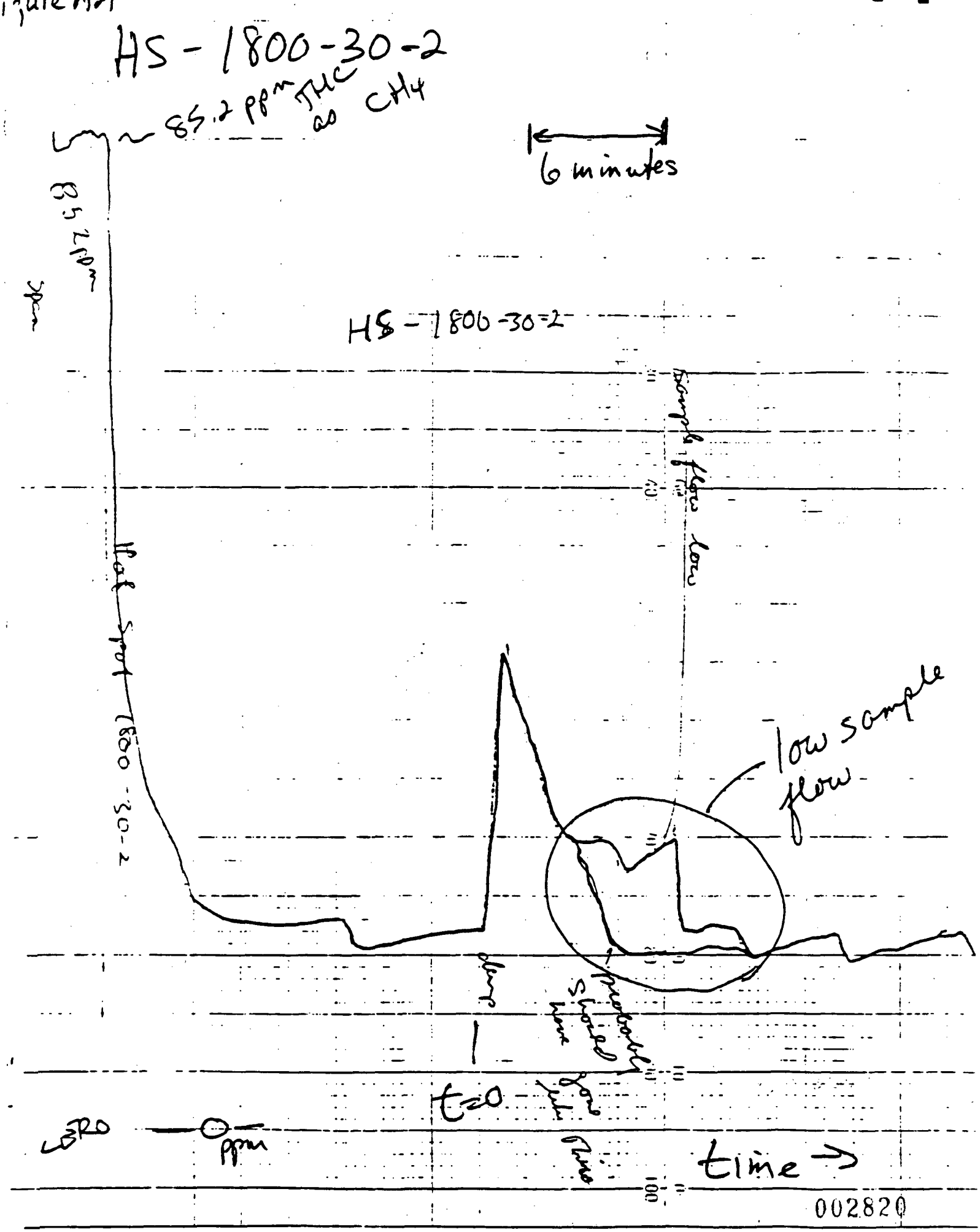

HS-1800-30-2
~85.2 ppm THC as CH4
6 minutes
85.2 ppm
span
HS-1800-30-2
sample flow low
Hot Spot 1800-30-2
low sample flow
Pretreatment should have low flow
t=0
LZRO
0 ppm
time →

Figure 4&8

HS-1800-60

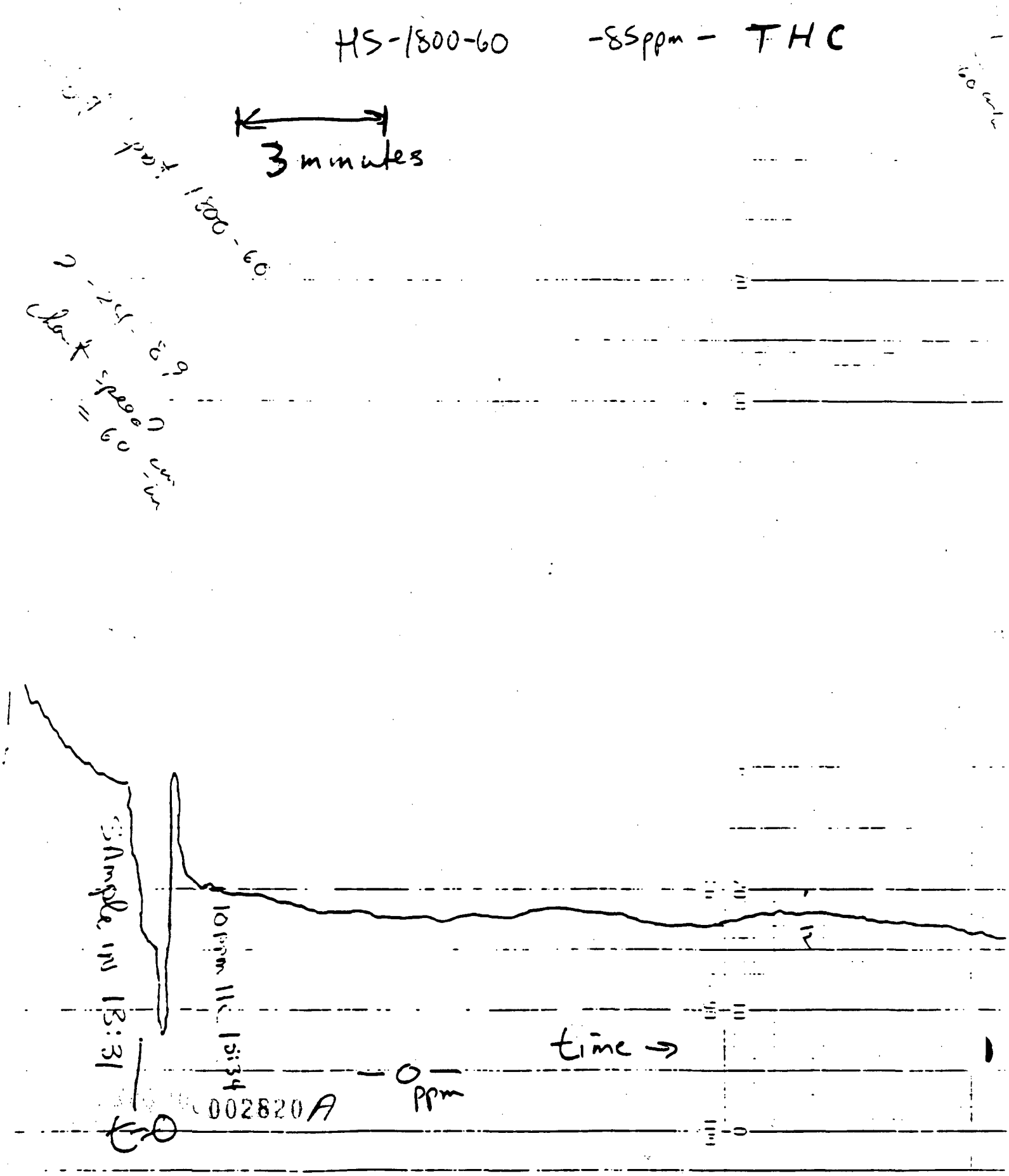
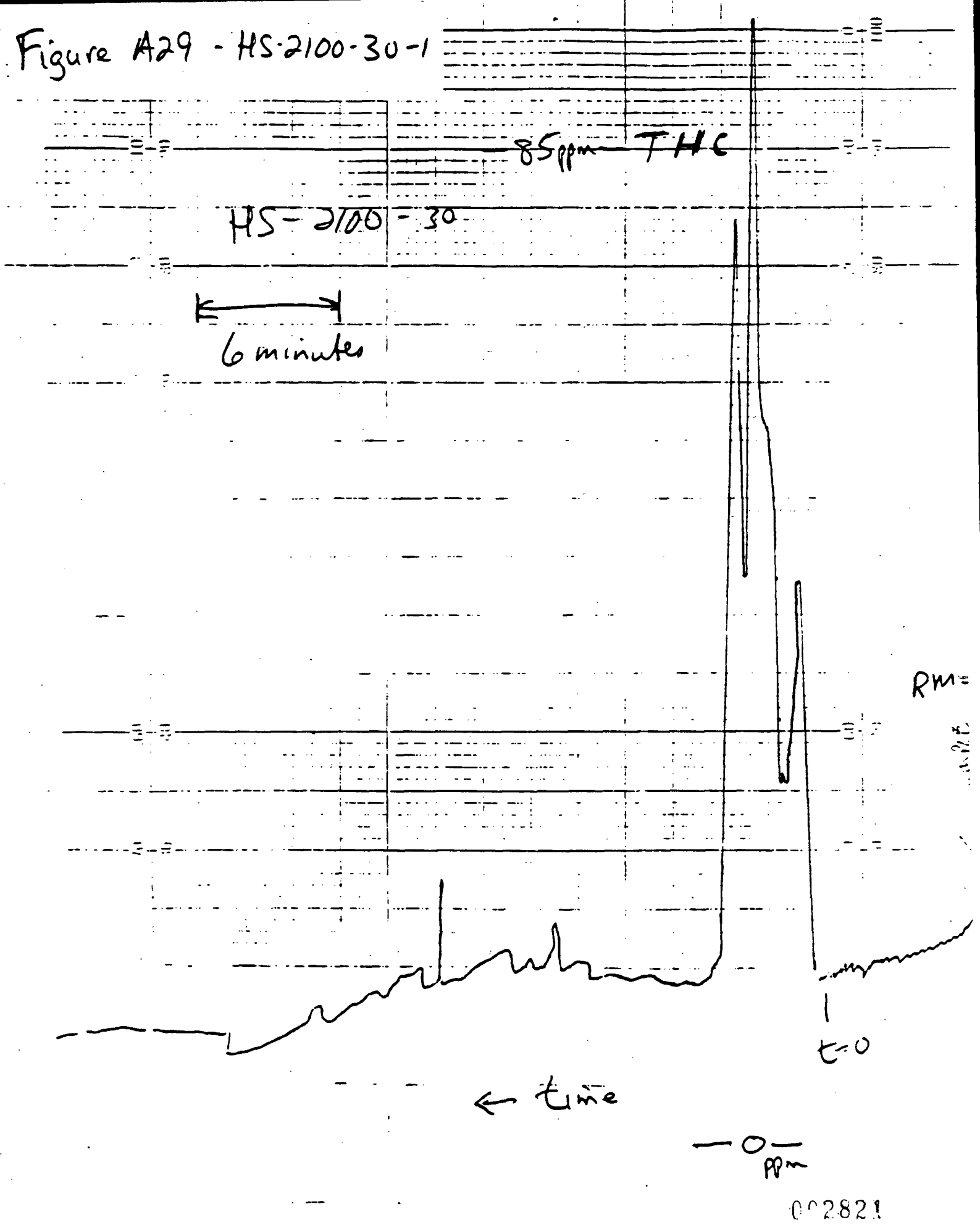
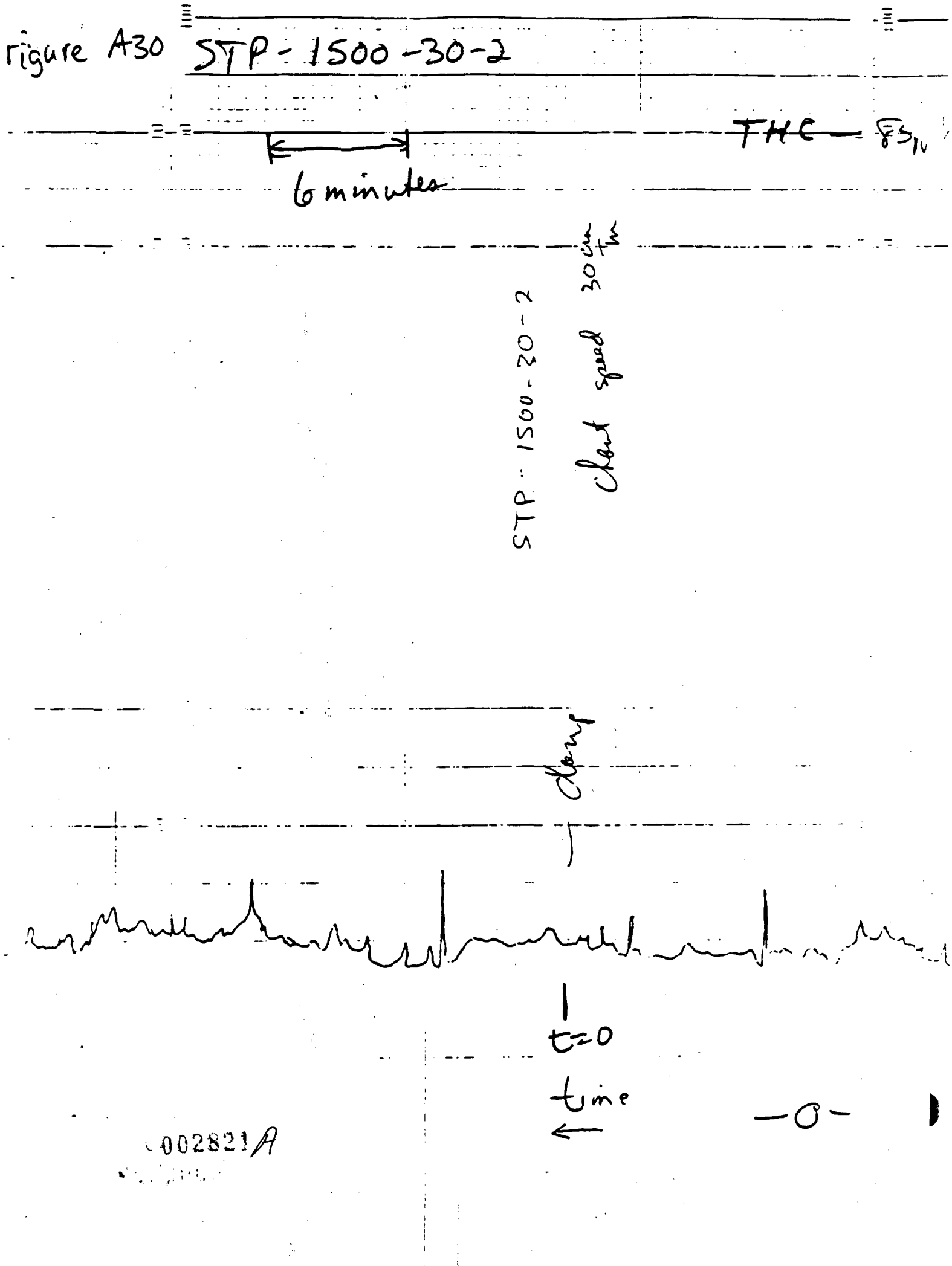


Figure A29 - HS-2100-30-1



002821

Figure A30 STP - 1500 - 30 - 2



002821A

-0-

Figure #31

STP - 1500-60

THC 85ppm

6 minutes

STP

1500-60

15:05

2-27-89

TEST START

Sample begin

t=0

← time

0 ppm

002822

Figure A32 STP-1800-30-2

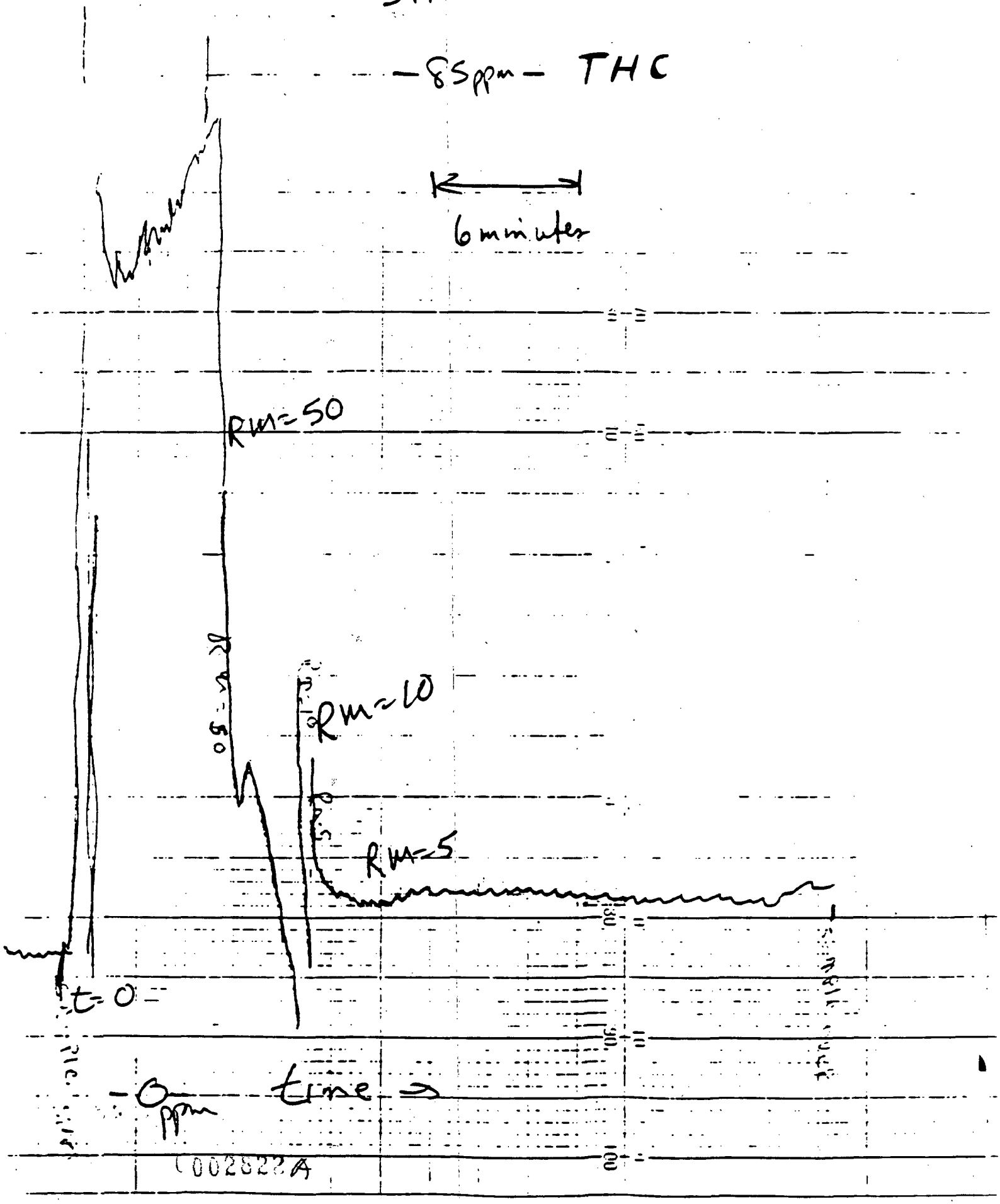


Figure A33- STP-1800-30-3

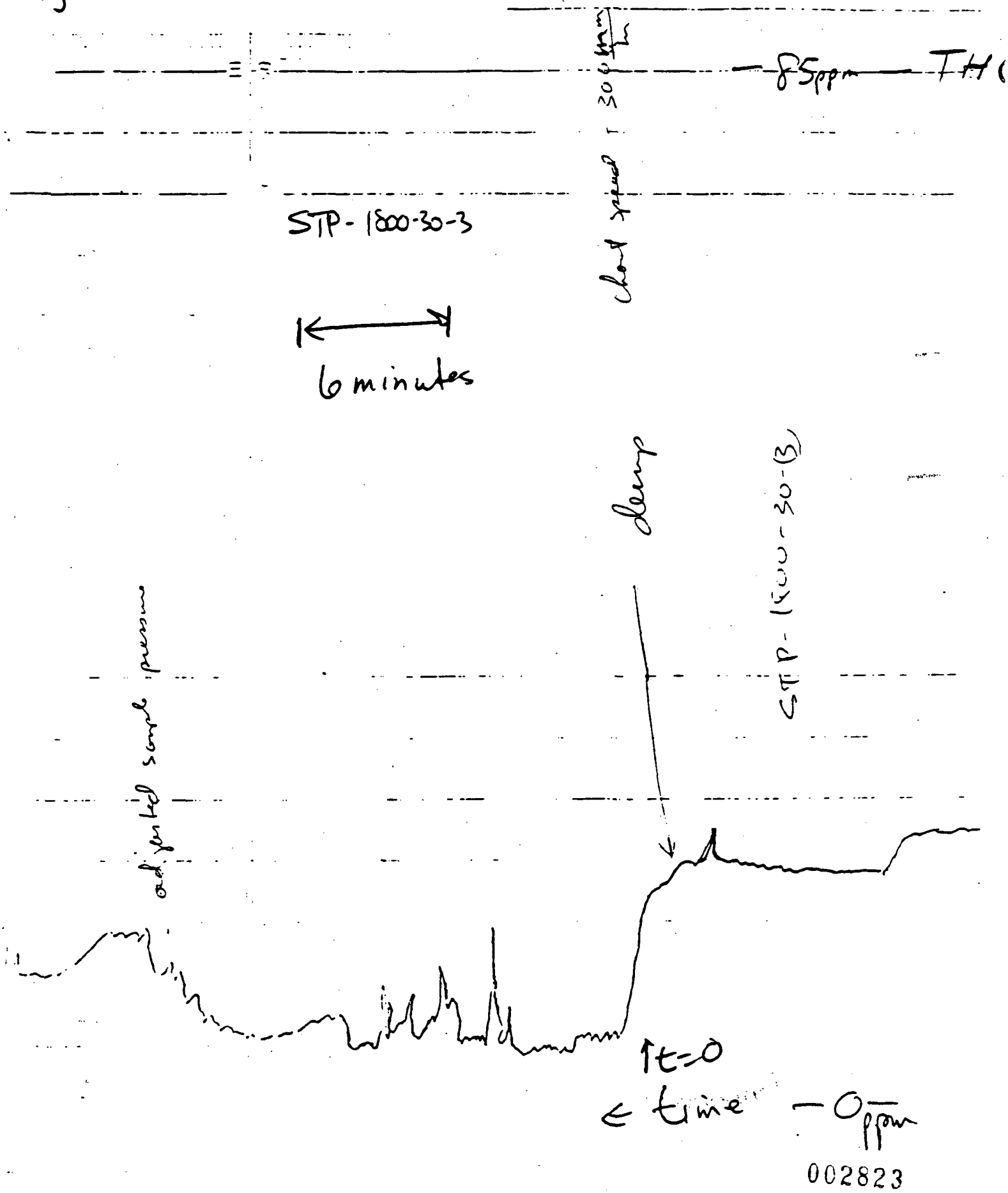


Figure A34 STP-1800-60-1

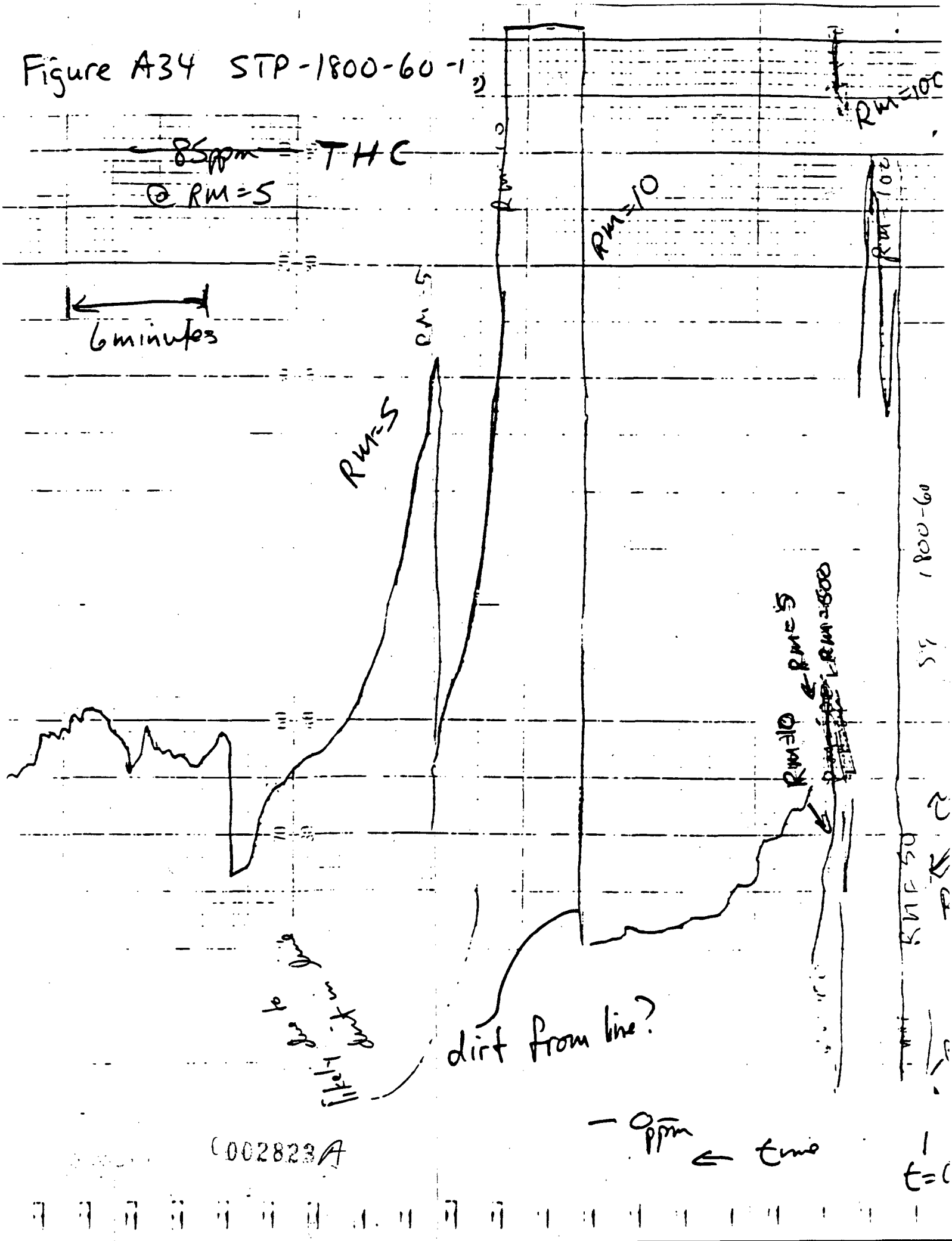


Figure A35- HS-1500-FID

002824

Figure A36 · HS-1800-FID

THC = 85 ppm THC

WINDY DAY

HS-1800-FID

6 minutes

HS-1800-FID

-very windy day

Toll Free (800) 423-2344
Inside Calif. (818) 767-0044

Quantity

1 Per Roll/Pkg
10 Rolls/Pkgs Per Box
25 Rolls/Pkgs Per Case

Model NO. ZN2-01-25-20M

Pendleton Street
Valley, CA 91352

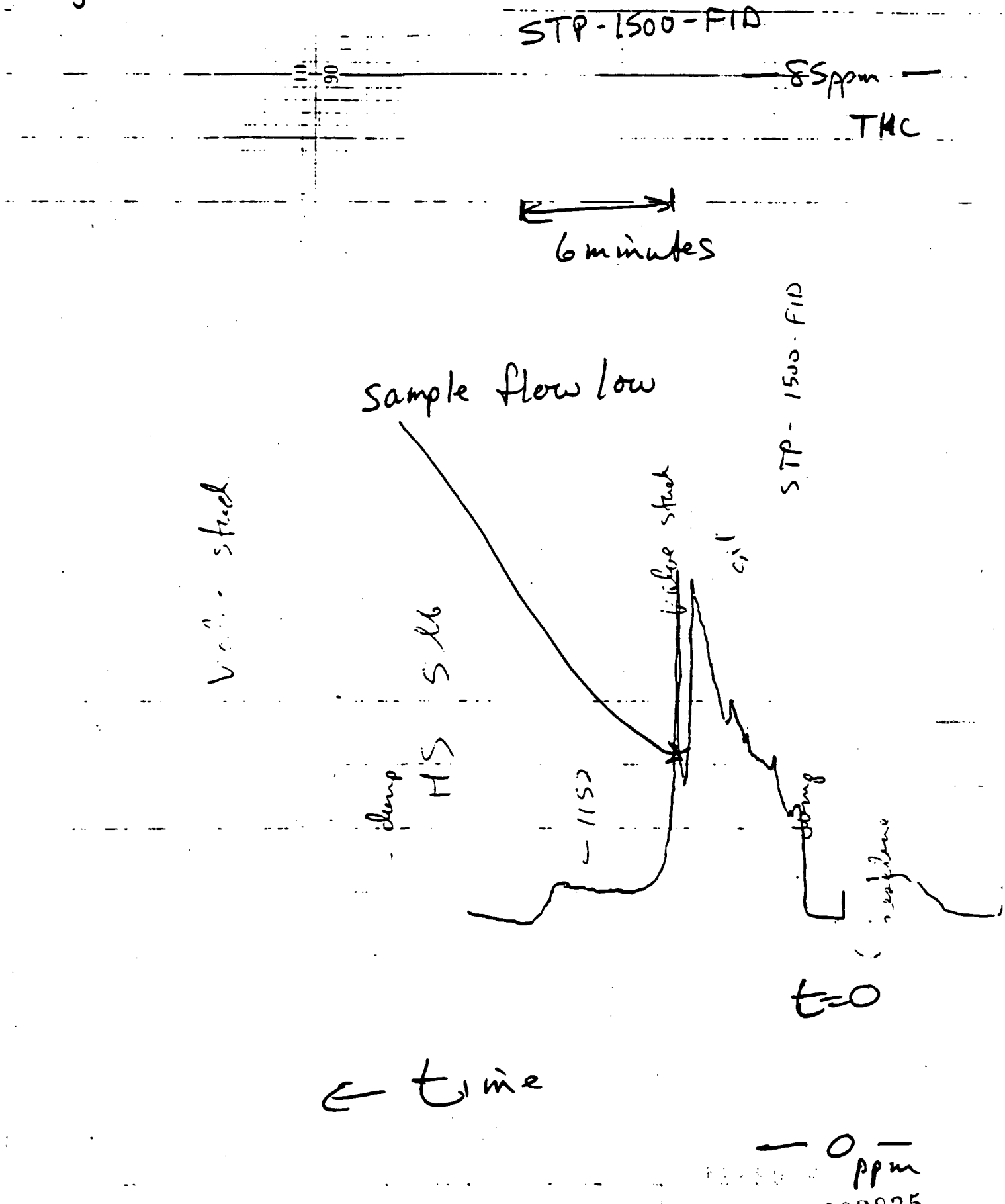
t=0

002824A

— ZERO GAS

← time

Figure A37 STP-1500-FID



002825 A

TABLE A2. PCBS AND PESTICIDES CONCENTRATIONS IN SOILS AND ASH

Analyte Compound	Concentration (μg/Kg) Hot Spot Composite Sample	STP Composite Sample	STP-1500-30-2 Ash Sample	All Other Ash Samples
Aldrin	<8.0	<8.0	<8.0	<8.0
Alpha-BHC	<8.0	<8.0	<8.0	<8.0
Beta-BHC	<8.0	<8.0	<8.0	<8.0
Gamma-BHC	<8.0	<8.0	<8.0	<8.0
Delta-BHC	<8.0	<8.0	<8.0	<8.0
Tech. Chlordane	<80.0	<80.0	<80.0	<80.0
4,4'-DDT	<16.0	<16.0	<16.0	<16.0
4,4'-DDE	<16.0	<16.0	<16.0	<16.0
4,4'-DDD	<16.0	<16.0	<16.0	<16.0
Dieldrin	220	<16.0	<16.0	<16.0
Endosulfan I	<8.0	<8.0	<8.0	<8.0
Endosulfan Sulfate	<16.0	<16.0	<16.0	<16.0
Endrin	<16.0	<16.0	<16.0	<16.0
Endrin Ketone	<16.0	<16.0	<16.0	<16.0
Heptachlor	<8.0	<8.0	<8.0	<8.0
Heptachlor Epoxide	<8.0	<8.0	<8.0	<8.0
Methoxychlor	<80.0	<80.0	<80.0	<80.0
Arochlor 1016	<80.0	<80.0	<80.0	<80.0
Arochlor 1221	<80.0	<80.0	<80.0	<80.0
Arochlor 1232	<80.0	<80.0	<80.0	<80.0
Arochlor 1242	<80.0	15,000,000	120.0	<80.0
Arochlor 1248	<80.0	<80.0	<80.0	<80.0
Arochlor 1254	<160.0	<160.0	<160.0	<160.0
Arochlor 1260	2200	<160.0	<160.0	<160.0
Toxaphene	<160.0	<160.0	<160.0	<160.0

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TABLE A3. METALS AND LEACHATES ANALYSES FOOTNOTES

B - Result is a value greater than or equal to the instrument detection limit but less than the contract-required detection limit.

E - The reported value is estimated because of interference.

N - The spiked sample recovery was not within control limits.

D - Duplicate analyses are not within control limits.

W - The post-digestion spike for furnace AA analysis is outside of the 85-115% control limits, while sample absorbence is less than 50% of the spike absorbence.

S - Value determined by method of standard addition.

+ - Correlation coefficient for method of standard addition is less than 0.995.

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APPENDIX

TABLE A1 - ULTIMATE ANALYSES OF SOIL SAMPLES
TABLE A2 - PCBS AND PESTICIDES CONCENTRATIONS IN SOILS AND ASH
TABLE A3 - METALS AND LEACHATES CONCENTRATIONS DATA FOOTNOTES
TABLE A4 - SOIL AND ASH METALS CONCENTRATIONS
TABLE A5 - SOIL AND ASH LEACHATE CONCENTRATIONS
TABLE A6 - PCBS DESTRUCTION AND REMOVAL EFFICIENCIES
TABLE A7 - PARTICULATE AND HCL EMISSIONS
TABLE A8 - METALS IN INCINERATOR EXHAUST

FIGURES A1 - A16 - CEMS STRIP CHARTS
FIGURES A17 - A25 - SO_2 STRIP CHARTS
FIGURES A26 - A37 - THC STRIP CHARTS

TABLE A1. ULTIMATE ANALYSES OF SOIL SAMPLES

Analyte	Hot Spot Composite	Sludge Tank and Pit Composite
Water (Wt %)	21	39
Carbon	NC	NC
Hydrogen	NC	NC
Nitrogen	NC	NC
Sulfur	NC	NC
Chlorine	NC	NC

NC - Analysis not completed

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Appendix G
Federal and State
ARARs and TBCs

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APPENDIX G

This Appendix contains two documents from USEPA concerning the identification of Applicable or Relevant and Appropriate Requirements (ARARs) for the SCP Feasibility Study.

The first document is dated 27 July 1988 and is entitled "SCP Site Identification of ARARs for Developing Remedial Alternatives Input for Feasibility Study".

The second document is dated 3 March 1989 and is titled "Re: Scientific Chemical Processing ("SCP") Site- Carlstadt, N.J. ARAR Note No. 2: Polychlorinated Biphenyls ("PCBs")

These MCLs were promulgated in January 3, 1989, and therefore no longer "to-be-considered", but are ARARs for the ground water at the site.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION II
26 FEDERAL PLAZA
NEW YORK, NEW YORK 10278

JUL 27 1988

EXPRESS MAIL

William L. Warren
Cohen, Shapiro, Polisher, Sheikman & Cohen
997 Lenox Drive - Building 3
Lawrenceville, New Jersey 08648

Re: SCP-Carlstadt Site Remedial Investigation/
Feasibility Study

Dear Mr. Warren:

Attached you will find a document entitled "Identification of ARARs for Developing Remedial Alternatives", prepared by EBASCO for EPA. This document identifies potential ARARs for the SCP-Carlstadt site, and should be utilized by Dames & Moore in the completion of the Feasibility Study.

EPA is in the process of finalizing comments on the Draft Remedial Investigation Report, the first two chapters of the Feasibility Study, and the proposed Revision to the Project Operations Plan. These comments will be forwarded to you shortly. At that time, EPA will provide you with a revised schedule for completion of the Feasibility Study.

If you have have any questions regarding the attached document please feel free to call me or James Rooney of the Office of Regional Counsel.

Sincerely yours,

Janet C. Feldstein, Environmental Engineer
Site Compliance Branch

Attachment

cc: Tom Armstrong, General Electric w/attachment
Medhat Reiser, Nepera "
Gerard Coscia, Dames & Moore "
Pamela Lange, NJDEP "

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SCP SITE

IDENTIFICATION OF ARARS FOR DEVELOPING REMEDIAL ALTERNATIVES

INPUT FOR FEASIBILITY STUDY

This paper identifies the requirements that appear to be "applicable or relevant and appropriate" to the SCP site cleanup effort. Applicable or relevant and appropriate requirements (ARARs) are used in the feasibility study process to evaluate the performance of remedial alternatives during detailed evaluation. An ARAR refers to any federal or state law or promulgated requirement that is either directly applicable, or addresses problems that are sufficiently similar to the hazardous substance, action, or location of a CERCLA site. Applicable requirements are not differentiated from relevant and appropriate requirements because, when used to assess remedial alternatives' performance, each is given equal weight and consideration.

As its definition suggests, an ARAR can be grouped as:

- (1) contaminant-specific;
- (2) action-specific; or
- (3) location-specific:

Contaminant-specific ARARs set health- and risk-based concentration limits in various environmental media for specific hazardous substances or contaminants. An action-specfic ARAR sets performance, design, or operating controls on particular remedial actions. A location-specific ARAR sets restrictions on the conduct of activities in particular locations (such as wetlands, floodplains, and national historic districts) or for environmental features, such as endangered species.

This paper also identifies material that may be considered for evaluating remedial alternatives when an ARAR does not exist for a contaminant or action or does not ensure a protective remedy. While not legally enforceable, "to be considered" material may provide cleanup standards or recommended procedures that explain or amplify the content of ARARs. State and federal guidance documents are examples of "to be considered" material. State promulgated requirements that are area-specific (i.e., not applicable statewide) also are treated as "to be considered" materials.

Contaminant-specific ARARS are used to establish cleanup criteria for remedial action in the context of EPA's mandate to protect human health, welfare and the environment. Therefore, ARARs must be evaluated to determine the level of protectiveness they provide before being applied to site cleanup. These

evaluations are performed in a risk assessment analysis, as defined by the Superfund Public Health Evaluation Manual (October 1986). If ARARs are determined to be unprotective, then risk-related factors established by the risk assessment will be used in their place.

1.0 CONTAMINANT-SPECIFIC ARARs

The following section identifies the contaminant-specific ARARs that are likely to exist for the SCP site based on the contaminants detected to date and identified in Table 2 of the Dames and Moore, "Draft Remedial Investigation Report," April 18, 1988. The section is organized according to the following media-specific ARARs: (1) ground water and surface water; (2) air; and (3) soil and sediments.

The section discussion is further broken down into federal and state ARARs. Generally speaking, state ARARs should be used where they are at least as or more stringent than the federal ARAR-equivalent. In addition, if more than one ARAR exists for a contaminant, the more stringent one should be used unless exposure pathways or other site-specific conditions dictate otherwise.[1]

1.1 Ground Water and Surface Water

Federal

- Safe Drinking Water Act (SDWA) - Maximum Contaminant Levels (MCLs) (40 CFR 141.11-.16)

SDWA MCLs establish safe levels for 31 contaminants in drinking water, including 14 compounds adopted as RCRA Maximum Concentration Limits (MCLs) (see "New Jersey Criteria for Ground Water Protection and Response"). SDWA MCLs reflect health factors and the technical and economic feasibility of removing contaminants from the water supply.

SDWA MCLs would establish design endpoints for SCP remedial alternatives where surface water or ground water is or may be used for drinking. Table 1.1 presents the SDWA MCLs for identified SCP chemicals. New Jersey has proposed MCLs that may be more stringent than Federal MCLs for some contaminants and should be evaluated instead when they become finalized (see Section 4.1, "To Be Considered" Material).

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(1) EPA's Interim Guidance on Compliance with ARARs ("Interim Guidance"), 52 Federal Register 32496, August 27, 1987.

- o RCRA Groundwater Protection Standards (40 CFR 264, Subpart F)

The groundwater protection standards establish maximum concentration limits (MCLs) for Appendix VIII contaminants in the uppermost aquifer underlying a waste management area for permitted RCRA treatment, storage and disposal facilities. New Jersey codified these requirements in their own administrative code as the "New Jersey Criteria for Groundwater Protection and Response" (see separate entry below).

- o Clean Water Act (CWA) - Water Quality Criteria (WQC) (CWA Section 304)

WQC are levels of contaminant concentrations in ambient surface water and ground water that would not result in adverse human health effects, or in the case of suspected carcinogens, are associated with cancer risk range of 10-6. WQC are provided to allow states to develop water quality standards based on state-specific surface water use and features. WQC are expressed in units of contamination per liter for three human exposure pathways: fish and water, fish only, and water only (derived). WOC are also expressed in concentrations considered protective of aquatic life. These concentrations should be used if there is a need to protect aquatic life in surface water.

WQC could be used as design endpoints for groundwater treatment systems at the SCP site, if water use at the site and vicinity corresponds to exposure pathway assumptions of the WQC. Based on the likely human exposure routes that exist in the area surrounding the SCP site (i.e., Berry's Creek runs through a residential area, making human consumption of contaminated fish and water possible), the WQC for fish and water ingestion should be used. Table 1.2 provides the human health WQC criteria for the SCP-identified chemicals. Because the Agency is still formulating its position concerning the use of WQC for human health evaluation, SDWA MCLs and state groundwater quality standards should be used where they are available.

<u>State of New Jersey</u>

- o New Jersey Groundwater Quality Standards (N.J.A.C. 7:9-6)

The groundwater quality standards provide cleanup levels for ground water classified as GW1 to GW4 based on total dissolved solids (TDS). Ground water underlying the SCP site is classified as GW2[2]. Table 1.3 provides the criteria levels for SCP

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(2) NJDEP has indicated that the groundwater underlying the site is classified as GW2, however no conclusive determination has yet been made.

contaminants based on a groundwater classification of GW2. For most chemicals, the GW2 standard is equivalent to the RCRA MCL and SDWA MCL. When they are not the same, the more stringent standards should be used (i.e., GW2 standard for endrin is 0.004 ug/l compared to the SDWA MCL of 2×10^{-4} mg/l).

- New Jersey Surface Water Quality Standards (N.J.A.C. 7:9-4)

The New Jersey Surface Water Quality Standards provide maximum concentrations of hazardous substances for various surface water classifications (e.g., FW2, SE, and SC waters). Surface water at the SCP site (e.g., Berry's Creek and Peach Island Creek) is classified as FW2-NT/SE2[3]. Table 1.4 presents the FW2-NT/SE2 surface water quality standards for toxic substances detected at the SCP site. Other substances regulated by the surface water quality standards are chlorides, pH, suspended solids, bacteria and phosphates.

- New Jersey Criteria for Groundwater Protection and Response (N.J.A.C. 7:14A-6.15)

The New Jersey Criteria for Groundwater Protection and Response represent the codified RCRA Groundwater Protection Standards. The criteria provide four categories of not-to-be-exceeded concentration limits for hazardous waste constituents identified in N.J.A.C. 7:26-8.16: (1) state groundwater quality standards (N.J.A.C. 7:9-6) or state surface water quality standards (N.J.A.C. 7:9-4); (2) Maximum Concentration Limits (MCLs); (3) Alternate Concentration Limits (ACLs); and (4) background concentration levels. The groundwater protection program also specifies that sampling and monitoring be performed.

Generally speaking, the state groundwater/surfacewater quality standards (Table 1.3), rather than the other three categories, should be used to establish cleanup standards for the SCP site, because they are more stringent and specific to state groundwater characteristics (see separate discussion above). For many contaminants, the water quality standards are equivalent to the RCRA MCLs and SDWA MCLs. Maximum concentration limits are provided in Table 1.5. ACLs can only be used to set CERCLA

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(3) Surface Water Quality Standards Guide and Index D, Surface Water Classifications of the Passaic, Hackensack and NY Harbor Complex Basin, July 1985. FW2/SE2 indicates there may be a salt/freshwater interface. The point of demarcation between fresh and saline water must be determined where salinity reaches 3.5 parts per thousand at mean high tide. "NT" means non-trout producing freshwater.

cleanup levels when point of human exposure is estimated within the facility's boundary, and MCLs are not otherwise appropriate. In general, background levels should not be adopted for establishing CERCLA cleanup levels.For the SCP site, the groundwater protection standards, particularly the New Jersey Groundwater Quality Standards (N.J.A.C. 7:9-6), should be used to evaluate the alternatives in the context of the vulnerability, use and value of the contaminated ground water. To the extent that the standards would restore ground waters to their current or potential uses, such standards may be applicable to SCP site cleanup.

- NJPDES Values for Toxic Effluent Limitations (N.J.A.C 7:14A-1, Appendix F,) (Whole effluent bioassay)

The values presented in Table 1.6 are the toxic effluent limitations used to establish discharge limitations in a NJPDES permit. Remedial actions that involve the discharge of contaminated ground water or leachate would have to comply with the NJPDES toxic effluent limitations. Remedial actions involving onsite discharges to ground water or surface water do not require a permit due to the CERCLA exemption. However, substantive effluent limitations must still be met.

1.2 Air

Federal

No contaminant-specific ARARs have been identified. See Section 2, "Action-Specific ARARs."

State of New Jersey

- New Jersey Ambient Air Quality Standards (N.J.A.C. 7:27-13)

The ambient air quality standards provide maximum concentrations of suspended particulate matter in air, sulfur dioxide, carbon monoxide, ozone, lead, and nitrogen dioxide. Table 1.7 presents the concentrations for these listed contaminants. Technologies utilized during SCP site remediation that are likely to emit these contaminants to air, such as air strippers, in-situ vitrification or on-site incinerators, would have to be designed to ensure that the ambient standards are not exceeded.

1.3 Soils and sediments

No contaminant-specific ARARs exist for soils and sediments. See Section, 4.3, "To Be Considered" Material for Soil and Sediment Cleanup.

2.0 ACTION-SPECIFIC ARARS

The following section presents the ARARs that are likely to pertain to the SCP site cleanup, based on the remedial actions that could be developed to correct site contamination.

According the the Dames and Moore, "Draft Remedial Investigation Report," contamination has been detected in ground water, surface water, soils, and stream sediment. Therefore, action-specific ARARs presented below would affect technologies that could be used to remedy contaminated media.

The presentation is organized according to the following treatment types: ground water and surface water treatment, air emission treatment, general treatment, hazardous waste transport, and disposal and site closure. In addition, ARARs that protect worker safety and specify site management procedures are discussed.

Because the implementation of RCRA has been delegated to the states, all of the RCRA action-specific ARARs that may affect design of a remedial action at SCP are presented under the State of New Jersey sections. The Hazardous and Solid Waste Act (HSWA) amendments to RCRA, for which New Jersey does not have authority, are described under the federal sections.

2.1 Ground Water and Surface Water Treatment

Federal

- Clean Water Act (Section 402) - National Pollutant Discharge Elimination System (NPDES) (40 CFR Parts 122-125)

The NPDES program establishes applicable effluent standards (i.e., technology-based and/or water-quality based) for direct and indirect discharges to surface water and ground water. The NPDES program is administered by EPA and authorized State agencies (see the New Jersey Pollutant Discharge Elimination System (NJPDES) discussion below).

- SDWA Underground Injection Control (UIC) Program (40 CFR 144 - 147)

The UIC program controls the injection of fluids through wells into underground aquifers. The purpose of the UIC program is to protect drinking water sources. The substantive requirements of the UIC program include RCRA manifest and corrective action requirements, well construction requirements, and well operation and closure requirements. In addition, if the fluid to be injected is classified as a RCRA hazardous waste, it must be treated according to Best Demonstrated Available Technology

(BDAT) prior to injection. RCRA-restricted waste at CERCLA sites must attain treatment levels or be subject to one of several variances before being disposed of in certain aquifers.

The UIC program ARAR would pertain to the SCP site if a groundwater treatment system were selected that involved reinjection of pumped/treated ground water to aquifers.

State of New Jersey

- New Jersey Pollutant Discharge Elimination System (NJPDES) (N.J.S.A. 58:10A-1)

The NJPDES program establishes applicable effluent standards (i.e., technology-based and/or water quality-based) for direct and indirect discharges to surface water, ground water and land. Technology-based effluent limitations have to be imposed on a case-by-case basis. Water quality-based limits include toxic and pretreatment standards (such as pretreatment standards for discharge into publicly-owned treatment works), water quality criteria, state water quality standards and NJPDES toxic effluent limits. (See separate entries under Section 1.0, "Contaminant-Specific ARARS.")

The NPDES program would apply to any remedial action that involves the direct discharge of treated or untreated ground water or liquid wastes, indirect stormwater runoff, underground reinjection of contaminated ground water, land application of sludge, rapid infiltration, and disposal of surface dredge spoils. (see NJPDES values for toxic effluent limits).

- Permit to Divert Surface or Subsurface Waters (Non-agricultural) (N.J.A.C. 7:19)

Actions involving water diversion from surface waters or ground waters in excess of 100,000 gallons per day (70 gallons per minute) must obtain a water allocation permit. CERCLA actions that involve onsite water diversion must comply with the substantive requirements of this regulation, but are exempt under CERCLA from administrative requirements.

- Well Drilling and Pump Installers Licensing Act (N.J.A.C. 7:8-3.11)

Any drilling, boring, coring or excavation of wells must be permitted. In addition, a licensed well driller must supervise the construction of all wells. CERCLA actions involving well drilling must receive the prior approval of the New Jersey DEP.

2.2 Air Emission Treatment

Federal

- Clean Air Act National Emission Standards for Hazardous Waste Air Pollutants (NESHAPs) (40 CFR Part 61)

The Clean Air Act NESHAPs establishes emission standards for mercury, vinyl chloride, arsenic, and benzene (fugitive). These emission standards apply to specific facilities or processes. In addition, the NESHAPs establish fugitive emission standards for general sources emitting hazardous air pollutants, which contain performance standards and repair schedules for various equipment.

To the extent that remedial actions selected for the SCP site resemble the processes listed in the NESHAP standards, the standards would be appropriate for use as design endpoints. Remedial technologies that might be subject to NESHAPs include, but are not limited to, air strippers, in-situ vitrification and incinerators. The fugitive emissions standards would pertain to any remedial action selected, including surface impoundments (i.e., evaporation), that potentially release contamination to air.

State of New Jersey

- New Jersey Air Permit Requirements (N.J.A.C. 7:27-8)

The air permit requirements state that emissions of organic substance (VOS) from waste or water treatment equipment must be calculated based on loading. Treatment equipment includes, but is not limited to, air strippers, aeration basins, and lagoons. Exemptions apply depending on type of equipment, VOS concentration and treatment capacity.

- New Jersey Control and Prohibition of Air Pollution by Toxic Substances (N.J.A.C. 7:27-17)

The New Jersey toxic emission standards control the storage, transfer, use and discharge of toxic volatile organic substances (TVOS). Any emission of toxic substances must be registered with the New Jersey DEP. No numerical emission standards exist. This regulation also sets the standard for using the lowest allowable rate whenever a TVOS is subject to the provisions of one or more New Jersey air standard. Chemicals detected at SCP that are contained in this regulation include benzene, chloroform, 1,1,2-trichloroethane, tetrachloroethylene, and trichloroethylene.

These standards would apply to any remedial alternative having air emissions, such as air strippers, surface impoundments (i.e., evaporation), in-situ vitrification and incinerators.

- New Jersey Regulations for Volatile Organic Substances (N.J.A.C. 7:27-16)

The New Jersey volatile organic substance (VOS) regulations control the storage, transfer, and emission of VOS from source operations. The maximum allowable emission level is expressed as a percentage of process emissions by weight. The maximum allowable emission levels range from 8 to 15 percent of process weight emissions, except for source operations with very high vapor pressure ranges, which have much lower allowable levels.

Any remedial action taken at SCP that would involve the release of VOS to air would be subject to these emission rates.

- New Jersey Regulations on Incinerators (N.J.A.C. 7:27 - 11)

The New Jersey regulations on incinerators specify contruction methods, particle emission standards for ash, and opacity standards. The regulations would require that a permit be obtained prior to construction. The contruction/operation of an incinerator as part of a CERCLA response must only adhere to the substantive permit requirements.

The use of an onsite incineration to treat hazardous waste at SCP would be subject to the ash emission and opacity standards.

2.3 General Treatment

- New Jersey Hazardous Waste Facility Design and Operating Requirements (N.J.A.C. 7:26 - 10.4 to 10.8 and 11.6 and 11.7)

New Jersey hazardous waste regulations provide design and operating standards for RCRA hazardous waste facilities, such as landfills, surface impoundments, or incinerators. The design requirements specify performance objectives, construction material restrictions, and liner system specifications for preventing contaminant migration to adjacent subsurface and air media. Landfills, for example, must have a double liner and leachate collection system. Incinerators must achieve certain contaminant destruction and removal efficiencies. The operating requirements state that facilities should be operated to prevent the release of contaminated material and waste migration to adjacent media. In addition, the regulations call for performing trial treatment studies.

RCRA facilities subject to these requirements that may be used to remedy the SCP are surface impoundments, tanks and containers, thermal/incineration treatment, landfills, and chemical, physical or biological treatment facilities (e.g., solidification or fixation).

2.4 Hazardous Waste Transport

Federal

- o DOT Rules for the Transportation of Hazardous Materials (49 CFR Parts 107, 171.1 - 171.500)

These regulations specify the procedures for packing, labeling, manifesting, and transporting hazardous materials from point of generation to point of treatment, storage or disposal. All transported hazardous materials must be identified with a DOT registration number.

Any remediation that calls for transport of contaminated soils, treatment residues, or dredged stream sediment would be subject to the DOT hazardous waste transport requirements.

State of New Jersey

- o New Jersey Hazardous Waste Hauler Responsibilities (N.J.A.C. 7:26 - 7)

The New Jersey hazardous waste hauler responsibilities include waste labeling, record keeping, manifesting, and applying for a license. These requirements would apply to hazardous waste transported from SCP to off-site treatment or disposal facilities.

2.5 Disposal and Site Closure

Federal

- o RCRA Land Disposal Restrictions (40 CFR Part 268)

The land disposal restrictions establish treatment standards and prohibition dates for the disposal of certain listed hazardous wastes. Currently, the land disposal restrictions are in effect for listed solvent- (F001 - F005) and dioxin- (F020-23, 26, and 27) containing wastes and "California List" wastes (e.g., liquid metals, liquid PCBs, liquid cyanides, liquid corrosives, and solid/liquid halogenated organic compounds).

Solvent-containing wastes at SCP whose extract exceeds the Table 2-1 threshold treatment levels must be treated according to best demonstrated available treatment (BDAT) until the waste

extract no longer exceeds such levels. The Toxicity Characteristic Leaching Procedure (TCLP) must be used to produce waste extracts. The following treatment technologies have been identified as BDAT for solvent-containing waste: batch distillation, thin film evaporation, incineration, steam stripping, biological treatment, carbon adsorbtion, air stripping, and wet air oxidation.

"California List" wastes at SCP whose extracts/total waste exceed regulatory threshold levels are subject to a BDAT standard or a ban on land disposal. Table 2-2 provides threshold levels pertaining to "California List" wastes; Table 2-3 provides the required BDAT for each "California List" waste that exceeds the threshold levels. Certain variances and exemptions apply to select wastes based on lack of available treatment capacity. The TCLP is used to produce waste extracts.

Among the chemicals detected at the SCP site that are regulated by the LDR are certain solvents, (e.g., tetrachloroethylene, trichloroethylene, methyl chloride, toluene, chlorobenzene, and 1,1,1-trichloroethane), and "California List" wastes (e.g., numerous metals, and liquid PCBs). Preliminary site data indicate that all these chemicals have contaminated the ground water. In addition, an on-site tank storing sludges reportedly contains PCBs (PCB sludges may test as liquid). Disposing of likely PCB sludges and pumping of contaminated ground water may generate restricted hazardous waste, and therefore may necessitate TCLP testing to determine whether treatment may be required prior to land disposal.

- TSCA Storage and Disposal of PCB Wastes (40 CFR 761.60 - 761.79)

This regulation requires that wastes containing PCBs in excess of 50 ppm be disposed of in a chemical landfill, incinerated, or by another method with equivalent destruction efficiencies. Site investigation indicates that contaminated soils/stream sediment contains PCBs in excess of 50 ppm, therefore site cleanup will be subject to the disposal methods identified above. The sludge in the on-site tank may also contain PCBs in excess of 50 ppm. (see Section 4.3, "To be Considered" Material for Soil/Sediment Cleanup).

- National PCB Spill Cleanup Policy (52 Federal Register 10688)

This policy establishes cleanup levels for new spills of PCB material in restricted and unrestricted land use areas. EPA does not intend that these requirements automatically affect PCB cleanup levels established for CERCLA cleanups, because CERCLA sites involve old spills that may pose different cleanup criteria.

State of New Jersey

- New Jersey Hazardous Waste Facility Closure/Post-Closure Requirements (N.J.A.C. 7:26)

The hazardous waste closure and post-closure regulations provide general and facility-specific closure/post-closure requirements.

Closure/post-closure requirements are provided for tanks, containers, surface impoundments, landfills, and other facilities. Generally speaking, wastes must be removed from facilities at closure and facilities decontaminated. For landfills, in which waste remains on site, final liner and cover requirements apply. For wastes that will remain on site (i.e., disposed of on site), a final cover must be designed to (1) provide long-term minimization of contaminated liquids' migration; (2) function with minimum maintenance over the long-term; (3) promote drainage and minimize erosion or abrasion of the cover; (4) accomodate settling and subsidence so that the cover's integrity is maintained; and (5) have a permeability of less than or equal to exponent 1×10^{-7} centimeters per second. In addition, leachate collection systems must be operated until leachate is no longer detected.

If the SCP site remedy involves the use of hazardous waste facilities, such a surface impoundments, tanks/containers, solidification/fixation equipment, the facility-specific closure requirements would be appropriate. In addition, any on-site disposal of contaminated soils at SCP would be subject to the final cover requirements described above.

- Soil Erosion and Sediment Control Plan Certification (N.J.S.A. 4:24-1)

Plan certification is required for projects which disturb more than 5,000 square feet of surface area of land. The plan must address soil erosion and sediment control measures for any excavation or closure activities that would occur during site remediation.

2.6 Worker Safety and Site Management

Federal

- Occupational Safety and Health Standards for Hazardous Response Contractors (29 CFR 1926)

The OSHA standards for hazardous response contractors establish worker safety and health program goals for CERCLA cleanups. Broadly speaking, a health and safety program must identify site hazards and procedures for mitigating these hazards; provide training and medical surveillance; provide protective equipment

and engineering controls to ensure that maximum permissable exposure limits are not exceeded; inform subcontractors of risks involved; decontaminate employees and equipment; and prevent accidental collapse of site excavations in which employees work. In addition, contractors involved in hazardous waste remediation must be registered with the State of New Jersey.

- o TSCA Recordkeeping, Reporting and Marking of PCB Equipment (40 CFR 761.40-761.79)

These regulations specify procedures for recordkeeping, reporting, and marking of PCB material and equipment for receipt at incinerators and chemical landfills. Any on-site chemical landfilling or incineration of PCB-containing waste would be subject to these adminitrative requirements.

State of New Jersey

- o New Jersey's Hazardous Waste Facility Requirements - General (N.J.A.C 7:26 Subchapter 9)

The general hazardous waste facility treatment standards require the development of waste analysis, preparedness and prevention, contingency and emergency plans. In addition, facilities must keep site activity records, provide 24-hour site security, perform site inspections, and train personnel. All RCRA treatment, storage, and disposal facilities are required to satisfy these requirements prior to obtaining an operating permit.

The final remedy selected at SCP would have to demonstrate that the plans and procedures described above would be performed as a matter of remedy implementation.

3.0 LOCATION-SPECIFIC ARARs

The following section presents the ARARs that likely pertain to the SCP site based on the SCP site's location in a floodplain and wetland. Also note that the site is within the jurisdiction of the Hackensack Meadowlands Development Commission. The section is organized according to federal and state location-specific ARARs.

Federal

- Executive Orders on Floodplain Management and Wetlands Protection (CERCLA Floodplain and Wetlands Assessments- E.O. 11988 and 11990)

The floodplain management and wetlands protection Executive Orders require federal agencies to assess the potential effects

of actions they take in a floodplain or wetland area. Agencies must demonstrate that any remedial action taken in a wetland or floodplain is the only practical alternative. In addition, the agency must show that the potential negative effects are minimal and must describe any steps necessary to prevent degradation of natural or beneficial values of floodplains or wetlands.

The SCP site is located in a Class IV wetland, although the site itself is filled, and therefore, not presently a wetland. Excavation of contaminated soils might impact the surrounding wetland. To comply with the Executive Orders, excavation may have to be backfilled, graded to its original grade and revegetated. In addition, erosion, sedimentation, and resuspension of sediments may have to be mitigated. To the extent that removal or remedial actions impact the surrounding wetlands, the Agency may be required to complete an assessment. In all cases, the Agency must document remedial action decisions in a Statement of Finding and Record of Decision. In addition, if the selected removal action is scheduled to extend beyond 45 days, a formal community relations plan must be developed.

- Clean Water Act Section 404 Requirements

Section 404 gives the Army Corps of Engineers authority to isssue permits for disposal or discharge of dredged or fill material to waters of the U.S., including isolated wetlands. Factors the Corps may use to evaluate whether or not to issue a permit include conservation considerations, economic values, recreation values, effects on shoreline or wetlands, fish and wildlife values, human health and welfare, and municipal water supply impacts. Under Section 404 (b)(1) guidelines (40 CFR 230.10(b)(c)), dredged or fill material may not be allowed to be discharged or disposed of if such action would violate toxic effluent standards under the CWA 307 or state water quality standards, or if there is a practical alternative to the proposed discharge that would have less adverse impact on the aquatic ecosystem.

To the extent that remedial action involves discharge of dredged material in wetlands; capping; or construction of berms, levees, and drains, it will be subject to Section 404 permit conditions.

<u>State of New Jersey</u>

- General Standards for Permitting Stream Encroachment (Flood Hazard Area Control Act Requirements N.J.S.A. 58: 16A-50) (N.J.A.C. 7:8-3.15)

These standards control soil erosion and sediment movement caused by construction or alteration of any structure or

permanent fill along a stream or in flood plain area. Remedial action at SCP site that consists of soil excavation in or near the stream bed would be subject to these requirements.

- o Hackensack Meadowlands Development Commission (HMDC) Zoning/Land Use/Environmental Requirements (N.J.A.C. 19:4)

The HMDC has lead responsibility for managing the Hackensack Meadowlands District (HMD) (boundaries are prescribed in the Hackensack Meadowlands Reclamation Act (N.J.S.A. 13:17-A et seq)). The HMD areas that lie within the coastal zone boundaries are treated differently than other parts of the coastal zone. Land use in the HMD is controlled by the Master Plan Zoning Ordinance Requirements (latest revision on June 20, 1988), which are compatible with the CZMA while reflecting the HMDC's mandate for business development. The HMDC is empowered to review and regulate construction plans to ensure the protection of wetland/estuary areas.

The SCP site is within the HMDC jurisdiction. HMDC requirements may be ARARs for detailed evaluations of remedial alternatives, particularly with regard to activities that would effect water quality of Peach Island Creek and wetland areas.

- o Coastal Zone Management Act (CZMA) of 1972 (16 U.S.C. 1451)

The Coastal Zone Management Act controls the use and activities performed in designated coastal areas. Most CERCLA remedial actions that would be taken in coastal areas are considered to be consistent with coastal zone restrictions; although consistency determinations must be sought.(4) CERCLA actions that do not properly mitigate coastal area impacts could be in conflict with the coastal zone requirements. See also Hackensack Meadowlands Development Commission requirements.

- o The Freshwater Wetlands Protection Act of 1987 (N.J.S.A. 13:98-1)

The Freshwater Wetlands Protection Act requires the permitting of activity in and around freshwater wetlands. It is likely that these provisions would apply, because Peach Island Creek may be classified FW2. Regulated activity includes removal, excavation, disturbance, or dredging of soil; disturbance of

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(4) Mr Bob Hargrove, Environmental Impacts Branch, U.S. E.P.A Region II at "CERCLA/SARA Environmental Review Seminar," April 15, 1988.

water table; dumping, discharge or filling; and driving of pillings; among others. Any remedial action selected for SCP site that employs one of these activities would be subject to these requirements, which become effective July 1, 1988.

4.0 "TO BE CONSIDERED" MATERIAL

The following section presents material that may need to be considered when developing and evaluating remedial alternatives at the SCP site. "To be considered" material is presented according to the the media it addresses.

4.1 Ground Water and Surface Water

Federal

- Safe Drinking Water Act Maximum Contamination Level Goals (MCLGs)

MCLGs are non-enforceable drinking water standards for 9 contaminants. EPA has proposed MCLGs for an additional 40 contaminants (40 FR 46936). MCLGs would result in no known or anticipated adverse health effects. For carcinogens, the MCLGs are set at zero.

MCLGs would be pertinent to the SCP site cleanup if multiple exposure pathways existed or other significant threats were identified.

- EPA Drinking Water Health Advisories

EPA drinking water health advisories are non-enforceable guidelines for drinking water suppliers that are protective of the most sensitive pupulation members. Health advisories are calculated to reflect the consumption and toxicological chracteristics for children and adults for various exposure durations. The advisories should be evaluated if indicator chemicals detected at SCP lack ARARs.

- EPA Health Effects Assessments (HEAs) and Toxicological Profiles

EPA's Office of Research and Development has published Health Effects Assessments (HEAs), which provide an analysis of toxicological and cancer potencies for about 60 chemicals. The toxicological profiles, which are currently under development, will update HEA analysis and reflect additional analysis for new chemicals. According to current schedule, the toxicological profiles should be finalized by early 1989.

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- EPA's Groundwater Classification Guidelines and Protection Strategy

EPA's Groundwater Classification Guidelines may be used to guide the application of contaminant-specific ARARs. Ground water is grouped into one of three classes depending on its potential for use as drinking water. The strategy states that SDWA MCLS are appropriate to use to protect ground water that is classified as a current or potential drinking water source.

State of New Jersey

- Interim Action Levels for Selected Organics in Drinking Water, January 1986

This guidance provides concentration ranges of hazardous contaminants detected in drinking water that trigger response action. The concentration ranges are health based levels. They are derived from Suggested No Adverse Response Levels or "SNARLS", maximum contaminant level goals, and risk assessment results. The response actions are divided into four levels: (1) Level I- no action; (2) Level II - sampling and monitoring; (3) Level III - sampling, monitoring, and treatment or new water system within one year; (4) Level IV - sampling, monitoring, and immediate remedial action. The interim action levels contained in this guidance will be replaced by maximum contaminant levels (proposed December 7, 1987 and expected to go final by early Fall 1988). Table 4.1 provides the interim action concentration levels and appropriate level responses.

- Interim Groundwater Cleanup Guidance (1986)

Table 4.4 contains the groundwater cleanup levels for specific chemical compounds provided by the guidance. Where a federal or state MCL exists for a chemical compound, the more stringent applies. In no case should the concentration of the sum of all compounds listed in Table 4-4 exceed 50 ppb in ground water.

- SCP Site-Specific Groundwater Cleanup Levels (July 9, 1988, NJDEP)

The groundwater cleanup levels provided in Table 4.5 were provided by NJDEP for the SCP-identified compounds listed in the Dames and Moore Report, "Draft Remedial Investigation," April 18, 1988. Although in many cases the NJDEP levels complement those contained elsewhere in ARARs or other "to be considered" material, they may be more stringent in some cases.

- New Jersey's Proposed Maximum Contaminant Levels for A-280 Chemicals (December 7,1987)

New Jersey's proposed Maximum Contamination Levels would replace the "Interim Action Levels for Hazardous Contaminants in Drinking Water" that were established as guidelines. The proposed MCLs were selected based on the principle that the health-based level should be the MCL unless the health-based level was below the practical quantitation level (PQL). In those cases, the MCL was set at the PQL. The proposed New Jersey MCLs are at least as or more stringent than the proposed federal MCLs.

When finalized, the New Jersey MCLs should be used to establish the drinking water cleanup standards for particular contaminants at the SCP site cleanup, because they are more stringent than the proposed federal MCLs. Table 4.2 provides the list of proposed New Jersey MCLs.

4.2 Air

- Proposed Air Emission Standards for Treatment, Storage and Disposal Facilities (52 Federal Register 3748, February 5, 1987)

EPA has proposed to regulate air emissions from certain equipment employed in volatile hazardous air pollutant (VHAP) service. To be regulated, VHAP equipment must contain or be in contact with liquids, gases or emissions from hazardous waste in concentrations greater than 10% organics by weight. VHAP equipment include process accumulator vessels, such as air strippers. The proposed standard would require that VHAP equipment have a closed-vent system capable of capturing and transporting any leakage to a control device designed and operated to achieve at least 95% emission reduction.

Remedial actions that employ air strippers would be subject to these requirements once they are finalized.

4.3 Soils and Sediments

The NJDEP soil cleanup approaches described in this section are pertinent only to upland soils. Development of cleanup levels for aquatic/estuarine sediments in Peach Island Creek or Berry's Creek should utilize EPA risk assessment approaches based upon Clean Water Act Water Quality Criteria for the parameters of concern.

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- New Jersey Department of Environmental Protection, Summary of Approaches to Soil Cleanup Levels

This guidance presents New Jersey DEP's theoretical approach to establishing cleanup objectives for contaminated soil. The theoretical approaches are discussed in the context of the DEP's overall objective for establishing soil cleanup levels:

- Protect humans from direct contact;
- Protect ground water from degradation due to leaching
- Protect surface water when migration of contaminated soil to surface water is possible.

Actual applications of the five approaches are discussed to provide further guidance on what the DEP believes are acceptable uses.

The four approaches discussed include cleanup based on: (1) background concentrations; (2) analytical detection limits; (3) risk assessment methodology; (4) surrogate or action levels; and (5) chemical class cleanup objectives. New Jersey suggests that background only be applied to contaminants that exist in nature.

Background contamination levels for inorganic compounds have been developed using specific site or literature values. The cleanup levels for inorganic compounds are generally 1 to 3 times background depending on range of concentration and toxicity observed. Table 4.3 presents New Jersey background, U.S. background, and suggested soil cleanup objectives for inorganic metals detected at SCP. Cleanup of inorganics in soil at the SCP site should achieve these levels. "Industrial" background for petroleum hydrocarbons is identified as 100 ppm. The objectives also provide a PCB soil cleanup level range of 1-5 ppm (7/19/88 transmittal from NJDEP to U.S. EPA).

The use of analytical detection limits results in cleanup levels at non-detectable limits. Analytical detection limits have been used to set cleanup levels for anthropogenic compounds, (i.e., those that do not occur naturally at the site). Therefore, this approach could be used to set soil cleanup levels for SCP chemicals for which alternative soil cleanup levels cannot be established.

The risk assessment methodology approach has been used to establish soil cleanup levels for organic compounds. A soil cleanup level should be developed to protect humans from direct contact and to protect ground water and surface water quality. If the risk-based cleanup level is below the detection limit,

then the detection limit becomes the cleanup level. A risk-based PCB soil cleanup level, which does not exceed a one-in-a-lifetime cancer risk, was calculated as 274 ppb. Because the current detection limit is approximately at 5 ppm, the acceptable soil contaminant level is 5 ppm (based on analytical methods). The risk assessment approach is recommended for establishing soil cleanup standards for PCBs, solvents (e.g., toluene and benzene), phenols, and phthalates, which were detected at SCP site.

The use of the risk assessment approach is limited by the adequacy of site data for characterizing the frequency and duration of exposure pathways. Although the department acknowledges the tendency for a risk assessment approach to overprotect the environment, it prefers using reasonable worst case exposure scenarios to protect the most sensitive individual likely to be exposed.

The chemical class cleanup objective approach for establishing soil cleanup levels is best applied for triggering additional analysis. Therefore, its use for establishing cleanup levels in soil at the SCP site is limited.

Finally, the surrogate or action level approach has been used for volatile organics, base neutrals and petroleum hydrocarbons. Like the chemical class cleanup approach, it is best applied for triggering additional analysis, such as risk assessment or determination of background levels). Moreover, in the absence of other soil cleanup standards, the action levels may be used. The following scale applies:

Volatile Organics	1 ppm
Base Neutrals	10 ppm
Petroleum Hydrocarbons	100 ppm

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TABLE 1.1

SAFE DRINKING WATER ACT (SDWA)
MAXIMUM CONTAMINANT LEVELS
(MCLs)

CHEMICAL NAME	MCL (mg/l)
Arsenic and Compounds	5.0×10^{-2}
Benzene	5.0×10^{-3}*
Cadmium and Compounds	1.0×10^{-2}
Chloroform	1.0×10^{-1}
Chromium VI and Compounds	5.0×10^{-2}
1,2-Dichloroethane	5.0×10^{-3}*
1,1-Dichloroethylene	7.0×10^{-3}*
Endrin	2.0×10^{-4}
Fluorides	4.0
Lead and Compounds (Inorganic)	5.0×10^{-2}
Mercury and Compounds (Inorganic)	2.0×10^{-3}
Methoxychlor	1.0×10^{-1}
Nitrate (as N)	$1.0 \times 10^{+1}$*
Selenium and Compounds	1.0×10^{-2}
Silver and Compounds	5.0×10^{-2}
1,1,1-Trichloroethane	2.0×10^{-1}
1,1,2-Trichloroethane	2.0×10^{-1}*
Trichloroethylene	5.0×10^{-3}*
Vinyl Chloride	2.0×10^{-3}*

* Proposed (Federal) as of 2/1987

TABLE 1.2 (Sheet 1 of 3)

CLEAN WATER ACT (CWA)

WATER QUALITY CRITERIA (WQC)

FOR PROTECTION OF HUMAN HEALTH

CHEMICAL NAME	WATER AND FISH INGESTION (Units per Liter)	FISH CONSUMPTION ONLY (Units per Liter)
Acenapthene (Organoleptic)*	20 ug	20 ug
Aldrin	0.074 ng	0.079 ng
Antimony and Compounds	146 ug	45,000 ug
Arsenic V and Compounds	2.2 ng	17.5 ng
Arsenic III and Compounds	-	-
Benzene	0.66 ug	40 ug
Benzidine	0.12 ng	0.53 ng
Beryllium and Compounds	5.9 ng	117 ng
Cadmium and Compounds	10 ug	-
Chlorinated Benzenes	488 ug	-
Chloroform	0.19 ug	15.7 ug
Chromium III and Compounds	170 mg	3,433 mg
Cyanide	200 ug	-
Dichlorobenzenes	400 ug	2.5 mg
1,2-Dichloroethane	0.94 ug	243 ug
Dichloroethylenes*	0.033 ug	1.85 ug
2,4-Dichlorophenol	3.09 mg	-
Dieldrin	0.071 ng	0.078 ng

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TABLE 1.2 (Sheet 2 of 3)

CLEAN WATER ACT (CWA)
WATER QUALITY CRITERIA (WQC)
FOR PROTECTION OF HUMAN HEALTH

CHEMICAL NAME	WATER AND FISH INGESTION (Units per Liter)	FISH CONSUMPTION ONLY (Units per Liter)
DDT	0.024 ng	0.204 ng
Endosulfan	74 ug	159 ug
Eldrin	1 ug	-
Ethyl benzene	1.4 mg	3.25 mg
Fluoranthene	42 ug	54 ug
Isophorone	5.2 mg	520 mg
Lead and Compounds (Inorganic)	50 ug	-
Mercury and Compounds (Inorganic)	144 ng	146 ng
Methoxychlor	100 ug	-
Nickel and Compounds	13.4 ug	100 ug
Nitrobenzene	19.8 mg	-
Phenol	3.5 mg	
PCBs	0.079 ng	0.079 ng
Selenium and Compounds	10 ug	-
Silver and Compounds	50 ug	-
1,1,2,2-Tetrachloroethane	0.17 ug	10.7 ug
Tetrachloroethylene	0.8 ug	8.85 ug
Thallium and Compounds	13 ug	48 ug

TABLE 1.2 (Sheet 3 of 3)

CLEAN WATER ACT (CWA)
WATER QUALITY CRITERIA (WQC)
FOR PROTECTION OF HUMAN HEALTH

CHEMICAL NAME	WATER AND FISH INGESTION (Units per Liter)	FISH CONSUMPTION ONLY (Units per Liter)
Toluene	14.3 mg	424 mg
1,1,1-Trichloroethane	18.4 mg	1.03 mg
1,1,2-Trichloroethane	0.6 ug	41.8 ug
Trichloroethylene	2.7 ug	80.7 ug
Vinyl Chloride	2 ug	525 ug

* Criteria designated as organoleptic are based on taste and odor effects, but not human effects. Health-based WQC are not available for these chemicals.

Source: "Water Quality Criteria, May 1, 1987; Office of Water, Regulation and Standards, USEPA 440/5-86-001.

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TABLE 1.3

NEW JERSEY GROUNDWATER
QUALITY STANDARDS FOR GW2
(NJAC 7:9-6)

CHEMICAL NAME	PRIMARY	SECONDARY
Arsenic and Compounds	0.05 mg/l	-
Aldrin/Dieldrin	0.003 ug/l	-
Benzidine	0.0001 mg/l	-
Cadmium and Compounds (Hexavalent)	0.01 mg/l	-
Chromium and Compounds	0.05 mg/l	-
DDT and Metabolites	0.001 ug/l	-
Endrin	0.004 ug/l	-
Lead and Compounds	0.05 mg/l	-
Mercury and Compounds	0.002 mg/l	-
Cyanide	0.2 mg/l	-
Phenol	3.5 mg/l	.3 mg/l
PCBs	0.001 ug/l	-
Selenium and Compounds	0.01 mg/l	-
Silver and Compounds	0.5 mg/l	-
Copper	-	1.0 mg/l
Fluoride	-	2.0 mg/l
Oil and Grease and Petroleum Hydrocarbons	-	none noticeable
Zinc and Compounds	-	5.0 mg/l

TABLE 1.4

NEW JERSEY SURFACE WATER
QUALITY STANDARDS (WQS)
(NJAC 7:9-4)

CHEMICAL NAME	WQS (ug/l)	CLASSIFICATION
Petroleum Hydrocarbons and other oil and grease	None noticeable in water or deposited along shore or on aquatic substance in quantity detrimental to natural biota	All
Aldrin/Dieldrin	0.0019	All
Arsenic	50.	FW2
Benzidine	0.1	All
Cadmium	10.0	FW2
Chromium	50.0	FW2
DDT and Metabolites	0.0010	All
Endosulfan	0.056	FW2
	0.0087	SE, SC
Endrin	0.0023	All
Lead	50.0	FW2
Mercury	2.0	FW2
PCBs	0.014	FW2
	0.030	SE, SC
Selenium	10.0	FW2
Silver	50.0	FW2

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TABLE 1.5

GROUNDWATER PROTECTION AND RESPONSE
MAXIMUM CONCENTRATION LIMITS
(RCRA MCLs)
(NJAC 7:14 A-6.15)

	MCLs (mg/l)
Arsenic	0.05
Cadimium	0.01
Chromium	0.05
Lead	0.05
Mercury	0.002
Selenium	0.01
Silver	0.05
Endrin	0.004 ug/l
Methoxychlor	0.1

TABLE 1.6 (Sheet 1 of 2)

NJPDES TOXIC EFFLUENT LIMITS
(NJAC 7:14 A-1 Appendix F)

TOXIC COMPOUND	MAXIMUM VALUE FOR PROTECTION OF POTABLE WATER SUPPLIES	
	10^{-6} Cancer Risk	Toxicity
Aldrin	0.074 ng/l	-
Dieldrin	0.071 ng/l	-
Antimony	-	146.0 ug/l
Arsenic (Inorganic)	2.2 ng/l	-
Benzene	0.66 ug/l	-
Benzidine	0.12 ng/l	-
Beryllium	3.7 ng/l	-
Cadmium	-	10.0 ug/l
Chloroform	0.19 ug/l	-
Chromium		
Trivalent	-	170 mg/l
Hexavalent	-	50 ug/l
Cyanide (free CN)	-	200 ng/l
DDT	0.024 ng/l	-
Dichlorobenzenes	-	400 ug/l
1,1-Dichloroethylene	0.033 ug/l	-
Endosulfan	-	74 ug/l
Endrin	-	1 ug/l
Ethylbenzene	-	1.4 mg/l
1,2-Dichloroethane	0.94 ug/l	-
1,1,1-Trichloroethane	-	18.4 mg/l
1,1,2-Trichloroethane	0.6 ug/l	-
1,1,2,2-Tetrachloroethane	0.17 ug/l	-

TABLE 1.6 (Sheet 2 of 2)

NJPDES TOXIC EFFLUENT LIMITS

(NJAC 7:14 A-1 Appendix F)

TOXIC COMPOUND	MAXIMUM VALUE FOR PROTECTION OF POTABLE WATER SUPPLIES	
	10^{-6} Cancer Risk	Toxicity
bis (3-Chloroethyl ether)	0.03 ug/l	-
Fluoranthene	-	42 ug/l
Isophorone	-	5.2 mg/l
Lead	-	50 ug/l
Mercury	-	144 ng/l
Nickel	-	13.4 ug/l
Nitrobenzene	-	19.8 mg/l
Phenol	-	3.5 mg/l
Dimethyl phthalate	-	313 mg/l
Diethyl phthalate	-	350 mg/l
Di butlyl phthalate	-	34 mg/l
PCBs	0.079 ng/l	-
Selenium	-	10 ug/l
Silver	-	50 ug/l
Tetrachloroethylene	0.8 ug/l	-
Thallium	-	1.0 ug/l
Toulene	-	14.3 mg/l
Trichloroethylene	2.7 ug/l	-
Vinyl Chloride	2.0 ug/l	-

TABLE 1.7 (Sheet 1 of 3)

NEW JERSEY AMBIENT AIR QUALITY STANDARDS

Suspended Particulate Matter

(a) Primary air quality standards are:

1. During any 12-consecutive months, the geometric mean value of all 24-hour averages of suspended particulate matter concentrations in ambient air shall not exceed 75 micrograms per cubic meter; and

2. During any 12 consecutive months, 24-hour average concentrations may exceed 260 micrograms per cubic meter no more than once.

(b) Secondary air quality standards are:

1. During any 12-consecutive months, the geometric mean value of all 24-hour averages of suspended particulate matter concentrations in ambient air shall not exceed 60 micrograms per cubic meter; and

2. During any 12-consecutive months, 24-hour average concentrations may exceed 150 micrograms per cubic meter no more than once.

Sulfur Dioxide

(a) The primary air quality standards are:

1. During any 12-consecutive months, the arithmetic mean concentration of sulfur dioxide in ambient air shall not exceed 80 micrograms per cubic meter (0.03 ppm); and

NEW JERSEY AMBIENT AIR QUALITY STANDARDS

2. During any 12-consecutive months, 24-hour average concentrations may exceed 365 micrograms per cubic meter (0.14 ppm) no more than once.

(b) The secondary air quality standards are:

1. During any 12-consecutive months, the arithmetic mean concentration of sulfur dioxide in ambient air shall not exceed 60 micrograms per cubic meter (0.02 ppm);

2. During any 12-consecutive months, 24-hour average concentrations may exceed 260 micrograms per cubic meter (0.1 ppm) no more than once; and

3. During any 12-consecutive months, three-hour average concentrations may exceed 1,300 micrograms per cubic meter (0.5 ppm) no more than once.

Carbon Monoxide

(a) The primary and secondary air quality standards are:

1. During any 12 consecutive months, eight-hour average concentrations of carbon monoxide in ambient air may exceed ten milligrams per cubic meter (9 ppm) no more than once; and

2. During any 12 consecutive months, one-hour average concentrations may exceed 40 milligrams per cubic meter (35 ppm) no more than once.

TABLE 1.7 (Sheet 3 of 3)

NEW JERSEY AMBIENT AIR QUALITY STANDARDS

Ozone

(a) The primary air quality standard is:

1. During any 12 consecutive months, daily maximum one-hour average concentrations of ozone in ambient air may exceed 0.12 ppm (235 micrograms per cubic meter) no more than once.

(b) The secondary air quality standard is:

1. During any 12 consecutive months, one-hour average concentrations of ozone in ambient air may exceed 0.08 ppm (160 micrograms per cubic meter) no more than once.

Lead

(a) The primary and secondary air quality standards are:

1. During any three consecutive months, the arithmetic mean of 24-hour averages of lead concentrations in ambient air shall not exceed 1.5 micrograms per cubic meter.

Nitrogen Dioxide

(a) The primary and secondary air quality standards are:

1. During any 12 consecutive months, the arithmetic mean concentration of nitrogen dioxide in ambient air shall not exceed 100 micrograms per cubic meter (0.05 ppm).

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TABLE 2-1

LAND DISPOSAL BAN
THRESHOLD LEVELS FOR SPENT SOLVENTS
CONSTITUENT IN WASTE EXTRACT

Spent Solvent (F001-F005)	Concentration in mg/l	
	Wastewaters	All Others
Chlorobenzene	0.15	0.05
1,2-Dichlorobenzene	0.65	0.125
Ethylbenzene	0.05	0.053
Methylene chloride (pharmaceutical industry)	12.7	0.96
Methyl ethyl ketone	0.05	0.33
Nitrobenzene	0.66	0.125
Tetrachloroethylene	0.079	0.05
Toluene	1.12	0.33
1,1,1-Trichloroethane	1.05	0.41
Trichloroethylene	0.062	0.091
Xylene	0.05	0.15

TABLE 2-2
LAND DISPOSAL BAN
"CALIFORNIA LIST" WASTES

REGULATORY LEVELS

Constituent	Specified Level	Waste Analysis Req.
Metals		
Arsenic	500 mg/l	Analysis of filtrate
Cadmium	100 mg/l	"
Chromium	500 mg/l	"
Lead	500 mg/l	"
Mercury	20 mg/l	"
Nickel	134 mg/l	"
Selenium	100 mg/l	"
Thallium	130 mg/l	"
Cyanide (free)	1,000 mg/l	"
Corrosives	pH 2.0	Analysis of total waste
PCBs	50 ppm	"
HOCs	1,000 mg/kg	"

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TABLE 2-3
LAND DISPOSAL BAN
"CALIFORNIA LIST" WASTES

TREATMENT METHODS AND EFFECTIVE DATES

Constituent	Treatment Method	Effective Date
Liquids with California List metals	BDAT not specified. Treat to below statutory levels or until no longer liquid.	7/8/87
Corrosive liquids with pH 2.0	BDAT not specified. Treat to above pH 2.0 or until no longer liquid.	7/8/87
Liquids containing free cyanides at levels 1,000 ppm	BDAT not specified. Treat to below 1,000 ppm or until no longer liquid.	7/8/87
Liquids containing PCBs from 50 ppm to 499 ppm	BDAT is incinerator or high efficiency boiler authorized under RCRA and TSCA.	7/8/87
Liquids containing PCBs 500 ppm	BDAT in incinerator authorized under RCRA and TSCA.	7/8/87
Liquid wastewaters containing HOCs between 1,000 ppm and 10,000 ppm	BDAT not specified. Treat to below 1,000 ppm. If stabilized or solidified, residual must still be under 1,000 ppm to be landfilled.	
Liquid non-wastewaters containing HOCs between 1,000 ppm and 10,000 ppm	BDAT is incinerator authorized under RCRA.	2-year variance granted until 7/8/89
Liquid non-wastewaters containing HOCs 10,000 ppm	BDAT is incinerator authorized under RCRA.	2-year variance granted until 7/8/89
Non-liquid hazardous wastes containing HOCs 1,000 ppm	BDAT is incinerator authorized under RCRA.	2-year variance granted until 7/8/89
Liquid hazardous wastes containing PCBs 50 ppm and other HOCs 950 ppm	BDAT is incinerator authorized under RCRA and TSCA.	7/8/87

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TABLE 4-1[a]

Interim Action Levels (ug/l) and Recommendations for Responses for Selected Organics in Drinking Water[b]

January, 1986

Hazardous Contaminant	Group[c]	Level I	Level II	Level III	Level IV
Benzene	A	0-0.68(1)	>0.68 ≤ 6.8	>6.8 ≤ 68	>68
Dichlorobenzene(s)	C	0-94(5)	>94 ≤ 425	>425 ≤ 750	>750(6)
1,2-Dichloroethane	A	0-0.7(7)	>0.7 ≤ 7	>7 ≤ 70	>70
1,1-Dichloroethylene	B	0.7(8)	>7 ≤ 53	>53 ≤ 100	>100(9)
Methylene Chloride	A	0-4.8(12)	>4.8 ≤ 47	>47 ≤ 479	>479
Polychlorinated Biphenyls	A	0-0.007(13)	>0.007 ≤ 0.07	>0.07 ≤ 0.7	>0.7
Tetrachloroethylene	A	0-0.67 (14)	>0.67 ≤ 6.6	>6.6 ≤ 66	>66
1,1,1-Trichloroethane	B	0-20 (15)	>20 ≤ 110	>110 ≤ 200	>200 (16)
Trichloroethylene	A	0-3.1 (17)	>3.1 ≤ 30	>30 ≤ 309	>309
Vinyl Chloride	A	0-0.015(18)	>0.015 ≤ 0.15	>0.15 ≤ 1.5	>1.5
Xylene(s)	C	0-100	>100 ≤ 550	>550 ≤ 1200	>1200(19)

SUMMARY OF RESPONSES

Level I - No recommended action, random spot check sampling.

Level II - Confirm sampling results; periodic monitoring; recommend alternative water sources and/or appropriate treatment techniques.

Level III - Confirm sampling results; monthly monitoring; develop within one year alternative water supplies and/or appropriate treatment techniques for public community water systems; recommend appropriate remedial actions to public noncommunity water systems; and quarterly progress reports from both public community and public noncommunity water systems.

Level IV - Confirm sampling results; immediate remedial action for both public community and public noncommunity water systems.

a Table 4-1 has been prepared by the Division of Water Resources and the Office of Science and Research of the New Jersey Department of Environmental Protection.

b All units in Levels I, II, III and IV are presented in micrograms per liter (ug/l) which also equals parts per billion (ppb). For the purpose of Table 1, ">" means "greater than" and "≤" means "less than or equal to". Numbers in parentheses, for example "(1)", indicate corresponding scientific references in Appendix 1 attached.

c The column title "Group" represents categorization of the listed hazardous contaminants based upon the weight of evidence of its carcinogenicity. For example, Group A refers to known or probable human carcinogens, Group B referes to possible carcinogens and Group C refers to insufficient or negative data available on carcinogenicity.

Source: Drinking Water Guidance, Interim Action Levels and Recommendations for Responses for Selected Organics in Drinking Water, January 1986.

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TABLE 4-2

PROPOSED NEW JERSEY MCLS

COMPOUND	MCL (ppb)
Benzene	1.0
Chlorobenzene	4.0
1,2-Dichloroethane	2.0
1,1-Dichloroethylene	2.0
Methylene Chloride	2.0
Polychlorinated Biphenyls (PCBs) (Total)	0.5
Tetracholorethylene	1.0
1,2-Trans-dichloroethylene	10.0
1,2,4-Trichlorobenzene	8.0
1,1,1-Trichloroethane	26.0
Trichloroethylene	1.0
Vinyl Chloride	2.0
Xylene(s)	44.0

TABLE 4.3

SOIL CLEANUP OBJECTIVES FOR INORGANIC METALS

Metal	N.J. Background[a]	U.S. Background	Cleanup Objective (ppm)	Time above NJ Background
Arsenic	N.A.	1.1 - 16.7	20	N.A.
Cadmium	1.0 - 4.0	0.01 - 1.0 ppm	3	1
Chromium	5.0 - 48	1 - 1,500	100	2
Copper	0.5 - 53.6	2 - 200	170	3
Cyanide	N.A.	0.09	12[c]	N.A.
Lead	1.0 - 180	2 - 200	250 - 1,000[c]	1-2
Mercury	N.A.	0.01 - 4.6	1	N.A.
Nickel	11.1 - 86.5	8 - 550	100	1
Selenium	0.01 - 4[b]	0.01 - 5.0	4	1
Silver	N.A.	0.01 - 5	5	N.A.
Zinc	4.5 - 168	10 - 3,000	350	2

a. Data from Stephen Toth or Harry Motto, Cook College, Rutgers University.

b. Agricultral soils in N.J.

c. Established by New Jersey Department of Health based on a 1986 study of exposure to lead in soils.

Source: New Jersey Department of Environmental Protection - "Summary of Approaches to Soil Cleanup Levels" (as of Feburary 19, 1987).

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TABLE 4.4

INTERIM GROUNDWATER CLEANUP LEVELS

Carcinogens (5 ppb)	Noncarcinogens (federal or state MCLs)
acrylonitrile	acrolein
benzene	bromoform
carbon tetrachloride	chlorobenzene
chloroform	chorodibromomethane
1,2-dichloroethane	chloroethane
1,1-dichloroethylene	2-chloroethylvinyl ether
methylene chloride	dichlorobromomethane
1,1,2,2-tetrachloroethane	1,1-dichloroethane
tetrachloroethylene	1,2-dichloropropane
trichloroethylene	1,3-dichloropropylene
vinyl chloride	ethylbenzene
1,1,2-trichloroethane	methyl bromide
	methyl chloride
	toluene
	1,2-trans-dichloroethylene
	1,1,1-trichloroethane* 200.0 ppb

* EPA proposed level applies in this case

TABLE 4.5 (Sheet 1 of 3)

GROUNDWATER CLEANUP LEVELS FOR THE SCP SITE REMEDIATION

COMPOUNDS[a]

Volatile Compounds	Cleanup Level (ppb)
Benzene	1.0
Chlorobenzene	4.0
Chloroethane	*
Chloroform	5.0
1,1 - Dichloroethane	*
1,2 - Dichloroethane	2.0
1,1 -Dichloroethylene	2.0
Ethylbenzene	*
Methylene chloride	2.0
1,1,2,2 -Tetrachloroethane	1.4
Tetrachloroethylene	1.0
Toluene	*
1,2 - Trans-dichloroethylene	10.0
1,1,1 - Trichloroethane	26.0
Trichloroethylene	1.0
Vinyl Chloride	2.0
Methyl ethyl ketone	-
m-xylene and o+p -Xylene	44.0 (total)
Acid Compounds	
2 - Chlorophenol	*
2,4 - Dichlorophenol	*
2,4 - Dimethylphenol	*
2 - Nitrophenol	*
Phenol	*
Base/Neutral Compounds	
Acenaphthene	*
Acenaphthylene	*
Anthracene	*

Source: New Jersey Department of Environmental Protection Memo to EPA (7/19/1988)

[a]This list of SCP-identified compounds was presented in the Dames and Moore Report and is based on samples collected on July and December 1987.

*Numbers to be developed

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TABLE 4.5 (Sheet 2 of 3)

GROUNDWATER CLEANUP LEVELS FOR THE SCP SITE REMEDIATION

COMPOUNDS[a]	Cleanup Level (ppb)
Base/Neutral Compounds (Cont'd)	
Benzo (a) pyrene	5.0
Benzo (b) fluoranthene	5.0
bis (2 - Chloroethyl) ether	5.0
Butyl benzyl phthalate	*
2 - Chloronaphthalene	*
Chrysene	5.0
1,2 - Dichlorobenzene	*
Diethyl phthalate	*
Dimethyl phthalate	*
Fluoranthene	5.0
Fluorene	*
Indeno (1, 2, 3 - c, d) pyrene	5.0
Isophorone	*
Naphthalene	*
Nitrobenzene	*
Phenanthrene	*
Pyrene	*
Pesticide Compounds	
Beta - BHC	-
4,4' DDT	3.5
Endosulfan I	-
Endrin	-
PCB Aroclors	
Aroclor 1242	0.5
Conventional Analysis	
Phenolics,Total	300.0
Cyanide, Total	200.0
Petroleum Hydrocarbons	ND (not detected)

*Numbers to be developed

TABLE 4.5 (Sheet 3 of 3)

GROUNDWATER CLEANUP LEVELS FOR THE SCP SITE REMEDIATION

COMPOUNDS[a]	Cleanup Level (ppb)
Metals	
Arsenic	50.0
Beryllium	-
Chromium	-
Copper	1000.0
Mercury	2.0
Nickel	-
Silver	50.0
Zinc	5000.0

*Numbers to be developed

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MAR 03 1989 UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

CERTIFIED MAIL P-545 546 783
RETURN RECEIPT REQUESTED

H. Gilbert Weil
Facility Coordinator
Union Carbide Corporation
P.O. Box 670
Bound Brook, New Jersey 08805

Re: Scientific Chemical Processing ("SCP") Site - Carlstadt, N.J.
ARAR Note No. 2: Polychlorinated Biphenyls ("PCBs")
Administrative Order Index No. II CERCLA-50114 ("the Order")

Dear Mr. Weil:

As you are aware, the data submitted to EPA in the draft Remedial Investigation report, dated September 1988 (which was prepared by the Respondents to the above Order) indicated that high levels of PCBs exist in the soil throughout the SCP Site.

PCBs were discovered in thirty (30) of thirty-four (34) soil samples taken at the Site. One soil sample even indicated the presence of PCBs at a concentration of 15,000 parts per million ("ppm") near the surface of the Site.

The highest concentrations of PCBs found at the Site were in the form of Aroclor 1242. The mean concentration of Aroclor 1242 in the unsaturated (above the water table) soil was 1416 ppm. The mean concentration of Aroclor 1242 in the saturated (below the water table) soil was 72.6 ppm. Aroclor 1242 was the most pervasive form of PCB at the Site. However, other Aroclor types, including Aroclor 1248, 1254 and 1260, were also detected in soil both above and below the water table at the Site. The presence of these other forms thereby indicates that Aroclor 1242 alone represents only a portion of the total PCB levels which exist at the Site.

An aquifer exists within a few feet of the surface of the Site. This aquifer has been classified as a Class GW2 system, i.e., as a potential potable water supply. This aquifer has, however, been and continues to be in direct contact with PCBs in soils. The aquifer is therefore a pathway for PCBs to migrate and leach from soils into groundwater. Likewise, Peach Island Creek, which adjoins the Site and in which PCBs have already been detected, can recieve both runoff of PCB laden soils and/or sediments and discharge of PCB contaminated groundwater from aquifers beneath the Site.

The groundwater data which the Respondents submitted to EPA, indicates that Aroclor 1242 levels in groundwater are at present at least four (and possibly six) orders of magnitude greater than the groundwater standard for total PCBs (0.000001 ppm PCBs) in the water table aquifer beneath the Site.

The magnitude of and the frequency with which PCBs have been detected in the soil and groundwater at the Site indicate gross and pervasive PCB contamination exists across the entire Site. The PCB data also indicates that PCBs and/or materials containing PCBs were "spilled" or otherwise released onto the soil across virtually all areas of the Site and that PCBs have already migrated down into the water table and into the soil which is in contact with the water table at almost all of the locations sampled to date.

It is also highly probable that PCBs have and will continue to migrate within and from this Site until adequate remedial measures are completed.

Please be advised that EPA - Region II has concluded that the 25 ppm total PCB cleanup requirement set forth at 40 CFR Part 761.125(c)(3)(v) must be met for all soil which exists at the SCP Site. This level (and levels lower than 25 ppm) has been and are being used as the target level for cleanups of PCBs in soil at numerous NPL Sites in EPA-Region II and throughout the country regardless of whether cleanups are being performed with federal funds or under a private party response (e.g., at Wide Beach, N.Y. (10 ppm), Burnt Fly Bog, N.J. (5 ppm), Goose Farm, N.J. (5 ppm), Renora, N.J. (5 ppm)).

Site specific risk factors or compliance with any other federal or state requirements may mandate additional treatment and/or removal to levels which are lower than the 25 ppm level stated above.

This letter revises and supersedes the entire section entitled "National PCB Spill Cleanup Policy" on page 11 of the document entitled "Identification of ARARs for Developing Remedial Alternatives" which was mailed to counsel for the Respondents on July 27, 1988 by the EPA - Region II. It does not supersede any other parts of that document which make reference to any more stringent soil cleanup levels.

The Feasibility Studies which are presently underway should immediately utilize this soil cleanup requirement in screening and assessing options for the first operable unit for the Site.

If there are any questions concerning this matter, please contact James Rooney in the Office of Regional Counsel (212-264-3297) or Janet Feldstein (212-264-0613) at your convenience.

Sincerely yours,

Raymond Basso, Chief
New Jersey Compliance Branch

cc: Thomas Armstrong, General Electric Co.
William Warren, Cohen Shapiro et al
Pamela Lange, NJDEP
Harry Yeh, EBASCO

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Appendix H
Hazardous Waste
Transport Modeling

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APPENDIX H
HAZARDOUS WASTE TRANSPORT MODELING

APPENDIX H

Transportation Risk Assessment

Remedial alternatives for the SCP site include excavation and off-site disposal of contaminated soil/sludge. The potential for spills associated with the transport of this material to a disposal facility may pose unacceptable risks to human health and the environment. The purpose of this appendix is to describe the methodology used in assessing this potential risk and to present the results found in the modeling effort.

USEPA's Transportation Release Model was the primary source used to estimate a relative risk score for the SCP site. The relative risk score represents the probability of a releasing accident en route or in loading and unloading operations; the potential quantity released given such an incident; and the probability that such an incident would impact surface and ground water so as to pose an unacceptable risk to human health and the environment.

The relative risk score is equal to the product of the total expected quantity of material released and a relative risk factor for the type of waste transported. The total expected quantity released is the sum of the spillage due to accidents en route, and spillage that occurs during loading and unloading of the material at the loading point and ultimate disposal point. The relative risk factor is a function of the waste toxicity and its potential to impact ground and surface water if released. Normally an effect factor, based on the class and type of vulnerable aquifers along the transport route, is included in this calculation. However, due to the long distance that this soil/sludge would be transported, this factor was not included in the overall calculation (Figure 1).

The intent of the Transportation Release Model is to estimate the potential contamination of surface and ground water that could result from releases during the off-site transport of waste, and the risk it may pose to human health and the environment . Accidents which involve the release of contaminated material can occur in transit or during loading and unloading at terminal

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points. In order to estimate these two parameters, US EPA's model uses the following variables:

- volume of waste transported
- type of container used for transport
- distance traveled per road type
- number of shipments
- accident rate per road type
- release rate per container type

The model derives accident and release rates for several road types from truck accident and volume data. These parameters were based on an analysis of accident statistics from California, Texas, and New Jersey. Therefore the data represent a variety of traffic conditions.

USEPA calculated the expected fraction released en route per mile shipped for various road and container types. Based on data from the US Department of Transportation (i.e.,HAZMAT), this value is a function of the releasing accident rates, as well as the physical characteristics and incident involvement rates for various container types (Table 1). USEPA also used similar information to calculate the expected fraction released at loading and disposal points (i.e. terminal points), for various container types . These data, along with the expected fractions released en route, are presented in Table 2.

In order to compute the total potential quantity released, the expected amounts released en route and at the terminal points are calculated. The expected quantity released en route is calculated by multiplying the expected fraction released per mile shipped by the number of miles shipped for each container and road type. For both TSCA facilities under consideration for off-site disposal, (i.e., Emmelle, Alabama, and Niagara Falls, New York), the expected fraction released en route is based on USEPA's average releasing vehicle accident rate for US interstate highways. As previously mentioned, these data are based on a variety of traffic conditions and are assumed appropriate for application to the SCP site remediation.

The expected amount released at terminal points is calculated using USEPA's expected fraction released at terminal points for

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5,700 trucks hauling 20 cy of material. This fraction is multiplied by the number of shipments and the quantity per shipment to derive the total expected amount released at the terminal points.

The total risk score is equal to the sum of the expected amounts released en route and at the terminal points, multiplied by the relative risk factor which is the sum of the susceptibility and toxicity of the material transported. Susceptibility and toxicity values are relative numbers. Susceptibility is a physical characteristic which represents the potential for a material spilled in transit to possibly affect surface and ground water. Toxicity is an inherent chemical characteristic which describes the potency of various classes of contaminants. For example, dry solid material such as the dewatered sludge/soil to be removed from the SCP site has a lower susceptibility than any other media such as liquids. Material from the SCP site is contaminated with a heterogeneous mixture of chemicals which has a greater potential for toxicity than a single class of chemicals, (e.g., nonhalogenated organics). It should be noted that these relative values are based on general assumptions and only represent potential rather than actual characteristics of the contaminated material.

Known as the relative risk factor, the resulting sum of the susceptibility and toxicity is the same for both destinations considered in this analysis. The relative risk factor is multiplied by the total expected amount released to derive the total risk score (Table 3). This risk score is a unitless number that describes, on a relative scale, the probability of a release en route and during loading and unloading of material; the expected quantity released given such incidents; and the impact of such events on human health and the environment due to resulting surface and ground water contamination that would presumably occur. As Table 3 indicates, the total risk scores for Emmelle, Alabama, and Niagara Falls, New York, are 315 and 131, respectively, which are proportional to their respective shipping distances, 700 and 290 miles, respectively.

Since both alternatives involve the same transport conditions,(i.e., road type, container type, quantity shipped, etc..), their difference in risk is due only to the difference in total shipping distance. The expected amount released en

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route is the driving factor for this calculation. The large quantity shipped and the number of shipments, along with the long distance involved, makes the total expected amount released greater than the contents of one truckload for both destinations being considered. The resulting risk scores are therefore higher than usual for most off-site disposal operations.

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FIGURE 1

RELATIVE RISK RANKING PROCESS

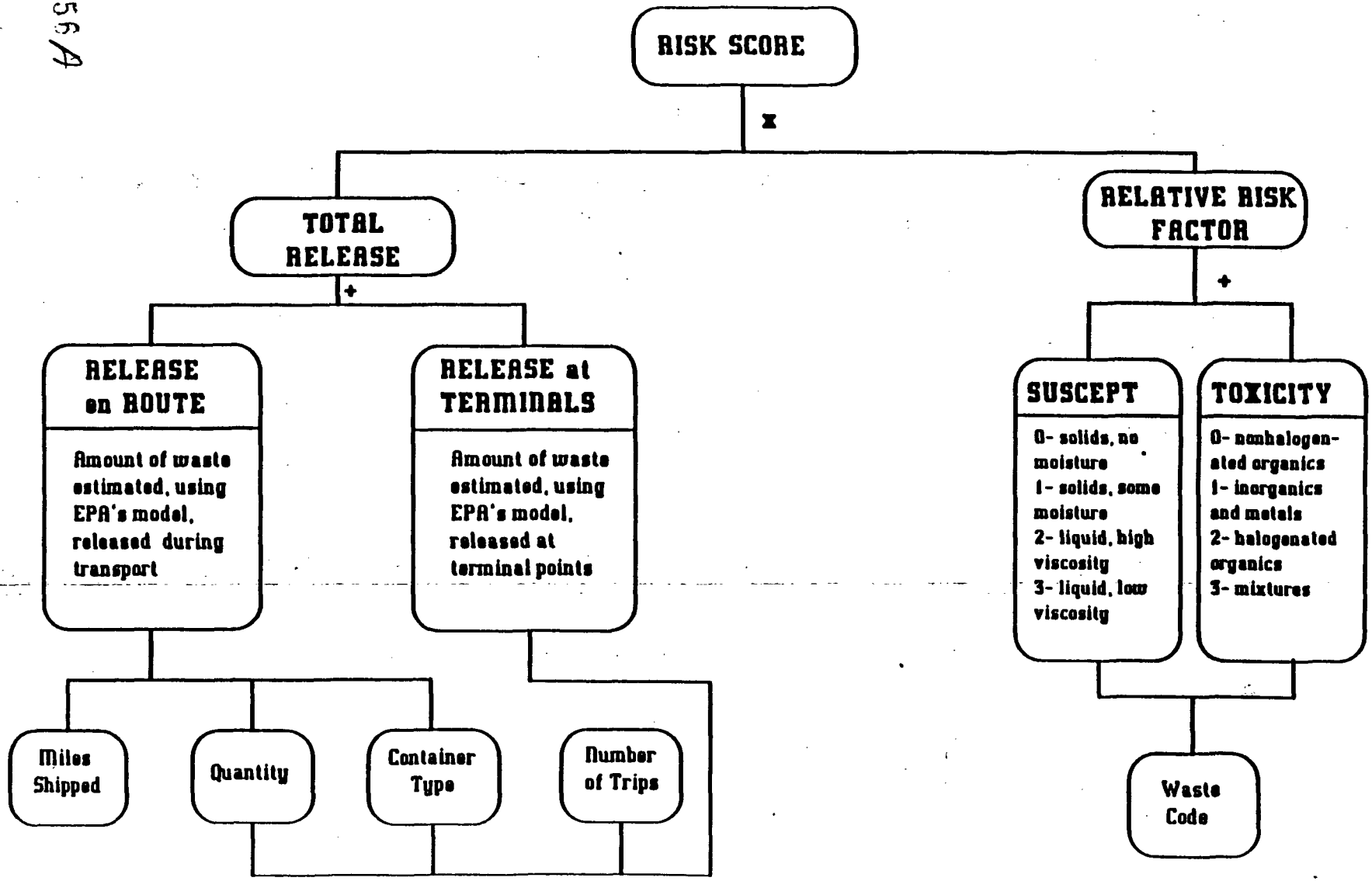

Table 1 Aggregate Accident Involvement Rates for Various Road Types (releasing accidents per truck mile) (1)

Road Type	Accident Involvement Rate (ø)
Interstates	$1.3E^{-7}$
U.S. and State Highways	$4.5E^{-7}$
Urban	7.3^{-7}
Composite	$2.8E^{-7}$

Table 2 Estimates of Fraction Released by Container Class (1)

Container Class	Expected Fraction Released Per Mile Shipped	Expected Fraction Released at Terminal Points
1 Cylinders	$1.3E^{-6}$+(.13 * ø)	$1.4E^{-4}$
2 Cans	$2.6E^{-6}$+(.12 * ø)	$4.0E^{-4}$
3 Glass	$1.7E^{-6}$+(.27 * ø)	$2.6E^{-4}$
4 Plastic	$4.1E^{-6}$+(.14 * ø)	$5.2E^{-4}$
5. Fiber Boxes	$1.3E^{-6}$+(.12* ø)	$6.1E^{-5}$
6 Tanks	$4.2E^{-8}$+(.19 * ø)	$7.6E^{-6}$
7 Metal drums/Pails	2.4E-6+(.10 * ø)	$2.9E^{-4}$

(1) USEPA 1984, "Assessing the Releases and Costs Associated with Truck Transport of Hazardous Waste",PBB84-224468

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Table 3
Estimation of Release Rates
by Road Type and Container Type

Completed by CAN
Date 3/28/89
Checked by JD
Date 3/30/89

Road Type	EPA Container Type	Number of miles shipped	Total Volume shipped(cy)	Quantity per shipment (cy)	Number of Shipments	Releasing Vehicle Accident Rate (accid /truck-mi)	Expected Fraction Released on route (cy/cy/mile)	Total Expected Release on rte (cy)	Expected Fraction Released at term (cy/cy/shipmt)	Total Expected Release at terminals (cy)	Total Release Expected (cy)	SUSCEPT	TOXICITY	Relative Risk Factor	Total Risk Score
Interstate (Emmelle)	1	700	1.14E+05	20	5,700	1.30E-07	1.32E-06	1.05E+02	1.40E-04	1.60E+01	1.05E+02	0	3	3	3.15E+02
Interstate (Negro)	1	200	1.14E+05	20	5,700	1.30E-07	1.32E-06	4.35E+01	1.40E-04	1.60E+01	4.35E+01	0	3	3	1.31E+02

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Appendix I
Air Emissions of FS Phase III Alternatives

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Deleted in accordance with EPA comments dated 12 July 1989.

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Appendix J
Alternative Cleanup Levels

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Deleted in accordance with EPA comments dated 12 July 1989.

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Appendix K
Cost Analysis

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APPENDIX K
COST ANALYSIS

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APPENDIX K

COST ESTIMATES

This appendix presents the capital and operation and maintenance (O&M) cost estimates for the Phase II and Phase III alternatives.

For purposes of clarity, the Phase III cost estimates have been developed based on the individual ground water, soil/sludge, and tank alternatives comprising the site-wide alternatives. The total cost for each site-wide alternative, based on these costs, is given in Table 4-3.

The No Action Alternatives (GW-1, S/S-2 and T-1 in Phase II; FOU-Alternative A in Phase III) do not have a capital cost. The tank sludge alternatives in Phase II and Phase III do not have an O&M cost, as the tank contents and shell would be treated and/or disposed of during remediation.

The Phase II capital and O&M cost of the Ground Water Limited Action Alternative (GW-2) are included under those for Soil/Sludge Alternative S/S-2. Similarly, O&M cost for the Ground Water No Action Alternative (GW-1) is included in the O&M cost for Soil/Sludge Alternative S/S-1.

Based on vendor information, the vacuum extraction system will be operated in a dewatering mode initially to dewater the site. This scenario is estimated for Phase II and Phase III costs where the alternative includes a dewatering step and vacuum extraction of the FOU.

The Phase III ground water costs are based on a one year operating period except where contaminant extraction or in situ soil/flushing is part of the site alternative. In these cases a two year operating period was assumed. The ground water cost tables entitled "Soil/Washing Extraction Fluid/Ground Water Treatment" are for 200 gpm systems that meet the requirements of the contaminant extraction and in situ soil/flushing alternatives.

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PHASE II

COST ANALYSIS

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PHASE II COST ESTIMATE

ALTERNATIVE GW-3
CHEMICAL OXIDATION / BIOLOGICAL TREATMENT

ESTIMATED INSTALLED COST
PURCHASE BASIS

ITEM	REFERENCE	REQUIRED SPACE (Sq. Ft.)	INSTALLED COST ($)
Solids Removal	Sloan Equipment Sales	50	167,500
Fenton's Reactor	ERM Information Files	68	20,600
Sequencing Batch Reactors	Riordan Materials Corp.	3,972	569,000
Carbon Adsorption	Calgon Carbon Corp.	63	165,000
Building	1988 Means	1,200	30,000
Site Preparation	ERM Information Files	5,000	25,000
Total Direct Construction Cost (TDCC)			977,100
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC			$244,000
Startup @ 10% of TDCC			$98,000
Subtotal			$1,319,100
Estimated Total Installed Cost w/20% Contingency			$1,583,000

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PHASE II COST ESTIMATE

ALTERNATIVE GW-5
SEQUENCING BATCH REACTORS

ESTIMATED INSTALLED COST
PURCHASE BASIS

ITEM	REFERENCE	REQUIRED SPACE (Sq. Ft.)	INSTALLED COST ($)
Solids Removal	Sloan Equipment Sales	50	167,500
Sequencing Batch Reactors	Riordan Materials Corp.	3,972	569,000
Carbon Adsorption	Calgon Carbon Corp.	63	165,000
Building	1988 Means	900	22,500
Site Preparation	ERM Information Files	5,500	27,500
Total Direct Construction Cost (TDCC)			$951,500
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC			$238,000
Startup @ 10% of TDCC			$95,000
Subtotal			$1,284,500
Estimated Total Installed Cost w/20% Contingency			$1,541,000

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PHASE II COST ESTIMATE

ALTERNATIVE GW-6
STEAM STRIPPING

ESTIMATED INSTALLED COST
PURCHASE BASIS

ITEM	REFERENCE	REQUIRED SPACE (Sq. Ft.)	INSTALLED COST ($)
Solids Removal	Sloan Equipment Sales	50	167,500
Steam Stripping	APV Crepaco, Inc.	170	962,500
Sand Filtration	Sloan Equipment Sales	16	74,300
Ultraviolet/Peroxidation	Peroxidation Systems, Inc.	32	204,900
Building	1988 Means	1,100	27,500
Site Preparation	ERM Information Files	1,900	9,500
Total Direct Construction Cost (TDCC)			$1,446,200
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC			$361,000
Startup @ 10% of TDCC			$145,000
Subtotal			$1,952,200
Estimated Total Installed Cost w/20% Contingency			$2,343,000

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PHASE II COST ESTIMATE

ALTERNATIVE GW-7
CRITICAL FLUID EXTRACTION

ESTIMATED INSTALLED COST
PURCHASE BASIS

ITEM	REFERENCE	REQUIRED SPACE (Sq. Ft.)	INSTALLED COST ($)
Solids Removal	Sloan Equipment Sales	50	167,500
Critical Fluid Extraction	CF Systems Corp..	900	4,000,000
Sand Filtration	Sloan Equipment Sales	16	74,300
Ultraviolet/Peroxidation	Peroxidation Systems, Inc.	32	204,900
Building	1988 Means	4,000	100,000
Site Preparation	ERM Information Files	5,400	27,000
Total Direct Construction Cost (TDCC)			$4,573,700
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC			$1,143,000
Startup at 10% of TDCC			$457,000
Subtotal			$6,173,700
Estimated Total Installed Cost w/20% Contingency			$7,408,000

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PHASE II COST ESTIMATE

ALTERNATIVE GW-8
POWDERED ACTIVATED CARBON ENHANCED BIOLOGICAL TREATMENT

ESTIMATED INSTALLED COST
PURCHASE BASIS

ITEM	REFERENCE	REQUIRED SPACE (Sq. Ft.)	INSTALLED COST ($)
Solids Removal	Sloan Equipment Sales	50	167,500
PACT	Riordan Materials Corp.	3,400	1,435,500
Sand Filtration	Sloan Equipment Sales	16	74,300
Ultraviolet/Peroxidation	Peroxidation Systems, Inc.	32	204,900
Building	1988 Means	800	20,000
Site Preparation	ERM Information Files	4,800	24,000
Total Direct Construction Cost (TDCC)			$1,926,200
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC			$482,000
Startup at 10% of TDCC			$193,000
Subtotal			$2,601,200
Estimated Total Installed Cost w/20% Contingency			$3,121,000

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PHASE II COST ESTIMATE

ALTERNATIVE GW-3
CHEMICAL OXIDATION / BIOLOGICAL TREATMENT

ESTIMATED INSTALLED COST
RENTAL BASIS

ITEM	REFERENCE	RENTAL COST ($)	CAPITAL AND INSTALLATION COST ($)
Solids Removal	Sloan Equipment Sales	72,000	107,000
Fenton's Reactor	ERM Information Files		20,600
Sequencing Batch Reactors	Riordan Materials Corp.	245,000	362,000
Carbon Adsorption	Calgon Carbon Corp.	60,000	130,000
Building	1988 Means		30,000
Site Preparation	ERM Information Files		25,000
Two Year Rental Cost		377,000	
Total Direct Construction Cost (TDCC)			674,600
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC			$169,000
Startup @ 10% of TDCC			$67,000
Subtotal			$910,000
Estimated Total Rental and Installed Cost w/20% Contingency			$1,545,000

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PHASE II COST ESTIMATE

ALTERNATIVE GW-5
SEQUENCING BATCH REACTORS

ESTIMATED INSTALLED COST
RENTAL BASIS

ITEM	REFERENCE	REQUIRED COST ($)	CAPITAL AND INSTALLATION COST ($)
Solids Removal	Sloan Equipment Sales	72,000	107,000
Sequencing Batch Reactors	Riordan Materials Corp.	245,000	362,000
Carbon Adsorption	Calgon Carbon Corp.	60,000	130,000
Building	1988 Means		22,500
Site Preparation	ERM Information Files		27,500
Two Year Rental Cost		377,000	
Total Direct Construction Cost (TDCC)			$649,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC			$162,000
Startup @ 10% of TDCC			$65,000
Subtotal			$876,000
Estimated Total Installed Cost w/20% Contingency			$1,503,000

002872

002872 A

PHASE II COST ESTIMATE

ALTERNATIVE GW-6
STEAM STRIPPING

ESTIMATED INSTALLED COST
RENTAL BASIS

ITEM	REFERENCE	RENTAL COST ($)	CAPITAL AND INSTALLATION COST ($)
Solids Removal	Sloan Equipment Sales	72,000	107,000
Steam Stripping	AWD Technologies, Inc.	1,680,000	1,000,000
Sand Filtration	Sloan Equipment Sales	32,000	47,000
Ultraviolet/Peroxidation	Peroxidation Systems, Inc.	67,000	130,000
Building	1988 Means		27,500
Site Preparation	ERM Information Files		9,500
Two Year Rental Cost		1,851,000	
Total Direct Construction Cost (TDCC)			$1,321,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC			$330,000
Startup @ 10% of TDCC			$132,000
Subtotal			$1,783,000
Estimated Total Rental and Installed Cost w/20% Contingency			$4,361,000

002873

C002873A

PHASE II COST ESTIMATE

ALTERNATIVE GW-7
CRITICAL FLUID EXTRACTION

ESTIMATED INSTALLED COST
RENTAL BASIS

ITEM	REFERENCE	RENTAL COST ($)	CAPITAL AND INSTALLATION COST ($)
Solids Removal	Sloan Equipment Sales	72,000	107,000
Critical Fluid Extraction	CF Systems Corp..	4,188,000	500,000
Sand Filtration	Sloan Equipment Sales	32,000	47,000
Ultraviolet/Peroxidation	Peroxidation Systems, Inc.	67,000	130,000
Building	1988 Means		100,000
Site Preparation	ERM Information Files		27,000
Two Year Rental Cost		4,359,000	
Total Direct Construction Cost (TDCC)			$911,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC			$228,000
Startup at 10% of TDCC			$91,000
Subtotal			$1,230,000
Estimated Total Rental and Installed Cost w/20% Contingency			$6,707,000

002879

002874A

PHASE II COST ESTIMATE

ALTERNATIVE GW-8
POWDERED ACTIVATED CARBON ENHANCED BIOLOGICAL TREATMENT

ESTIMATED INSTALLED COST
RENTAL BASIS

ITEM	REFERENCE	REQUIRED COST ($)	CAPITAL AND INSTALLATION COST ($)
Solids Removal	Sloan Equipment Sales	72,000	107,000
PACT	Riordan Materials Corp.	618,000	914,000
Sand Filtration	Sloan Equipment Sales	32,000	47,000
Ultraviolet/Peroxidation	Peroxidation Systems, Inc.	67,000	130,000
Building	1988 Means		20,000
Site Preparation	ERM Information Files		24,000
Two Year Rental Cost		789,000	
Total Direct Construction Cost (TDCC)			$1,242,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC			$311,000
Startup at 10% of TDCC			$124,000
Subtotal			$1,677,000
Estimated Total Rental and Installed Cost w/20% Contingency			$2,959,000

002875

002875A

PHASE II COST ESTIMATE

ALTERNATIVE GW-3
CHEMICAL OXIDATION / BIOLOGICAL TREATMENT

ESTIMATED OPERATION AND MAINTENANCE COST

ITEM	REFERENCE	ANNUAL QUANTITY	ANNUAL COST ($)
Electrical Power	ERM Information Files	28,000 kWh	2,000
Fenton's Reagent	FMC Corporation	115,200 lb.	99,400
Granular Activated Carbon	Calgon Carbon Corp	10,000 lb	8,500
Carbon disposal	Chemical Waste Management	10 Tons	10,800
Sludge Disposal	Chemical Waste Management	62 Tons	26,500
Monitoring & Analysis	ERM Information Files	-	125,000
O & M Labor	ERM Information Files	3 Operators	350,000
	Estimated Total Annual O & M Cost		$622,000

002876

C002876 A

PHASE II COST ESTIMATE

ALTERNATIVE GW-5
SEQUENCING BATCH REACTORS

ESTIMATED OPERATION AND MAINTENANCE COST

ITEM	REFERENCE	ANNUAL QUANTITY	ANNUAL COST ($)
Electrical Power	ERM Information Files	26,000 kWh	1,800
Granular Activated Carbon	Calgon Carbon Corp	10,000 lb	8,500
Carbon disposal	Chemical Waste Management	10 Tons	10,800
Sludge Disposal	Chemical Waste Management	62 Tons	26,500
Monitoring & Analysis	ERM Information Files	-	125,000
O & M Labor	ERM Information Files	3 Operators	350,000
	Estimated Total Annual O & M Cost		$523,000

002877

002877A

PHASE II COST ESTIMATE

ALTERNATIVE GW-6
STEAM STRIPPING

ESTIMATED OPERATION AND MAINTENANCE COST

ITEM	REFERENCE	ANNUAL QUANTITY	ANNUAL COST ($)
Electrical Power	ERM Information Files	74,000 kWh	5,200
Steam	APV Crepaco, Inc.	3,600,000 lb.	18,000
Peroxide	Peroxidation Systems, Inc.	1,300 lb.	1,000
Sludge Disposal	Chemical Waste Management	22 Tons	9,300
Organic Decant Disposal	Rollins Environmental	5,000 gal.	6,700
Monitoring & Analysis	ERM Information Files	-	125,000
O & M Labor	ERM Information Files	3 Operators	350,000
	Estimated Total Annual O & M Cost		$515,000

002878

L002878A

PHASE II COST ESTIMATE

ALTERNATIVE GW-7
CRITICAL FLUID EXTRACTION

ESTIMATED OPERATION AND MAINTENANCE COST

ITEM	REFERENCE	ANNUAL QUANTITY	ANNUAL COST ($)
Electrical Power	ERM Information Files	65,000 kWh	4,500
CF Extraction	CF Systems Corp.	3.1×10^6 gal.	62,000
Peroxide	Peroxidation Systems, Inc.	1,300 lb.	1,000
Sludge Disposal	Chemical Waste Management	22 Tons	9,300
Monitoring & Analysis	ERM Information Files	-	125,000
O & M Labor	ERM Information Files	3 Operators	350,000
	Estimated Total Annual O & M Cost		$552,000

002879

002879A

PHASE II COST ESTIMATE

ALTERNATIVE GW-8
POWDERED ACTIVATED CARBON ENHANCED BIOLOGICAL TREATMENT

ESTIMATED OPERATION AND MAINTENANCE COST

ITEM	REFERENCE	ANNUAL QUANTITY	ANNUAL COST ($)
Electrical Power	ERM Information Files	103,000 kWh	7,200
Powdered Carbon	Riordan Materials Corp.	12,900 lb.	6,900
Peroxide	Peroxidation Systems, Inc.	1,300 lb.	1,000
Sludge Disposal	Chemical Waste Management	22 Tons	9,300
Monitoring & Analysis	ERM Information Files	-	125,000
O & M Labor	ERM Information Files	3 Operators	350,000
	Estimated Total Annual O & M Cost		499,000

002880

002880 A

PHASE II COST ESTIMATE

ALTERNATIVE S/S-2
LIMITED ACTION

ESTIMATED INSTALLED COST

ITEM	REFERENCE	INSTALLED COST
Fencing	*	$92,400
Total Direct Construction Cost (TDCC)		$92,400
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		$23,100
SUBTOTAL		$115,500
Estimated Total Installed Cost w/20% contingency		$139,000

* Previous Site Remediation Experience

002881

002881A

PHASE II COST ESTIMATE

ALTERNATIVE S/S-3
SLURRY WALL, DEWATER UNIT, CAP

ESTIMATED INSTALLED COST

ITEM	REFERENCE	INSTALLED COST
Site Preparation	*	$500,000
Ground Water Collection System	1988 Means	$81,000
Perimeter Slurry Wall (bentonite)	VFL Technology	$370,000
Multi-media Cap	Keating, Gundle 1988 Means	$1,400,000
Total Direct Construction Cost (TDCC)		$2,351,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		$588,000
SUBTOTAL		$2,939,000
Estimated Total Installed Cost w/20% contingency		$3,530,000

* Previous Site Remediation Experience

002882

002882 A

PHASE II COST ESTIMATE

ALTERNATIVE S/S-4
SLURRY WALL, DEWATER UNIT, VACUUM EXTRACTION, ON-SITE INCINERATION, ON-SITE STABILIZATION, CAP

ESTIMATED INSTALLED COST

ITEM	REFERENCE	INSTALLED COST
Site Preparation	*/1988 Means	$1,000,000
Structural Slurry Wall (concrete wall)	VFL Technology	$1,816,000
Vacuum Extraction	Estimate	$2,000,000
Excavation	*	$1,500,000
On-Site Incineration	OH Materials	$53,400,000
On-Site Stabilization/Solidification	OH Materials	$9,000,000
Backfill & Placement of Stabilized Ash	*	$2,600,000
Asphalt Cap	1988 Means	$400,000
Total Direct Construction Cost (TDCC)		$71,716,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		$17,929,000
SUBTOTAL		$89,645,000
Estimated Total Installed Cost w/20% contingency		$108,000,000

* Previous Site Remediation Experience

002883

C0028834

ALTERNATIVE S/S-5
SLURRY WALL, DEWATER UNIT, VACUUM EXTRACTION, ON-SITE STABILIZATION, CAP

ESTIMATED INSTALLED COST

ITEM	REFERENCE	INSTALLED COST
Site Preparation	*1988 Means	$1,000,000
Excavation	*	$1,500,000
In Situ Vacuum Extraction	Estimate	$2,000,000
Structural Slurry Wall (concrete wall)	VFL Technology	$1,816,000
Stabilization/Solidification	OH Materials	$9,000,000
Backfill of Stabilized Material	*	$2,600,000
Asphalt Cap	1988 Means	$400,000
Total Direct Construction Cost (TDCC)		$18,316,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		$4,579,000
SUBTOTAL		$22,895,000
Estimated Total Installed Cost w/20% contingency		$27,500,000

* Previous Site Remediation Experience

002884

002884A

PHASE II COST ESTIMATE

ALTERNATIVE S/S-6
SLURRY WALL, DEWATER UNIT, IN SITU VITRIFICATION, COVER

ESTIMATED INSTALLED COST

ITEM	REFERENCE	INSTALLED COST
Site Preparation	*	$500,000
Ground Water Collection System	1988 Means	$81,000
Perimeter Slurry Wall (Bentonite)	VFL Technology	$370,000
In Situ Vitrification	Geosafe	$62,300,000
Pilot Study	Geosafe	$100,000
Backfill Soil	Keating Const.	$136,000
Total Direct Construction Cost (TDCC)		$63,487,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		$15,872,000
SUBTOTAL		$79,359,000
Estimated Total Installed Cost w/20% contingency		$95,200,000

* Previous Site Remediation Experience

002885

L002885A

PHASE II COST ESTIMATE

ALTERNATIVE S/S-7
SLURRY WALL, DEWATER UNIT, VACUUM EXTRACTION, OFF-SITE LAND DISPOSAL

ESTIMATED INSTALLED COST

ITEM	REFERENCE	INSTALLED COST
Site Preparation	*/1988 Means	$750,000
Structural Slurry Wall (concrete wall)	VFL Technology	$1,816,000
In Situ Vacuum Extraction	Estimate	$2,000,000
Excavation	*	$1,500,000
Disposal Off-Site in Landfill	Chemical Waste Mg.	$65,513,000
Backfill and Placement	*/1988 Means	$1,650,000
Total Direct Construction Cost (TDCC)		$73,229,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		$18,307,000
SUBTOTAL		$91,536,000
Estimated Total Installed Cost w/20% contingency		$110,000,000

* Previous Site Remediation Experience

002886

002886A

PHASE II COST ESTIMATE

ALTERNATIVE S/S-8
SLURRY WALL, DEWATER UNIT, IN SITU SOIL FLUSHING
IN SITU STABILIZATION, CAP

ESTIMATED INSTALLED COST

ITEM	REFERENCE	COST
Site Preparation	*/1988 Means	$750,000
Perimeter Slurry Wall (bentonite)	VFL Technology	$370,000
Ground Water Collection System	1988 Means	$264,000
In Situ Soil Flushing (no metals removal)	OH Materials	$12,500,000
Stabilization/Solidification	OH Materials	$7,000,000
Asphalt Cap	1988 Means	$400,000
Total Direct Construction Cost (TDCC)		$21,284,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		$5,321,000
SUBTOTAL		$26,605,000
Estimated Total Installed Cost w/20% contingency		$31,900,000

* Previous Site Remediation Experience

002887

002887A

PHASE II COST ESTIMATE

ALTERNATIVE S/S-9
SLURRY WALL, DEWATER UNIT, VACUUM EXTRACTION, CONTAMINANT EXTRACTION, ON-SITE STABILIZATION, CAP

ESTIMATED INSTALLED COST

ITEM	REFERENCE	INSTALLED COST
Site Preparation	*/1988 Means	$1,000,000
Structural Slurry Wall (concrete wall)	VFL Technology	$1,816,000
In Situ Vacuum Extraction	Estimate	$2,000,000
Excavation	*	$1,500,000
On-Site Contaminant Extraction (no metals removal)	OH Materials	$12,500,000
Stabilization/Solidification	OH Materials	$9,000,000
Backfill and Placement	*	$2,600,000
Asphalt Cap	1988 Means	$400,000
Total Direct Construction Cost (TDCC)		$30,816,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		$7,704,000
SUBTOTAL		$38,520,000
Estimated Total Installed Cost w/20% contingency		$46,200,000

* Previous Site Remediation Experience

002888

002888A

PHASE II COST ESTIMATE

ALTERNATIVE S/S-10
SLURRY WALL, DEWATER UNIT,
IN SITU SOIL FLUSHING, CAP

ESTIMATED INSTALLED COST

ITEM	REFERENCE	INSTALLED COST
Site Preparation	*/1988 Means	$750,000
Ground Water Collection System	1988 Means	$264,000
Perimeter Slurry Wall (bentonite)	VFL Technology	$370,000
In Situ Soil Flushing (no metals removal)	OH Materials	$12,500,000
Multi-media Cap	S/S-3	$1,400,000
Total Direct Construction Cost (TDCC)		$15,284,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		$3,821,000
SUBTOTAL		$19,105,000
Estimated Total Installed Cost w/20% contingency		$22,900,000

* Previous Site Remediation

002889

002889A

PHASE II COST ESTIMATE

ALTERNATIVE S/S-11
SLURRY WALL, DEWATER UNIT,
IN SITU SOIL FLUSHING OF PARTIAL SITE, CAP

ESTIMATED INSTALLED COST

ITEM	REFERENCE	INSTALLED COST
Site Preparation	*/1988 Means	$750,000
Ground Water Collection System	1988 Means	$150,000
Perimeter Slurry Wall (bentonite)	VFL Technology	$370,000
In Situ Soil Flushing of Partial Site		$6,250,000
Multi-media Cap	S/S-3	$1,400,000
Total Direct Construction Cost (TDCC)		$8,920,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		$2,230,000
SUBTOTAL		$11,150,000
Estimated Total Installed Cost w/20% contingency		$13,380,000

* Previous Site Remediation Experience

002890

002890A

PHASE II COST ESTIMATE

ALTERNATIVE S/S-12
SLURRY WALL, DEWATER UNIT,
IN SITU STABILIZATION , CAP

ESTIMATED INSTALLED COST

ITEM	REFERENCE	INSTALLED COST
Site Preparation	*	$500,000
Perimeter Slurry Wall (bentonite)	VFL Technology	$370,000
Ground Water Collection System	1988 Means	$81,000
In Situ Stabilization/Solidification	OH Materials	$7,000,000
Asphalt Cap	1988 Means	$400,000
Total Direct Construction Cost (TDCC)		$8,351,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		$2,088,000
SUBTOTAL		$10,439,000
Estimated Total Installed Cost w/20% contingency		$12,500,000

* Previous Site Remediation Experience

002891

002891A

PHASE II COST ESTIMATE

ALTERNATIVE S/S-13
SLURRY WALL, DEWATER UNIT,
VACUUM EXTRACTION, OFF-SITE INCINERATION

ESTIMATED INSTALLED COST

ITEM	REFERENCE	INSTALLED COST
Site Preparation	*/1988 Means	$1,000,000
Structural Slurry Wall (concrete wall)	VFL Technology	$1,816,000
In Situ Vacuum Extraction	Estimate	$2,000,000
Excavation	*	$1,500,000
Off-Site Incineration	Chemical Waste Mgmt.	$150,000,000
Backfill and Placement	*/1988 Means	$1,650,000
Total Direct Construction Cost (TDCC)		$157,966,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		$39,492,000
SUBTOTAL		$197,458,000
Estimated Total Installed Cost w/20% contingency		$237,000,000

* Previous Site Remediation Experience

002892

002892A

PHASE II COST ESTIMATE

ALTERNATIVE S/S-14
SLURRY WALL, DEWATER UNIT, VACUUM EXTRACTION, CAP

ESTIMATED INSTALLED COST

ITEM	REFERENCE	INSTALLED COST
Site Preparation	*/1988 Means	$750,000
Perimeter Slurry Wall (bentonite)	VFL Technology	$370,000
In Situ Vacuum Extraction	Estimate	$2,000,000
Multi-media Cap	S/S-3	$1,400,000
Total Direct Construction Cost (TDCC)		$4,520,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		$1,130,000
SUBTOTAL		$5,650,000
Estimated Total Installed Cost w/20% contingency		$6,780,000

002893

002893A

PHASE II COST ESTIMATE

ALTERNATIVE S/S-15
SLURRY WALL, DEWATER UNIT, VACUUM EXTRACTION, CONTAMINANT EXTRACTION OF PARTIAL SITE, CAP

ESTIMATED INSTALLED COST

ITEM	REFERENCE	INSTALLED COST
Site Preparation	*/1988 Means	$750,000
Structural Slurry Wall (concrete wall)	VFL Technology	$1,816,000
In Situ Vacuum Extraction	Estimate	$2,000,000
Excavation	*	$750,000
Contaminant Extraction of Partial Site	OH Materials	$6,250,000
Backfill	*	$750,000
Multi-media Cap	S/S-3	$1,400,000
Total Direct Construction Cost (TDCC)		$13,716,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		$3,429,000
SUBTOTAL		$17,145,000
Estimated Total Installed Cost w/20% contingency		$20,600,000

* Previous Site Remediation Experience

002894

002894 A

PHASE II COST ESTIMATE

ALTERNATIVE S/S-16
SLURRY WALL, DEWATER UNIT, VACUUM EXTRACTION, CONTAMINANT EXTRACTION OF PARTIAL SITE, ON-SITE STABILIZATION, CAP

ESTIMATED INSTALLED COST

ITEM	REFERENCE	INSTALLED COST
Site Preparation	*/1988 Means	$750,000
Structural Slurry Wall (concrete wall)	VFL Technology	$1,816,000
In Situ Vacuum Extraction	Estimate	$2,000,000
Excavation	*	$750,000
Contaminant Extraction of Partial Site	OH Materials	$6,250,000
On-Site Stabilization/Solidification	OH Materials	$4,500,000
Backfill of Stabilized Material	*	$1,300,000
Multi-media Cap	S/S-3	$1,400,000
Total Direct Construction Cost (TDCC)		$18,766,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		$4,692,000
SUBTOTAL		$23,458,000
Estimated Total Installed Cost w/20% contingency		$28,100,000

002895

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PHASE II COST ESTIMATE

ALTERNATIVE S/S-16'
SLURRY WALL, DEWATER UNIT, VACUUM EXTRACTION, CONTAMINANT EXTRACTION FOR METALS , OFF-SITE INCINERATION, CAP

ESTIMATED INSTALLED COST

Item	Reference	Estimated Installed Cost
Site Preparation	S/S-13	$1,000,000
Structural Slurry Wall (concrete wall)		$1,816,000
In Situ Vacuum Extraction	Estimate	$2,000,000
Excavation	*	$1,500,000
Contaminant Extraction of Metals	Vendor/Estimate	$23,000,000
Off-site Incineration	Chemical Waste Mgmt	$150,000,000
Backfill soil and placement	*/1988 Means	$1,650,000
Total Direct Construction Cost (TDCC)		$180,966,000
Engineering, Legal, Health & Safety, and Construction Management @ 25% of TDCC		$45,242,000
SUBTOTAL		$226,208,000
Estimated Total Installed Cost w/20% Contingency		$271,000,000

* Previous Site Remediation Experience

002896

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PHASE II COST ESTIMATE

ALTERNATIVE S/S-17
SLURRY WALL, DEWATER UNIT, VACUUM EXTRACTION, CONTAMINANT EXTRACTION FOR METALS, ON-SITE INCINERATION, CAP

ESTIMATED INSTALLED COST

Item	Reference	Estimated Installed Cost
Site Preparation	S/S-4	$1,000,000
Structural Slurry Wall (concrete wall)	S/S-4	$1,816,000
In Situ Vacuum Extraction	Estimate	$2,000,000
Excavation	*	$1,500,000
Contaminant Extraction of Metals	Vendors/Estimate	$23,000,000
On-site Incineration	OH Materials	$57,300,000
Backfill ash	*	$1,500,000
Multi-media Cap	S/S-3	$1,400,000
Total Direct Construction Cost (TDCC)		$89,516,000
Engineering, Legal, Health & Safety, and Construction Management @ 25% of TDCC		$22,379,000
SUBTOTAL		$111,895,000
Estimated Total Installed Cost w/20% Contingency		$140,000,000

* Previous Site Remediation Expenditures

002897

002897A

PHASE II ESTIMATE

SOIL.SLUDGE ALTERNATIVES
ESTIMATED OPERATION AND MAINTENANCE COST

SOIL/SLUDGE ALTERNATIVE	ITEMS INCLUDE	REFERENCE	ANNUAL O&M COST ($)	REMEDIAL DURATION ASSUMED FOR COSTING
S/S-1	Ground Water Monitoring	*	$42,000	1-30 years
S/S-2	Ground Water Monitoring, Fence Maintainance	*	$44,000	1-30 years
S/S-4, S/S-5, S/S-6, S/S-7, S/S-8, S/S-9, S/S-12, S/S-13, S/S-16'	Ground Water Monitoring, Fence Maintainance, Yearly Inspections, Mowing, Asphalt Cap or Dirt Cover Maintenance and Water Collection and Disposal	*	$60,000	1-30 years
S/S-3, S/S-10, S/S-11, S/S-14, S/S-15, S/S-16, S/S-17	Ground Water Monitoring, Fence Maintainance, Yearly Inspections, Mowing, Asphalt Cap Maintenance, and Water Collection and Disposal	*	$61,000	1-30 years

002898

* Previous Site Remediation Experience

C002898A

PHASE II COST ESTIMATE

ALTERNATIVE T-1
IN SITU VITRIFICATION

ESTIMATED INSTALLED COST

ITEM	REFERENCE	INSTALLED COST
Sand	1988 Means	$1,000
Excavation/Placement	Estimate	$3,000
Vitrification	Geosafe	$20,000
Total Direct Construction Cost (TDCC)		$24,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		$6,000
SUBTOTAL		$30,000
Estimated Total Installed Cost w/20% contingency		$36,000

002899A

PHASE II COST ESTIMATE

ALTERNATIVE T-2
IN-TANK STABILIZATION/SOLIDIFICATION, ON-SITE DISPOSAL

ESTIMATED INSTALLED COST

ITEM	REFERENCE	INSTALLED COST
Excavation, Placement, Backfill	Estimate	$3,000
Fill and Stabilize Contents	OH Materials	$2,000
Encapsulation	Estimate	$45,000
Total Direct Construction Cost (TDCC)		$50,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		$13,000
SUBTOTAL		$63,000
Estimated Total Installed Cost w/20% contingency		$76,000

C002900A

PHASE II COST ESTIMATE

ALTERNATIVE T-3
ON-SITE INCINERATION

ESTIMATED INSTALLED COST

ITEM	REFERENCE	INSTALLED COST
Sludge Removal/Handling, Tank Washing	Estimate	$10,000
Incineration-Sludge and Cleaning Solvents	Estimate	$3,000
Tank Cut Up/Disposal	Estimate	$3,000
Excavation/Backfill	1988 Means	$3,000
Total Direct Construction Cost (TDCC)		$19,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		$5,000
SUBTOTAL		$24,000
Estimated Total Installed Cost w/20% contingency		$29,000

002901

002901A

PHASE II COST ESTIMATE

ALTERNATIVE T-4
ON-SITE CONTAMINANT EXTRACTION, ON-SITE STABILIZATION/SOLIDIFICATION, WITH PLACEMENT ON-SITE

ESTIMATED INSTALLED COST

ITEM	REFERENCE	INSTALLED COST
Sludge Removal/Handling, Tank Washing	Estimate	$10,000
Contaminant Extraction	OH Materials	$2,000 *
Stabilization/Solidification	OH Materials	$2,000
Excavation/Backfill	1988 Means	$3,000
Tank Cut Up/Disposal	Estimate	$3,000
Unstabilized Sludge and Cleaning Solvent/Off-Site Disposal	Estimate	$3,000
Total Direct Construction Cost (TDCC)		$23,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		$6,000
SUBTOTAL		$29,000
Estimated Total Installed Cost w/20% contingency		$35,000

* Assumes extraction equipment already on site

002902

002902A

PHASE II COST ESTIMATE

ALTERNATIVE T-5
ON-SITE STABILIZATION/SOLIDIFICATION, OFF-SITE DISPOSAL

ESTIMATED INSTALLED COST

ITEM	REFERENCE	INSTALLED COST
Sludge Removal/Handling, Tank Washing	Estimate	$10,000
Stabilization/Solidification	OH Materials	$2,000
Tank Cut Up/Disposal	Estimate	$3,000
Sludge and Cleaning Solvent Off-Site Disposal	Estimate	$7,000
Total Direct Construction Cost (TDCC)		$22,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		$6,000
SUBTOTAL		$28,000
Estimated Total Installed Cost w/20% contingency		$34,000

002903

002903A

PHASE II COST ESTIMATE

ALTERNATIVE T-6
CONTAMINANT EXTRACTION, ON-SITE STABILIZATION/SOLIDIFICATION, OFF-SITE DISPOSAL

ESTIMATED INSTALLED COST

ITEM	REFERENCE	INSTALLED COST
Sludge Removal/Handling, Tank Washing	Estimate	$10,000
Contaminant Extraction	OH Materials	$2,000 *
Stabilization/Solidification	OH Materials	$2,000
Tank Cut Up/Disposal	Estimate	$3,000
Sludge and Cleaning Solvent/Off-Site Disposal	Estimate	$7,000
Total Direct Construction Cost (TDCC)		$24,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		$6,000
SUBTOTAL		$30,000
Estimated Total Installed Cost w/20% contingency		$36,000

* Assumes extraction equipment already on site

002904

002904A

PHASE II COST ESTIMATE

ALTERNATIVE T-8
ON-SITE CONTAMINANT EXTRACTION, OFF-SITE INCINERATION

ESTIMATED INSTALLED COST

ITEM	REFERENCE	INSTALLED COST
Sludge Removal/Handling, Tank Washing	Estimate	$10,000
Contaminant Extraction, Organics and PCBs	OH Materials	$2,000
Contaminant Extraction Metals	OH Materials	$6,000
Tank Cut Up/Disposal	Estimate	$3,000
Off-Site Incineration of Remaining Sludge	Chemical Waste Mg.	$16,000
Total Direct Construction Cost (TDCC)		$37,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		$9,000
SUBTOTAL		$46,000
Estimated Total Installed Cost w/20% contingency		$55,000

002905

L002905A

PHASE II COST ESTIMATE

ALTERNATIVE T-9
CONTAMINANT EXTRACTION, ON-SITE INCINERATION, ON-SITE STABILIZATION

ESTIMATED INSTALLED COST

ITEM	Reference	INSTALLED COST
Sludge removal/handling, tank washing	Estimate	$10,000
Contaminant extraction, orgainic and PCBs	OH Materials	$2,000 *
Contaminant extraction metals	OH Materials	$6,000 *
Tank cut up/disposal	Estimate	$3,000
On-site incineration of remaining sludge	Chemical Waste Mg.	$7,000
On-site stabilization	OH Materials	$2,000
Backfill	OH Materials	$1,000
Total Direct Construction Cost (TDCC)		$31,000
Engineering, Legal Health & Safety and Construction Management @ 25% of TDCC		$8,000
Subtotal		$39,000
Estimate Total Installed Cost w/20% contingency		$47,000

* Assumes extraction equipment already on site

L002906A

PHASE III

COST ANALYSIS

002907

L002907A

PHASE III COST ESTIMATE

ALTERNATIVE GW-6
STEAM STRIPPING
ESTIMATED INSTALLED COST

PURCHASE BASIS

Item	Reference	Installed Cost ($)	Required Space (sq ft)
Solids Removal	Sloan Equipment Sales	167,000	50
Steam Stripping	APV Crepaco, Inc.	962,500	170
Sand Filtration	Sloan Equipment Sales	74,300	16
Ultraviolet/Peroxidation	Peroxidation Systems, Inc.	204,900	32
Building	1988 Means	27,500	1,100
Site Preparation	ERM Information Files	9,500	1,900
Total Direct Construction Cost (TDCC)		1,446,200	
Engineering, Legal, Health & Safety, and Construction Management @ 25% of TDCC		$362,000	
Startup at 10% of TDCC		$457,000	
SUBTOTAL		$1,953,200	
Estimated Total Installed Cost w/20% Contingency		$2,343,000	

* Previous Site Remediation Experience

002908

002908A

PHASE III COST ESTIMATE

ALTERNATIVE GW-7
CRITICAL FLUID EXTRACTION
ESTIMATED INSTALLED COST

PURCHASE BASIS

Item	Reference	Installed Cost ($)	Required Space (sq ft)
Solids Removal	Sloan Equipment Sales	1,675,000	50
Critical Fluid Extraction	CF Systems Corp.	4,000,000	900
Sand Filtration	Sloan Equipment Sales	74,300	16
Ultraviolet/Peroxidation	Peroxidation Systems, Inc.	204,900	32
Building	1988 Means	100,000	4,000
Site Preparation	ERM Information Files	27,000	5,400
Total Direct Construction Cost (TDCC)		4,573,700	
Engineering, Legal, Health & Safety, and Construction Management @ 25% of TDCC		$1,143,000	
Startup at 10% of TDCC		$457,000	
SUBTOTAL		$6,173,700	
Estimated Total Installed Cost w/20% Contingency		$7,408,000	

* Previous Site Remediation Experience

0 2 9 0 9

L002909A

PHASE III COST ESTIMATE

ALTERNATIVE GW-6
GROUND WATER TREATMENT
ESTIMATED INSTALLED COST

RENTAL BASIS

Item	Reference	Rental Cost ($)	Capital and Installation Cost ($)
Solids Removal	Sloan Equipment Sales	68,000	107,000
Steam Stripping	AWD Technologies, Inc.	840,000	1,000,000
Sand Filtration	Sloan Equipment Sales	30,000	47,000
Ultraviolet/Peroxidation	Peroxidation Systems, Inc.	34,000	130,000
Building	1988 Means		27,500
Site Preparation	ERM Information Files		9,500
One Year Rental Cost		972,000	
Total Direct Construction Cost (TDCC)			1,321,000
Engineering, Legal, Health & Safety, and Construction Management @ 25% of TDCC			$330,000
Startup at 10% of TDCC			$132,000
SUBTOTAL			$1,783,000
Estimated Total Installed Cost w/20% Contingency			$3,306,000

002910

• Pre Site Remediation Experience

002910A

PHASE III COST ESTIMATE

ALTERNATIVE GW-7
CRITICAL FLUID EXTRACTION
ESTIMATED INSTALLED COST

RENTAL BASIS

Item	Reference	Rental Cost ($)	Capital and Installation Cost ($)
Solids Removal	Sloan Equipment Sales	68,000	107,000
Critical Fluid Extraction	CF Systems Corp.	2,094,000	500,000
Sand Filtration	Sloan Equipment Sales	30,000	47,000
Ultraviolet/Peroxidation	Peroxidation Systems, Inc.	34,000	130,000
Building	1988 Means		27,500
Site Preparation	ERM Information Files		9,500
One Year Rental Cost		2,222,600	
Total Direct Construction Cost (TDCC)			911,000
Engineering, Legal, Health & Safety, and Construction Management @ 25% of TDCC			$228,000
Startup at 10% of TDCC			$91,000
SUBTOTAL			$1,230,000
Estimated Total Installed Cost w/20% Contingency			$4,147,000

* Previous Site Remediation Experience

002911A

PHASE III COST ESTIMATE

ALTERNATIVE GW-6
GROUND WATER TREATMENT
ESTIMATED OPERATION AND MAINTENANCE COST

Item	Reference	Annual Quantity	Annual Cost ($)
Electrical Power	ERM Information Files	148,000 kWh	10,300
Steam	APV Crepaco, Inc.	7,200,000 lb.	36,000
Peroxide	Peroxidation Systems, Inc.	2,600 lb.	2,000
Sludge Disposal	Chemical Waste Management	44 tons	18,600
Organic Decant Disposal	Rollins Invironmental	10,000 gal.	13,300
Monitoring and Analysis	ERM Information Files	-	125,000
O&M Labor	ERM Information Files	3 operators	350,000
Estimated Total Annual O&M Cost			$555,000

002912

• Pre· ; Site Remediation Experience

C002912A

PHASE III COST ESTIMATE

ALTERNATIVE GW-7
GROUND WATER TREATMENT
ESTIMATED OPERATION AND MAINTENANCE COST

Item	Reference	Annual Quantity	Annual Cost ($)
Electrical Power	ERM Information Files	130,000 kwh	9,100
CF Extraction	CF Systems Corp.	6,200,000 gal	124,000
Peroxide	Peroxidation Systems, Inc.	2,600 lb.	2,000
Sludge Disposal	Chemical Waste Management	44 tons	18,600
Monitoring and Analysis	ERM Information Files	-	125,000
O&M Labor	ERM Information Files	3 operators	350,000
Estimated Total Annual O&M Cost			$629,000

002913

002913A

PHASE III COST ESTIMATE

ESTIMATED INSTALLED COST
SOIL WASHING EXTRACTION FLUID/GROUND WATER TREATMENT
PURCHASE BASIS
STEAM STRIPPING

ITEM	REFERENCE	INSTALLED COST ($)	REQUIRED SPACE (Ft^2)
Solids Removal	Sloan Equipment Sales	217,000	94
Steam Stripping	APV Crepaco, Inc.	2,062,500	218
Sand Filtration	Sloan Equipment Sales	124,000	55
Ultraviolet/Peroxidation	Peroxidation Systems, Inc.	340,300	44
Building	1988 Means	40,000	1600
Site Preparation	ERM Information Files	12,500	2500
Total Direct Construction Cost (TDCC)		2,796,300	
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		699,000	
Startup at 10% of TDCC		280,000	
Subtotal		3,775,300	
Estimated Total Installed Cost w/20% Contingency		4,530,000	

002914

002914A

PHASE III COST ESTIMATE

ESTIMATED INSTALLED COST
SOIL WASHING EXTRACTION FLUID/GROUND WATER TREATMENT
PURCHASE BASIS
CRITICAL FLUID EXTRACTION

ITEM	REFERENCE	INSTALLED COST ($)	REQUIRED SPACE (Ft^2)
Solids Removal	Sloan Equipment Sales	217,000	94
Critical Fluid Extraction	CF Systems Corp.	7,500,000	1800
Sand Filtration	Sloan Equipment Sales	124,000	55
Ultraviolet/Peroxidation	Peroxidation Systems, Inc.	340,300	44
Building	1988 Means	195,000	1600
Site Preparation	ERM Information Files	48,500	9700
Total Direct Construction Cost (TDCC)		8,424,800	
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC		2,106000	
Startup at 10% of TDCC		842,000	
Subtotal		11,372,800	
Estimated Total Installed Cost w/20% Contingency		13,647,000	

C002915A

PHASE III COST ESTIMATE

ESTIMATED INSTALLED COST
SOIL WASHING EXTRACTION FLUID/GROUND WATER TREATMENT
RENTAL BASIS
STEAM STRIPPING

ITEM	REFERENCE	RENTAL COST ($)	CAPITAL AND INSTALLED COST ($)
Solids Removal	Sloan Equipment Sales	93,000	138,000
Steam Stripping	AWD Technologies, Inc.	1,680,000	1,000,000
Sand Filtration	Sloan Equipment Sales	53,000	79,000
Ultraviolet/Peroxidation	Peroxidation Systems, Inc.	96,000	217,000
Building	1988 Means		40,000
Site Preparation	ERM Information Files		12,500
Two Year Rental Cost		1,922,000	
Total Direct Construction Cost (TDCC)			1,486,000
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC			372,000
Startup at 10% of TDCC			149,000
Subtotal			2,007,500
Estimated Total Installed Cost w/20% Contingency			4,715,000

002916A

PHASE III COST ESTIMATE

ESTIMATED INSTALLED COST
SOIL WASHING EXTRACTION FLUID/GROUND WATER TREATMENT
RENTAL BASIS
CRITICAL FLUID EXTRACTION

ITEM	REFERENCE	RENTAL COST ($)	CAPITAL AND INSTALLED COST ($)
Solids Removal	Sloan Equipment Sales	93,000	138,000
Critical Fluid Extraction	CF Systems Corp.	7,752,000	1,100,000
Sand Filtration	Sloan Equipment Sales	53,000	79,000
Ultraviolet/Peroxidation	Peroxidation Systems, Inc.	96,000	217,000
Building	1988 Means		195,000
Site Preparation	ERM Information Files		48,500
Two Year Rental Cost		7,994,000	
Total Direct Construction Cost (TDCC)			1,777,500
Engineering, Legal, Health & Safety and Construction Management @ 25% of TDCC			444,000
Startup at 10% of TDCC			178,000
Subtotal			2,399,500
Estimated Total Installed Cost w/20% Contingency			12,472,000

C002917A

PHASE III COST ESTIMATE

ESTIMATED OPERATION AND MAINTENANCE COST
SOIL WASHING EXTRACTION FLUID/GROUND WATER TREATMENT
STEAM STRIPPING

ITEM	REFERENCE	ANNUAL QUANTITY	ANNUAL COST ($)
Electrical Power	ERM Information Files	1,194,000 kWH	83,600
Steam	APV Crepaco, Inc.	122.6×10^6 lb.	613,200
Peroxide	Peroxide Systems, Inc.	43,800 lb.	32,800
Sludge Disposal	Chemical Waste Management	751 Tons	258,300
Monitoring & Analysis	ERM Information Files	-	125,000
O & M Labor	ERM Information Files	3 Operators	350,000
	Estimated Total Annual O & M Cost		$1,463,000

002918 A

PHASE III COST ESTIMATE

ESTIMATED OPERATION AND MAINTENANCE COST
SOIL WASHING EXTRACTION FLUID/GROUND WATER TREATMENT
CRITICAL FLUID EXTRACTION

ITEM	REFERENCE	ANNUAL QUANTITY	ANNUAL COST ($)
Electrical Power	ERM Information Files & CF Systems	13,353,000 kWH	934,700
CF Extraction Utilities	CF Systems Corp.	-	620,200
Peroxide	Peroxide Systems, Inc.	43,800 lb.	32,800
Sludge Disposal	Chemical Waste Management	751 Tons	258,300
Monitoring & Analysis	ERM Information Files	-	125,000
O & M Labor	ERM Information Files	3 Operators	350,000
	Estimated Total Annual O & M Cost		$2,321,000

002919

002919A

PHASE III COST ESTIMATE

ALTERNATIVE S/S-3:
SLURRY WALL, DEWATER UNIT, CAP

Item	Quantity/Unit	Unit Cost	Reference	Installed Cost
Site preparation:				
Electrical, water, fencing trailers, decon facilities, grading	-	-	*	$500,000
Upgraded Slurry Wall				
3' wide Slurry wall + 2 liners	35,700 sq ft	$16.00/sq ft	VFL Technology	$571,000
Backfill, perimeter road, water	-	-	1988 Means & Keating Construction	$60,000
Respread excavated material	4,000 cu yd	$3.75/cu yd	1988 Means	$15,000
Dewatering System	-	-	Estimate	$131,000
Multimedia Cap: **				
Fill to create slope + 2' layer	56,700 cu yd	$10/cu yd	Keating Construction	$567,000
Clay	10,000 cu yd	$25/cu yd	Keating Construction	$250,000
Low Permeability Soil	10,000 cu yd	$10/cu yd	Keating Construction	$100,000
Topsoil	10,000 cu yd	$16/cu yd	1988 Means	$160,000
Spreading and compaction	86,700 cu yd	$3/cu yd	1988 Means	$260,000
60-mil HDPE liner w/8% excess	291,600 sq ft	$.60/sq ft	Experience	$175,000
60-mil HDPE liner w/8% excess	291,600 sq ft	$.60/sq ft	Experience	$175,000
Seeding, fertilizing	30,000 sq yd	$1.60 sq yd	1988 Means	$48,000
Perimeter erosion control, runoff diversion, etc.	-	-	Estimate	$40,000
		Total Direct Construction Costs (TDCC)		$3,052,000
		Engineering, Legal, Health & Safety, and Construction Management @25% of TDCC		$763,000
		20% Contingency		$610,000
		Estimated Total Installed Cost		$4,425,000

Previous Site Remediation Experience
Multimedia cap cost calculates out to be $6.57/sq ft

6002920 A

PHASE III COST ESTIMATE

ALTERNATIVE S/S-4
SLURRY WALL, DEWATER UNIT, VACUUM EXTRACTION
ON-SITE INCINERATION, ON-SITE STABILIZATION, CAP

Item	Quantity/Unit	Unit Cost	Reference	Installed Cost
Site Preparation				
-Same as S/S-3	-	-	S/S-3	$500,000
-Slab for incinerator	1,630 cu yd	$200/cu yd	1988 Means	$326,000
-Backfill to slab excavation	24,000 cu yd	$25/cu yd	* and Keating	$600,000
Structural Concrete Slurry Wall				
-Slurry wall	35,700sq ft	$41/sq ft	VFL Technology	$1,464,000
-Perimeter road, water	-	-	1988 Means	$10,000
In Situ Vacuum Extraction, Including Sampling, Electricity, Fuel, Incinerator Operator and Pilot Test **	-	-	Midwest Water Resources	$4,070,000
Excavation	114,000 cu yd	$15/cu yd	*	$1,710,000
On-site Incineration	178,000 tons	$300/ton		$53,400,000
Dewatering (after vacuum extraction)	-	-	Estimate	$80,000
Stabilization/Solidification	114,000 cu yd	$90/cu yd	OH Materials	$10,260,000
Backfill of stabilized Material	142,000 cu yd	$15/cu yd	*	$2,130,000
Asphalt Cap				
-Low permeability soil, compacted	10,000cu yd	$13/cu yd	Keating Const.	$130,000
-Stone	8,300cu yd	$18/cu yd	1988 Means	$150,000
-Asphalt	28,560sq yd	$13.90/sq yd	1988 Means	$397,000
		Total Direct Construction Costs (TDCC)		$75,227,000
		Engineering, Legal, Health & Safety, and Construction Management @ 25% of TDCC		$18,807,000
		20% Contingency		$15,045,000
		Estimated Installed Cost		$109,079,000

* Previous Site Remediation Experience

** Based on vendor information, the vacuum extraction system will be operated in a dewatering mode initially to dewater the site.

002921A

PHASE III COST ESTIMATE

ALTERNATIVE S/S-5:
SLURRY WALL, DEWATER UNIT, VACUUM EXTRACTION, ON-SITE STABILIZATION, CAP

Item	Quantity/Unit	Unit Cost	Reference	Installed Cost
Site preparation: Electrical, water, fencing trailers, decon facilities, grading	-	-	*	$500,000
Structural Concrete Slurry Wall: Slurry wall	35,700 sq ft	$41/sq ft	VFL Technology	$1,464,000
Perimeter road, water	-	-	Estimate	$10,000
Excavation	114,000 cu yd	$15/cu yd	*	$1,710,000
In Situ Vacuum Extraction, ** including sampling, electricity, fuel incinerator, operator & pilot test	-	-	Midwest Water Resources	$4,070,000
Stabilization/Solidification	114,000 cu yd	$90/cu yd	OH Materials	$10,260,000
Backfill of stabilized material	142,000 cu yd	$15/cu yd	*	$2,130,000
Asphalt Cap	-	-	S/S-4	$677,000
	Total Direct Construction Costs (TDCC)			$20,821,000
	Engineering, Legal, Health & Safety, and Construction Management @ 25% of TDCC			$5,205,000
	20% Contingency			$4,164,000
	Estimated Total Installed Cost			$30,190,000

Previous Site Remediation Experience

* Based on vendor information, the vacuum extraction system will be operated in a dewatering mode initially to dewater the site

L002922 #

PHASE III COST ESTIMATE

ALTERNATIVE S/S-6:
SLURRY WALL, DEWATER UNIT, IN SITU VITRIFICATION, COVER

Item	Quantity/Unit	Unit Cost	Reference	Installed Cost
Site preparation: Electrical, water, fencing trailers, decon facilities, grading	- -	- -	S/S-3	$500,000
Slurry Wall (Bentonite): Slurry wall	35,700 sq ft	$8.25/sq ft	VFL Technology	$295,000
Backfill perimeter road, water	-	-	S/S-3	$60,000
Dewatering System	-	-	1988 means	$152,000
Engineering Scale Test	1	$50,000	Geosafe	$50,000
On-site Full Scale Test	1	$250,000	Geosafe	$250,000
Mobilization, Demobilization	-	-	Geosafe	$150,000
In Situ Vitrification	178,000 ton	$355/ton	Geosafe	$63,190,000
Backfill and Placement	25,000 cu yd	$13/cu yd	Keating Construction and 1988 Means	$325,000
		Total Direct Construction Costs (TDCC)		$64,972,000
		Engineering, Legal, Health & Safety, and Construction Management @ 25% of TDCC		$16,243,000
		20% Contingency		$12,994,000
		Etimated Total Installed Cost		$94,209,000

002923A

PHASE III COST ESTIMATE

ALTERNATIVE S/S-9:
SLURRY WALL, DEWATER UNIT, VACUUM EXTRACTION, CONTAMINANT EXTRACTION, ON-SITE SOLIDIFICATION, CAP

Item	Quantity/Unit	Unit Cost	Reference	Installed Cost
Site preparation:				
Same as S/S-3	-	-	S/S-3	$500,000
Slab for extraction equipment	550 cu yd	$200/cu yd	Estimate	$110,000
Backfill material, including placement, spreading and compaction	4,200 cu yd	$25/cu yd	*Keating	$105,000
Waste storage tanks (10,000 gal)	2	$15,000	Estimate	$30,000
Chemical storage tank (5,000 gal)	1	$10,000	Estimate	$10,000
In Situ Vacuum Extraction***	-	-	Midwest Water Resources	$4,070,000
Structural Concrete Slurry Wall:				
Same as S/S-5	-	-	S/S-5	$1,474,000
Excavation:				
Same as S/S-5	-	-	S/S-5	$1,710,000
Stabilization/Solidification	14,000 cu yd	$90/cu yd	OH Materials	$10,260,000
On-Site Extraction:				
Water treatment system	-	-	Vendors/	$14,627,000
On-site extraction	14,000 cu yd	$100/cu yd	Estimate	$11,400,000 **
Backfill of Stabilized Material	42,000 cu yd	$15/cu yd	*	$2,130,000
Asphalt Cap:				
Same as S/S-4	-	-	S/S-4	$677,000
		Total Direct Construction Costs (TDCC)		$47,103,000
		Engineering, Legal, Health & Safety, and Construction Management @ 25% of TDCC		$11,776,000
		20% Contingency		$9,421,000
		Estimated Total Installed Cost		$68,300,000

Previous Site Remediation Experience

Not conclusive. This number is based on available data for similar operations.

Cost data for countercurrent extraction is currently not available. This value includes the handling of rubble.

* Based on vendor information, the vacuum extraction system will be operated in a dewatering mode initially to dewater the site.

002924 A

PHASE III COST ESTIMATE

ALTERNATIVE S/S-12
SLURRY WALL, DEWATER UNIT, IN SITU STABILIZATION, CAP

Item	Quantity/Unit	Unit Cost	Reference	Installed Cost
Site Preparation -Same as S/S-3	-	-	S/S-3	$500,000
Upgraded Slurry Wall -Same as S/S-3	-	-	S/S-3	$646,000
Dewatering System	-	-	S/S-6	$152,000
In Situ Stabilization	114,000 cu yd	$85/cu yd	OH Materials	$9,690,000
Asphalt Cap -Same as S/S-4	-	-	S/S-4	$677,000
		Total Direct Construction Costs (TDCC)		$11,665,000
		Engineering, Legal, Health & Safety, and Construction Management @ 25% of TDCC		$2,916,000
		Start-up and Shake-down Costs		$2,333,000
		20% Contingency		
		Estimated Installed Cost		$16,914,000

002925 A

PHASE III COST ESTIMATE

ALTERNATIVE S/S-14:
SLURRY WALL, DEWATER UNIT, VACUUM EXTRACTION, CAP

Item	Quantity/Unit	Unit Cost	Reference	Installed Cost
Site preparation: Same as S/S-3	-	-	S/S-3	$500,000
Upgraded Slurry Wall: Same as S/S-3	-	-	S/S-3	$646,000
In Situ Vacuum Extraction* : Same as S/S-5	-	-	S/S-5	$4,070,000
Multi-Media Cap: Same as S/S-3	-	-	S/S-3	$1,775,000
		Total Direct Construction Costs (TDCC)		$6,991,000
		Engineering, Legal, Health & Safety, and Construction Management @ 25% of TDCC		$1,748,000
		20% Contingency		$1,398,000
		Estimated Total Installed Cost		$10,137,000

Based on vendor information, the vacuum extraction system will be operated in a dewatering mode initially to dewater the site.

002926A

PHASE III COST ESTIMATE

ALTERNATIVE S/S-15:
SLURRY WALL, DEWATER UNIT, VACUUM EXTRACTION, CONTAMINANT EXTRACTION OF PARTIAL SITE, CAP

Item	Quantity/Unit	Unit Cost	Reference	Installed Cost
Site preparation: Same as S/S-9	-	-	S/S-9	$755,000
Slurry Wall (Concrete): Same as S/S-5	-	-	S/S-5	$1,474,000
In Situ Vacuum Extraction*** Same as S/S-5	-	-	Midwest Water Resources	$4,070,000
Excavation	57,000 cu yd	$15/cu yd	*	$855,000
On-Site Extraction: Water treatment system	1	1	Vendors	$14,627,000
On-Site Extraction	57,000 cu yd	$100/cu yd	Estimate	$5,700,000 **
Backfill and Placement of Soil	57,000 cu yd	$15/cu yd	*	$855,000
Multi-Media Cap: Same as S/S-3	-	-	S/S-3	$1,775,000
		Total Direct Construction Costs (TDCC)		$30,111,000
		Engineering, Legal, Health & Safety, and Construction Management @ 25% of TDCC		$7,582,000
		20% Contingency		$6,022,000
		Estimated Total Installed Cost		$43,661,000

* Previous Site Remediation Experience

** Not conclusive. Based on available data for other operations. This value includes the handling of rubble.

*** Based on vendor information, the vacuum extraction system will be operated in a dewatering mode initially to dewater the site

C002927A

PHASE III COST ESTIMATE

ALTERNATIVE S/S-16:
SLURRY WALL, DEWATER UNIT, VACUUM EXTRACTION, CONTAMINANT EXTRACTION OF PARTIAL SITE, ON-SITE STABILIZATION, CAP

Item	Quantity/Unit	Unit Cost	Reference	Installed Cost
Site preparation:				
Same as S/S-9	-	-	S/S-9	$755,000
Structural Concrete Slurry Wall:				
Same as S/S-5	-	-	S/S-5	$1,474,000
Excavation	57,000 cu yd	$15/cu yd	*	$855,000
In Situ Vacuum Extraction***	-	-	Midwest Water Resources	$4,070,000
On-Site Extraction:				
Water treatment system	1	1	Vendors	$14,267,000
PCB Extraction	57,000 cu yd	$100/cu yd	Estimate	$5,700,000 **
Stabilization/Solidification:				
Stabilization	57,000 cu yd	$90/cu yd	OH Materials	$5,130,000
Backfill stabilized material	71,250 cu yd	$15/cu yd	*	$1,069,000
Multi-media Cap:				
Same as S/S-3	1	-	S/S-3	$1,775,000
		Total Direct Construction Costs (TDCC)		$35,095,000
		Engineering, Legal, Health & Safety, and Construction Management @ 25% of TDC		$8,774,000
		20% Contingency		$7,019,000
		Estimated Total Installed Cost		$50,888,000

* Previous Site Remediation Experience

** Not conclusive. This number is based on available data for similar soil flushing operations. Cost data for countercurrent extraction is currently not available. This value includes the handling of rubble

*** Based on vendor information, the vacuum extraction system will be operated in a dewatering mode initially to dewater the site

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PHASE III COST ESTIMATE

ALTERNATIVE S/S-16*
SLURRY WALL, DEWATER UNIT, VACUUM EXTRACTION, OFF-SITE INCINERATION, CONTAMINANT EXTRACTION OF METALS

Item	Quantity/Unit	Unit Cost	Reference	Installed Cost
Site Preparation				
-Same as S/S-3	-	-	S/S-3	$500,000
- Slab for extraction area	550 cu yd	$200/cu yd	*	$110,000
-Slab for drumming and loading area	500 cu yd	$200/cu yd	S/S-13	$100,000
Structural Concrete Slurry Wall				
-Same as S/S-4	-	-	S/S-4	$1,474,000
Vacuum Extraction***				
-Same as S/S-4	-	-	S/S-4	$4,070,000
Dewatering (after vacuum extraction)	-	-	Estimate	$80,000
Excavation	114,000 cu yd	$15/cu yd	*	$1,710,000
Contaminant Extraction for Metals:				
- Treatment plant	-	-	Vendors	$14,627,000
-Contamimant Extraction	114,000 cu yd	$205/cu yd	Vendors/Estimate	$23,370,000
Off-site Incineration	114,000 cu yd	$1500/cu yd	Chemical Waste Management	$171,000,000
Backfill and placement	142,500 cu yd	$25/cu yd	Keating and 1988 Means	$3,562,000
		Total Direct Construction Costs (TDCC)		$220,603,000
		Engineering, Legal, Health & Safety, and Construction Management @ 25% of TDCC		$55,151,000
		20% Contingency		$44,121,000
		Estimated Installed Cost		$319,875,000

* Previous Site Remediation Experience

** Not conclusive. This number is based on available data for similar soil flushing operations. Cost data for countercurrent extraction is currently not available. This value includes the handling of rubble.

*** Based on vendor information, the vacuum extraction system will be operated in a dewatering mode initially to dewater the site.

002929A

PHASE III COST ESTIMATE

ALTERNATIVE S/S-17
SLURRY WALL, DEWATER UNIT, VACUUM EXTRACTION, CONTAMINANT EXTRACTION OF METALS FOR PARTIAL SITE, ON-SITE INCINERATION OF PARTIIAL SITE, CAP

Item	Quantity/Unit	Unit Cost	Reference	Installed Cost
Site Preparation:				
Same a S/S-4	-	-	*	$1,426,000
Extraction Setup	-	-	S/S-9	$255,000
Structural Concrete Slurry Wall:				
Same as S/S-4	-	-	VFL Technology	$1,464,000
In Situ Vacuum Extraction***	-	-	S/S-4	$4,070,000
Dewatering (after vacuum extraction)	-	-	Estimate	$80,000
Excavation	114,000 cu yd	$15/cu yd	*	$1,710,000
Contaminant Extraction of Metals:				
Extraction	114,000 cu yd	$205/cu yd	Vendors/Estimate	$23,370,000
Waste Treatment Plant	-	-	Vendors	$14,627,000 **
Onsite Incineration	178,000 tons	$300/ton	OH Materials	$53,400,000
Backfill of Ash	114,000 cu yd	$15/cu yd	*	$1,710,000
Multi-media Cap:				
Same ad S/S-3	-	-	S/S-3	$1,775,000
	Total Direct Consturction Cost (TDCC)			$103,887,000
	Engineering, Legal, Health & Safety and Costruction Management @ 25% of TDCC			$25,972,000
	20% Contingency			$20,777,000
	Estimated Installed Cost			$150,636,000

Previous Site Remediation Experience

Not conclusive. This number is based on available data for similar soil flushing operations. Cost data for countercurrent extraction is currently not available. This value includes the handling of rubble.

* Based on vendor information, the vacuum extraction system will be operated in a dewatering mode initially to dewater the site.

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PHASE III COST ESTIMATE

SOIL/SLUDGE ALTERNATIVES
ESTIMATED OPERATION AND MAINTENANCE COST

SITE ALTERNATIVE	ITEMS INCLUDED	REFERENCE	ANNUAL O&M COST ($)	REMEDIAL DURATION ASSUMED FOR COSTING
FOU-A	Ground Water Monitoring	*	$42,000	1-30 year
FOU-D, FOU-D', FOU-G, FOU-H, FOU-I, FOU-K	Ground Water Monitoring, Fence Maintenance, Yearly Inspections, Asphalt Cap or Dirt Cover Maintenance, and Water Collection and Disposal	*	$60,000	1-30 year
FOU-B, FOU-C, FOU-E, FOU-F, FOU-J	Ground Water Monitoring, Fence Maintenance, Yearly Inspections, Mowing, Cap Maintenance, and Water Collection and Disposal	*	$61,000	1-30 year

*Previous Site Remediation Experience

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PHASE III COST ESTIMATE

ALTERNATIVE T-1:
IN SITU VITRIFICATION

Item	Quantity/Unit	Unit Cost	Reference	Installed Cost
Excavation, Placement, Backfill	- -	- -	Estimate	$5,000
Cut Open Tank	1	$3,000	Estimate	$3,000
Vitrification	20 ton	$355/ton	Geosafe	$7,000
		Total Direct Construction Costs (TDCC)		$15,000
		Engineering, Legal, Health & Safety, and Construction Management @ 25% of TDC		$4,000
		20% Contingency		$3,000
		Estimated Total Installed Cost		$22,000

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PHASE III COST ESTIMATE

ALTERNATIVE T-2:
IN-TANK STABILIZATION, ON-SITE DISPOSAL

Item	Quantity/Unit	Unit Cost	Reference	Installed Cost
Excavation, Placement, Backfill	- -	- -	Estimate	$3,000
Fill and Stabilize Contents	15 cu yd	$130/cu yd	OH Material and Estimate	$2,000
Encapsulation: Fiberglass. single-walled, 12,000-gal tank in 2 halves, assembled on site		$15,000	Estimate	$15,000
Resin for annular space, mix and fill	2,000 gal	$20/gal	OH Materials and Estimate	$40,000
		Total Direct Construction Costs (TDCC)		$60,000
		Engineering, Legal, Health & Safety, and Construction Management @ 20% of TDC		$15,000
		25% Contingency		$12,000
		Estimated Total Installed Cost		$87,000

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PHASE III COST ESTIMATE

ALTERNATIVE T-3

Item	Quantity/Unit	Unit Cost	Reference	Installed Cost
Sludge Removal, Handling, and Tank Washing	-	-	Estimate	$10,000
On-Site Incineration of Sludge	23 tons	$300/ton	OH Materials	$7,000
Tank Cut Up/Disposal			Estimate	$3,000
Stabilization of Ash and Backfill	15 cu yd	$130/cu yd		$2,000
	Total Direct Consturction Cost (TDCC)			$22,000
	Engineering, Legal, Health & Safety and Costruction Management @ 25% of TDCC			$6,000
	20% Contingency			$4,000
	Estimated Installed Cost			$32,000

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PHASE III COST ESTIMATE

ALTERNATIVE T-4:
CONTAMINANT EXTRACTION, ON-SITE STABILIZATION, ON-SITE DISPOSAL

Item	Quantity/Unit	Unit Cost	Reference	Installed Cost
Sludge Removal, Handling, and Tank Washing	- -	- -	Estimate	$10,000
Contaminant Extraction	15 cu yd	$125/yd	OH Material	$2,000
Stabilization Solidification and Backfill	15 cu yd	$105/cu yd	OH Materials and Estimate	$2,000
Tank Cut Up and Disposal	- -	- -	Experience	$3,000
Solvent Disposal	- -	- -	Estimate	$3,000
		Total Direct Construction Costs (TDCC)		$20,000
		Engineering, Legal, Health & Safety, and Construction Management @ 20% of TDC		$5,000
		25% Contingency		$4,000
		Estimated Total Installed Cost		$29,000

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PHASE III COST ESTIMATE

ALTERNATIVE T-8
CONTAMINANT EXTRACTION, OFF-SITE INCINERATION

Item	Quantity/Unit	Unit Cost	Reference	Installed Cost
Sludge Removal, Handling, and Tank Washing	-	-	Estimate	$10,000
Contaminat Extraction, organics and PCBs	15 cu yd	$200/cu yd	OH Materials	$3,000 *
Contaminat Extraction, of metals	15 cu yd	$400/cu yd		$6,000 *
Tank Cut Up/Disposal				$3,000
Off-Site Incineration of Remaining Sludge				$22,000
	Total Direct Consturction Cost (TDCC)			$44,000
	Engineering, Legal, Health & Safety and Costruction Management @ 25% of TDCC			$11,000
	20% Contingency			$9,000
	Estimated Installed Cost			$64,000

* Assumes extraction equipment already on-site

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PHASE III COST ESTIMATE

ALTERNATIVE T-9
CONTAMINANT EXTRACTION, ON-SITE INCINERATION
ON-SITE STABILIZATION

Item	Quantity/Unit	Unit Cost	Reference	Installed Cost
Sludge Removal, Handling, and Tank Washing	-	-	Estimate	$10,000
Contaminat Extraction, organics and PCBs	15 cu yd	$200/cu yd	OH Materials	$3,000 *
Contaminat Extraction, of metals	15 cu yd	$400/cu yd	Vendors/Estimate	$6,000 *
Tank Cut Up/Disposal	-	-	Estimate	$3,000
On-Site Incineration of Remaining Sludge	23 tons	$300/ton	OH Materials	$7,000
On-Site Stabilization	15 cu yd	$130/cu yd	OH Materials/Est.	$2,000
Backfill				$1,000
	Total Direct Consturction Cost (TDCC)			$32,000
	Engineering, Legal, Health & Safety and Costruction Management @ 25% of TDCC			$8,000
	20% Contingency			$6,000
	Estimated Installed Cost			$46,000

* Assumes extraction equipment already on-site

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Appendix L
EP Tox

002938

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APPENDIX L
EP TOXICITY SAMPLE RESULTS

The USEPA requested documentation of the hazardous nature of the SCP site soil. ERM conducted field sampling of 12 locations at the SCP site in January 1989. The samples and a duplicate were analyzed for EP toxicity and compared to the maximum permitted concentrations before a waste is labeled hazardous. All samples indicated concentrations of at least one compound above the allowable concentration. The sample results are provided in Table L-1.

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TABLE L-1

EP Toxicity Test Results from Grab Samples at SCP-Carlstadt Site

Sample Number	Sample Location	Arsenic	Barium	Cadmium	Chromium	Lead	Selenium	Silver	Mercury
14924	B-6	2.4U	[29]	4.0U	[7.9]	6.6	7.0U	5.5U	0.2U
14925	B-1	33	[68]	4.0U	6.3U	0.45U	11	5.5U	0.2U
14926	B-2	12	371	29	211	1150	7.0U	5.5U	8.0
14927	B-3	21	[127]	8.1	30	429	7.0U	5.5U	0.45
14928	B-4	[5.5]	[106]	[4.0]	[8.1]	83	15	5.5U	0.2U
14929	B-5	33	[145]	4.0U	6.3U	[2.0]	7.0U	5.5U	0.2U
14930	P-2	12	[16]	4.0U	[9.0]	18	7.0U	5.5U	0.2U
14931	P-3	11	[122]	4.0U	6.3U	57	8.6	5.5U	0.2U
14932	P-4	2.4U	[35]	4.0U	6.3U	30	7.0U	5.5U	0.2U
14933	MW-5D	12U	[19]	4.0U	6.3U	15	7.0U	5.5U	5.9
14934	MW-3S								
14935	MW-6S	14	[45]	4.0U	23	47	7.0U	5.5U	6.8
14937	B-5 Dupl	30	[146]	5.4	6.3U	0.45U	7.0U	5.5U	0.2U
Max Conc (mg/L)		5.0	100.0	1.0	5.0	5.0	1.0	5.0	0.2
Instr Det Limit (ug/L (ug/L)		48	0.85	4.3	5.0	39	67	4.3	0.11

U = Compound was analyzed for but not detected. Total reported is the Instrument Detection Limit

[ ] = Total is greater than Instrument Detection Limit but less than EPA Required Detection Limit

Samples tested by CompuChem Laboratories for E. P. Toxicity Leachate RCRA/SDWA Metals on 2/7/89

Appendix M
Volume Calcs.

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Deleted in accordance with EPA comments dated 28 March 1990.

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Appendix N
GW Calcs.

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APPENDIX N
GROUND WATER CALCULATIONS FOR ALTERNATIVE FOU-C

- Fill Unit Water Balance
- Slurry Wall Upgrade

002943A

SCP-Carlstadt Site
Reviewer Sheet

Draft Number: 1

Document Name: FILL UNIT (FOU) WATER BALANCE

Draft Date: 2/21/89

Lead Author: Richard C. Karr

Reviewer: Steve Sayko

Scope of Review: Entire document

Technical: Calculations, Assumptions, technical approach

Regulatory: N/A

Editorial: N/A

Signature: [illegible] Date: 2/28/89

Transmitted to: Marian Carlin Date: 2/28/89

Outstanding Issues:

See attached notes

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Review of water balance calcs for SCP Carlstadt
by Steve Saylor 2/28/89

Calcs. 802 01 01 01

p1. of 10.

1.2 a) 7 in/yr is probably ½ to ⅓ to actual infiltration
— unless the area is covered largely w/ impermeable materials & runoff is high

c) max Q_I is therefore ≈ 6 gpm

2.1 Slug test permeabilities are typically lower than the "average" aquifer permeability, therefore these calcs will underestimate flow. Also Rick calculated 3.4×10^{-3} ft/min using all of the slug test data, about 3x higher than the average used here (but still lower than the aquifer average).

15 ~ 20 in/year

1 ft to 2'/year

2.25 K of till is low

2.26 infiltration = 0.675 gpm
≈ 2 inches/year infiltration.

not a bad estimate given your data base (in fact I'd say very close given your data base). However this could be as much as a factor of 10 low.

002945

ERM MEMORANDUM

From: Rick Karr RK Date: Feb 22, 1989

To: Marian Carlin
File 802.01.00.01

Re: SCP Carlstadt
Fill unit water balance
Errata to 2/21/89 memo

In checking over my water balance calculations for the fill unit submitted in my 2/21/89 memo to you, I have found an error in unit conversions for one calculation. Unfortunately, this incorrect value was incorporated in several other calculations. The following are errata corrections/changes which should be noted. They are referenced by section number of my calculations.

SECTION	ERRATA
2.2.5 (d)	$Q_{out\ D}$ = 0.096 gpm
2.2.6 (b)	$Q_{out\ D}$ = 0.096 gpm Runoff must = 1.455 gpm Infiltration must = 0.675 gpm
3.1.3	$Q_{out\ d}$ = 0.096 gpm
3.5 (b)	$Q_{out\ d}$ = 0.096 gpm $Q_{out\ GW}$ = 0.496 gpm
3.5 (c)	Runoff = 1.84 gpm Infiltration = 0.28 gpm GW outflow = 0.496 gpm

002945A

ERM MEMORANDUM

From: Rick Karr RIC Date: Feb 21, 1989

To: Marian Carlin Re: SCP Carlstadt
File 802.01.00.01 Fill unit water balance

Since Dames and Moore did not do a water balance for the SCP site or any portion of the site, I thought the FS engineers might find this helpful. The attached calculations are two approaches to a water balance for the fill unit. The first is performed as though the radial flow interpretation promoted in the RI report is valid. The second is performed as though there is a ground water inflow along the eastern site boundary. Relevant figures with the defined flow zones are included (1:100 scale). You may want to distribute these calculations to Jack Harrison and/or the rest of the project team concerned with water treatment, etc. I have been over the calculations, but a peer review may be needed if you can find someone to do it.

A few comments regarding the water balance calculations:

1. For simplicity, a uniform fill thickness of 8.2 feet is assumed over the site. This is not necessarily true along the boundaries.

2. I did not attempt to consider the peat underlying the fill separately. For simplicity, the combined fill/peat thickness is 8.2 ft and they have equivalent hydraulic conductivities. This is not true in reality.

3. I found it difficult to construct flow zones along the Patterson Plank Road and finally simplified the problem by considering inflow/outflow of groundwater along that boundary to be nominal. The data suggest that this is not entirely unreasonable.

4. Hydraulic conductivities vary over 2 orders of magnitude as outlined in the RI report. I averaged them and used that number. Just realize that ground water inflow and outflow numbers can also be + or - an order of magnitude for this reason.

1.0 Precipitation Infiltration (Q_I)

1.1 Page 13 of RI Report. "... annual precipitation of approximately 7 inches which, in theory, is the amount of water available for groundwater recharge and surface runoff."

1.2 Assume No Runoff (worst case)

a) $(7 in/yr)\left(\frac{1 ft}{12 in}\right)\left(\frac{1 yr}{525600 min}\right) = 1.11 \times 10^{-6}$ ft/min

b) Approximate area of site:

PAGE 2 of RI Report, Sect. 1.1.1
"The site occupies .... approximately 5.9 acres."

$(5.9 \text{ acres})(43560 \text{ ft}^2/\text{acre}) = 2.57 \times 10^5 \text{ ft}^2$

c) MAXIMUM Q_I due to infiltration of precipitation

$(1.11 \times 10^{-6} \text{ ft/min})(2.57 \times 10^5 \text{ ft}^2)(7.481 \text{ gal/ft}^3) = \boxed{2.13 \text{ gpm}}$

2.0 GROUND WATER FLOW CALCULATIONS (CASE #1)

Assumptions:
1. AVERAGE UNIT THICKNESS = 8.2 ft
2. Radial Flow interpretation is valid
3. Peat unit has no effect

2.1 Hydraulic Conductivities
Reference: RI Rpt. p. 54, Sec. 4.3.2.1

$K = 1 \times 10^{-3}$ cm/sec $= 1.97 \times 10^{-3}$ ft/min
to
$K = 1 \times 10^{-4}$ cm/sec $= 1.97 \times 10^{-4}$ ft/min

AVG $= 1.09 \times 10^{-3}$ ft/min

2.2 CASE #1 - discharge (Q_{OUT}) from FILL (GENUINE RADIAL FLOW)

2.2.1 Q_{OUT} - ZONE 1

a) Surface Elev. @ P-7 = 7.6 ft
∴ SATURATED THICKNESS @ Site Boundary =
(7.6 ft - 6.0 ft) = 1.6 ft
(8.2 ft - 1.6 ft) = 6.6 ft

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b) Length of zone 1 along discharge boundary ~ 310 ft.

c. i_1 = gradient in zone 1

$= (6.5\ ft - 5.5\ ft) / 182\ ft$

$= 0.005$

d.) $Q_{OUT\,1} = K\, i_1\, A$

$= (1.08 \times 10^{-3}\ ft/min)(0.005)(6.6\ ft)(310\ ft)$

$= 1.10 \times 10^{-2}\ ft^3/min$

$= 0.08\ gpm$

2.2.2 Q_{OUT} - Zone 2

a) Surface elevation @ MW-6S = 5.62 ft

∴ Saturated thickness @ site boundary ≈

$(5.62\ ft - 2.0\ ft) = 3.62\ ft$

$(8.2\ ft - 3.62\ ft) = 4.58\ ft$

b) Length of zone #2 along site boundary

≈ 400 ft

c) i_2 = gradient in zone 2

$= (6.5\ ft - 1.5\ ft) / 250\ ft$

$= 0.020$

d) $Q_{OUT\,2} = K\, i_2\, A$

$= (1.08 \times 10^{-3}\ ft/min)(0.02)(4.58\ ft)(400\ ft)$

$= 3.96 \times 10^{-2}\ ft^3/min$

$= 0.30\ gpm$

2.2.3 Q_{OUT} - Zone 3

a) Surface elevation @ MW-5 = 6.44 ft

∴ Saturated Thickness @ site boundaries

$(8.2\ ft - (6.44\ ft - 2\ ft)) \approx 3.76\ ft$

b) Length of zone #3 along site boundary

$165\ ft + 180\ ft = 345\ ft$

c) i_3 = gradient in zone #3

$\approx (6.5 - 1.5) / 420\ ft = 0.012$

d) $Q_{OUT\,3} = K i_3 A$

$= (1.08 \times 10^{-3}\ ft/min)(0.012)(3.76\ ft)(345\ ft)$

$= 1.68 \times 10^{-2}\ ft^3/min$

$\boxed{= 0.126\ gpm}$

2.2.4 Q out – Zone 4

→ Assume Nominal Flow to off-site along Patterson Plank Rd

a) Surface elevation @ P-12 = 7.1 ft

∴ (8.2 ft – (7.1 ft – 2.5 ft)) = 3.6 ft = saturated thickness

b) Length of zone 4 along site boundary ≈ 250 ft

c) i_4 = gradient in zone 4

(6.5 – 2.5) / 420 ft = 0.01

d) $Q_{OUT\,4} = K i_4 A$

$= (1.08 \times 10^{-3}\ ft/min)(0.01)(3.6\ ft)(250\ ft)$

$= 9.72 \times 10^{-3}\ ft^3/min$

$\boxed{= 0.073\ gpm}$

2.2.5 Q_{OUT} → Downward to Till

a) AREA = 5.9 acres = $2.57 \times 10^5\ ft^2$

b) $K = 5.05 \times 10^{-7}\ cm/sec$ (AVG of VALUES in TABLES of RI Rpt.)

$= 9.94 \times 10^{-7}\ ft/min.$

c) i_D → downward gradient (Based on MW-7 well cluster as measured on 3/14/88)

$i_D = \frac{\Delta H}{\Delta L} = \frac{(5.8 - 3.5)}{(0.6 - (-45.42))}$

002947A $i_D = 0.05$ Downward

d) $Q_{OUT\,D} = K i_D A$

$= (1.94 \times 10^{-7}\ ft/min)(0.05)(2.57 \times 10^{5}\ ft^2)$

$= 1.28 \times 10^{-2}\ ft^3/min$

~~$= 0.0012$ gpm~~ $= 0.096$ gpm

2.2.6 CASE #1 WATER BALANCE (Genuine Radial Flow)

a) $Q_I = Q_{OUT\,1} + Q_{OUT\,2} + Q_{OUT\,3} + Q_{OUT\,4} + Q_{OUT\,D}$

b) Using computed values from above.

$Q_I = 2.13$ gpm $\quad Q_{OUT\,3} = 0.126$ gpm

$Q_{OUT\,1} = 0.08$ gpm $\quad Q_{OUT\,4} = 0.073$ gpm

$Q_{OUT\,2} = 0.30$ gpm $\quad Q_{OUT\,DMM} =$ ~~0.0019 gpm~~ 0.0

$2.13\ gpm = (0.08 + 0.3 + 0.126 + 0.073 + \cancel{0.001}\ 0.096)$

$2.13\ gpm \neq$ ~~0.58 gpm~~ 0.675 gpm

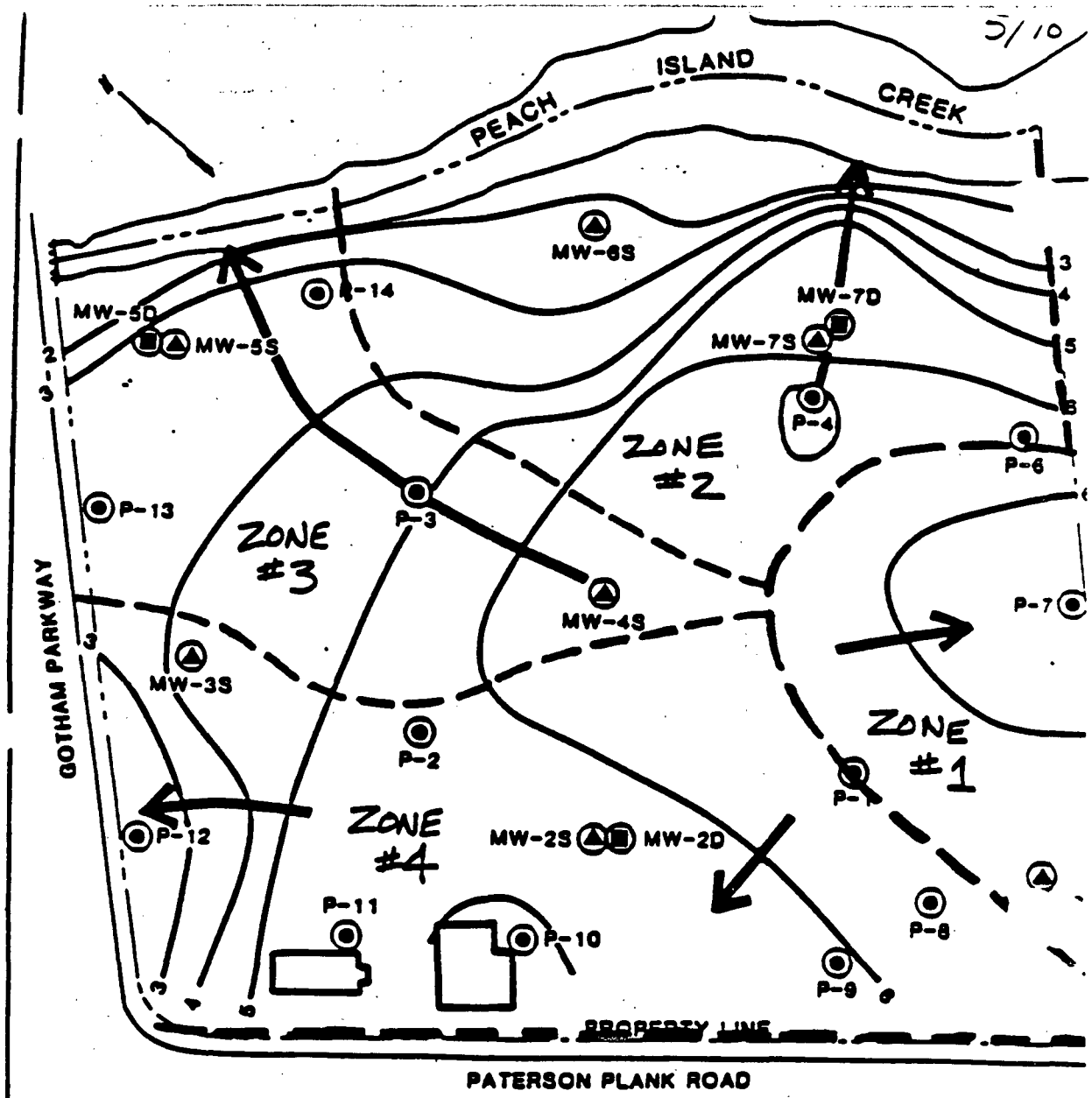
$\therefore$ Runoff must $=$ ~~1.54 gpm~~ 1.455 gpm

Infiltration must $= 0.675$ gpm

~~Q_{OUT} - Runoff~~

~~Q_{pre}~~ =

5/10



WATER TABLE ELEVATION
SHALLOW AQUIFER- MARCH 14, 1988

SCP SITE, CARLSTADT, N.J.

0 100 200 FEET

KEY:

- SHALLOW PIEZOMETER
- SHALLOW MONITORING WELL
- DIRECTION OF GROUNDWATER FLOW

DAMES & MO

FIGUR

CASE #1

LEGEND

FLOW BOUNDARY

002948A

GENUINE RADIAL FLOW

3.0 Ground water Flow Calculations (Case #2)

Assumptions: 1) Average Unit Thickness ~ 8.2 ft.

2) RADIAL FLOW INTERPRETATION IS NOT VALID. GROUND WATER ENTERS SITE ALONG SE BOUNDARY.

3) Offsite GRADIENT ≈ gradient w/in 100 ft of bound...

3.1 Calculated values or DATA USED FROM SEC 2.0

3.1.1 Hydraulic CONDUCTIVITIES
- SAME AS DISCUSSED PREVIOUSLY IN SEC. 3.1

AVG = 1.08×10^{-3} ft/min

3.1.2 Q_I = 2.13 gpm

3.1.3 $Q_{OUT\,O}$ = ~~0.0017 gpm~~ 3.6116 gpm

3.2 ZONE #1

3.2.1 $Q_{IN\,1}$ - GW flow in from offsite

a) ELEVATION @ P-6 ≡ 7.4'

∴ SATURATED THICKNESS ≈
(8.2 ft - (7.4-6.5)) = 7.3 ft

b) $i \approx 0.01$

c) Length of in flow area ~ 115 ft

d) $Q_{in1} = K i A$

$= (1.08 \times 10^{-3}\,ft/min)(0.01)(7.3\,ft)(115\,ft)$

$= 9.07 \times 10^{-3}\,ft^3/min$

= 0.07 gpm

3.2.2 $Q_{OUT\,2}$ - GW flow out of zone 3

a) Elevation @ MW 6 = 5.62 ft

∴ Saturated Thickness @ Site Boundary ≈
(8.2 - (5.62 - 2.0)) = 4.58 ft

b) i_2 = (6.5 - 1.5) / 350 ft
= 0.01

c) Length of discharge boundary ≈ 410 ft

d) $Q_{OUT2} = KiA$

$= (1.08 \times 10^{-3} ft/min)(0.01)(4.58)(410 ft)$

$= 7.03 \times 10^{-2} ft^3/min$

$= 0.15$ gpm

3.3 ZONE #2

3.3.1 Q_{IN2}

—NO GW INFLOW INTO ZONE 2

3.3.2 Q_{OUT2}

a) Surface elevation @ MW-5 = 6.44 ft

∴ Saturated thickness @ site boundary ≈

(8.2 ft - (6.44 ft - 2 ft)) = 3.76 ft

b) Length of discharge boundary ≈ 210 ft + 165 ft

≈ 375 ft

c) $i_2 = (6.5 - 1.5)/450$ ft

$i_2 = 0.01$

d) $Q_{OUT2} = Ki_2A$

$= (1.08 \times 10^{-3} ft/min)(0.01)(3.76 ft)(375 ft)$

$= 1.52 \times 10^{-2} ft^3/min$

$= 0.11$ gpm

3.4 ZONE #3

—ASSUME NOMINAL INFLOW OR DISCHARGE ALONG PATTERSON PLANK Rd boundary

3.4.1 Q_{IN3}

a) Surface elevation @ MW-1 = 7.65 ft

∴ SATURATED THICKNESS ≈

(8.2 ft − (7.65 ft − 6.5 ft) = 7.05 ft

b) $i \sim 0.01$

c) Length of inflow boundary in zone #3
~ 250 ft

d) $Q_{in\,3} = K_i A$

$= (1.08 \times 10^{-3})(0.01)(7.05\ ft)(250\ ft)$

$= 1.90 \times 10^{-2}\ ft^3/min$

$\boxed{= 0.14\ gpm}$

3.4.2 $Q_{out\,3}$

a) Surface elevation @ P-12 = 7.1 ft
∴ saturated thickness along discharge boundary ≈
$(8.2\ ft - (7.1\ ft - 2.5\ ft)) = 3.6\ ft$

b) Length of discharge boundary ~ 230 ft

c) i_3 = Gradient in zone 3
$= (6.5 - 2.5)/580 = 0.007$

d) $Q_{out\,3} = K i_3 A$

$= (1.08 \times 10^{-3})(0.007)(3.6\ ft)(230\ ft)$

$= 6.26 \times 10^{-3}\ ft^3/min$

$= 0.05$ gpm

3.5 Water balance for Fill Unit (Case #2)

a) $Q_{in\,GW} = Q_{in\,1} + Q_{in\,2} + Q_{in\,3}$

$= 0.07\,gpm + \cancel{0} + 0.14\,gpm$

$= 0.21\,gpm$

b) $Q_{out\,GW} = Q_{out\,1} + Q_{out\,2} + Q_{out\,3} + Q_{out\,D}$

$= 0.15\,gpm + 0.11\,gpm + 0.14\,gpm + \cancel{0.0017\,gpm}$

$= \cancel{0.40\,gpm}$ 2.496 gpm $\cancel{0.0017}$ 0.096 gpm

c) $Q_I - Runoff = Q_{out\,GW} - Q_{in\,GW}$

$2.13\,gpm - Runoff = \cancel{0.40\,gpm}$ 0.496 gpm $- 0.21\,gpm$

$2.13\,gpm = \cancel{0.19\,gpm}$ 0.286 $+ Runoff$

~~1.94~~ 1.84 gpm =	Runoff
~~0.19~~ 0.28 gpm =	Infiltration
0.21 gpm =	GW inflow
~~0.40~~ 0.496 gpm =	GW outflow

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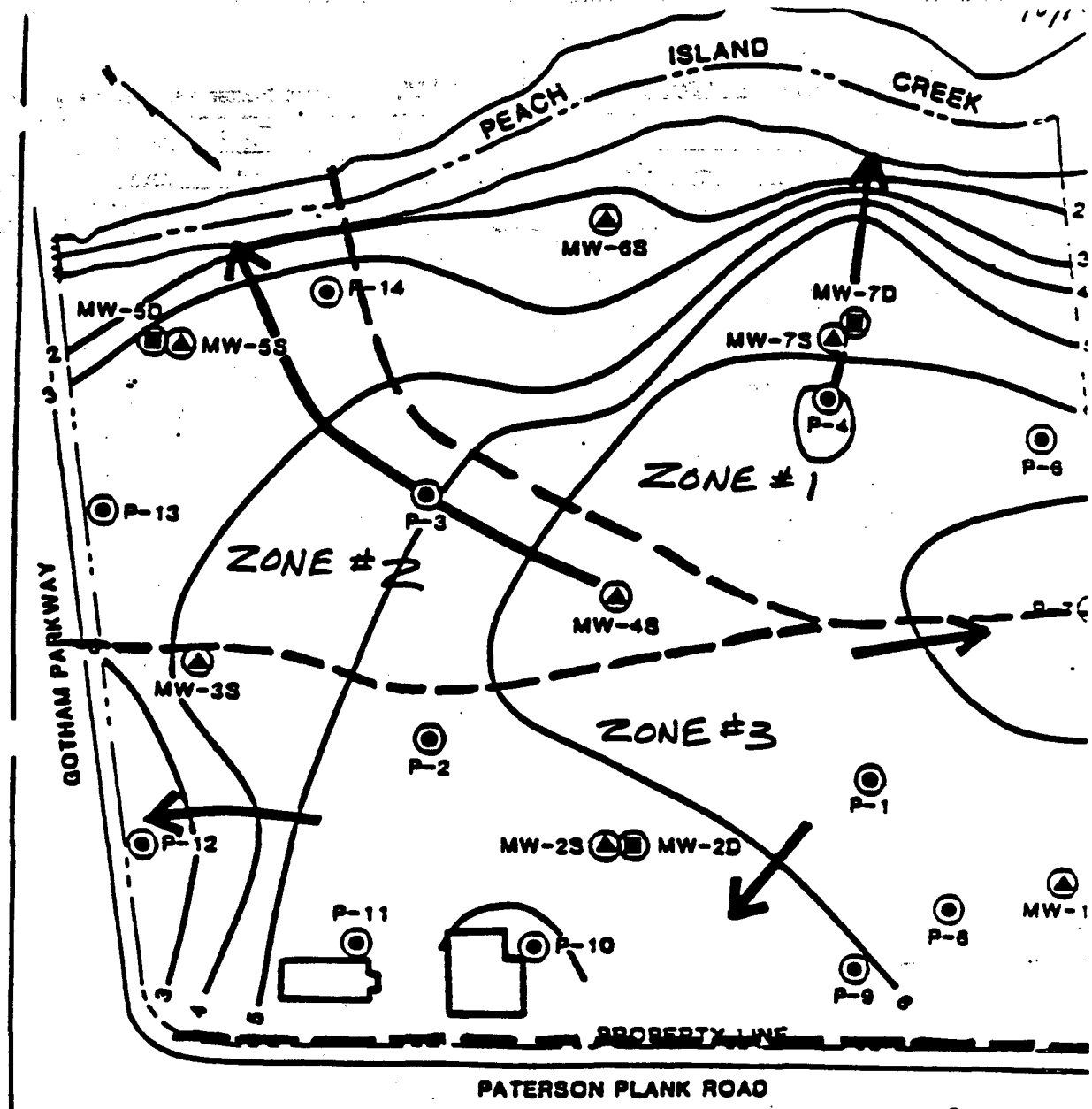

WATER TABLE ELEVATION
SHALLOW AQUIFER- MARCH 14, 1988

SCP SITE, CARLSTADT, N.J.

0 100 200 FEET

KEY:
- SHALLOW PIEZOMETER
- SHALLOW MONITORING WELL
- DIRECTION OF GROUNDWATER FLOW

DAMES & M

FIG

CASE #2

GW Flow
From off-site

LEGEND

— — — Flow Zone Boundaries

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1. Introduction

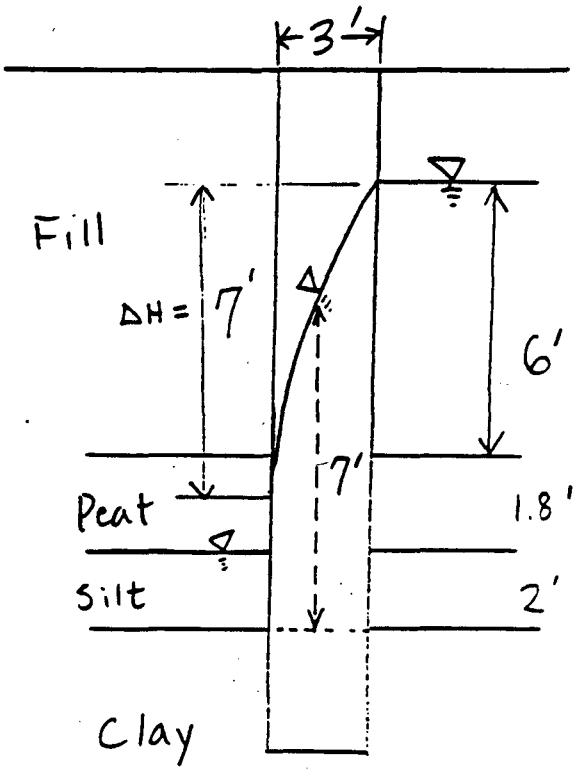
Regular slurry wall (i.e., 10^{-7} cm/sec) would allow seepage volume of 80 gallons per day. (See estimated seepage below)

$K = 1 \times 10^{-7}$ cm/sec
$= 2.8 \times 10^{-4}$ ft/day

$A = 2100' \times 7.8 = 16{,}380$ SF

$i = 7/3$

$Q = KiA = 10.7$ CFD $= 80$ gpd



It is desireable to reduce this seepage by upgrading the slurry wall design.

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2. Upgrade

- Backfill design mix to achieve 2×10^{-8} cm/sec or 5.7×10^{-5} ft/day
- Insall membrane liner on both sidewalls

Note: Because of rough sidewall surface, it is expected that many holes would develop in the liner. Thus, leakage through the liner needs to be estimated.

3. Leakage Estimate

Step 1: Assume no liner, just 2×10^{-8} cm/sec slurry wall

$$Q = KiA = 5.7 \times 10^{-5} \times 16{,}380 \times 7/3 = 2.18 \text{ CFD}$$
$$= 16 \text{ gpd}$$

Step 2: Assume numerous small holes over the entire membrane, then flow lines and phreatic surface would remain the same while flow area is only through the open holes.

Assume the area of open holes is about 4% of the total (very conservative!)

Flow rate through this open holes would be

$$Q_{hole} = 16 \text{ gpd} \times 0.04 = 0.64 \text{ gpd}$$

4. Total Inflow

Infiltration through the cap = 7 CF per year
(see attached HELP output) = 0.14 gpd

total inflow 0.14 + 0.64 = 0.78 gpd

Say less than one gallon per day

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1.1 HOW MANY YEARS OF OUTPUT DO YOU WANT?
(BETWEEN 2 AND 5 YEARS MAY BE USED.)
5

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SCP FEASIBILITY STUDY PROJECT
NEW JERSEY
29 MARCH 1989

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EXCELLENT GRASS

LAYER 1

LATERAL DRAINAGE LAYER

THICKNESS	=	12.00 INCHES
EVAPORATION COEFFICIENT	=	3.400 MM/DAY**0.5
POROSITY	=	0.4210 VOL/VOL
FIELD CAPACITY	=	0.1760 VOL/VOL
WILTING POINT	=	0.0900 VOL/VOL
EFFECTIVE HYDRAULIC CONDUCTIVITY	=	4.55000019 INCHES/HR

LAYER 2

LATERAL DRAINAGE LAYER

SLOPE	=	2.00 PERCENT
DRAINAGE LENGTH	=	250.0 FEET
THICKNESS	=	24.00 INCHES
EVAPORATION COEFFICIENT	=	3.100 MM/DAY**0.5
POROSITY	=	0.4292 VOL/VOL
FIELD CAPACITY	=	0.2718 VOL/VOL
WILTING POINT	=	0.1840 VOL/VOL

EFFECTIVE HYDRAULIC CONDUCTIVITY = 0.01650000 INCHES/HR

LAYER 3

BARRIER SOIL LAYER WITH LINER .

THICKNESS	=	11.00 INCHES
EVAPORATION COEFFICIENT	=	3.100 MM/DAY**0.5
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.4500 VOL/VOL
WILTING POINT	=	0.3600 VOL/VOL
EFFECTIVE HYDRAULIC CONDUCTIVITY	=	0.00014200 INCHES/HR

LAYER 4

LATERAL DRAINAGE LAYER

SLOPE	=	2.00 PERCENT
DRAINAGE LENGTH	=	250.0 FEET
THICKNESS	=	1.00 INCHES
EVAPORATION COEFFICIENT	=	3.100 MM/DAY**0.5
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.4500 VOL/VOL
WILTING POINT	=	0.3600 VOL/VOL
EFFECTIVE HYDRAULIC CONDUCTIVITY	=	0.00014200 INCHES/HR

LAYER 5

BARRIER SOIL LAYER WITH LINER

THICKNESS	=	12.00 INCHES
EVAPORATION COEFFICIENT	=	3.100 MM/DAY**0.5
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.4500 VOL/VOL
WILTING POINT	=	0.3600 VOL/VOL
EFFECTIVE HYDRAULIC CONDUCTIVITY	=	0.00014200 INCHES/HR

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GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	47.80
TOTAL AREA OF COVER	=	255360. SQ. FT
EVAPORATIVE ZONE DEPTH	=	18.00 INCHES
LINER LEAKAGE FRACTION	=	0.000010
EFFECTIVE EVAPORATION COEFFICIENT	=	3.386 MM/DAY**0.5
UPPER LIMIT VEG. STORAGE	=	7.6272 INCHES
INITIAL VEG. STORAGE	=	2.9634 INCHES

CLIMATOLOGIC DATA FOR NEW YORK, CITY NEW YORK

MONTHLY MEAN TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
32.40	33.69	40.57	51.18	62.68	72.00
76.63	75.34	68.47	57.86	46.35	37.03

MONTHLY MEANS SOLAR RADIATION, LANGLEYS PER DAY

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
162.54	226.57	325.00	431.43	517.37	559.77
547.29	483.26	384.84	278.40	192.46	150.06

LEAF AREA INDEX TABLE

DATE	LAI
1	0.00
100	0.00
121	1.84
142	3.00
163	3.00
184	3.00
206	3.00
227	3.00
248	2.70
269	1.96
290	0.96
311	0.50
366	0.00

EXCELLENT GRASS

WINTER COVER FACTOR = 1.80

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AVERAGE MONTHLY TOTALS FOR 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	4.59 3.60	2.46 4.95	3.50 5.63	2.69 3.12	3.68 2.68	3.60 4.30
RUNOFF (INCHES)	2.654 0.000	0.958 0.145	0.596 0.382	0.437 0.004	0.000 0.817	0.000 1.081
EVAPOTRANSPIRATION (INCHES)	0.964 3.713	1.142 4.575	1.957 3.987	2.886 2.716	5.702 1.157	4.003 1.158
PERCOLATION FROM TOP BARRIER (INCHES)	0.0000 0.0001	0.0000 0.0001	0.0000 0.0001	0.0000 0.0000	0.0000 0.0000	0.0001 0.0000
PERCOLATION FROM BASE OF COVER (INCHES)	0.0000 0.0001	0.0000 0.0001	0.0000 0.0001	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
DRAINAGE FROM TOP BARRIER (INCHES)	0.307 0.069	0.286 0.096	0.330 0.081	0.327 0.147	0.197 0.196	0.075 0.300
DRAINAGE FROM BASE OF COVER (INCHES)	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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AVERAGE ANNUAL TOTALS FOR 74 THROUGH 78

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	44.79	953216.	100.00
RUNOFF	7.074	150525.	15.79
EVAPOTRANSPIRATION	33.957	722597.	75.81
PERCOLATION FROM TOP BARRIER	0.0004	7.	0.00

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PERCOLATION FROM BASE OF COVER	0.0003	7.	0.00
'AGE FROM TOP BARRIER LAYER	2.410	51286.	5.38
DRAINAGE FROM BASE OF COVER	0.000	0.	0.00

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PEAK DAILY VALUES FOR 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	3.77	80225.6
RUNOFF	1.730	36811.7
PERCOLATION FROM TOP BARRIER	0.0000	0.5
PERCOLATION FROM BASE OF COVER	0.0000	0.3
DRAINAGE FROM TOP BARRIER LAYER	0.048	1011.0
DRAINAGE FROM BASE OF COVER	0.000	0.0
HEAD ON TOP BARRIER LAYER	36.1	
HEAD ON BASE OF COVER	0.0	
SNOW WATER	0.00	0.0

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4237

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1213

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[redacted]