WORK PLAN

ADDITIONAL INVESTIGATIONS
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY

Shore Realty Site
Glenwood Landing
New York

October 2, 1989

Prepared for:

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CONTENTS

TABLES

FIGURES

APPENDICES

INTRODUCTION

A Remedial Investigation (RI) report for the Shore Realty Site has been submitted to the New York State Department of Law and the Department of Environmental Conservation (State). After the RI report was submitted, a review of the analytical methods and QA/QC procedures was conducted by the State. As a result of that review, the State determined that a portion of the laboratory analytical data collected for the RI were unacceptable. Thus, the State has required that additional soil and water samples be collected and analyzed. This Work Plan incorporates State's resampling requirements.

Also included in this Work Plan are the previously proposed Post Screening Field Investigation tasks. Five of these Tasks: soil gas measurements; two additional deep wells; resampling DW-1; ambient air sampling; and sediment sampling; were requested by the State. These Tasks have been revised in response to State comments on the March 1988 draft Work Plan.

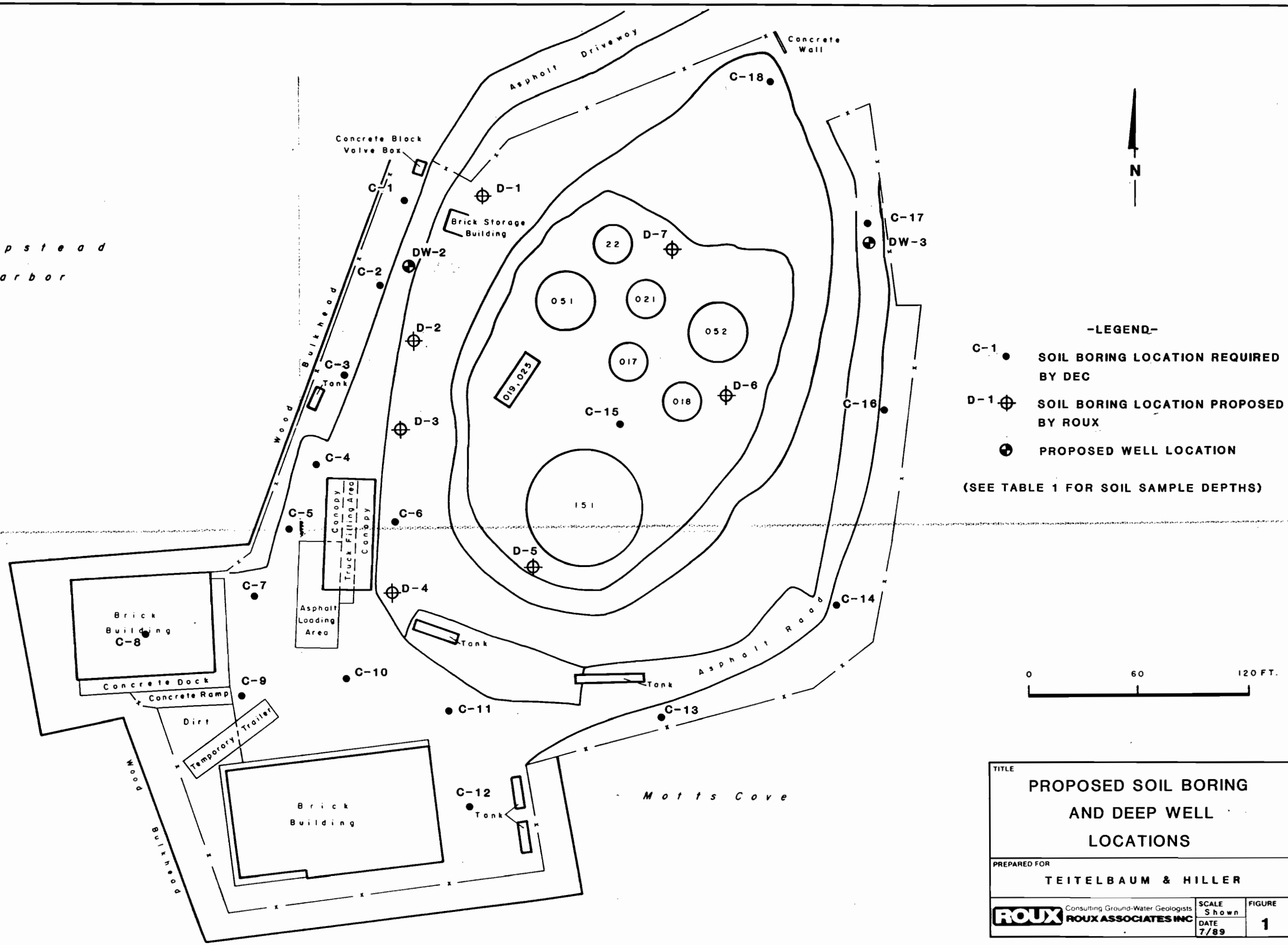
The remaining Tasks, additional soil borings and biotreatability bench scale tests, were proposed by Roux Associates to provide data needed for the Feasibility Study.

TASK I - SOIL BORINGS AND SOIL SAMPLES

Two different sets of soil borings are proposed as part of the additional investigations. These consist of eighteen (18) soil borings required by the State to replace unacceptable previous analyses and seven (7) soil borings proposed by Roux to yield additional information for the Feasibility Study. A total of 32 soil samples will be collected from these 25 borings as well as one additional soil sample from deep well, DW-2.

Subtask IA - Soil Borings Required by the State

The State has required that soil samples be collected at the depth of the water table from eighteen (18) locations at the Shore Realty Site. The locations of these samples, designated C-1 through C-18, are indicated on Figure 1. All soil borings will be completed using a truck-mounted hollow stem auger rig. Split-spoon samplers will be used to collect the soil samples, one from each boring. The split spoon samples will be collected ahead of the auger flights from undisturbed sediments and logged in detail. Immediately after the logging is completed, the sample for volatile analysis will be taken. The sample jar will be filled so that no headspace remains, then it will be sealed and placed on ice. The remaining sample from each split spoon will be split lengthwise. One half of the sample will be placed in a clean glass jar, sealed and placed on ice for analysis. Non-volatile soil samples will be homogenized before being placed



TITLE

PROPOSED SOIL BORING AND DEEP WELL LOCATIONS

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ROUX Consulting Ground-Water Geologists ROUX ASSOCIATES INC

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DATE 7/89	

in the sample jars using a stainless steel spatula and a stainless steel mixing bowl. This equipment will be decontaminated between samplings following the procedures in Appendix C. The other half of the sample will be screened for volatile organics in accordance with Appendix A. Protocols for sample collection are given in Appendix B.

Soil Samples from each location will be collected and preserved in accordance with the requirements of the specific analyses to be run. Analyses specified by the State for each soil sample are summarized in Table 1. In order to avoid cross contamination between borings, all drilling equipment, including auger flights, rods and any other tools and equipment used for drilling, will be steam cleaned prior to the first boring and between all subsequent borings. Soil sampling equipment will be decontaminated in accordance with the procedures listed in Appendix C.

Subtask IB - Post Screening/Field Investigation Soil Borings

In order to more fully characterize the lateral and vertical extent of soil contamination, and allow the Feasibility Study to be completed, seven soil borings are proposed by Roux Associates. In addition, deeper (below the water table) soil samples will be collected in five of the State requested borings (Table 1) and one soil sample will be collected from the boring for Well DW-2. The locations of the seven borings proposed by Roux (designated

Table 1. Soil Sample Depths and Analyses

Boring #	DEC Designation	Estimated Sample Depth (ft)	VOA	BNA	PCBs	CN	Total Phenols	Total Metals	EP Tox Metals
C-1	1E	3-5			X			X	O
C-2	1D	3-5		X	X	X	X		O
C-3	1C	3-5			X			X	O
C-4	1B	3-5		X	X	X	X		O
	-	10-15	O		O				O
C-5	1A	3-5			X			X	O
C-6	1F	3-5			X				O
	-	10-15	O		O				O
C-7	2C	3-5			X				O
C-8	2A	3-5			X				O
C-9	2B	3-5			X			X	O
C-10	3A	3-5		X	X	X	X		O
	-	10-15	O	O	O	O	O		O
	-	25-30	O		O				O
C-11	3B	3-5			X			X	O
	-	10-15	O		O				O
	-	25-30	O		O				O
C-12	3C	3-5			X				O
C-13	4A	3-5			X				O
C-14	4B	3-5			X			X	O
C-15	6A	10-15	X	X	X	X	X	X	O
C-16	5A	5-10			X				O
C-17	5B	5-10			X				O
C-18	6B	5-10	X		X			X	O
D-1	-	10-15	O		O				O
D-2	-	10-15	O		O				O
D-3	-	10-15	O		O				O
D-4	-	10-15	O		O				O
D-5	-	25-30	O		O				O
	-	35-40	O		O				O
D-6	-	10-15	O		O				O
D-7	-	10-15	O		O				O
DW-2	-	10-15	O		O				O

X - Required by DEC
O - Proposed by Roux

D-1 through D-7) are shown on Figure 1. The estimated sample depths and analyses to be run for each sample are presented in Table 1.

Soil borings will be completed using a truck-mounted hollow stem auger rig. During advancement of each boring, one split spoon sample will be collected from each predetermined depth. All soil samples will be collected and analyzed in accordance with the protocols specified in the appendices of this work plan.

After sampling has been completed, all shallow soil borings will be backfilled with cuttings from that boring. Deeper borings (C-4, C-6, C-15, D-1, D-2, D-3, D-4) will be backfilled with a clean material with a permability lower than the formation. The three deepest borings C-10, C-11 and D-5 will be pressure grouted through a tremi pipe from the bottom of the hole.

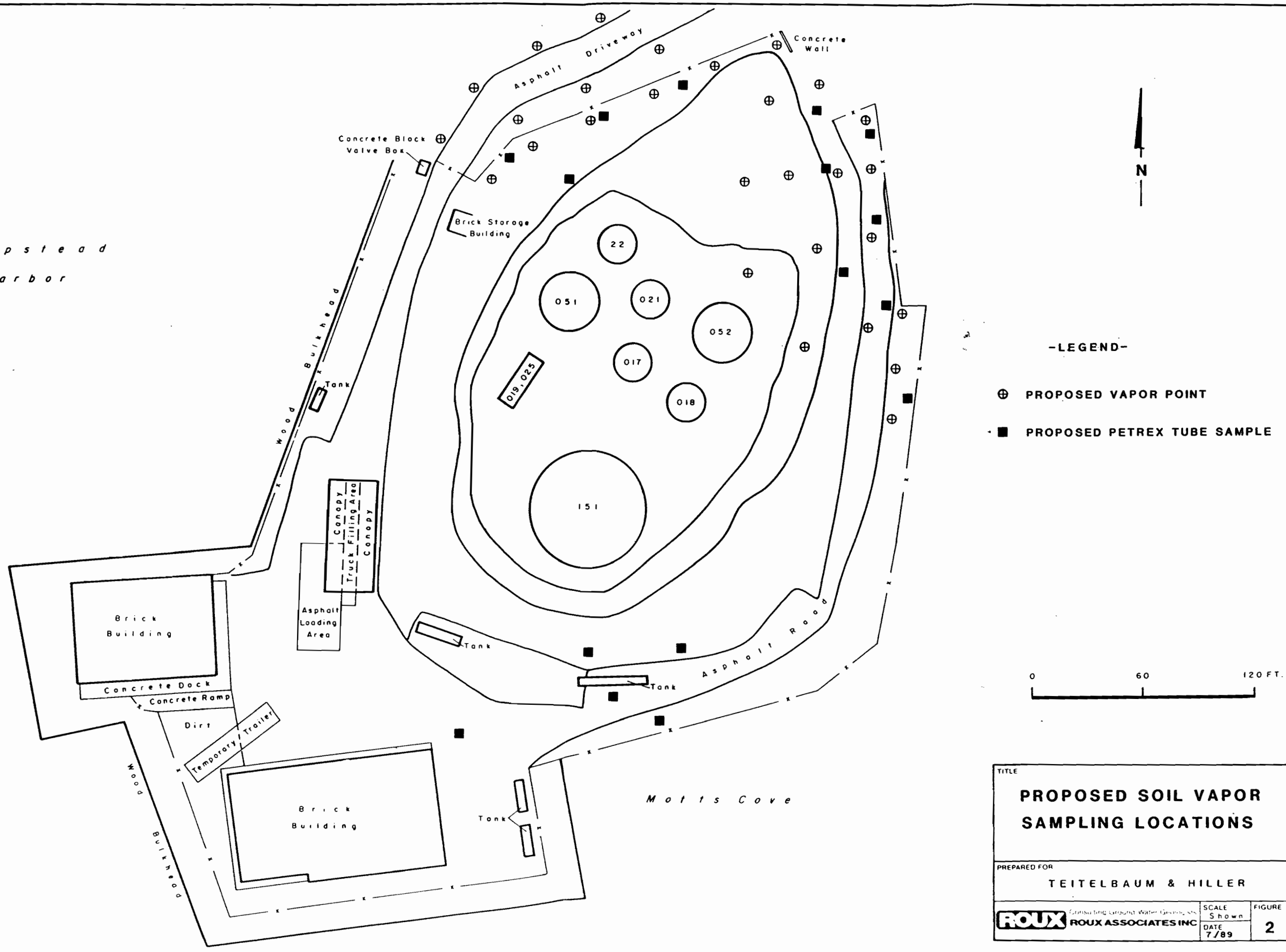
TASK II - SOIL GAS MEASUREMENTS

Additional field measurements and laboratory analysis of soil gas will be undertaken to better characterize soil gas data developed during the Remedial Investigation.

Approximately 30 soil gas measurements will be made with a photoionization meter along the north and northeast edges of the site. The proposed locations of these measurements (vapor points) are shown on Figure 2. The measurements will be made following the protocols described in Appendix D.

Based on the results of the soil gas measurements, up to 20 PETREX tube samples will be collected and analyzed in the laboratory. The PETREX tube samples will allow the specific volatile organic vapors present in the soil to be determined. The PETREX tube samples will be collected, following the protocols recommended by PETREX (see Appendix E), at the locations shown on Figure 2 or from the areas of highest photoionization meter readings to be agreed upon between Roux Associates and the State during the survey. In the event that the locations of elevated photoionization readings are substantially different from the original survey, fewer than 20 PETREX tube samples may be collected (with State concurrence).

Analysis of the carbon coated collection wire in a PETREX tube is done by mass spectrometry. PETREX tube analysis routinely



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PROPOSED SOIL VAPOR SAMPLING LOCATIONS

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FIGURE: 2

detects the majority of volatile priority pollutants in the low (i.e., 5-10) ppb range. High levels of ethylbenzene, toluene and xylene at the Site should not affect the ability of the mass spectrometer to distinguish other contaminants present in the soil gas.

Appendix F contains a list of compounds which can be detected by PETREX tubes.

TASK III - ADDITIONAL DEEP MONITORING WELLS

Two additional monitoring wells will be installed onsite to the same depth as DW-1. One well, DW-2, will be installed adjacent to SW-1 (Figure 1). The purpose of this well is to determine if the downward direction of ground-water flow between WT-2 and SW-1 continues or reverses with depth.

The location of this well corresponds with a proposed additional soil boring location. Therefore, after a soil sample has been collected from the appropriate depth for laboratory analysis, the boring will be advanced to allow for the installation of the well.

When the borehole at DW-2 is completed, a 2-inch diameter PVC well with a 10-foot screen will be installed at the same depth as DW-1. DW-2 will be drilled and constructed in the same manner as DW-1 (see Appendix G).

In order to more fully determine the ground-water characteristics beneath the site, a third deep well will be installed in the northeast corner of the site (Figure 1). This well, DW-3, will be screened at the same depth, and constructed in the same manner, as the other two deep wells.

Wells DW-2 and DW-3 will then be developed, purged and sampled. Wells SW-1 and DW-1 will be purged and sampled at the same time

and all four samples will be analyzed for the Target Compound List parameters in accordance with the November 1987 version of the NY State CLP.

A temporary tidal gauge will be installed and readings recorded every 30 minutes over one tidal cycle. Water levels will also be measured every 30 minutes in DW-1, DW-2, SW-2, WT-6 and SW-1 so that the water-table readings can be correlated with the tidal readings.

TASK IV - ADDITIONAL GROUND-WATER SAMPLING

Ground-water samples will be collected from the monitoring wells for analysis. Some of the analyses are required by the State and some have been proposed by Roux Associates (Table 2). Ground-Water samples will be collected following the protocols in Appendix H. All ground-water samples will be analyzed for purgeable organics (EPA method 624), in addition to analyses required by the State. This synoptic round of ground-water samples will help to evaluate any changes in ground-water quality which may have occurred since the completion of the Remedial Investigation.

Table 2. Ground-Water Samples and Analyses

Sample Number	Matrix	VOA	BNA	PCBs	CN	Total Phenols	Metals	Biotreat-ability Analysis
WT-2	Ground-Water	+	X		X	X	X	
WT-3	Ground-Water	+	X		X	X	X	
WT-5	Ground-Water	+	X		X	X	X	
WT-6 (A-15)	Ground-Water	+					X	+
WT-7	Ground-Water	+					X	
WT-10	Ground-Water	+	X		X	X	X	
WT-12	Ground-Water	+	X		X	X	X	
WT-13	Ground-Water	+					X	
WT-14	Ground-Water	+					X	
SW-1	Ground-Water		Targeted Compound List					+
SW-2	Ground-Water	+					X	+
SW-3	Ground-Water	+					X	+
SW-4	Ground-Water	X					X	+
SW-5	Ground-Water	+					X	+
SW-6	Ground-Water	+					X	+
DW-1	Ground-Water		Targeted Compound List					+
DW-2	Ground-Water		Targeted Compound List					
DW-3	Ground-Water		Targeted Compound List					

X Required by DEC
\+ Proposed by Roux Associates, Inc.

TASK V - ADDITIONAL SEDIMENT SAMPLES

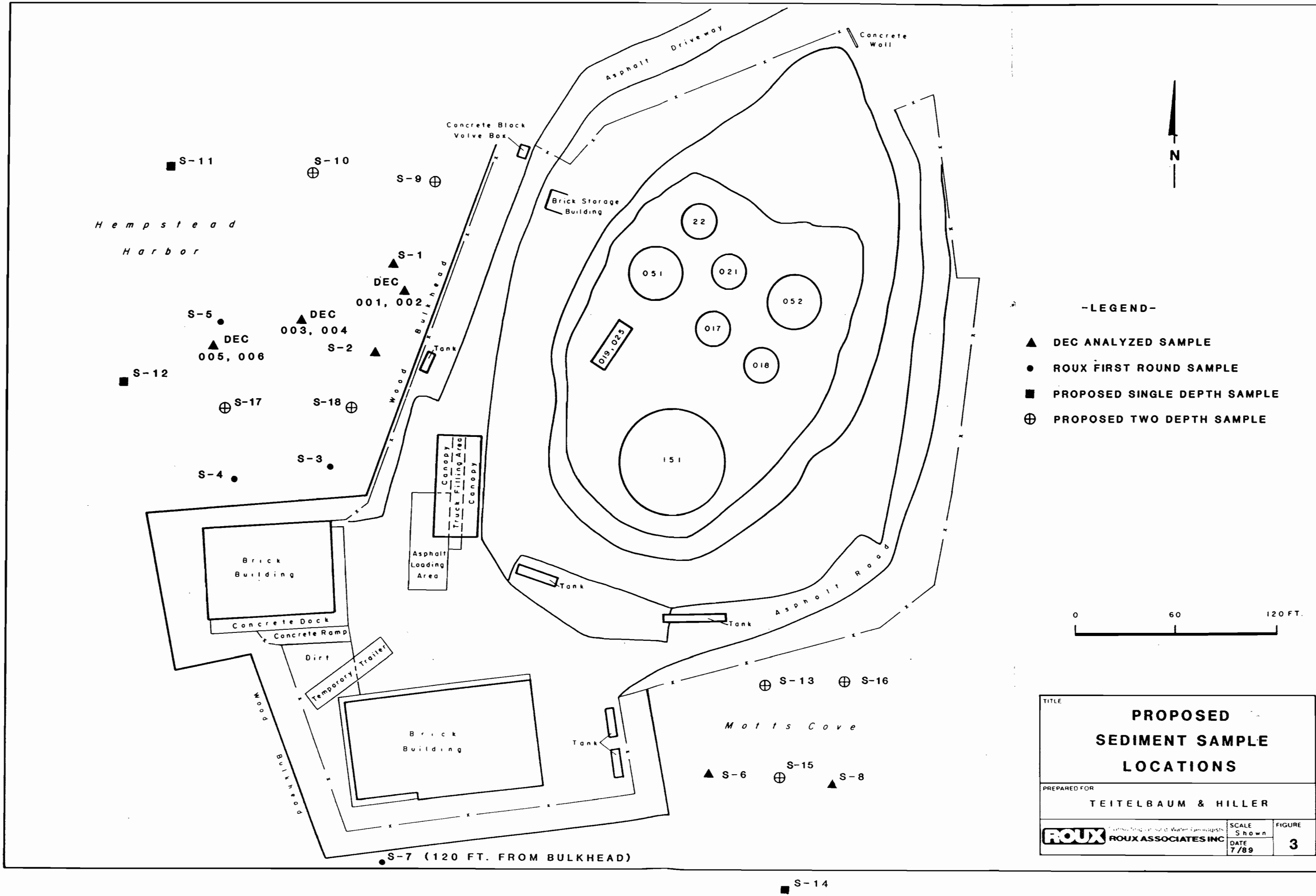
Additional sampling of sediments in Hempstead Harbor and Motts Cove is required by the State. The objectives of this sampling are to:

1. further characterize the concentrations and types of organic chemicals and metals which may be present in the sediments;

2. further characterize the extent and distribution of organic chemicals and metals in sediments relative to the site; and

3. determine if the organic chemicals detected in sediment analyses are primarily related to a thin organic layer on the surface of the sediments and are therefore transient, or are distributed throughout a thick section of sediments possibly representing more permanent contamination that may require direct remediation of sediments.

To accomplish these objectives, Roux Associates will collect sediment samples at the tentative locations shown on Figure 3. The proposed sample locations are based upon previous sampling data obtained by both Roux Associates and the State. Actual sampling locations will be selected in the field (by State and Roux Associates personnel) to include, to the extent possible, areas with a surface sheen and areas where there is a relatively thick layer of fine-grained sediments (indicating an area of



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PROPOSED SEDIMENT SAMPLE LOCATIONS

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sediment deposition).

Ten locations on the floor of Hempstead Harbor will be selected. At each of these locations, one or two samples will be collected depending on location relative to the Site. At single-sample locations, a sample will be collected at 0-1 in. At two-sample locations, samples will be collected at 0-1 in. and at 1.5-2.0 ft. A cylindrical metal ring will be placed around the sampling point and pressed into the sediment to prevent running surface water from disturbing the sample during collection. The surface sample will represent the effects of the organic liquid discharging to the surface of the sediments and which will be quickly degraded or flushed by tidal action. The deeper sample is intended to represent the condition of the sediments below the active tidal flushing area.

The surface samples will be collected using a stainless steel spatula. Surface samples will not be taken at depth greater than 1 in. The 1.5-2.0 ft. sediment samples will be collected by pushing a stainless steel Shelby tube or similar sampling device to the required depth. The Shelby tube will then be withdrawn and sediment core will be removed. Sediment samples from the appropriate intervals in each core will be placed in the appropriate laboratory jars for shipping. All samples will be placed on ice immediately after collection. Splits of all samples will be made available to the State, if requested.

A photoionization meter will be used during the sampling to ensure that the Health and Safety program is followed.

All sediment samples will be analyzed for Target Compound List parameters in accordance with the November 1987 version of the NY State CLP.

TASK VI - BIOTREATABILITY BENCH SCALE TESTS

Soil and ground-water samples from selected locations will be collected for bench scale testing to determine the applicability and effectiveness of bioremediation as a potential remedial alternative for the Shore Realty Site. Selected soil samples from borings described in Subtask IB and ground-water samples from monitoring wells SW-1 through SW-6, DW-1, WT-6, WT-13 and WT-14 will be analyzed to determine the presence of indigenous microorganisms and their suitability for the degradation of organic constituents present in the soil and on the water table. These data will be used in the Feasibility Study to evaluate pilot scale or full scale biological treatment systems.

TASK VII - AMBIENT AIR SAMPLES

Ambient air samples will be collected above the mud flats during low tide and analyzed for volatile and semi-volatile contaminants. Three samples will be taken west of the Site and two south of the Site. Exact sampling locations will be selected in the field jointly by the State and Roux Associates personnel.

Sampling will be planned for a warm day on which winds are slight, preferrably below 8-10 mph, and blowing across the mudflats, so as to collect a representative sample of the contaminants volatilizing directly off the harbor sediments.

Samples will be collected using a high volume air sampler. Protocols for analysis and use of the sorbent cartridges, as well as a description of the sampling train, are included in Appendix L. Appendix L also contains a table of analytes, acceptable ambient levels (AALs), and target detection limits.

Sorbent cartridges, analytic methods and collection methods discussed here and in Appendix L will be utilized unless an alternate method is approved by the State and Roux Associates, Inc.

SCHEDULE

The work outlined above will be performed according to the following schedule. The schedule will start upon Roux Associates notification of State approval of the Work Plan.

Weeks 1-3 Schedule drilling contractor and laboratory.

Weeks 4-5 Conduct soil gas survey, air sampling and collect sediment samples.

Weeks 6-8 Install DW-2 and DW-3, collect ground-water samples, measure water levels, install soil borings, install PETREX tubes, start bench scale testing program.

Weeks 9-12 Laboratory Analyses (Includes PETREX tubes).

Weeks 13-16 Data Validation

Weeks 13-18 Prepare draft report.

DATA PRESENTATION

To aid in the selection of remedial alternatives, the following summary data, as applicable, will be incorporated into the RI report:

a. General Site Characteristics:

Area (acres):

Site Topography:

Adjacent Waterbody:

Adjacent Wetlands:

b. Geology:

Type of Soil:

Depth of contamination:

Site Cover:

Depth to Water Table:

c. Physical Characteristics of Waste:

	liquid (gal)	Solid (cu.yd.)
Matrix Volume:		
BTU/lb:		
Viscosity (units):		
Ash Content:		

d. Biological Nutrients Information:

Total Ammonia:

Total Nitrogen:

Total Phosphorus:

Total Organic Carbon:

Total Suspended Solids:

Dissolved Oxygen:

Total BOD:

e. Chemical Analysis - Liquid Medium:

TVOC (ppb, ppm, %):

TSVOC (ppb, ppm, %):

Total Metals (ppm):

Total Pesticides (ppm):

PCBs (ppm):

Dioxins (ppb):

Cyanide (ppb):

Total Sulfur (%):

Total Chlorine (%):

Most Abundunt Components	Volatile Organic	Semi Volatile	Heavy Metal
a. First Highest			
Conc: (ppb, ppm,%)			
b. Second Highest			
Conc: (ppb, ppm,%)			
c. Third Highest			
Conc: (ppb, ppm,%)			

f. Chemical Analysis-Solid Medium:

TVOC (ppb, ppm,%):

TSVOC (bbp, ppm,%):

Total Metals (ppm):

PCBs (ppm):

Dioxins (ppb):

Cyanide (ppb):

Total Sulfur (%):

Total Chlorine (%):

Most Abundant Components	Volatile Organic	Semi Volatile	Heavy Metal
a. First Highest			
Conc. (ppb, ppm,%)			
b. Second Highest			
Conc. (ppb, ppm,%)			
c. Third Highest			
Conc. (ppb, ppm,%)			

g. Other Relevant Information:

In addition, State supplied forms (Appendix J) will be filled out by the laboratory and included with the final data package.

QUALITY ASSURANCE PLAN

Data Quality Objectives/Data Uses

The objective of this field investigation is to acquire site specific data that will accurately characterize environmental conditions at the Shore Realty Site. The data quality objective, accordingly, is to produce data with an accuracy such that they can be evaluated in the context of the applicable standards as set forth in the New York State ARAR's. Ultimately, the collected data will be used to determine:

- the identity and quantity of on-site contaminations;
- the extent to which contaminants have migrated to the surrounding environment;
- the potential impact of the contaminants on human health and the environment; and
- the feasibility of various remedial alternatives.

Data Quality Assurances and Requirements

All samples will be collected and handled in accordance with Roux Associates, Inc. standard operating procedures as detailed in the appendices of this work plan.

Each sample will be accompanied by a chain-of-custody form. The chain-of-custody form will be completed by the person collecting

the sample and the original of the form will remain with the sample. The original will be signed each time the sample is relinquished to another person. All samples will be delivered to the laboratory within 24-48 hours from time of collection.

Table 3 indicates the number of samples to be collected, and the analytes to be analyzed for, in each matrix. Table 3A lists the anticipated QA/QC samples that will be collected or analyzed for. All laboratory analyses will be in accordance with the November 1987 NYSState CLP. Table 4 indicates the specific analytical protocol to be used for each analysis.

Sample Analysis

NYTest Environmental Inc. (NEI), of Port Washington, New York, will be the contracted lab for all sample analyses. NEI maintains DOH ELAP certification and will follow CLP (November 1987) protocol for all analyses.

- Holding Times

  All water and soil samples collected for the analysis of volatile organics will be analyzed within seven days of verifiable receipt at the laboratory. Table 3B lists applicable holding times.

- Analytical Cleanups

  When matrix interference is noted on BNA or pesticide/PCB

Table 3. Samples to be Collected

	VOA	Semi-Volatile	Total Metals	EP TOX Metals	BNA	Pesticide/PCB	CN	Total Phenol	Target Compound List
Ground-Water	14	-	14	-	5	-	6	6	4
Soil	17	-	33	33	4	33	5	5	-
Sediment (Harbor)	-	-	-	-	-	-	-	-	17
Air	5	5	-	-	-	-	-	-	-

Table 3A. QA/QC Samples

	Field Blanks	Trip Blanks	Duplicates	Lab QA/QC Spikes & Spike Duplicates
Volatile Analysis	1 water -	1 water -	1 water -	1 ea water 1 ea soil
Metals	1 water 1 soil	- -	1 water -	1 ea soil 1 ea water
BNA	1 soil 1 water	- -	1 water -	1 ea soil 1 ea water
Pest/PCB	1 soil	-	-	1 ea soil
EP Tox	-	-	-	1 ea soil
CN	-	-	- -	1 ea soil 1 ea water
Phenol	1 water		-	1 ea soil 1 ea water
Target Compound List	-	-	1 sediment 1 water	
Volatile (air)	-	-	-	1
Semi-Volatile (air)	-	-	-	1

Table 4 indicates analytic methods to be used for all procedures.

TABLE 3B. Holding Times

Analyte	Maximum Days To Extraction	Maximum Holding Time (Days)*
Volatile Organics	-	7
BNA/Pest./PCB	5 (water) 10 (soil)	40 40
Cyanide		14
Mercury		26
Other Metals**		6 months

* Days from verified receipt at laboratory.
** Hexavalent chromium samples must be analyzed within 24 hours of collection.

Table 4. Analytic Protocols

ANALYTICAL METHODS

A. Groundwater/Soil/Sediment Samples

NYSDEC Contract Laboratory Protocol, November 1987

Volatiles:	Volume I, Exhibit D, Part II
B/N/A:	Volume I, Exhibit D, Part III
Pest/PCB:	Volume I, Exhibit D, Part IV
TCL Metals:	Volume I, Exhibit D, Part V, Sections I-VI
Cyanide:	Volume I, Exhibit D, Part V, Section VII
Phenol:	Volume III, Part XV
EP Toxicity for Metals:	Volume II, Part VI, VII, IX

B. Air Samples

Volatiles:	NYSDOH Analytical Handbook of Organic Analytical Chemistry, Method 311-2
Semi-Volatiles:	Technical Assistance Document for Sampling and Analysis of Toxic Organic Compounds in Ambient Air EPA-600/4-83-027, Table 17, Para. H
	Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, EPA-600/4-84-041, Method T04

samples, analytical cleanup will automatically be completed. Cleanup will be by one of the following methods from SW 846:

Aluminum Column Cleanup.....Method 3610
Florisil Column Cleanup.....Method 3620
Silica Gel Cleanup.....Method 3630
Sulfur Cleanup.....Method 3660

- Sample cleanup on BNA and pesticide/PCB samples is mandatory before any dilution is attempted.

- Only BNA and pesticide/PCB samples will be subject to matrix clean-up and, if necessary, dilution. No sample will be diluted more than 1 to 5 except if necessary to bring an analyte on scale. When a sample is diluted more than 1 to 5, both the diluted and undiluted sample results will be provided..

- The analytical laboratory will expend such effort necessary to best achieve the method detection limits.

- The analytical laboratory will provide missing data, or an explanation of unusual data, within ten days of receiving a request for additional information.

Prior to the subcontract being signed between Roux Associates, Inc. and NYTest Environmental, Inc. the contract will be sent to

the NYSState QA office for review and approval.

No deviations will be made to the agreed on protocols in this work plan without prior notification of the State QA/QC office.

Holding times for all samples will conform with required time limits, as published in the State NYDOH Cert. #10195, for the pertinent analyses to be run.

All samples will be placed on ice and kept at a temperature of 4°C. For specific analyses that require additional preservative techniques, such as the addition of an acid or a base, the contracted lab will supply sample bottles with the appropriate preservatives already added, in accordance with CLP protocol.

Limits of Concern/Detection Limits

Preliminary investigations completed as part of the initial Remedial Investigation at the Shore Realty Site have indicated that a number of chemical compounds are present. Table 5 summarizes the list of compounds found and their concentrations in soils and ground water. As illustrated in Table 5, the predominant compounds found at the site are ethylbenzene, toluene, and xylene (ETX). These three compounds make up over 98 percent of the priority pollutant content of all samples analyzed; in one soil sample the combined ETX concentration is close to 5 million ppb. Such high levels of ETX make it

TABLE 5 Summary of Chemical Types Identified

Parameter (ppb)	CS-1(2'-2.5')	CS-2(0.5'-1.0')	B-2(2'-4')	B-3(2'-4')	B-11(1'-3')	B-29(14'-16')	S-1(0'-0.1')	S-2(0'-0.1')	S-6(0'-0.1')	S-8(0'-0.4')	WT-2	WT-3	WT-5	WT-7	WT-10	WT-12	DW-1
Benzene	<16,000	<5	<28,000	<3,000	<2,600	<2,800	<8	<6	<8	<18	<250	270	130	<5	6	<5	<5
Ethylbenzene	240,000	<5	520,000	<3,000	41,000	9,900	<8	65	<8	<18	5,500	5,600	600	<5	<5	<5	<5
Toluene	350,000	39	1,400,000	11,000	160,000	27,000	<8	<6	<8	<18	22,000	140,000	5,900	<5	350	<5	<5
Xylenes	1,500,000	38	3,000,000	13,000	250,000	130,000	<8	540	<8	<18	45,000	41,000	17,000	830	450	<5	<5
1,1-Dichloroethane	<16,000	<5	<28,000	<3,000	<2,600	<2,800	<8	<6	<8	<18	<250	<250	<25	11	6	<5	<5
Trans 1,2-Dichloroethene	<16,000	<5	<28,000	<3,000	<2,600	<2,800	<8	<6	<8	<18	<250	<250	31	25	31	<5	<5
1,2-Dichloropropane	<16,000	<5	<28,000	<3,000	<2,600	<2,800	<8	<6	<8	<18	<250	<250	<25	5	<5	<5	<5
1,1,1-Trichloroethane	<16,000	<5	<28,000	<3,000	5,400	<2,800	<8	<6	<8	<18	<250	<250	<25	6	7	<5	<5
Trichloroethene	<16,000	<5	<28,000	<3,000	<2,600	<2,800	<8	<6	<8	<18	<250	<250	<25	29	23	<5	<5
Vinyl Chloride	<16,000	<5	<28,000	<3,000	<2,600	<2,800	<8	<6	<8	<18	<250	<250	<25	<5	12	<5	<5
Tetrachoroethene	<16,000	<5	<28,000	<3,000	<2,600	<2,800	<8	<6	<8	<18	<250	<250	<25	<5	430	14	<5
Base/Neutral Extractables																	
Bis(2-ethylhexyl)phthalate	<3,500	<350	3,700	16,000	37,000	(930)	<2,200	<1,900	<2,200	<5,900	<10	<10	<10	19	43	<10	<10
Di-n-Octylphthalate	<3,500	<350	3,300	(810)	<1,800	<1,800	<2,200	<1,900	<2,200	<5,900	<10	<10	<10	<10	<10	<10	<10
Flourene	<3,500	<350	<1,800	(460)	(310)	(330)	<2,200	<1,900	<2,200	<5,900	<10	<10	<10	<10	<10	<10	<10
Naphthalene	4,300	<350	2,200	2,700	20,000	4,900	<2,200	<1,900	<2,200	<5,900	14	23	36	(6)	(3)	<10	<10
2-Methylnaphthalene	6,600	<350	2,200	3,000	26,000	9,200	<2,200	1,700	<2,200	<5,900	10	12	(7)	<10	<10	<10	<10
Di-n-butylphthalate	<3,500	<350	<1,800	<2,000	(930)	<1,800	<2,200	<1,900	<2,200	<5,900	<10	<10	<10	<10	<10	<10	<10
Phenanthrene	<3,500	<350	<1,800	<2,000	(340)	(480)	<2,200	<1,900	<2,200	<5,900	<10	<10	<10	<10	<10	<10	<10
Acid Extractables																	
2,4 Dimethylphenol	<3,500	<350	<1,800	<2,000	(450)	<1,800	<2,200	<1,900	<2,200	<5,900	270	150	77	17	<10	<10	<10
2-methylphenol	(1500)	<350	<1,800	<2,000	<1,800	<1,800	<2,200	<1,900	<2,200	<5,900	92	670	52	33	14	<10	<10
4-methylphenol	<3,500	<350	<1,800	<2,000	(380)	<1,800	<2,200	<1,900	<2,200	<5,900	37	170	46	(6)	<10	<10	<10
Phenol	<3,500	<350	<1,800	<2,000	<1,800	<1,800	<2,200	<1,900	<2,200	<5,900	<10	33	10	<10	<10	<10	<10
Total Phenol	1,600	100	20	30	40	40	<20	<20	<20	<20	865	105	245	37	<10	<10	<10
Inorganic																	
Cadmium	<390	<390	<420	<450	<390	<410	<620	<430	<580	<1,380	<3.7	<3.7	<3.7	<3.7	262	<3.7	<3.7
Chromium	3,080	7,950	<490	<540	<470	<490	<740	<510	<680	<1,640	<4.4	<4.4	<4.4	<4.4	<4.4	<4.4	<4.4
Copper	5,300	7,200	11,200	14,000	<330	<340	42,400	4,310	202,000	190,000	13	17	17	16	682	6.0	60
Lead	17,800	47,400	22,100	444,000	15,400	13,200	69,400	<560	88,300	154,000	30	19.3	<4.8	35	2,180	<4.8	20
Nickel	<890	<890	<940	<1,020	<890	<930	<1,420	<980	<1,310	<3,120	<8.4	<8.4	<8,4	<8.4	329	<8.4	<8.4
Silver	<760	<760	<810	<880	<760	<800	<1,220	<840	<1,120	<2,680	<7.2	<7.2	<7.2	<7.2	11.6	<7.2	<7.2
Zinc	26,800	28,500	38,500	76,100	4,560	<720	98,800	19,200	91,600	28,600	56.2	95.5	190	83.7	339	21.5	60
Pesticides/PCBs																	
PCB 1260	<64	<64	<67	<73	<64	<67	<79	<70	99	<214	<0.50	<0.50	<0.50	<0.50	.89	<0.50	<0.50

NOTE: (454) - Detected Below Required CLP Detection Limits
Results of 40 Peaks Analysis Given in Appendix C

analytically difficult or impossible to achieve low detection limits for other contaminants of comparatively low concentration. It is difficult, therefore, to predict realistic analytic detection limits for soils at this point. Due to this fact, Roux Associates has proposed a pilot soil venting program to reduce the levels of ETX. When the soil venting program is completed it may then be possible to achieve lower detection limits for other compounds which may still be present.

Ground-water beneath the Site and the sediments in the harbor, are essentially clean compared to the soils on the Site, and can therefore be analyzed with lower detection levels for all compounds.

Table 6 gives the limits of concern in ground-water for the compounds that were identified at the site during the initial investigation. All efforts will be made by the analyzing laboratory to reach detection limits lower than the limits of concern using approved CLP procedures. Sediment samples will also be analyzed by approved CLP procedures to the best capability of the method in light of the levels of various compounds present.

All final evaluations and cleanups will be done in accordance with the standards and limits set forth in the NYS ARARs, or based on a site specific risk assessment, however at this time, the levels of ETX present in some shallow soils precludes analyzing to very low detection limits.

Table 6. Limits of Concern for Groundwaters

Parameter (ppb)	
Benzene	ND
Ethylbenzene	50
Toluene	50
Xylenes	50
1,1-Dichloroethane	50
Trans 1,2-Dichloroethene	50
1,2-Dichloropropane	50
1,1,1-Trichloroethane	50
Trichloroethene	10
Vinyl Chloride	5
Tetrachloroethene	0.7
<u>Base/Neutral Extractables</u>	
Bis(2-ethylhexyl)phthalate	4.2
Di-n-Octylphthalate	50
Flourene	50
Naphthalene	10
2-Methylnaphthalene	*
Di-n-butylphthalate	*
Phenanthrene	50
<u>Acid Extractables</u>	
2,4 Dimethylphenol	+
2-methylphenol	+
4-methylphenol	+
Phenol	+
Total Phenol	1
<u>Inorganic</u>	
Cadmium	10
Chromium	50
Copper	1,000
Lead	25
Nickel	*
Silver	50
Zinc	5,000
Pesticides/PCBs	
PCB 1260	0.1

* No standard or guidance value given in ARARs + standard for phenols given for total phenols. Values given are from New York State Ambient Water Quality Standards and guidance values - class GA waters April 1, 1987.

Data Validation

Roux Associates, Inc. will designate a data validator for this project. The data validator will be a laboratory or firm specializing in data validation independent of the analytical lab doing the analysis. A proposed data validator will be submitted to the State's QAO for approval prior to selection. Appendix K includes the criteria by which the data will be validated and also includes the resume of the proposed data validator.

Samples which contain high levels of volatile organics (generally above 10,000 ppb) will not be data validated for volatile organics. It is currently assumed that the shallow soil samples at C-1 through C-7, C-10, C-11 and D-1 through D-5 will not need data validation. A final determination will be made by Roux Associates for approval by DEC, after the analytical results are received.

Project Organization

All field work will be done by, or under the direct supervision of, an experienced Hydrogeologist from Roux Associates. A Quality Assurance (QA) Officer and Health and Safety Officer will be assigned to this project. The QA Officer will be present for critical phases, will inspect site activities, review procedures, to ensure that all protocols are being follows, inspect field notes, check chain-of-custody forms and observe sampling

PROJECT STAFFING
AND
ORGANIZATION
SHORE REALTY SITE

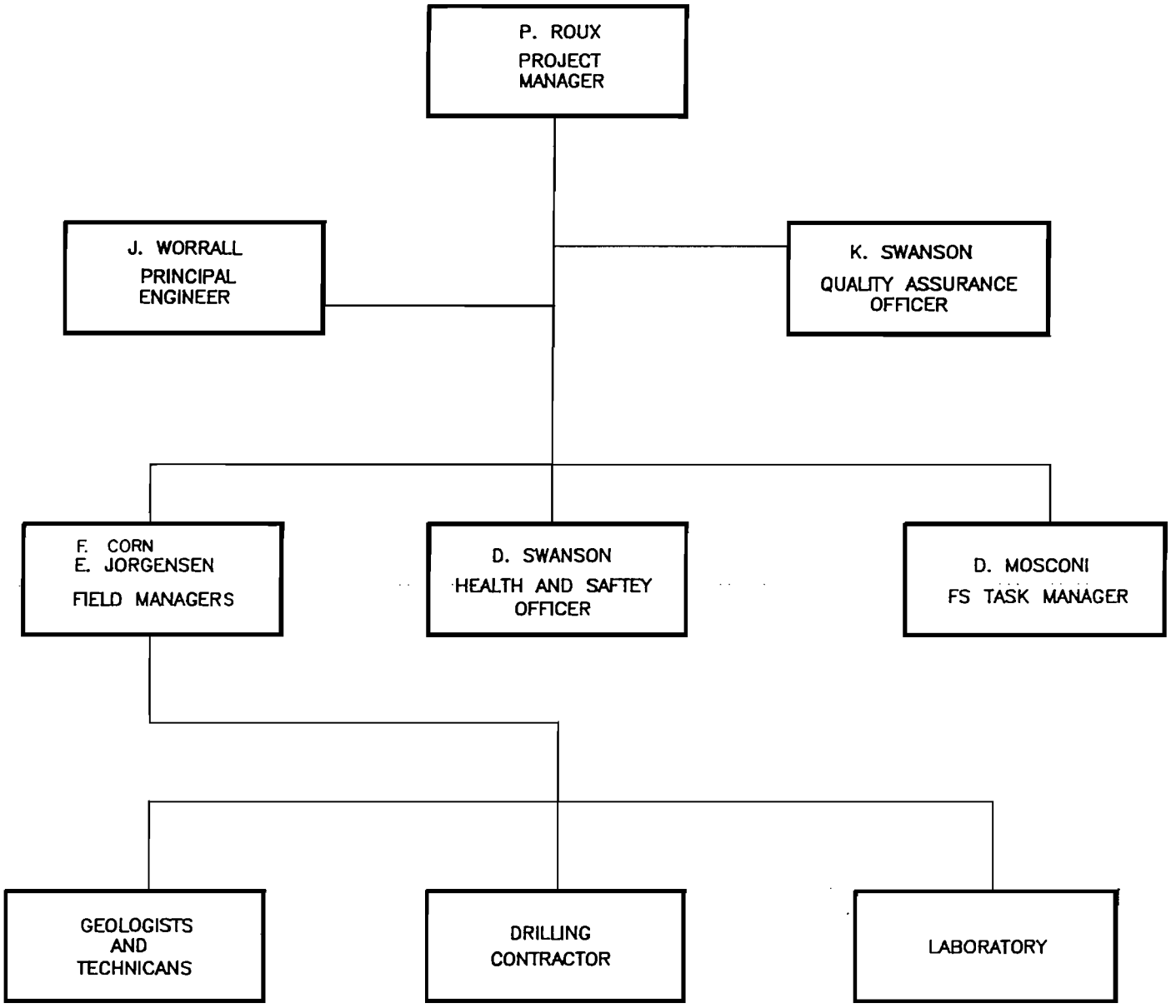


FIGURE 4

activities. The QA Officer will prepare Quality Assurance Reports that will be submitted to the Project Manager. The QA Officer will have no other responsibilities with regard to this project other than quality assurance. An organization chart for the project is shown on Figure 4.

Appendix M contains the resumes of the personnel who will work on the project.

Respectfully Submitted,

ROUX ASSOCIATES, INC.

Paul H. Roux
Project Manager

Karen A. Swanson, Ph.D
Quality Assurance Officer

APPENDIX A

Protocol for Volatile Organic Screening of Soil Samples

Protocol for Volatile Organic Screening of Soil Samples

A) Open the split-spoon sampler, measure the recovery, separate the wash from the true sample by using a dedicated spatula.

B) Please the sample in a pre-cleaned glass jar (as quickly as possible to avoid loss of volatiles) filling the jar half full. Please an aluminum foil seal between the glass and metal cap and screw tight.

C) Jars will be labeled with the boring number, depth of sample, date of collection and blow counts. In addition, the hydrogeologist will ensure that:

* samples are taken at appropriate depths;
* unrepresentative portions of the sample are discarded properly;
* that the sampler is decontaminated properly between use; and
* the driller uses proper methods during sample collection and does not use oil or grease on tools entering the borehole.

D) Log the sample in detail and record sediment characteristics (color, odor, moisture, texture, density, consistency, layering).

E) After the sample has been collected, heat the sample under controlled conditions to 80°F for a two minute period.

F) Pierce the aluminum foil seal with the probe from the photoionization meter and measure relative concentration of volatiles in headspace of the soil sample. The photoionization meter will be calibrated on a daily basis in accordance with the calibration instructions provided by the manufacturer.

G) Record photoionization meter reading in field book and on base map, if appropriate.

H) Any sedimentary material not representative of the interval sampled will be placed in a pile with the other cuttings from the borehole.

I) The split-spoon core barrels will be cleaned in a plastic bucket by using a scrub brush, detergent and clean potable water, and then steam cleaned. The spoon will then be rinsed with distilled water, assembled and placed on a plastic sheet for reuse.

APPENDIX B

Protocols for the Collection of Soil Samples for Laboratory Analyses

PROTOCOLS FOR THE COLLECTION OF SOIL SAMPLES FOR LABORATORY ANALYSES

Procedure

1. Split-spoon core samplers or stainless steel bucket type hand augers are used to collect sediment samples. Split-spoon samplers will be driven using a standard 140 lb weight and a 30 inch drop (as per ASTM Method D1586); blow counts will be recorded in the appropriate fieldbook for each 6 inches of the 24 inches.

2. Prior to collection of the soil sample, all sampling equipment is thoroughly pre-cleaned according to State and Federal decontamination protocols (see Appendix C).

3. Once the sample is collected it is placed on a clean plastic sheet and logged in detail by the geologist as quickly as possible to reduce the potential for the loss of volatile organics.

4. Using disposable vinyl gloves and pre-cleaned plastic spoons the sample is then placed in appropriate (EPA-approved) laboratory supplied, pre-cleaned containers.

5. The sample containers are then labeled with the following information:

   - Name of person(s) collecting soil sample
   - Sample location
   - Time and date of sample collection
   - Sample designation

6. Samples are then placed immediately on ice to maintain a temperature of 4°C.

7. A chain-of-custody form is filled out for each sample collected.

8. At the end of each day samples are delivered or shipped to the laboratory for analysis.

APPENDIX C

Sampling Equipment Decontamination Procedure

SAMPLING EQUIPMENT DECONTAMINATION PROCEDURE

Procedure

1. Wash with non-phosphate detergent solution.
2. Rinse with potable water.
3. Rinse with a 10% nitric acid solution (if metals are to be analyzed).
4. Rinse with potable water.
5. Rinse with pesticide grade hexane (if PCBs are to be analyzed).
6. Rinse with potable water.
7. Rinse with methanol (pesticide grade).
8. Rinse three times with deionized, distilled water. (One field blank of the deionized distilled water will be submitted to the lab to ensure that it is analyte free).

DOWNHOLE EQUIPMENT

DECONTAMINATION PROCEDURE

All downhole equipment will be decontaminated before starting any new hole at a site. Downhole equipment includes augers, hand augers, soil vapor probes and any other tools or equipment that come into contact with soils.

1. Remove loose soil by hand or with a disposable tool.
2. Wash with water.
3. Steam clean.
4. Air dry prior to reuse.

APPENDIX D

Protocol for Volatile Organic Screening of Site Using a Vapor Probe

PROTOCOL FOR VOLATILE ORGANIC SCREENING OF SITE USING A VAPOR PROBE

1. Use a pre-cleaned hand auger to auger down to top of desired zone to be sampled.

2. Place a pre-cleaned stainless steel 1/4 inch diameter probe with a one foot slotted section into borehole.

3. Drive the slotted section of probe one foot into the undisturbed sediment to be sampled.

4. Cap the probe with a section of teflon tubing and clamp off tubing to create an air tight seal.

5. Attach a vacuum pump to the tubing, release clamp and vacuum out probe to create air inflow of volatile organic vapors. Reclamp tubing.

6. Place tip of photoionization meter into tubing creating an air tight seal and release clamp.

7. Record reading on photoionization meter in field book and on base map.

APPENDIX E

PETREX Field Survey Procedures

PETREX Field Survey Procedures

1. Installation

Locations for PETREX tube emplacement will be determined by results from photoionization meter measurements. In the predetermined location a 10-inch hole will be made using a stainless steel auger. The auger will be decontaminated between borings using a non-phosphate detergent followed by a fresh water rinse and a deionized water rinse.

The cap of the PETREX tube will be removed leaving the protective tape over the threads, and the tube emplaced open end down in the hole. The cap will be stored in a zip lock bag. Soils will then be packed around the tube and backfilled to ground level making certain that the tub remains vertical. If freezing weather is expected, soil will not be packed around the tube; the hole, however, will be securely covered. The collection location will be marked with a numbered stake.

2. Retrieval

PETREX tube collectors should be retrieved between 10 and 14 days after emplacement. Calibration tubes will be pulled earlier and sent to PETREX lab for determination of optimal sampling time.

Retrieval will be made in the same order as emplacement to ensure as uniform a residence time in the soils as possible. The backfilled soil will be carefully removed until the top of the tube is visible. While the tube is held steady the soil around the tube will be removed until the tube can be pulled free. Excess soil will be wiped off the tube, the tape will be removed exposing clean threads, and the cap replaced securely. The tube will be identified by a three digit number printed on a self-sticking tab located on the cap, and then placed in a zip lock plastic bag. Collected tubes will be safely packaged and shipped to the PETREX lab via Federal Express for analysis accompanied by a chain-of-custody form.

3) Quality Assurance

- Two duplicate samples will be taken from randomly selected locations.
- Two transportation blanks will be brought to the site but not opened and returned to the lab for analysis.

APPENDIX F

Compounds Detectable by PETREX Samplers

COMPOUNDS DETECTABLE BY PETREX SAMPLERS

NOTE:

The following list of compounds have been trapped in soil gas by the PETREX collector and detected by mass spectrometry. Verification has been conducted using duplicate PETREX collectors with GC/MS and other analytical instruments.

Most volatile compounds are detectable from ground water sources. Semi volatiles and the most soluble of volatiles may be detectable only from very shallow ground water or vadose zone sources. This list should not be applied to specific sites and situations without the advise of Northeast Research Institute personnel. It should be used as a guide to developing environmental strategies.

HYDROCARBONS

Aromatics (Benzene-based)

All aromatic hydrocarbons from C_6 (Benzene) to C_{12} (C_6 Alkyl Benzene), including specifically identified:

- Benzene
- Toluene
- Xylenes
- Ethyl Methyl Benzene
- Ethyl benzene
- Trimethyl Benzenes
- Propyl Benzenes

Alkanes (Aliphatics/Paraffins)

All alkane hydrocarbons from C_4 (Butane) to C_{15} (Pentadecanes), plus C_2 (Ethane), including alkanes with various alkyl groups attached. All cycloalkanes with various alkyl groups attached, including specifically:

- Ethane
- Butanes
- Pentanes
- Hexanes
- Heptanes
- Octanes
- Nonanes
- Decanes
- Undecanes
- Dodecanes
- Tridecanes
- Octadecanes
- Cyclopropane
- Cyclobutanes
- Cyclopentanes
- Cyclohexanes
- Cycloheptanes
- Cyclo octanes
- Cyclononanes
- Cyclodecanes
- Octyl cyclopropane
- Methyl cyclopentane
- Methyl propyl cyclopentane
- Methyl hexane
- Trimethyl hexane
- Methyl cyclohexane
- Trimethyl cyclohexane
- Ethyl methyl cyclohexane
- Ethyl-methyl ethyl cyclohexane
- Methyl octa decane
- Dimethyl heptane
- Dimethyl octane
- Ethyl methyl octane
- Dimethyl undecane

Alkenes (Olefins)

All alkenes from C_3 (propylene) to C_{15} (pentadecane), including alkenes with various alkyl and other hydrocarbon groups attached. Also, C_4-C_{15} cycloalkenes, including those with various alkyl groups and other hydrocarbons attached, including specifically:

- Ethylene
- Propylene
- Butenes
- Pentenes
- Hexenes
- Heptenes
- Octenes
- Nonenes
- Decenes
- Cycl butene
- Cyclopentene
- Cyclohexene
- Cycloheptene
- Cyclo octene
- Cyclo nonene
- Cyclodecene
- Methyl pentene
- Methyl cyclohexene

Dienes

Dienes from C_6-C_{16}

Alkynes

Alkynes from C_6-C_{16}

Styrenes

Styrenes, including:

- Styrene
- Methyl styrene
- C_2-C_6 styrenes

Mixtures

PETREX has detected and can characterize fresh and aged hydrocarbon mixtures, including:

- Gasolines (leaded/unleaded)
- Diesel fuels
- Jet fuels (JP4/JP5)
- Aviation gasoline
- White gasoline
- Hydraulic Fluids
- Lubricants (light oils to greases)
- Cutting oils
- Coolants
- Seal oils
- Creosotes

VOLATILE HALOGENATED COMPOUNDS

* Vinyl Chloride
Chloromethane
* Methylene Chloride
Chloroform
Carbon Tetrachloride
Chloroethane
Dichloroethanes
Trichloroethanes
Tetrachloroethanes
Dichloropropanes
Dichloroethenes
Trichloroethene
Tetrachloroethene
Dichloropropene
Trichloropropene
Chlorobenzene
Chlorotoluene
Dichlorodifluoromethane
Trichlorofluoromethane
Trichlorotrifluoromethane
Bromoform
Dibromoethane
Bromodichloromethane
Dibromochloromethane
Bromodichloropropane

Semi Volatile Organics

Hexachloroethane
Hexachlorocyclohexane
Hexachlorobutadiene
Hexachloropentadiene
Dichlorobenzenes
Trichlorobenzene
Tetrachlorobenzene
Hexachlorobenzene
Dibromochloropropane
Phenol
Methyl Phenol
C_2-C_3 Phenols
Naphthalene
Methyl Naphthalenes
C_2-C_4 Naphthalenes
Chlorophenols
Chloronaphthalenes
Chlorobenzotrifluoride
Dichlorobenzotrifluoride
Trichlorobenzotrifluoride
Nitrobenzene
Nitrotoluene
Dinitrotoluene
Anthracene
Phenanthrene
Acenaphthalene

Sulfur Compounds

Hydrogen Sulfide
Sulfur Dioxide
Carbon Disulfide
Carbonyl Sulfide

OTHER DETECTABLE COMPOUNDS

Ethanol
Methoxyethanol
Propanol
Butanol
Dimethyl Butanol
Hexanol
Nonanol
MEK
Butanone
Methyl Butanone
Hexanone
Methyl Hexanone
Tridecanone
Aldehyde
Benzaldehyde
Acetaldehyde

APPENDIX G

Installation of Two Deep Wells

Installation of Two Deep Wells

The wells will be drilled using a truck mounted hollow stem auger rig. Split-spoon core barrel samplers will be used to collect samples every five feet. The split-spoon samples will be collected in undisturbed sediment ahead of the auger flights.

After completion of the soil boring, a 10-foot long, 2-inch diameter, schedule 40 PVC, slotted (.010 slot) section will be installed at the same depth as well DW-1. An appropriate length of blank PVC riser will be connected to the slotted PVC. Prior to installation of the well, all well materials (screen, riser, and caps) will be steam cleaned, and all personnel handling the materials will wear clean rubber gloves to minimize cross contamination. Prior to installation of the screened section, two inches of clean sand will be placed, through a tremi pipe, in the bottom of the hole. A suitable sized graded sand will be used to sand pack, through a tremi pipe, the annular space around the screen zone and to at least 2-3 feet above. Once the sand pack is in place a two foot thick bentonite pellet seal will be installed through a tremi pipe on top of the sand pack. The remainder of the annular space will be pressure grouted through a tremi with a cement/bentonite slurry at a ratio of 6:1 to two feet below land surface. The wells will be completed by cementing in a 5 foot long, 4-inch diameter steel casing with locking lid.

APPENDIX H

Ground-Water Sampling Procedure
Volatile Organics and Other Constituents

GROUND WATER SAMPLING PROCEDURE - VOLATILE ORGANICS AND OTHER CONSTITUENTS

(1) Identify the well and enter presampling information in the field notebook and on the sampling form. Fill out other items on sampling form.

(2) Inspect protective casing and note any items of concern such as missing lock or bent casing.

(3) Cut a slit in one corner of a dedicated plastic sheet and slip it over and around the well or place near the well, creating a clean surface onto which the sampling equipment can be positioned. Do not kick, transfer, drop or in any way let soil or other material fall onto this sheet unless it comes from inside the well. Do not place any meters, tools, equipment, etc., on the sheet unless they have been cleaned with a clean rag to remove any sediments.

(4) Clean the top of the well off with a clean rag and remove the cap or plug, placing it on the plastic sheet.

(5) Clean the steel tape according to NYSDEC approved protocol and measure the depth to water. Record this and compute the volume of water in the well.

(6) Existing wells will be purged by the hydrogeologist on site. All monitoring wells will be pumped or bailed before sampling and a minimum three to five casing volumes will be removed if the recharge rate is adequate to accomplish this within a reasonable amount of time. Hand bailers, submersible pumps, etc. will be clean and sediment-free prior to use in accordance with NYSDEC approved protocol. Samples will not be taken until the well produces water which meets the DHWR's 50 NTU requirement.

(7) Record the physical appearance of the water on the field data form (color, odor, turbidity, etc.) as it is pumped or bailed.

(8) Prepare the bottles for receiving their samples (labels, place on ice, etc.).

(9) After the well has been purged and developed, a teflon bailer will be used to collect the ground-water sample. This bailer will have been thoroughly pre-cleaned. Immediately prior to

lowering the bailer in the well, rinse three volumes of distilled water through the bailer. In addition, the first three bailer volumes obtained from the well should be discarded. Use non-absorbent nylon cord to lower the bailer into the well. This cord will be discarded after use in the well.

(10) Lower the bailer into the well gently, making certain to only submerge it far enough to fill it completely.

(11) Standard 40 ml, pre-cleaned, volatile organic sample bottles with teflon caps are required. Fill the bottles to the top creating a convex surface with no air bubbles. Place the cap on tightly. Gently turn the bottle over and tap lightly on the soft surface to insure that no air bubbles are present.

(12) Fill the other containers provided by the laboratory according to directions.

(13) Label the bottle with location number, date and other pertinent information. Record all information on the sampling data form. Cool the sample immediately on ice. Maintain the samples in a secure area and deliver to the laboratory within 24 hours.

(14) After the last sample is collected, measure and record the temperature, conductivity, pH, and the physical appearance of the water.

(15) Replace the well cap and cover the well, locking the protective cap.

(16) Rinse out the bailer and/or pump with clean water.

(17) Discard the cord, rags, gloves, etc. in an appropriate manner.

(18) Complete sampling data form.

APPENDIX I

Health and Safety Plan

6.0 HEALTH AND SAFETY PLAN

6.1 Employee Training

All site personnel shall have completed the required 40 hour EPA approved health and safety training program for hazardous waste sites prior to entry on site and start of the field investigation. This includes all Roux Associates personnel and all subcontractors hired to complete the scope of work. In addition all personnel will be given a copy of the site specific health and safety plan and required to review and sign-off stating such. A general briefing, including an explanation of the Health and Safety Plan (with a question and answer period), will be given prior to site entry. Any updates made to the health and safety plan during the investigation will be conveyed. Any employee not fit tested for respiratory equipment will be fit tested prior to site entry. OSHA standards at 29 CFR 1920.120 will be met.

6.2 Air Quality Monitoring

Ambient air quality will have been established by Roux Associates prior to the field investigation. This will be accomplished through a Site wide photoionization meter

screening. Details are given in the site investigation section of the work plan. As part of the health and safety program the photoionization meter will be used continuously during the field investigation to monitor any air quality changes due to site activities.

6.3 General Safe Work Practices

- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand to mouth contact and ingestion of material is prohibited in any area of the site.

- Hands must be washed thoroughly upon leaving the site area before eating, drinking, or any other activities transpire. This will be done in the decontamination staging area.

- Contaminated protective equipment shall not be removed from the site until it has been decontaminated or properly packaged and labeled.

- Portable or fixed emergency shower/eyewash stations shall be located in the decontamination staging area.

- A deluge shower or hose and nozzle shall be available if needed in the decontamination area to wash down heavily contaminated personnel before removing protective clothing.

- No excessive facial hair which interferes with a satisfactory fit of respiratory equipment will be allowed on personnel that may be required to wear respiratory protective equipment.

- An emergency first aid kit and fire extinguisher shall be on-site at all times.

- All respiratory protection selected to be used on site shall meet NIOSH/MSHA requirements for contaminants expected.

- Any skin contact with surface and ground water shall be avoided (tyvek suits, rubber gloves, leather boots).

- No contact lenses may be worn on site.

6.4 Personal Protective Equipment

Based on background data from previous investigations at

the site, Level C will be worn during the initial opening of the existing wells and photoionization readings taken. From this point on, level D protection will be worn except when photoionization readings exceed 5 ppm in the breathing zone. If photoionization readings are in the range of 5 ppm-25 ppm level C protection will be worn. If photoionization readings exceed 25 ppm level B protection would be necessary. Photoionization readings will be made continuously during all tasks where organic fumes are a possibility and otherwise at the discretion of the safety officer. It is not expected that Level A or B protection will be required. If such equipment is needed for certain tasks, the work plan will be modified to either obtain the equipment or subcontract the task.

6.5 Levels of Protection

The level of protection selected is based primarily on:

- type(s) and measured concentration(s) of the chemical substances(s) in the ambient atmosphere and its toxicity. The portable photoionization meter will be used to conduct these measurements.

- potential or measured exposure to substances in air, splashes of liquids, or other direct contact with material due to work being performed.

D. Level D Protection

1. Personal protective equipment

- Coveralls
- Gloves*
- Boots/shoes, leather or chemical-resistant, steel toe and shank
- Boots (outer), chemical-resistant (disposable)*
- Safety glasses or chemical splash goggles*
- Hard hat (face shield)*
- Escape mask*

* Optional

2. Criteria for selection

Reading on the photoionization meter are less than 5 ppm in the breathing zone.

Work functions preclude splashes, immersion, or potential for unexpected inhalation of any chemicals.

C. Level C Protection

1. Personal protective equipment

- Full-face, air-purifying, canister-equipped respirator (MSHA/NIOSH approved)
- Chemical-resistant clothing (coverall; hooded, two-piece chemical splash suit; chemical-resistant hood

and apron; disposable chemical-resistant coveralls)

- Coveralls*
- Gloves (outer), chemical-resistant
- Gloves (inner), chemical-resistant*
- Boots (outer), chemical-resistant, steel toe and shank*
- Boots (outer), chemical-resistant (disposable)*
- Hard hat (face shield*)
- Escape mask*
- 2-Way radio communications (intrinsically safe)

*Optional

2. Criteria for selection

- Total vapor readings register between 5 ppm and ___ ppm on instruments such as the Tip II Photoionization and Century OVA System.
- Measured air concentration of identified substances will be reduced by the respirator to at or below the substance's exposure limit, and the concentration is within the service limit of the canister.
- Atmospheric contaminant concentrations do not exceed IDLH levels.

APPENDIX J

- Sample Identification and Analytical Requirement Forms
- Sample Preparation and Analysis Summary Forms

To be included with all lab data and wit each workplan

Attachment 2

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SAMPLE IDENTIFICATION AND ANALYTICAL REQUIREMENT SUMMARY

Customer Sample Code	Laboratory Sample Code	Analytical Requirements*					
		*VOA GC/MS	*BNA GC/MS	*VOA GC	*PEST PCB	*METALS	*OTHER

* Check Appropriate Boxes

* CLP, Non-CLP
* HSL, Priority Pollutant

PLEASE INDICATE YEAR OF PROTOCOL USED

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SAMPLE PREPARATION AND ANALYSIS SUMMARY
B/N-A
ANALYSES

SAMPLE ID	MATRIX	DATE COLLECTED	DATE REC'D AT LAB	DATE EXTRACTED	DATE ANALYZED

DU.OPREP.1

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SAMPLE PREPARATION AND ANALYSIS SUMMARY

ORGANIC ANALYSES

SAMPLE ID	MATRIX	ANALYTICAL PROTOCOL	EXTRACTION METHOD	AUXILARY CLEAN UP	DIL/CONC FACTOR

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SAMPLE PREPARATION AND ANALYSIS SUMMARY
VOA
ANALYSES

SAMPLE ID	MATRIX	DATE COLLECTED	DATE REC'D AT LAB	DATE EXTRACTED	DATE ANALYZED

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SAMPLE PREPARATION AND ANALYSIS SUMMARY
PESTICIDE/PCB
ANALYSES

SAMPLE ID	MATRIX	DATE COLLECTED	DATE REC'D AT LAB	DATE EXTRACTED	DATE ANALYZED

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SAMPLE PREPARATION AND ANALYSIS SUMMARY

INORGANIC ANALYSES

SAMPLE ID	MATRIX	METALS REQUESTED	DATE RECEIVED	DATE DIGESTED	DATE ANALYZED

:DU,IPFEF,1

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SAMPLE PREPARATION AND ANALYSIS SUMMARY

INORGANIC ANALYSES

LABORATORY SAMPLE CODE	MATRIX	ANALYTICAL PROTOCOL	DIGESTION PROCEDURE	MATRIX MODIFIER	DIL/CONC FACTOR

APPENDIX K

Validation Criteria and Validator Resume

Environmental Standards, Inc.

Specialists in Environmental Risk Assessment and Data Validation

The Commons at Valley Forge, Unit 4, 1220 Valley Forge Rd.
P.O. Box 911, Valley Forge, PA 19481 (215) 935-5577

TABLE 1

ITEMS REVIEWED DURING THE ESI DATA VALIDATION

Areas Examined	Applicability (Organic, Inorganic, Both)
Laboratory Chain-of-Custodies (Traffic Reports, Field Notes, Etc.) Laboratory Narrative and QC Summaries	Both
Holding Times	Both
Extraction/digestion Logs	Both
Blanks - Field and Laboratory (Accuracy)	Both
Instrument Tune	Organic
Standards	Both
Linearity	Both
Sensitivity/Stability	Both
Selectivity/Specificity	Both
EPA Criteria (SPCC and LCS)	Both
Variability of Technique) (internal standards)	Organic
Analyte Breakdown	Organic
Analytical Sequence	Organic
ICP Interference	Inorganic
Control Standards	Inorganic
Samples	
Detection Limits	Both
Instrument Printouts	Both
ICP Data	Inorganic
AA Data	Inorganic
GC Data	Organic
GC/MS Data	Organic
Autoanalyzer Data	Inorganic
Qualitative Identification	Both
Mass spectra	Organic
Pesticide/PCB results	Organic
Tentatively Identified Compounds	Organic
Quantitative Reliability	Both
Calculations/Equations	Both
Matrix Spikes (accuracy) Bias	Both
Matrix Spike duplicates Bias Accuracy & Precision	Organic
Surrogate Spikes Bias	Organic
Duplicates (field and laboratory) Precision Representativeness	Both
Post-Digestion Spikes Matrix effects	Inorganic

Environmental Standards, Inc.
Specialists in Environmental Risk Assessment and Data Validation

The Commons at Valley Forge, Unit 4, 1220 Valley Forge Rd.
P.O. Box 911, Valley Forge, PA 19481 (215) 935-5577

ROCK J. VITALE

QUALITY ASSURANCE SPECIALIST

FIELDS OF COMPETENCE

* Theoretical and practical knowledge of all facets of quantitative analysis for organic and inorganic pollutants by EPA methodologies.
* Determination of the adequacy of analytical data generated to support RI/FS, ECRA (property transfers, RCRA closures, RCRA Permit B, etc.)
* Preparation of quality assurance project plans (QAPP).
* Technical liaison between laboratories and consultants.
* Designing specific requirements and specifications for analytical services.
* Training and management of data review staff.
* Sampling design, sampling protocols, data validation and documentation for litigation, analytical/environmental chemistry and multimedia fate and transport mechanisms of pollutants.

CREDENTIALS

B.S., Environmental Science and Biology, Marist College, New York, 1981
Additional Undergraduate Chemistry credits to satisfy B.S., Chemistry, Villanova University and Rider College, 1982-1985.
M.S., Chemistry, Villanova University, PA (Candidate)

ROCK J. VITALE

EXPERIENCE SUMMARY

Four years analytical experience performing analyses for organic and inorganic contaminants in a variety of media by instrumental and classical methods, including research and development of analytical methodologies. Attended many analytical conferences as a technical representative marketing an environmental laboratory.

In addition, Mr. Vitale was the Quality Assurance Manager for a large environmental consulting firm with 26 offices, nationwide. He designed and implemented a quality assurance and data validation program for all RI/FS, site inspections and RCRA closures. Responsibilities also included the preparation of quality assurance project plans (QAPPs) for Superfund studies in EPA Regions I, II, III, and V. He also trained and managed a staff of five data reviewers. Mr. Vitale served as technical liason between PRP's, laboratories and/or state/federal agencies.

Prior to that position, he had three years experience as a quality assurance chemist with a primary EPA Superfund contractor for U.S. EPA Region III. He provided quality assurance reviews for over 300 EPA site inspections, based upon rigorous examination of GC, GC/MS (high and low resolution), GFAA and ICP data. He has coauthored and provided peer review comments on several documents on the subject of data validation for both state and federal agencies.

PROFESSIONAL AFFILIATIONS

American Chemical Society
American Institute of Chemists
American Association for the Advancement of Science
Association of Official Analytical Chemists

KEY PROJECTS

* A contributing author of the "Functional Guidelines for Organic Data Validation" prepared for EPA Region III, currently used on a nationwide basis.

* Project chemist for over 300 CERCLA site inspections for the characterization of environmental samples obtained in and around landfills/dump sites. Quality assurance reviews for all organic and inorganic analytical data generated by 60 contract laboratories (CLP) were submitted to EPA.

KEY PROJECTS (continued)

* Conceived, designed and implemented a comprehensive quality assurance program for a major environmental engineering firm. This included designing quality control requirements for all sampling investigations, a complete Chain-of-Custody and a sample tracking program and the performance of quality assurance reviews for all analytical data generated from sampling investigations, several of which involved litigation.

* Prepared many quality assurance project plans (QAPP) which are required for all remedial investigation/feasibility studies (RI/FS). The preparation of these plans included providing input for sampling design and negotiations with lead agency.

* Solicited and contracted five major laboratories to perform analytical services for a large environmental engineering firm (including 26 branch and affiliate offices). Contract negotiations involved designing specific requirements for laboratory performance. Acted as technical liaison between the laboratory and the consultant. Established specialized analytical methodologies to achieve project specific goals.

* Trained and supervised five quality assurance chemists in the area of qualitative and quantitative data validation. In addition, frequent technical assistance and training seminars were conducted for various consultant groups on the East and Gulf Coasts.

* Performed numerous laboratory audits at the request of several large corporations or the laboratories themselves. Provided critical comments, performance evaluation reports and recommendations for improvement.

* At the request of several large corporation PRP (potentially responsible party) committees, state or EPA enforcement-led RI/FS were critically reviewed to determine if an appropriate level of quality assurance was performed according to SARA guidelines and if the analytical data were properly validated.

* Prepared analytical requirements for laboratory RFPs prior to the initiation of 16 CERCLA site inspections for specific compounds/constituents which were known site contaminants but were not routinely analyzed for (i.e., phosphorus herbicides).

KEY PROJECTS (continued)

* Project chemist for several major remedial investigations in which more than 2,000 samples were obtained. Duties included validation of all analytical data, providing on-going changes in sampling design, providing technical input for the recommendation of additional analytical parameters, data presentation and final report to EPA.

* Set up and maintained a quality assurance/quality control program for an independent environmental laboratory. This program is necessary to sustain EPA drinking water certification.

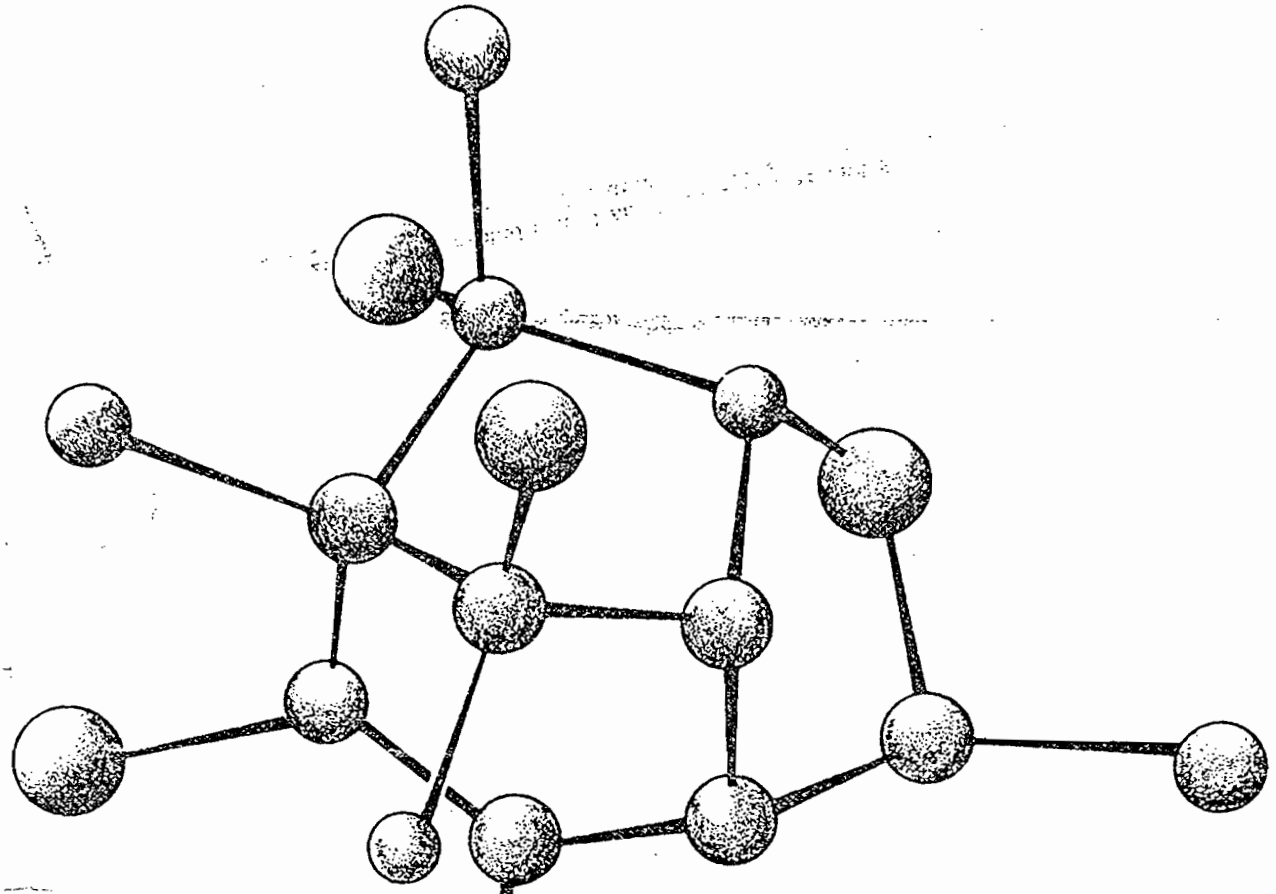
APPENDIX L

Protocols For Air Sampling Analytes and AALs

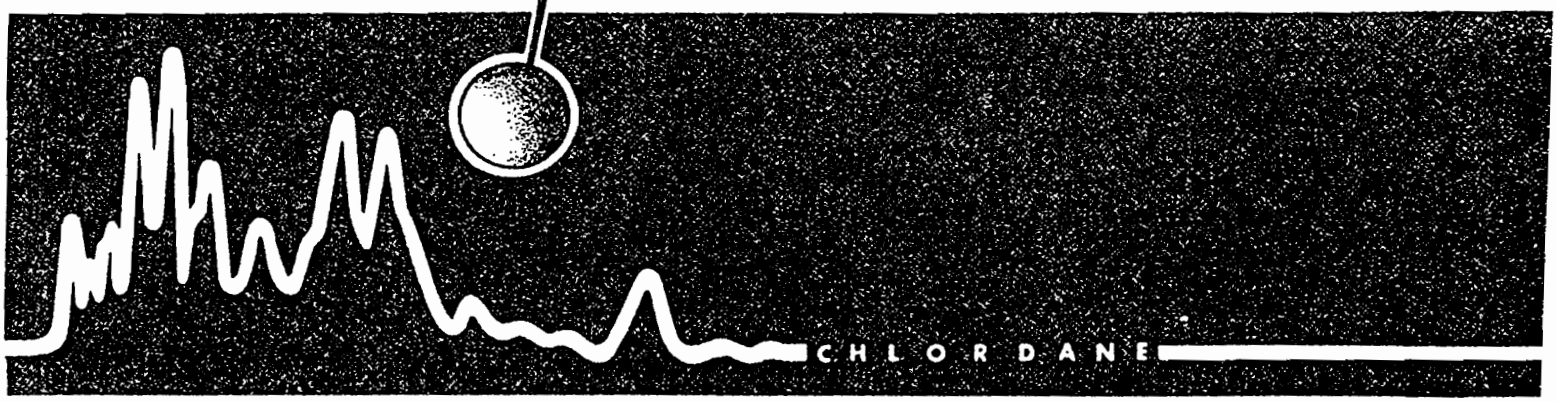
Protocols for Air Sampling
Analytes and AALs

Analyte	AAL (ug/m^3)	Target Detection Limit
Volatiles		
Benzene	100	10
Ethylbenzene	1,450	10
Toluene	7,500	10
Xylenes	1,450	10
1,1-Dichloroethane	*	10
Trans 1,2-Dichloroethene	*	10
1,2-Dichloropropane	*	10
1,1,1-Trichloroethane	38,000	10
Trichloroethene	900	10
Vinyl Chloride	0.4+	10
Tetrachloroethene	1,116	10
Bade/Neutral Extractables		
Bis(2-ethylhexyl) phthalate	*	1.0
Di-n-Octylphthalate	*	1.0
Flourene	*	1.0
Naphthalene	166.7	1.0
2-Methylnaphthalene	*	1.0
Di-n-butylphthalate	*	1.0
Phenanthrene	*	1.0
Acid Extractables		
2,4 Dimethylphenol	*	1.0
2-methylphenol	*	1.0
4-methylphenol	*	1.0
Phenol	19	1.0
Total Phenol		1.0

* No AAL listed in New York State Air Guide - 1
+ AAL under review by DOH



ANALYTICAL HANDBOOK



LABORATORY OF ORGANIC ANALYTICAL CHEMISTRY
WADSWORTH CENTER FOR LABORATORIES AND RESEARCH
NEW YORK STATE DEPARTMENT OF HEALTH

New York State Department of Health
Wadsworth Center for Laboratories and Research
Division of Environmental Sciences
Albany, N.Y. 12201

January 1986

Volatile Organics in Air - Tentative

1. Scope and Application

1.1 This method covers the determination of both aromatic and halogenated volatile organic compounds in air.

1.2 This method is applicable to the determination of the following compounds in air:

Electron Capture Detector (ECD) or Hall Detector (HECD)	Photoionization Detector (PID)
chloroform	
1,1,1-trichloroethane	benzene
trichloroethene	toluene
carbon tetrachloride	chlorobenzene
bromodichloromethane	o,m,p-xylenes
1,1,2-trichloroethane	o,m,p-chlorotoluenes
tetrachloroethene	
1,2-dibromoethane	
bromoform	
1,1,2,2-tetrachloroethane	

1.3 The method may be extended to the compounds listed below. However, validation of accuracy and precision for each additional compound is necessary.

ECD/HECD	PID
o,m,p-dichlorobenzenes	o,m,p-dichlorobenzenes
cis-1,3-dichloropropene	ethylbenzene
dibromochloromethane	cumene
trans-1,3-dichloropropene	styrene
1,2-dichloroethane	n-propyl benzene
trans-1,2-dichloroethane	tert-butyl benzene
1,1-dichloroethane	bromobenzene
1,1-dichloroethene	1,3,5-trimethyl benzene
	1,2,4-trimethyl benzene
	p-cymene
	cyclo propyl benzene
	sec-butyl benzene
	n-butyl benzene

1.4 Detection limits are 1 μg/cubic meter for chlorinated organics by ECD, 10 μg/cubic meter for chlorinated organics by HECD, and 10 μg/cubic meter for aromatics by PID. These detection limits are achievable when the optimum volume of air in cubic meters is collected and breakthrough volumes have not been exceeded. (See 1.5).

1.5 The breakthrough volume of the collection system is generally independent of analyte concentration. If testing is to be done for those compounds listed in Section 1.2 as ECD/HECD, the maximum sampling volume may not exceed 25 liters. If testing is to be done only for those compounds listed in Section 1.2 as PID, the maximum sampling volume may not exceed 40-50 liters.

The breakthrough volume has not yet been determined for those compounds listed in Section 1.3.

2. Summary of Method

Volatile organic compounds are trapped on Porapak-N by passing a known volume of air through a cartridge containing this material. Volatiles are eluted from the cartridge with a known volume of methanol. Aliquots of the methanolic eluate are injected into a gas chromatography system using electron capture detector (ECD) or Hall detector (HECD), and photoionization detector (PID).

3. Interferences

3.1 Solvents, glassware and associated equipment may produce artifacts leading to misinterpretation of gas chromatographic tracings. All reagents and glassware must be demonstrated to be free from interferences under the conditions of analysis. In particular, the eluting solvent (methanol) is a frequent cause of interference and

purification or clean-up may be required. The Porapak N cartridges are also an occasional source of contamination.

3.2 The gas chromatographic technique may produce peaks from substances that coelute. For absolute identification, mass spectral confirmation is necessary. It should be noted that HECD is more specific than ECD for halogenated compounds, therefore HECD provides a greater probability of correct qualitation than does ECD.

4. Apparatus and Materials

4.1 Porapak N - 80/100 mesh, T.M. - Supelco Corp.

4.2 Serum vials, 10 ml, with Teflon-lined caps

4.3 Pasteur capillary pipets

4.4 Glass tubing - Pyrex 1/4 inch x 10 inch

4.5 Pump - Gast (T.M.) carbon vanes oil-less Model #1531-107-288 or equivalent

4.6 Column packings

4.6.1 Column for Hall

Carbopak B, 60/80 mesh with 1% SP-1000 packed in an 8 ft. x 0.1 inch I.D. stainless steel or glass column with helium carrier gas at 40 ml/min flow rate. Column temperature held at 45°C for 3 minutes, programmed at 8°C/min to 220°C, held for 18 minutes.

4.6.2 Column for PID

5% SP-1200 + 1.75% Bentone-34 on 100/120 mesh Supelcoport packed in a 6 ft. x 0.082 inch I.D. stainless steel or glass column. Carrier gas is helium at a flow rate of 30 ml/minute. Temperature program sequence: 50°C for 2 minutes, then program at 4°C/min. to 110°C, hold

until all compounds have eluted. (20 minutes is suggested).

NOTE: Whenever column is not being used and is attached to PID, maintain it at the upper temperature of the program (90°C). Condition new Bentone/SP-1200 columns at 120°C for several days with helium before connecting to the detector.

4.6.3 Column for ECD and/or PID

15% SF-96 + 6% OV-225 on Chromasorb WAW-DMCS, 6 ft x 1/4 inch O.D. glass column with argon/methane carrier gas for ECD at a flow rate of 30 ml/min. Operate at 60°C isothermally.

4.7 Manifold for collection of duplicate samples

4.8 Polyethylene "tees", "crosses" and Tygon tubing

4.9 Calibrated rotameter

4.10 Manifold - for purging cartridges in a conditioning oven

4.11 Polyethylene caps (Caplugs) for 1/4 inch glass tubing

4.12 Glass wool - silanized, methanol washed

5. Reagents, Solvents, and Standards

5.1 Methanol - may need to be prepurified (see methanol cleanup)

5.2 Standards - reference grade for all compounds of interest

5.3 Standard Stock Solutions

5.3.1 Prepare standard stock solutions at least every four weeks.

5.3.2 Place about 9.8 ml of methanol into a ground glass stoppered 10 ml Class A volumetric flask.

5.3.3 Allow the flask to stand unstoppered about 10 minutes or until all alcohol wetted surfaces have dried.

5.3.4 Weigh the flask to the nearest 0.1 mg.

5.3.5 For compounds which are liquids at room temperature: using a 100 μl syringe, immediately add 2 or 3 drops of the standard to the flask, then reweigh. Be sure that the drops fall directly into the methanol without contacting the neck of the flask.

5.3.6 For compounds which are solids at room temperature: using a clean spatula, immediately add a few crystals of the standard to the flask, then reweigh. Be sure that the crystals fall directly into the methanol.

5.3.7 Dilute the solutions from 5.3.5 and 5.3.6 to volume, stopper, then mix by inverting the flask several times.

5.3.8 Transfer the solution to a dated and labelled screw cap vial with a Teflon liner.

NOTE: Because of the toxicity of many of the compounds, it is recommended that primary dilutions be prepared in a hood. It is further recommended that a NIOSH approved toxic gas respirator be used when the analyst handles high concentrations of such materials.

5.3.9 Calculate the concentration from the net gain in weight. Calculate the concentration taking into account the percent purity of the original standard compound.

5.3.10 Store the solutions at 4°C.

5.4 Mixed Standard Solution(s)

It is suggested that the individual stock solutions be diluted into a combined working solution in the range of 1-10 ng/μl,

depending upon the detector used and the limit of detection desired.

5.5 Argon/Methane - 95%/5%

5.6 Helium

6. Calibration

6.1 The working solution(s) prepared in Section 5.4 can be used to either prepare a calibration curve or to bracket the samples by either injecting varying volumes or by preparing additional concentrations of analytes.

6.2 Each day the gas chromatographic systems are operated, demonstrate, through the use of calibrating standards, that the gas chromatographic system is functioning properly.

7. Quality Control

7.1 Sample collection must be carried out in duplicate (or triplicate) with individually calibrated cartridges.

7.2 Since flow rate may vary considerably from one cartridge to the next, it is important to attempt assurance of uniform packing by visual inspection for loose Porapak N. In a further check of proper packing, sample throughput rate will be checked at the beginning and end of sampling. If this rate differential is more than 10%, the cartridge should be discarded.

7.3 At least two field blank cartridges must be carried to and from the sampling site and must be transported along with the actual cartridges for samples.

7.4 Each batch of Porapak N cartridges will be checked for contamination by gas chromatographic analysis of methanol eluate. If contamination is detected the entire batch of cartridges must be rejected. 10% of each batch should be tested in this manner.

7.5 Methanol will be checked by gas chromatographic analysis for contamination on each day samples are eluted.

7.6 Duplicate sample analyses should be performed on 10% of samples collected or a minimum of one per analysis batch.

7.7 Standards

7.7.1 Standards must be analyzed daily.

7.7.2 Concentrations of standards analyzed will be such that peak areas obtained will approximate those in samples.

7.7.3 Standards must contain all analytes which are present in samples.

7.8 Spikes

With each group of samples to be eluted, a spike must be tested. This is done by adding a methanolic solution of selected analytes to a Porapak N cartridge. Elution is performed following the procedure in Section 8.3. Spiked recovery should be calculated and appropriate quality control limits determined. Spiked recoveries not meeting the designated QC limits should be immediately investigated, with elution of duplicate sample cartridges being recommended.

8. Procedure

8.1 Sample Cartridge Preparation

8.1.1 Porapak N is added to a glass column and conditioned overnight at 180°C with helium or nitrogen as a carrier gas.

8.1.2 A 4 inch column of Porapak N is then inserted into a 10 inch x 1/4 inch borosilicate glass tube and is held in position by methanol-washed, silanized glass wool plugs. The Porapak N should be at one end of the glass tube, not

in the center. This now constitutes a cartridge.

8.1.3 Cartridges are attached to a manifold in an oven and heated at 160-180°C for 30-45 minutes with carrier gas (He or N) flowing at approximately 20 ml/min.

8.1.4 Cartridges are capped when cool enough to handle. Store cartridges in a contamination-free area.

8.1.5 Following sample collection and solvent elution, cartridges may be reused if reconditioned as outlined in section 8.1.3.

8.2 Sample Collection

8.2.1 Cartridges are attached to the sampling manifold using Tygon tubing for connection between the cartridge and the GAST vacuum pump. Polyethylene "X" connectors are used to collect replicate, parallel samples. Flow rates are measured in the field using a laboratory calibrated rotameter and are measured both before and after sampling. Flow rates of 0.3 to 0.5 liters per minute are generally observed with the collection volume being appropriate for the analytes of interest (see 1.5). A critical orifice is not usually necessary because the resistance of the cartridge itself limits the flow rate.

8.2.2 Cartridges are kept capped until sample collection. After sampling the caps are replaced on the cartridges and the cartridges are either placed in screw capped test tubes with Teflon liners or wrapped tightly in aluminum foil. Cartridges should be refrigerated at 4°C immediately after sample collection and transported to the laboratory

promptly. Analysis should be performed as soon as possible after collection. A maximum holding time of 14 days is recommended.

8.3 The methanol elution of a cartridge is performed by clipping the cartridge in a vertical position with the lower end at about the 2 ml graduation of the collection tube. Methanol is added to the top of the cartridge and elution proceeds until 1.5 ml (or other known volume) of eluate has been collected. Once elution is begun, it must be completed without allowing the top of the Porapak N to be exposed to the air.

8.4 Blanks, spikes, and replicates should be eluted using the procedure in Section 8.3

8.5 Gas chromatographic analysis is performed on eluates using conditions detailed in Sections:

8.5.1 - Hall (HECD) detector

8.5.2 - Photoionization (PID) detector

8.5.3 - Electron capture (ECD) detector and/or PID

9. Calculations

9.1 Calculations are performed using the general formula:

$$\text{Concentration in air in } \mu g/M^3 = \frac{A}{B} \times \frac{C}{D} \times \frac{E}{F}$$

A = Area (or peak height) of sample peak

B = Area (or peak height) of standard peak

C = ng of standard represented by B

D = Volume of sample injected in μl

E = Final volume of eluate in ml

F = Sampling volume in cubic meters (M^3)

9.2 If the analyst uses a calibration curve the following equation may be used:

$$\text{Concentration in Air in } \mu g/M^3 = \frac{A \times B}{C}$$

A = Concentration in eluate in $\mu g/ml$

B = Final volume of eluate in ml

C = Sampling volume in cubic meters (M^3)

10. References

10.1 Van Tassel, S., Amalfitano, N., and Narang, R.S., "Determination of Arenes and Volatile Halo-organic Compounds in Air at Microgram/Cubic Meter Levels by Gas Chromatography". Analytical Chemistry, November 1981.

HANDBK19 (311-2)
Implemented: 1978, Revised August 1981, January 1986

EPA-600/4-84-041
April 1984

COMPENDIUM OF METHODS FOR THE DETERMINATION OF TOXIC ORGANIC COMPOUNDS IN AMBIENT AIR

by

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Contract No. 68-02-3745 (WA-9)

EPA Project Officer:
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ENVIRONMENTAL MONITORING SYSTEM LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NORTH CAROLINA 27711

METHOD FOR THE DETERMINATION OF ORGANOCHLORINE PESTICIDES AND POLYCHLORINATED BIPHENYLS IN AMBIENT AIR

1. Scope

1.1 This document describes a method for determination of a variety of organochlorine pesticides and polychlorinated biphenyls (PCBs) in ambient air. Generally, detection limits of >1 ng/m^3 are achievable using a 24-hour sampling period.

1.2 Specific compounds for which the method has been employed are listed in Table 1. Several references are available which provide further details on the development and application of the method. The sample cleanup and analysis methods are identical to those described in U. S. EPA Method 608. That method is included as Appendix A of this methods compendium.

2. Applicable Documents

2.1 ASTM Standards

D1356 Definition of Terms Related to Atmospheric Sampling and Analysis (7).

2.2 Other Documents

Ambient Air Studies (1-3)

U. S. EPA Technical Assistance Document (4).

U. S. EPA Method 608 (5). See Appendix A of methods compendium.

3. Summary of Method

3.1 A modified high volume sampler consisting of a glass fiber filter with a polyurethane foam (PUF) backup absorbent cartridge is used to sample ambient air at a rate of ~200-280 L/minute.

3.2 The filter and PUF cartridge are placed in clean, sealed containers and returned to the laboratory for analysis. The PCBs and pesticides are recovered by Soxhlet extraction with 5% ether in hexane.

3.3 The extracts are reduced in volume using Kuderna-Danish (K-D) concentration techniques and subjected to column chromatographic cleanup.

3.4 The extracts are analyzed for pesticides and PCBs using gas chromatography with electron capture detection (GC-ECD), as described in U. S. EPA Method 608 (5).

4. Significance

4.1 Pesticides, particularly organochlorine pesticides, are widely used in both rural and urban areas for a variety of applications. PCBs are less widely used, due to extensive restrictions placed on their manufacture. However, human exposure to PCBs continues to be a problem because of their presence in various electrical products.

4.2 Many pesticides and PCBs exhibit bioaccumulative, chronic health effects and hence monitoring ambient air for such compounds is of great importance.

4.3 The relatively low levels of such compounds in the environment requires the use of high volume sampling techniques to acquire sufficient sample for analysis. However, the volatility of these compounds prevents efficient collection on filter media. Consequently, this method utilizes both a filter and a PUF backup cartridge which provides for efficient collection of most organochlorine pesticides, PCBs, and many other organics within the same volatility range.

5. Definitions

Definitions used in this document and any user-prepared SOPs should be consistent with ASTM D1356 (7). All abbreviations

and symbols are defined within this document at the point of use.

6. Interferences

6.1 The use of column chromatographic cleanup and selective GC detection (GC-ECD) minimizes the risk of interference from extraneous organic compounds. However, the fact that PCBs as well as certain organochlorine pesticides (e.g. toxaphene and chlordane) are complex mixtures of individual compounds can cause difficulty in accurately quantifying a particular formulation in a multiple component mixture.

6.2 Contamination of glassware and sampling apparatus with traces of pesticides or PCBs can be a major source of error in the method, particularly when sampling near high level sources (e.g. dumpsites, waste processing plants, etc.) careful attention to cleaning and handling procedures is required in all steps of the sampling and analysis to minimize this source of error.

7. Apparatus

7.1 Hi-Vol Sampler with PUF cartridge - available from General Metal Works (Model PS-1). See Figure 1.

7.2 Sampling Head to contain glass cartridge with PUF plug - available from General Metal Works. See Figure 2.

7.3 Calibration orifice - available from General Metal Works.

7.4 Manometer - to use with calibration orifice.

7.5 Soxhlet extraction system - including Soxhlet extractors (500 and 250 mL), heating mantels, variable voltage transformers, and cooling water source - for extraction of PUF cartridges before and after sampling. Also for extraction of filter samples.

7.6 Vacuum oven connected to water aspirator - for drying extracted PUF cartridges.

7.7 Gas chromatograph with electron capture detector - (consult U. S. EPA Method 608 for specifications).

7.8 Forceps - to handle quartz fiber filter samples.

7.9 Die - to cut PUF plugs.

7.10 Various items for extract preparation, cleanup, and analysis - consult U. S. EPA Method 608 for detailed listing.

7.11 Chromatography column - 2 mm I.D. x 15 cm long - for alumina cleanup.

8. Reagent and Materials

8.1 Polyurethane foam - 3 inch thick sheet stock, polyether type used in furniture upholstering. Density 0.022 g/cm^3.

8.2 Polyester gloves - for handling PUF cartridges and filters

8.3 Filters, quartz fiber - Pallflex 2500 QAST , or equivalent.

8.4 Wool felt filter - 4.9 mg/cm^2 and 0.6 mm thick. To fit sample head for collection efficiency studies. Pre-extracted with 5% diethyl ether in hexane.

8.5 Hexane - Pesticide or distilled in glass grade.

8.6 Diethyl ether - preserved with 2% ethanol - distilled in glass grade, or equivalent.

8.7 Acetone - Pesticide or distilled in glass grade.

8.8 Glass container for PUF cartridges.

8.9 Glass petri dish - for shipment of filters to and from the laboratory.

8.10 Ice chest - to store samples at ~0°C after collection.

8.11 Various materials needed for extract preparation, cleanup, and analysis - consult U. S. EPA Method 608 for details (Appendix A of this compendium).

8.12 Alumina - activity grade IV. 100/200 mesh

9. Assembly and Calibration of Sampling Apparatus

9.1 Description of Sampling Apparatus

9.1.1 The entire sampling system is diagrammed in Figure 1. This sampler was developed by Syracuse University

Research Corporation (SURC) under a U. S. EPA contract (6) and further modified by Southwest Research Institute and the U. S. EPA. A unit specifically designed for this method is now commercially available (Model PS-1 - General Metal Works, Inc., Village of Cleves, Ohio). The method writeup assumes the use of the commercial device, although the earlier modified device is also considered acceptable.

9.1.2 The sampling module (Figure 2) consists of a glass sampling cartridge and an air-tight metal cartridge holder. The PUF plug is retained in the glass sampling cartridge.

9.2 Calibration of Sampling System

9.2.1 The airflow through the sampling system is monitored by a venturi/Manehelic assembly, as shown in Figure 1. A multipoint calibration of the venturi/magnehelic assembly must be conducted every six months using an audit calibration orifice, as described in the U. S. EPA High Volume Sampling Method (8). A single point calibration must be performed before and after each sample collection, using the procedure described below.

9.2.2 Prior to calibration a "dummy" PUF cartridge and filter are placed in the sampling head and the sampling motor is activated. The flow control valve is fully opened and the voltage variator is adjusted so that a sample flow rate corresponding to ∿110% of the desired flow rate is indicated on the magnehelic (based on the previously obtained multipoint calibration curve). The motor is allowed to warmup for ∿10 minutes and then the flow control valve is adjusted to achieve the desired flow rate. The ambient temperature and barometric pressure should

be recorded on an appropriate data sheet (e.g. Figure 3).

9.2.3 The calibration orifice is then placed on the sampling head and a manometer is attached to the tap on the calibration orifice. The sampler is momentarily turned off to set the zero level of the manometer. The sampler is then switched on and the manometer reading is recorded, once a stable reading is achieved. The sampler is then shut off.

9.2.4 The calibration curve for the orifice is used to calculate sample flow from the data obtained in 9.2.3, and the calibration curve for the venturi/ magnehelic assembly is used to calculate sample flow from the data obtained in 9.2.2. The calibration data should be recorded on an appropriate data sheet (e.g. Figure 3). If the two values do not agree within 10% the sampler should be inspected for damage, flow blockage, etc. If no obvious problems are found the sampler should be recalibrated (multipoint) according to the U. S. EPA High Volume Sampling procedure (8).

9.2.5 A multipoint calibration of the calibration orifice, against a primary standard, should be obtained annually.

10. Preparation of Sampling (PUF) Cartridges

10.1 The PUF adsorbent is a polyether-type polyurethane foam (density No. 3014 or 0.0225 g/cm^3). This type of foam is used for furniture upholstery. It is white and yellows on exposure to light.

10.2 The PUF inserts are 6.0 cm diameter cylindrical plugs cut from 3 inch sheet stock and should fit with slight compression in the glass cartridge, supported by the wire

screen. See Figure 2. During cutting the die is rotated at high speed (e.g. in a drill press) and continuously lubricated with water.

10.3 For initial cleanup the PUF plug is placed in a Soxhlet extractor and extracted with acetone for 14-24 hours at approximately 4 cycles per hour. When cartridges are reused, 5% diethyl ether in n-hexane can be used as the cleanup solvent.

10.4 The extracted PUF is placed in a vacuum oven connected to a water aspirator and dried at room temperature for approximately 2-4 hours (until no solvent odor is detected).

10.5 The PUF is placed into the glass sampling cartridge using polyester gloves. The module is wrapped with hexane rinsed aluminum foil, placed in a labeled container and tightly sealed.

10.6 Other adsorbents may be suitable for this method as indicated in the various references (1-3). If such materials are employed the user must define appropriate preparation procedures based on the information contained in these references.

10.7 At least one assembled cartridge from each batch must be analyzed, as a laboratory blank, using the procedures described in Section 12, before the batch is considered acceptable for field use. A blank level of <10 ng/plug for single compounds is considered to be acceptable. For multiple component mixtures (e.g. Arochlors) the blank level should be <100 ng/plug.

11. Sampling

11.1 After the sampling system has been assembled and calibrated as described in Section 9 it can be used to collect air samples as described below.

11.2 The samples should be located in an unobstructed area, at least two meters from any obstacle to air flow. The exhaust hose should be stretched out in the downwind

direction to prevent recycling of air.

11.3 A clean sampling cartridge and quartz fiber filter are removed from sealed transport containers and placed in the sampling head using forceps and gloved hands. The head is tightly sealed into the sampling system. The aluminum foil wrapping is placed back in the sealed container for later use.

11.4 The zero reading of the Magnehelic is checked. Ambient temperature, barometric pressure, elapsed time meter setting, sampler serial number, filter number and PUF cartridge number are recorded. A suitable data sheet is shown in Figure 4.

11.5 The voltage variator and flow control valve are placed at the settings used in 9.2.3 and the power switch is turned on. The elapsed time meter is activated and the start time recorded. The flow (Magnehelic setting) is adjusted, if necessary using the flow control valve.

11.6 The Magnehelic reading is recorded every six hours during the sampling period. The calibration curve (Section 9.2.7) is used to calculate the flow rate. Ambient temperature and barometric pressure are recorded at the beginning and end of the sampling period.

11.7 At the end of the desired sampling period the power is turned off and the filter and PUF cartridges are wrapped with the original aluminum foil and placed in sealed, labeled containers for transport back to the laboratory.

11.8 The Magnehelic calibration is checked using the calibration orifice as described in Section 9.2.4. If the calibration deviates by more than 10% from the initial reading the flow data for that sample must be marked as suspect and the sampler should be inspected and/or removed from service.

11.9 At least one field blank will be returned to the laboratory with each group of samples. A field blank is treated exactly as a sample except that no air is drawn through the cartridge.

11.10 Samples are stored at ∿20°C in an ice chest until receipt at the analytical laboratory, at which time they are stored refrigerated at 4°C.

12. Sample Preparation and Analysis

12.1 Sample Preparation

12.1.1 All samples should be extracted within 1 week after collection.

12.1.2 PUF cartridges are removed from the sealed con-container using gloved hands, the aluminum foil wrapping is removed, and the cartridges are placed into a 500-mL Soxhlet extraction. The cartridges are extracted for 14-24 hours at ∿4 cycles/hour with 5% diethyl ether in hexane. Extracted cartridges can be dried and reused following the handling procedures in Section 10. The quartz filter can be placed in the extractor with the PUF cartridges. However, if separate analysis is desired then one can proceed with 12.1.3.

12.1.3 If separate analysis is desired, quartz filters are placed in a 250-mL Soxhlet extractor and extracted for 14-24 hours with 5% diethyl ether in hexane.

12.1.4 The extracts are concentrated to 10 mL final volume using 500-mL Kuderna-Danish concentrators as described in EPA Method 608 (5), using a hot water bath. The concentrated extracts are stored refrigerated in sealed 4-dram vials having teflon-lined screw-caps until analyzed or subjected to cleanup.

12.2 Sample Cleanup

12.2.1 If only organochlorine pesticides and PCBs are sought, an alumina cleanup procedure reported in the literature is appropriate (1). Prior to cleanup the sample

extract is carefully reduced to 1 mL using a gentle steam of clean nitrogen.

12.2.2 A glass chromatographic column (2 mm ID x 15 cm long) is packed with alumina, activity grade IV and rinsed with ~20 mL of n-hexane. The concentrated sample extract (from 12.2.1) is placed on the column and eluted with 10 mL of n-hexane at a rate of 0.5 mL/minute. The eluate volume is adjusted to exactly 10 mL and analyzed as described in 12.3.

12.2.3 If other pesticides are sought, alternate cleanup procedures (e.g. Florisil) may be required. Method 608 (5) identifies appropriate cleanup procedures.

12.3 Sample Analysis

12.3.1 Sample analysis is performed using GC/ECD as described in EPA Method 608 (5). The user must consult this method for detailed analytical procedures.

12.3.2 GC retention times and conditions are identified in Table 1 for the compounds of interest.

13. GC Calibration

Appropriate calibration procedures are identified in EPA Method 608 (5).

14. Calculations

14.1 The total sample volume (V_m) is calculated from the periodic flow readings (Magnehelic) taken in Section 11.6 using the following equation.

$$V_m = \frac{Q_1 + Q_2 \ldots Q_N}{N} X \frac{T}{1000}$$

where

V_m = Total sample volume (m^3).

Q_1, $Q_2 \ldots Q_N$ = Flow rates determined at the beginning, end, and intermediate points during sampling (L/minute).

N = Number of data points averaged.

T = Elapsed sampling time (minutes).

14.2 The volume of air sampled can be converted to standard conditions (760 mm Hg pressure and 25°C) using the following equation:

$$V_s = V_m \times \frac{P_A}{760} \times \frac{298}{273+t_A}$$

where

V_s = Total sample volume at 25°C and 760 mm Hg pressure (m^3)

V_m = Total sample flow under ambient conditions (m^3)

P_A = Ambient pressure (mm Hg)

t_A = Ambient temperature (°C)

14.3 The concentration of compound in the sample is calculated using the following equation:

$$C_A = \frac{A \times V_E}{V_i \times V_s}$$

where

C_A = Concentration of analyte in the sample, $\mu g/m^3$

A = Calculated amount of material injected onto the chromatograph based on calibration curve for injected standards (nanograms)

V_i = Volume of extract injected (µL).

V_E = Final volume of extract (mL).
V_s = Total volume of air samples corrected to standard conditions (m^3).

14. Performance Criteria and Quality Assurance

This section summarizes the quality assurance (QA) measures and provides guidance concerning performance criteria which should be achieved within each laboratory.

14.1 Standard Operating Procedures (SOPs)

14.1.1 Users should generate SOPs describing the following activities as accomplished in their laboratory: 1) assembly, calibration and operation of the sampling system, 2) preparation, purification, storage and handling of sampling cartridges, 3) assembly, calibration and operation of the GC/ECD system, and 4) all aspects of data recording and processing.

14.1.2 SOPs should provide specific stepwise instructions and should be readily available to, and understood by, the laboratory personnel conducting the work.

14.2 Process, Field, and Solvent Blanks

14.2.1 One PUF cartridge and filter from each batch of approximately twenty should be analyzed, without shipment to the field, for the compounds of interest to serve as a process blank.

14.2.2 During each sampling episode at least one PUF cartridge and filter should be shipped to the field and returned, without drawing air through the sampler, to serve as a field blank.

14.2.3 During the analysis of each batch of samples at least one solvent process blank (all steps conducted but no PUF cartridge or filter included) should be

carried through the procedure and analyzed.

14.2.4 Blank levels should not exceed ~10 ng/sample for single components or ~100 ng/sample for multiple component mixtures (e.g. PCBs).

14.3 Collection Efficiency and Spike Recovery

14.3.1 Before using the method for sample analysis each laboratory must determine their collection efficiency for the components of interest.

14.3.2 The glass fiber filter in the sampler is replaced with a hexane-extracted wool felt filter (weight 14.9 mg/cm^2, 0.6 mm thick). The filter is spiked with microgram amounts of the compounds of interest by dropwise addition of hexane solutions of the compounds. The solvent is allowed to evaporate and filter is placed into the sampling system for immediate use.

14.3.3 The sampling system, including a clean PUF cartridge, is activated and set at the desired sampling flow rate. The sample flow is monitored for 24 hours.

14.3.4 The filter and PUF cartridge are then removed and analyzed as described in Section 12.

14.3.5 A second sample, unspiked is collected over the same time period to account for any background levels of components in the ambient air matrix.

14.3.6 A third PUF cartridge is spiked with the same amounts of the compounds used in 14.3.2 and extracted to determine analytical recovery.

14.3.7 In general analytical recoveries and collection efficiencies of 75% are considered to be acceptable method performance.

14.3.8 Replicate (at least triplicate) determinations of collection efficiency should be made. Relative standard deviations for these replicate determinations of ± 15% or less is considered acceptable performance.

14.3.9 Blind spiked samples should be included with sample sets periodically, as a check on analytical performance.

14.4 Method Precision and Accuracy

Typical method recovery data are shown in Table 1. Recoveries for the various chlorobiphenyls illustrate the fact that all components of an Arochlor mixture will not be retained to the same extent. Recoveries for tetrachlorobiphenyls and above are generally greater than 85% but di- and trichloro homologs may not be recovered quantitatively.

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4. Riggin, R. M., "Technical Assistance Document for Sampling and Analysis of Toxic Organic Compounds in Ambient Air", EPA-600/4-83-027., U. S. Environmental Protection Agency, Research Triangle Park, NC, 1983.

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6. Bjorkland, J., Compton, B., and Zweig, G., "Development of Methods for Collection and Analysis of Airborne Pesticides." Report for Contract No. CPA 70-15, National Air Pollution Control Association, Durham, NC, 1970.

7. Annual Book of ASTM Standards, Part 11.03, "Atmospheric Analysis", American Society for Testing and Materials, Philadelphia, PA, 1983.

8. Reference Method for the Determination of Suspended Particulates in the Atmosphere (High Volume Method). Federal Register, Sept. 14, 1972 or 40CFR50 Appendix B.

TABLE 1. SELECTED COMPONENTS DETERMINED USING HI-VOL/PUF SAMPLING PROCEDURE

Compound	GC Retention Time, Minutes[a]	24-Hour Sampling Efficiency[b]	
		Air Concentration ng/m^3	% Recovery
Aldrin	2.4	0.3-3.0	28
4,4'-DDE	5.1	0.6-6.0	89
4,4'-DDT	9.4	1.8-18	83
Chlordane	(c)	15-150	73
Chlorobiphenyls			
4,4' Di-	--	2.0-20	62
2,4,5 Tri-	---	0.2-2.0	36
2,4',5 Tri-	--	0.2-2.0	86
2,2',5,5' Tetra-	--	0.2-2.0	94
2,2',4,5,5' Penta-	--	0.2-2.0	92
2,2',4,4',5,5' Hexa	--	0.2-2.0	86

(a) Data from U.S. EPA Method 608. Conditions are as follows:

Stationary Phase - 1.5% SP2250/1.95% SP-2401 on Supelcoport (100/120 mesh) packed in 1.8 mm long x 4 mm ID glass column.

Carrier - 5/95 methane/Argon at 60 mL/Minute

Column Temperature - 160°C except for PCBs which are determined at 200°C.

(b) From Reference 2.

(c) Multiple component formulation. See U.S. EPA Method 608.

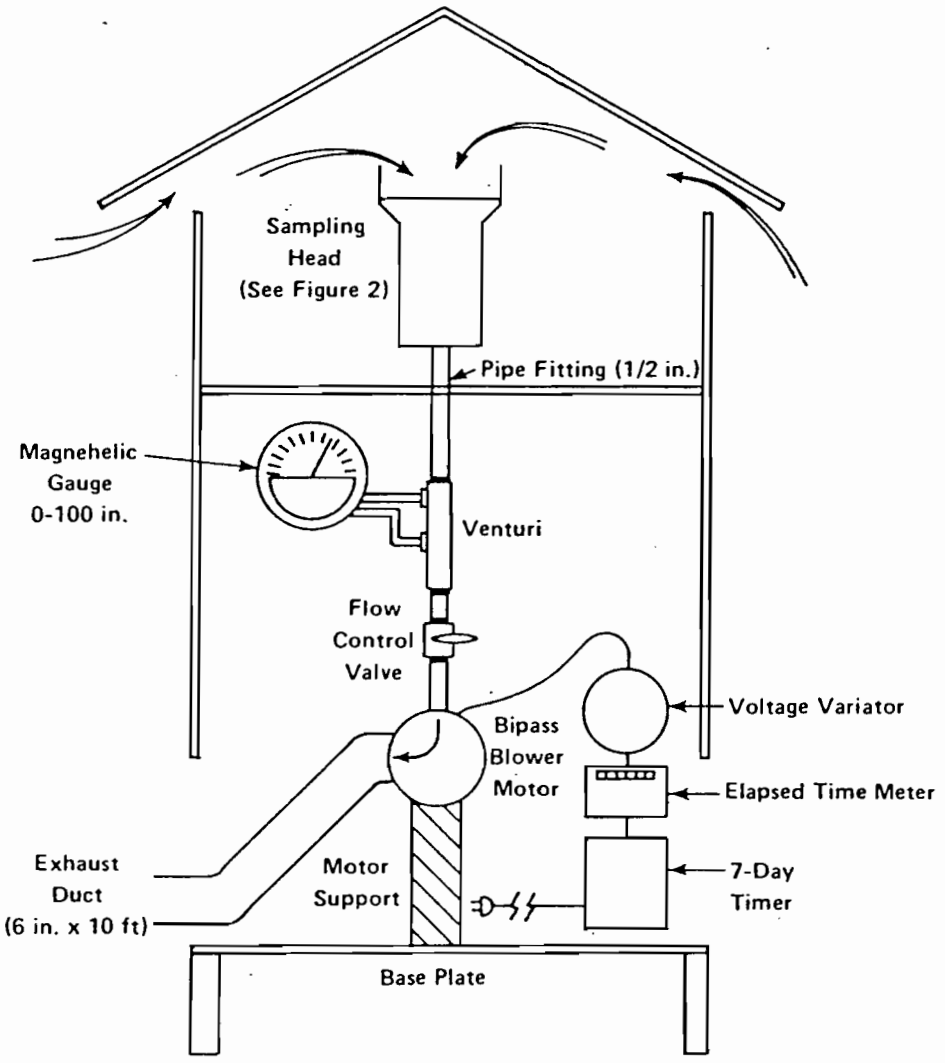

FIGURE 1. HIGH VOLUME AIR SAMPLER. AVAILABLE FROM GENERAL METAL WORKS (MODEL PS-1)

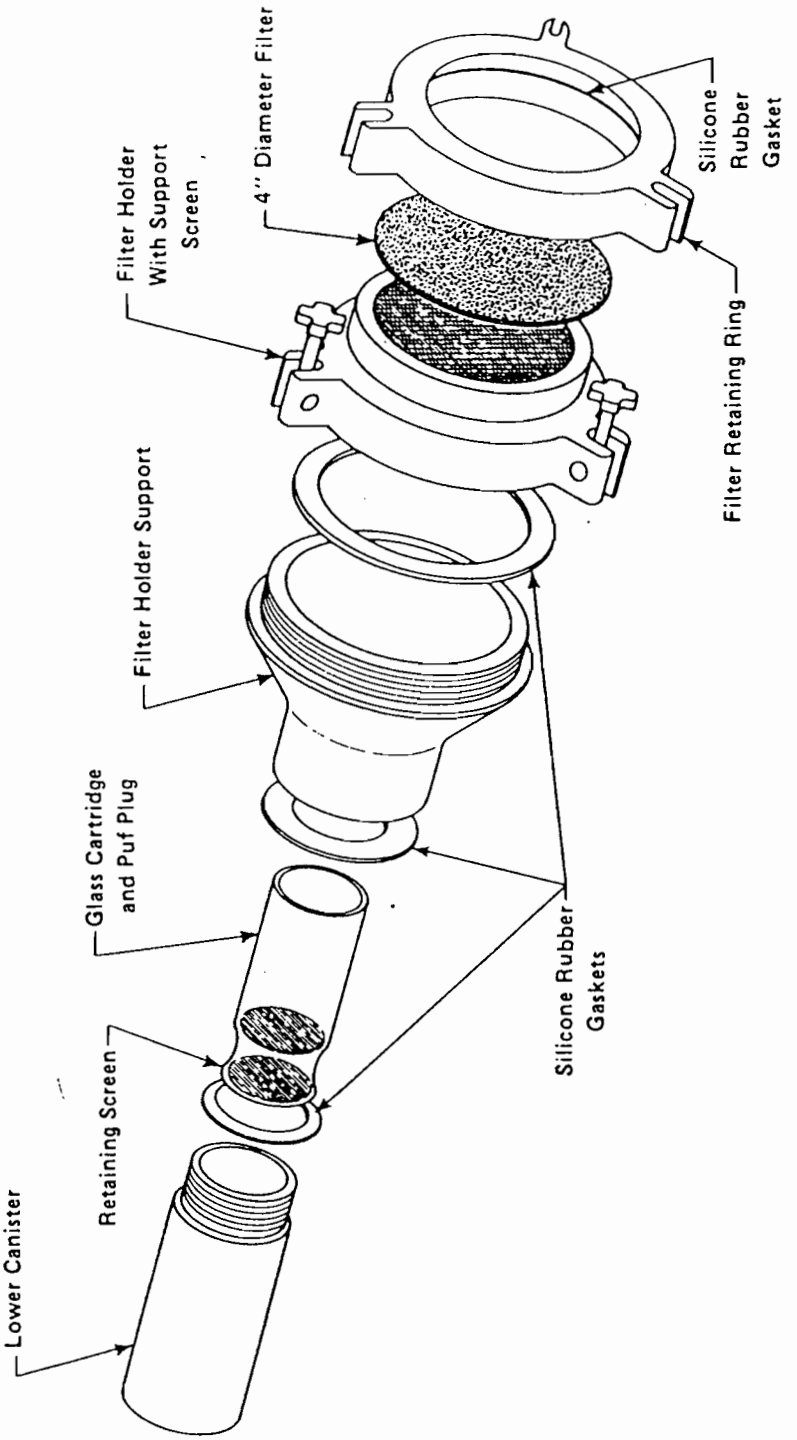

FIGURE 2. SAMPLING HEAD

Performed by_____ Calibration Orifice S/N_____ Ambient Temperature_____°C

Date/Time_____ Manometer S/N _____ Bar.Press. _____ mm Hg

Sampler S/N	Variac Setting V	Timer OK? Yes/No	Calibration Orifice Data		Sampler Venturi Data		% Difference Between Calibration and Sample Venturi Flow Rates	Comments
			Manometer, in. H_2O	Flow Rate, scm /min(a)	Magnehelic, in. H_2O	Flow Rate scm/min (b)		
	/							

(a) From Calibration Tables for Calibration Orifice or Venturi Tube

(b) From Calibration Tables for Venturi Tube in each Hi-Vol unit. Date check by_____ Date_____

FIGURE 3. TYPICAL CALIBRATION SHEET FOR HIGH VOLUME SAMPLER

Site _____ Date _____ Performed by _____

Sampler S/N	Sampling Location I.D.	New Filter (√)	PUF Cart. No.	Variac Setting	Clock Time			Sampler Timer			Venturi Readings: Time/Magnehelic in. H_2O				Ambient Temperature, °C		Barometric Pressure, mm Hg		Comments
					Start, hr CDT	Stop, hr CDT	Min Elapsed	Start, min	Stop, min	Min Elapsed	1	2	3	4	Start	Stop	Start	Stop	

(a) Record any evidence of tampering with sampler and/or abnormalities in sampler operation, PUF cartridge condition or handling, etc.

Data Checked By _____ Date _____

FIGURE 4. TYPICAL SAMPLING DATA FORM FOR HIGH VOLUME PESTICIDE/PCB SAMPLER

EPA-600/4-83-027
June 1983

TECHNICAL ASSISTANCE DOCUMENT FOR SAMPLING AND ANALYSIS OF TOXIC ORGANIC COMPOUNDS IN AMBIENT AIR

by

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TABLE 17. (Continued)

Method Designation	Compounds Determined	Sampling and Analysis Approach	Detection Limit	Accuracy	Precision	Relative Cost: Instrument	Relative Cost: Time/Materials	References	Limitations	Comments
F. —	Nonpolar volatiles (B.P. 0–100°C)	Adsorption on carbon molecular sieves; thermal desorption into canister; analysis by GC/FID or GC/MS	0.01–1 ppbv (20 liter sample)	80–100%	±20%	Moderate to high, depending on GC detector	Moderate	14	High temperature (350°C) required for desorption may decompose labile compounds.	See Method D.
G. NIOSH P&CAM 206	PAH	Collection of particulate matter on high volume filter; ultrasonic extraction with cyclohexane/silica powder; analysis by normal phase HPLC	3 ng/m^3 (1500 m^3 sample)	95%	±5%	Moderate	Moderate	2	PAHs more volatile than benzo(a)pyrene may be lost by volatilization during the sampling period. Approaches similar to reference 40 may be required for such compounds.	PAH and other particle bound components may be determined using GC/MS.
Halogenated Hydrocarbons										
Methods A–F can be used for volatile halogenated hydrocarbons as well, except that GC/ECD should be used in place of GC/FID in most cases.										
H. —	PCBs, PCNs, organochlorine pesticides, and other semivolatile organics (B.P. 140–450°C)	Adsorption on solid adsorbent such as polyurethane foam (PUF), XAD-2, or Chromosorb 102); solvent desorption; GC/ECD, GC/MS, or GC/FID analysis	3 ng/m^3 (1500 m^3 sample)	60–100%	±20%	Moderate to high, depending on GC detector	Moderate	40 Lower volume approaches (41,42,50)	—	Similar approaches using low volume sampling trains may be more useful for detecting higher levels (1–10 μg/m^3). Hydrocarbons with boiling points >140°C (>C_8) can be determined.

APPENDIX M

Resumes of Personnel

PAUL H. ROUX
President

EDUCATION

M.A. Geology, 1978, Queens College, City University of New York
B.S. Engineering Science, 1968, C.W. Post College, Long Island University

PROFESSIONAL SOCIETIES

National Water Well Association, Ground-Water Technology Division
American Institute of Professional Geologists (Executive Committee, Northeast Section 1980-1982)
American Institute of Hydrology

REGISTRATION

Certified Professional Hydrogeologist, American Institute of Hydrology
Certified Professional Geologist, American Institute of Professional Geologists
Certified Professional Geologist, Indiana and North Carolina

PROFESSIONAL EXPERIENCE

1981 - Date	President of Roux Associates
1979 - 1981	Senior Hydrogeologist, Stauffer Chemical Company
1972 - 1979	Hydrogeologist and Senior Hydrogeologist, Geraghty & Miller, Inc.
1970 - 1972	Engineer, Spectral Data Corporation
1967 - 1970	Research Assistant, Science Engineering Research Group, Long Island University

KEY PROJECT EXPERIENCE

- Directed the remedial investigation feasibility studies for several hazardous waste sites listed on the National Priorities List and several state Superfund sites.
- Planned and directed several studies to define areas vulnerable to ground water contamination from pesticide application.

KEY PROJECT EXPERIENCE (Cont'd)

- Planned and directed a monitoring well drilling and sampling program to determine the potential for pesticide leaching under various soil and hydrogeologic conditions.

- Evaluated ground-water conditions at over 100 industrial plant sites throughout the United States to determine existing and potential problems.

- Developed ground-water contamination abatement systems and monitoring programs at numerous industrial sites.

- Advised client management on corporate responses to ground-water portions of RCRA, SDWA (UIC), and CERCLA, including determination of reportable facilities and development of monitoring programs.

- Negotiated ground-water and hazardous waste matters with EPA and state regulatory agency personnel in Connecticut, Delaware, Kentucky, Massachusetts, Michigan, New Jersey, New York, Nevada, Ohio, and Tennessee.

- Served on the Chemical Manufacturers Association's Ground-Water Management and Superfund task groups.

- Determined the effectiveness of an emergency clean-up of a 7000 gallon PCB spill near a public supply well-field in New Jersey.

- Established the sources and distribution of organic solvents polluting a public supply well in the Old Bridge and Farrington aquifers in South Brunswick, New Jersey.

- Designed and supervised the installation of a system of pumping wells to control contaminated ground water at a major industrial waste treatment facility in southern New Jersey.

- Evaluated the impact of waste disposal facilities on the ground-water resources of Gloucester and Camden Counties, New Jersey for the U.S. EPA.

- Designed a ground-water removal and reinjection system for an in situ bioreclamation program at a chemical plant in northern New Jersey.

KEY PROJECT EXPERIENCE (Cont'd)

- Evaluated the impact of waste disposal on the ground-water resources of Westchester County, New York.

- Carried out water supply development projects for numerous clients including: East Orange and Fairlawn, N.J., Middletown and Weston, CT., Shell Oil Co., Union Carbide and the Puerto Rico Water Resources Authority.

PUBLICATIONS

The Nature and Movement of Leachate from Two Solid Waste Disposal Sites in the Northeast, 1975, Abstracts, Northeast Section, 10th Annual Meeting of the Geological Society of America, p.12.

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PUBLICATIONS (Cont'd)

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Impact of Site Hydrogeology on In Situ Remediation Strategies, 1985, Proceedings of the Hazpro '85 Conference, Baltimore, Maryland pp. 274-287.

Sensitivity Analysis for Pesticide Application on a Regional Scale, 1986, Proceedings from the National Water Well Association Conference on Agricultural Impacts on Ground Water, Omaha, Nebraska.

JAMES V. WORRALL
Principal Engineer

EDUCATION

B.S. Chemical Engineering, Purdue University

PROFESSIONAL SOCIETIES

American Institute of Chemical Engineers
Association of Ground Water Scientists and Engineers

REGISTRATION

Certified Hazardous Materials Manager, Master Level - Institute of Hazardous Materials Management

PROFESSIONAL EXPERIENCE

1986 - Date	Principal Engineer and Vice President, Roux Associates
1979 - 1986	Senior Environmental Project Engineer, Corporate Environmental Control, Stauffer Chemical Company
1975 - 1979	Senior Project Engineer, Corporate Engineering, Stauffer Chemical Company
1971 - 1975	Plant Superintendent, Industrial Chemical Division, Stauffer Chemical Company
1969 - 1971	Technical Director, Cowles Chemical Division, Stauffer Chemical Company
1966 - 1969	Assistant Chief Engineer, Cowles Chemical Company
1962 - 1966	Superintendent - Plant Engineering, National Aniline Division, Allied Chemical Corporation
1960 - 1962	Construction Superintendent, National Aniline Division, Allied Chemical Corporation

PRESENTATIONS

New Jersey Environmental Exposition, 1986; "Underground Storage Tank Management Program for Industry".

Water and Wastewater Operations Center, Westford, MA; "Management of Underground Storage Tanks".

KEY PROJECT EXPERIENCE

- Managed a remedial investigation and remediation project involving underground tank leaks and on-site disposal pits for a Fortune 100 corporation in Connecticut. The investigation demonstrated that ground-water intercept and treatment was not required, and a risk assessment convinced the CT DEP to allow some contaminated soil to remain in place. Approximately 22 truckloads of soil were removed from four locations defined by the investigation. Supervised the remedial feasibility study, waste classification, disposal facility screening, RFQ and contracting for hauling and disposal, excavation, truck loading, and waste manifesting.

- Conducted a plant decontamination survey for a major chemical company in preparation for possible sale of buildings and facilities. The survey covered six plants across the country, and required inspections of all buildings and facilities. The object of the survey was to provide company management with recommendations regarding decontamination methods and procedures, and estimated costs of decontamination and hazardous waste disposal. This was done based upon knowledge of the chemicals handled, and products manufactured, and observations of building materials of construction, and contaminant build-up.

- Managed assessment and remedial recommendations for wetlands and flood plain for Industriplex 128 Superfund Site in Woburn, MA, as part of the Feasibility Study requirements under SARA. EPA Region 1 has issued the Record of Decision.

- Supervised large underground tank removal project in Connecticut for Fortune 500 company, and prepared all required forms for property transfer under Connecticut's "Negative Declaration" law.

KEY PROJECT EXPERIENCE (Cont'd)

- Managed soil and ground-water investigation related to cutting oils discharged to a septic system at a manufacturing facility in Berlin, Connecticut. The investigation proved that there was no ground-water contamination. Supervised excavation and disposal of a limited quantity of soil at a local landfill.

- Managed investigation and feasibility study related to extensive diesel oil contamination at a large railroad terminal in Connecticut. The investigation defined the areal extent and thickness of free phase oil, and recommended conceptual design of interceptor trench and free product pump-out. Installation of facilities has started.

- Managed the remediation of contamination at a coal tar impoundment site in Upstate New York with an in-situ chemical and biological treatment facility for ground water. Handled all design, procurement, construction management, start-up, operating and maintenance manual, and client training. Provided technical oversite of operations to optimize ground-water contours and flow, and chemical and biological treatment levels.

- Managed remedial investigation and feasibility study related to an underground gasoline tank leak at a Connecticut private school, requiring exploration near and under school buildings and dormatories. The feasibility study indicated that soil venting is the most appropriate remediation, and a short pilot test on site will be conducted as part of the remediation design. Project is on-going.

- Managed or directed projects for plant closures, decontamination, waste disposal, PCB-transformer disposal, dismantlement and demolition at four chemical plants.

- Directed feasibility studies at a Superfund-listed site for remediation of two plumes of ground water contaminated with VCM, EDC and TCE; proposed ground-water intercepts, air stripping, and industrial use of treated water.

KEY PROJECT EXPERIENCE (Cont'd)

- Chaired technical committee and coordinated consultants for industry-sponsored remedial investigations/feasibility studies at NPL Superfund-listed site and related state-listed abandoned waste site; proposed multi-level ground-water intercept, air stripping column and reinfiltration/soil flushing system.

- Managed investigation, sampling and analyses of three square miles of dried-out chemical waste evaporation ponds containing friable asbestos. Demonstrated to regulatory agency through air sampling and layering of ponds solids that asbestos would not become airborne, thereby avoiding cost of capping all ponds. Corrective action was limited to protective gates with warning signs.

- Directed task group to investigate all methods and processes for destruction/disposal of PCB-laden viscous process waste from three large storage tanks. Collaborated and negotiated with commercial facilities for blending with other waste streams to facilitate incineration prior to TSCA regulatory deadline.

- Negotiated environmental investigations, remedial measures and waste disposal alternatives with Federal EPA and state regulatory personnel in Nevada, New York, Delaware, Connecticut, Massachusetts and Virginia.

- Reviewed and critiqued environmental mitigation measures proposed to be implemented during $660 MM New York Power Authority expansion project at Niagara Falls, NY. Plans for the final investigation phase and for the construction excavation have been changed to address the deficiencies noted in the critique.

- Designed and established a program for the management of risks, costs and RCRA regulatory compliance associated with underground storage tanks (UST) for a major chemical company. Utilized state-of-the-art methodology for leak age prediction.

KEY PROJECT EXPERIENCE (Cont'd)

- Directed site investigation/feasibility studies to prevent contamination of a metropolitan drinking water supply from multi-source organic chemical leach beds solubilized by benzene from a large underground tank failure. Directed project team in source identification, design, installation and start-up of a 2000 foot long barrier well intercept system, and 180 gpm treatment facilities. Treatment included precipitation and clarification of silica compounds prior to air stripping of volatiles and reinfiltration of treated water downgradient. Negotiations and communications with state agency throughout. Total project cost $4.3MM.

- Designed, engineered, and installed chemical manufacturing process facilities, large plant expansions, air and water pollution control facilities, and related service facilities.

- Managed operation of chemical plant process waste water treatment facility which included a four column carbon adsorption system, neutralization, coagulation, precipitation, dual settling ponds, and NPDES discharge to New York State trout stream.

- Established and directed hazardous waste treatment/disposal program for major chemical company with 70 facilities nationwide. Negotiated and arranged contracts with all major commercial TSD facilities to insure compliance with federal and state RCRA regulations, and DOT requirements. Issued company standard policy and practice instructions for hazardous waste management; waste identification, RCRA classification and manifesting; DOT classification, packaging, labeling and placarding.

- Developed first hand knowledge of commercial treatment/disposal sites and capabilities nationwide. Established and directed program for approval, inspection and subsequent auditing program related to use of off-site commercial facilities.

- Directed and advised site closure team regarding RCRA and TSCA regulatory requirements in the removal and closure of a PCB still-bottom waste pond. Negotiated $150,000 reduction in disposal costs.

KEY PROJECT EXPERIENCE (Cont'd)

- Conducted site investigation and feasibility study to determine disposition of piles of abandoned, now inert, incendiary devices. Based upon hazard assessment and environmental fate analysis, proposed on-site capping as cost-effective solution.

- Project engineer and project coordinator for feasibility study, design, construction and procurement of equipment for state-of-the-art $12 MM toxicology laboratory.

DOUGLAS J. SWANSON
Principal Hydrogeologist

EDUCATION

B.S. Geology, Hofstra University, 1981
M.S. Geology, West Virginia University, 1983

PROFESSIONAL SOCIETIES

Association of Ground-Water Scientists and Engineers

PROFESSIONAL EXPERIENCE

1988 - Date	Principal Hydrogeologist, Roux Associates,Inc. Huntington, New York
1988	Senior Hydrogeologist, Dan Raviv Associates, Inc. Millburn, New Jersey
1985 - 1988	Staff Hydrogeologist, Geraghty & Miller, Inc. Denver, Colorado
1984 - 1985	Project Hydrogeologist, Geraghty & Miller, Inc. Syosset, New York

KEY PROJECT EXPERIENCE

- Managed an NJDEP Enforcement investigation to delineate and remediate coal tar contamination in soil and ground water at a former coal gasification plant in Jersey City, New Jersey. Tasks included the management of a large-scale soil and ground-water remedial investigation, the design of a ground-water remedial system to capture floating and sinking separate phase product in shallow and deep aquifers, and the supervision of an in-situ bioremediation program to remediate coal tar wastes.

- Managed two multi-million dollar ECRA site cleanups at two oil terminals in New Jersey. The projects required the design, installation and operation of ground-water recovery and treatment systems to mitigate separate phase and dissolved ground-water contamination. Also supervised the on-site bioremediation of approximately 15,000 cubic yards of petroleum-contaminated soils.

- Managed a ground-water remediation project in a residential area of Babylon, New York. The project included the design, installation and operation of a ground-water recovery and treatment system to mitigate separate phase and dissolved contamination.

- Designed and installed a ground-water recovery trench within a shallow, shale bedrock aquifer in Somerset, New Jersey.

- Designed a ground-water recovery trench and treatment system to mitigate contamination in an unconsolidated aquifer at an ECRA industrial site in Fairview, New Jersey.

DOUGLAS J. SWANSON

KEY PROJECT EXPERIENCE (Cont'd)

- Designed two ground-water recovery well systems to mitigate shallow and deep ground-water contaminant plumes in shale bedrock as part of an ECRA investigation at a chemical plant in Somerset, New Jersey.

- Managed ECRA and NJDEP Enforcement soil cleanups at three industrial sites in New Jersey. The projects included the management of several subcontractors selected to perform in-situ bioremediation and land treatment techniques to degrade coal tar and fuel-related contaminants in soils.

- Managed an ECRA investigation to delineate and remediate heavy metals contamination in soils and ground water at an industrial site in Somerset, New Jersey.

- Managed a CERCLA investigation to determine the extent and impact of contamination in fractured crystalline and sedimentary bedrock aquifers underlying an industrial site in Denver, Colorado.

- Managed a ground-water investigation to recover separate phase fuel oil from a water table aquifer at a railroad yard in Denver, Colorado. Tasks included the design of a remedial plan and preparation of a COPDES discharge permit application for the site.

- Developed and directed a source characterization study of buried waste ponds at an industrial site in Denver, Colorado. Soil chemistry, ground-water quality and bench-scale treatability test data were developed to determine impact of source materials on the ground-water system and to identify remedial technology alternatives for site cleanup.
- Performed a hydrogeologic investigation including soil sampling, monitoring well installation and ground-water monitoring at a Superfund site in Albuquerque, New Mexico.

- Managed a fuel oil contamination investigation of domestic supply wells in a suburban community in Montville Township, New Jersey. The project included the sampling of domestic water supplies to identify impacted wells, identification of potential contaminant source areas, and the design and installation of whole-house treatment units as an interim remedial measure.

- Directed a hydrogeologic investigation including aquifer testing, ground-water monitoring and source area characterization to characterize hydraulic and contaminant (coal tar) conditions at an ECRA site in East Rutherford, New Jersey.

- Supervised a ground-water monitoring program at a large industrial site in St. Louis, Missouri.

- Performed a soil vapor study to delineate shallow ground-water contamination at an oil refinery in Casper, Wyoming.

KAREN A. SWANSON
Senior Geochemist

EDUCATION

Ph.D. Geochemistry, 1988, The Pennsylvania State University
M.S. Geology, 1979, University of Pennsylvania
B.S. Chemistry, 1976, Worcester Polytechnic Institute

PROFESSIONAL SOCIETIES

American Chemical Society
Geological Society of America
National Water Well Association

CERTIFICATION

OSHA approved 40 Hour Health and Safety Training Course for Hazardous Waste Operations.

PROFESSIONAL EXPERIENCE

1989 - Date	Senior Geochemist, Roux Associates
1988 - 1989	Research Scientist and Section Chief, Bureau of Aquifer Protection, New Jersey, Department of Environmental Protection (NJDEP)
1987 - 1988	Section Chief, Environmental Cleanup Responsibility Act (ECRA) Section, Bureau of Ground Water Quality Management NJDEP
1986 - 1987	Supervising Geologist, ECRA Section, NJDEP
1985 - 1986	Senior Geologist, Bureau of Ground Water Quality Management, NJDEP
1979 - 1984	Research Assistant, Pennsylvania State University
1977 (Summer)	Chemist, Sandoz Crop Protection Company
1973 - 1975 (Summers)	Analytical Chemist, Sandoz Pharmaceuticals Company

KEY PROJECT EXPERIENCE

- Reviewed and revised New Jersey ground-water standards and regulations based on current technical literature.
- Coordinated with other state and federal agencies on ground-water issues.
- Supervised eleven geologists involved in review of sampling and cleanup plans for the ECRA Program.
- Evaluated hydrogeologic data to determine the extent of ground-water contamination at industrial facilities.

KAREN A. SWANSON

KEY PROJECT EXPERIENCE (Cont'd)

- o Issued ground-water discharge permits under the New Jersey Pollutant Discharge Elimination System (NJPDES).
- o Designed ground-water monitoring programs.
- o Evaluated RCRA Part A and Part B permit applications and determined RCRA status of hazardous waste facilities.
- o Synthesized organic compounds for development of insecticides and herbicides.
- o Assayed raw materials and finished products using spectrophotometry, chromatography and wet chemistry methods.

PUBLICATIONS

Swanson, K.A. and A.H. Johnson (1980). "Trace Metal Budgets for a Forested Watershed in the New Jersey Pine Barrens", Water Resources Research 43, p. 373-376.

Turner, R.S., K.A. Swanson, and I. Demir (1980). "Lead Retention and Movement in the New Jersey Pine Barrens" (abstr.), Geological Society of America Abstracts with Programs 12, p. 88-89.

CONTINUING EDUCATION

"Management II", NJDEP Division of Personnel, Trenton, New Jersey, October - November, 1988.

"Management I", NJDEP Division of Personnel, Trenton, New Jersey, June 1988

"Advanced Interpretation of Mass Spectra", short course sponsored by Finnigan MAT Institute, Trenton, New Jersey, February 29 - March 4, 1988.

New Jersey Certified Public Manager Program, Levels I - III, sponsored by the NJ Department of Personnel and Rutgers University, Princeton, NJ, September 1987 - June 1988.

"Groundwater Modeling Methodology and Application", Short Course sponsored by The International Groundwater Modeling Center of the Holcomb Research Institute, New York, NY, September 8-12, 1986.

"Groundwater Pollution and Hydrology", Short Course sponsored by Princeton Associates, Princeton, NJ, July 8-12, 1985.

"RCRA Reauthorization and Part B Permit Writing", sponsored by USEPA, Kingston, NY, April 22-25, 1985.

DEBORAH A. MOSCONI
Hydrogeologist

EDUCATION

M.S. Geology, 1987, The Pennsylvania State University
B.S. Geology, 1984, State University of New York at Oneonta

PROFESSIONAL SOCIETIES

National Water Well Association
Association of Ground Water Scientists and Engineers

CERTIFICATION

40 hour OSHA Health and Safety Training Course for Hazardous Waste Operations

PROFESSIONAL EXPERIENCE

1988 - Date	Hydrogeologist, Roux Associates
1987 - 1988	Hydrogeologist, ERT, Inc.
1984 - 1986	Hydrogeologist, Meiser and Earl/Hydro-geologist, Inc.
1984 - 1986	Graduate Research and Teaching Assistant, The Pennsylvania State University

KEY PROJECT EXPERIENCE

- Project hydrogeologist responsible for characterization of ground-water hydrogeology in RCRA compliance project for coal tar refinery in Illinois. Responsibilities included conducting field investigations such as monitoring well installation and pumping tests to determine the feasibility of ground-water recovery systems; ground-water quality and hydrogeologic data interpretation and preparation of quarterly ground-water assessment reports.

- Project hydrogeologist for the Feasibility Study (FS) of a wood treating facility in Washington, conducted in accordance with the National Contingency Plan under CERCLA. Responsibilities included technical evaluation of previous RI data; detailed evaluation of remedial technologies suitable for site remediation; evaluation and recommendation of ground-water and free product recovery systems; preparation of feasibility study report, including detailed

KEY PROJECT EXPERIENCE (Cont'd)

cost estimates and regulatory review; and engineering design of expedited response action which consisted of free product recovery systems for interim site remediation.

- Project coordinator for the Feasibility Study of a hazardous waste site listed on the National Priorities List, conducted in accordance with the National Contingency Plan under CERCLA. Responsibilities included technical evaluation of remedial technologies and development of remedial alternatives for contaminated ground water, soil, wastewater impoundments and wetland areas; coordination of project personnel; and preparation of Feasibility Study Report.

- Project hydrogeologist for the Feasibility Study of a hazardous waste site listed on the National Priorities List, conducted in accordance with the National Contingency Plan under CERCLA. Responsibilities included technical evaluation and development of remedial technologies and alternatives for ground-water contamination which impacted municipal water supply wells and negotiations with the U.S. EPA.

- Conducted background and field investigations of several commercial facilities to determine the potential for environmental liability for the purpose of real estate transactions.

- Conducted field investigations and a ground-water modeling study to characterize site containing ground-water contamination within a fractured bedrock aquifer caused by a road salt stockpile. Field studies included supervision of monitoring well installation; collection and interpretation of water-table elevation data; ground-water sampling and water-quality data interpretation; terrain conductivity surveying; and collection and analysis of pumping test data. Field data were used for ground-water modeling study to predict potentially affected areas of ground-water contamination.

- Conducted hydrogeologic investigation of ground-water contamination caused by operating municipal landfill. Responsibilities included characterization of site geology, hydrogeology and ground-water quality.

- Conducted landfill expansion study. Responsiblilities included test drilling and monitoring well installation, geophysical surveying, hydrogeologic interpretation and preliminary landfill design.

KEY PROJECT EXPERIENCE (Cont'd)

- Conducted hydrogeologic investigation of coal strip mine site; including test drilling, ground-water sampling, water-quality data interpretation and hydrogeologic data interpretation. Data were used to evaluate the environmental impacts of strip mining on ground water and surface water both on-site and off-site.

- Characterized and hydrogeology of strip mine sites for mine permitting applications. Evaluated site geology, ground-water and surface-water flow systems, and the potential for adverse environmental impacts associated with proposed strip mining.

CONTINUING EDUCATION

Ground-Water Treatment Technology, National Water Well Association

ERIC JORGENSEN
Geologist

EDUCATION

BS Geology, Columbia University, 1987

PROFESSIONAL EXPERIENCE

1988 - Present	Geologist, Roux Associates, Inc.
1986 - 1987	Research Assistant, Lamont Doherty Geological Observatory

KEY PROJECT EXPERIENCE

- Field sampling and data analysis for large scale retrospective study of pesticides in surface and ground-waters.
- Geologic logging and supervision of monitoring well installation at Brookhaven National Laboratory.
- Preparation of Environmental Impact Statement for large scale commercial development.
- Site set up, field sampling and data analysis for pesticide leaching study.
- Climatological study of ancient environments using grain size analysis and ocean sediment mineralogy.
- Survey of existing data to compare theoretical and actual hydrofracture pressures for geologic units of varying fluid pore pressure.
- Conducted field investigations of water supply systems reportedly impacted by pesticides.

CERTIFICATION

OSHA approved Health and Safety Course, 1989.

FREDERICK CORN
Environmental Engineer

EDUCATION

B.S. Chemical Engineering, 1985 University of Massachusetts at Amherst
M.S. Environmental Engineering, 1989 University of North Carolina at Chapel Hill

PROFESSIONAL SOCIETIES

Tau Beta Pi Engineering Honors Society
American Institute of Chemical Engineers
American Geophysical Union

PROFESSIONAL EXPERIENCE

January 1989 - Present	Environmental Engineer Roux Associates, Inc. Huntington, New York
1987 - 1988	Research Assistant University of North Carolina Chapel Hill, North Carolina

KEY PROJECT EXPERIENCE

- Designed pump and treat system to recover fuel oil and treat the ground water at the site of a leaking underground storage tank.
- Coordinated subcontracting to remove industrial underground storage tanks.
- Conducted study of the transport of volatile organics in the unsaturated zone. Tasks included site investigations, laboratory bench scale studies, and computer modeling.