

✓D

03.03-12/15/92-00347

**FINAL
SAMPLING AND ANALYSIS PLAN**

**PART II:
QUALITY ASSURANCE PROJECT PLAN**

**PHASE I REMEDIAL INVESTIGATION
INSTALLATION RESTORATION PROGRAM
ACTIVITIES**

**NAVAL STATION ROOSEVELT ROADS
PUERTO RICO**

CONTRACT TASK ORDER 0007

Prepared For:

**DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES
ENGINEERING COMMAND
*Norfolk, Virginia***

Under the:

**LANTDIV CLEAN Program
Contract N62470-89-D-4814**

Prepared By:

**BAKER ENVIRONMENTAL, INC.
*Coraopolis, Pennsylvania***

DECEMBER 15, 1992

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1.0 INTRODUCTION	1-1
2.0 SCOPE OF QUALITY ASSURANCE PROJECT PLAN	2-1
3.0 PROJECT DESCRIPTION	3-1
4.0 PROJECT ORGANIZATION	4-1
5.0 QUALITY ASSURANCE OBJECTIVES FOR DATA MEASUREMENT	5-1
5.1 Project Quality Assurance Objectives	5-1
5.2 Data Quality Objectives	5-2
6.0 SAMPLING PROCEDURES	6-1
7.0 SAMPLE AND DOCUMENT CUSTODY PROCEDURES	7-1
7.1 Sampling Handling	7-1
7.2 Chain-of-Custody Procedures	7-1
7.3 Document Custody Procedures	7-8
8.0 CALIBRATION PROCEDURES AND FREQUENCY	8-1
8.1 Field Instruments	8-1
8.2 Laboratory Instruments	8-1
9.0 ANALYTICAL PROCEDURES	9-1
9.1 Field Analysis	9-1
9.2 Laboratory Analysis	9-1
10.0 DATA REDUCTION, VALIDATION, AND REPORTING	10-1
10.1 Field Data Procedures	10-1
10.2 Laboratory Data Procedures	10-1
11.0 INTERNAL QUALITY CONTROL CHECKS	11-1
11.1 Field Internal Quality Control Checks	11-1
11.2 Types of QC Samples	11-1
11.3 Laboratory Control Limits	11-3
11.4 Quality Assurance Review of Reports, Plans and Specifications	11-5
12.0 PERFORMANCE AND SYSTEM AUDITS	12-1
13.0 PREVENTIVE MAINTENANCE	13-1
13.1 Field Maintenance	13-1
13.2 Laboratory Maintenance	13-1

TABLE OF CONTENTS
(Continued)

<u>Section</u>	<u>Page</u>
14.0 DATA MEASUREMENT ASSESSMENT PROCEDURES	14-1
14.1 Overall Project Assessment	14-1
14.2 Field Quality Assessment	14-1
14.3 Laboratory Data Quality Assessment	14-1
14.4 Laboratory Data Validation	14-4
15.0 CORRECTIVE ACTION	15-1
15.1 Corrective Action	15-1
15.2 Limits of Operation	15-2
16.0 QUALITY ASSURANCE REPORTING PROCEDURES	16-1
 APPENDICES	
A Field Water Quality Instruments	
B Resumes of Key Personnel	

LIST OF FIGURES

<u>Number</u>		<u>Page</u>
4-1	Project Organization Chart	4-2
7-1	Example Sample Label	7-4
7-2	Sample Chain-of-Custody Form	7-6
7-3	Example Custody Seal	7-7

LIST OF TABLES

<u>Number</u>		<u>Page</u>
5-1	Definitions of Data Quality Indicators	5-3
5-2	Volatile Data Quality Objectives - CLP Analyses	5-4
5-3	Semivolatile Data Quality Objectives - CLP Analyses	5-5
5-4	TCL Polychlorinated Biphenyls and Pesticides Data Quality Objectives - CLP Analyses	5-6
5-5	TAL Metals and Cyanide Data Quality Objectives	5-7
5-6	Herbicides Data Quality Objectives - TCLP Leachates	5-8
5-7	Pesticides Data Quality Objectives - TCLP Leachates	5-9
5-8	Ethylene Bromide Data Quality Objectives - SW-846 Method	5-10
5-9	Additional Inorganic Parameters Data Quality Objectives - SW 846 Methods	5-11
5-10	Summary of QA/QC Samples and Criteria	5-12
7-1	Sample Containers, Preservation, and Holding Times	7-2
9-1	TCL Volatile Organic Compounds Contract Required Quantitation Limits in Soil, Sediment, Groundwater, and Rinsate Samples	9-2
9-2	TCL Semivolatile Organic Compounds Contract Required Quantitation Limits in Soil, Sediment, Groundwater, and Rinsate Samples	9-4
9-3	TCL Polychlorinated Biphenyls (PCBs) and Pesticides Contract Required Quantitation Limits in Soil, Sediment, Groundwater, and Rinsate Samples	9-8
9-4	TAL Metals and Cyanide Contract Required Detection Limits in Soil, Sediment, Groundwater, and Rinsate Samples	9-10
9-5	Herbicide Compounds Reporting Limits - TCLP Leachates	9-11
9-6	Pesticides Compounds Reporting Limits - TCLP Leachates	9-12
9-7	Ethylene Bromide Organic Compounds Contract Reporting Limit in Soil, Sediment, Solid, and Rinsate Samples	9-13
9-8	Additional Inorganic Parameters Reporting Limits in Soil, Sediment, Solid, and Rinsate Samples	9-14
12-1	System Audit Checklist - Field Operations	12-2

1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) was prepared for the Navy CLEAN Program, Contract Number N62470-89-D-4814, Contract Task Order (CTO) 0007 for Naval Station Roosevelt Roads (NSRR), Puerto Rico.

This Quality Assurance Project Plan (QAPP), which is Part II of the SAP, addresses the quality assurance and quality control steps and procedures that will be administered for the sample collection and analysis for this Phase I Remedial Investigation (Phase I RI). Detailed information regarding sample handling and analytical methods are provided in Sections 6.0 and 9.0, respectively.

The sites at NSRR addressed in this Work Plan are:

- **Site 1 - Quebrada Disposal Site**
- **Site 2 - Mangrove Disposal Site**
- **Site 5 - Army Cremator Disposal Site**
- **Site 6 - Langley Drive Disposal Site**
- **Site 7 - Station Landfill**
- **Site 10 - Building 25 Storage Area**
- **Site 13 - Tanks 210-217**
- **Site 14 - Ensenada Honda Shoreline and Mangroves**
- **Site 16 - Old Power Plant, Building 38**
- **Site 18 - Pest Control Shop and Surrounding Areas**
- **Site 21 - Old Pesticide Storage Building**

2.0 SCOPE OF QUALITY ASSURANCE PROJECT PLAN

This Quality Assurance Project Plan (QAPP) addresses sample collection and analysis to be conducted for the Phase I RI at NSRR. The QAPP has been developed for the Navy in accordance with U. S. Environmental Protection Agency (USEPA) guidelines. Baker and contractor personnel will follow QA/QC practices and procedures, including chain-of-custody procedures, while conducting all sample collection and analysis activities.

In order to provide adequate QA/QC regarding samples collected and analyzed, this investigation will require:

1. Use of a NEESA-certified analytical laboratory;
2. Use of accepted analytical methods for the samples outlined by the Sampling and Analysis Plan. Analysis of samples for hazardous constituents parameters will be performed using Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, 3rd Edition (SW-846).
3. Field audit(s) during initial sampling activities to verify that sampling is being performed according to the Plan.

The structure of this QAPP and the QA elements addressed are:

- Title Page
- Introduction
- Table of Contents
- Project Description
- Project Organization
- QA Objectives for Data Measurement
- Sampling Procedures
- Sample and Document Custody
- Calibration Procedures and Frequency
- Analytical Procedures
- Data Reduction, Validation, and Reporting
- Internal QC Checks
- Performance and System Audits
- Preventive Maintenance
- Data Measurement Assessment Procedures
- Corrective Action
- QA Reports to Management

3.0 PROJECT DESCRIPTION

An introduction to the Phase I RI describing the project objectives and scope is given in Section 1.0 of the Work Plan. Site background information and site history are discussed in Section 1.0. A description of the Phase I RI including sample location and designation, sampling procedures and frequency is presented in Section 2.0 of the Field Sampling Plan (FSP).

4.0 PROJECT ORGANIZATION

The Project Manager and Project Geologist are the key personnel responsible for technical performance and quality assurance throughout the duration of the Phase I RI. Baker will utilize contractors to perform photo-interpretation, laboratory analysis, data validation, translation, and surveying. Figure 4-1 shows the project organization, lines of authority, and support personnel/organizations. Resumes of key project personnel are provided as Appendix B.

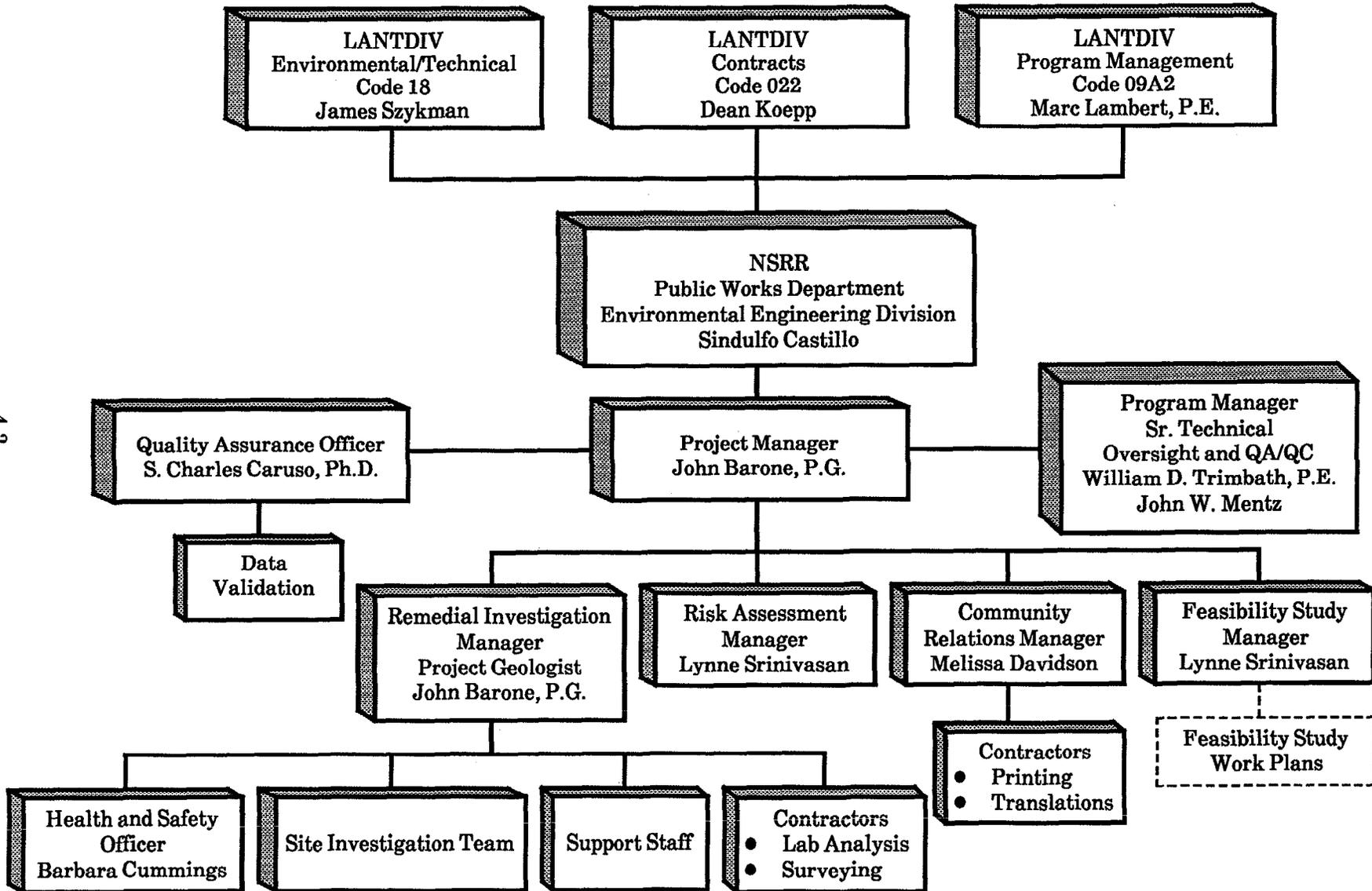
The contractors identified for this Phase I RI are as follows:

Photo-Interpretation:	GeoDecisions, Inc. Harrisburg, PA
Laboratory Analysis:	American Environmental Network Columbia, MD
Data Validation:	Heartland Environmental Services, Inc. St. Peters, MO
Translation:	The Language Center Pittsburgh, PA
Surveying:	Environmental Service and Technology Corporation (ENSAT) Culpeper, VA

The responsibilities of some key personnel are presented below:

1. The Program Manager, Mr. William D. Trimbath, P.E., has final responsibility and authority for all work performed under the project. He will manage the day-to-day operations of the entire contract and the Navy CLEAN Program Management Office. He will provide overall program direction, client contact and quality assurance. From a quality perspective, the Program Manager is responsible for:
 - Ensuring, through an effective quality assurance program, that program and project direction is implemented and accomplished.
 - Approving and funding the quality assurance program.

**FIGURE 4-1
PROJECT ORGANIZATION**



4.2

- Participating actively in the quality assurance process.
- Assisting the Quality Assurance Officers, as necessary.

Mr. Trimbath is with Baker Environmental, Inc., Coraopolis, Pennsylvania, and can be reached at (412) 269-2007.

2. The Deputy Program Manager, Mr. John W. Mentz, will serve as the primary technical contact with contractors, with responsibilities for budget and schedule control, project management, and health and safety issues. From a quality perspective, the Deputy Program Manager has responsibilities similar to those outlined above for the Program Manager. Mr. Mentz is with Baker Environmental, Inc., Coraopolis, Pennsylvania, and can be reached at (412) 269-2008.
3. The Project Manager, Mr. John Barone, P.G., is responsible for managing all work for this CTO, from initiation to final closeout. He is responsible for maintaining budget, schedule, and technical performance as well as operational quality performance for the CTO. The Project Manager shall receive support from all project management staff and use the capabilities of the technical staff. The Project Manager is responsible for implementing and maintaining all aspects of this Quality Assurance Program for a CTO. Mr. Barone is with Baker Environmental, Inc., Coraopolis, Pennsylvania, and can be reached at (412) 269-2034.
4. Laboratory Quality Assurance Officer (QAO)

The Quality Assurance Officer (QAO) for project review, S. Charles Caruso, Ph.D., will monitor the quality assurance activities. The QAO will identify and implement project QA/QC procedures and requirements. Some responsibilities of the Quality Assurance Officer include:

- Verifying that the Project Manager and project team implement the appropriate level of QA/QC.
- Assisting in the development of Data Quality Objectives, and review of QAPPs.
- Verifying observance of chain-of-custody and document control procedures.

- Initiating corrective actions.
- Oversight of project startup to ensure that all QA/QC systems and procedures are in place and properly operating.

The Laboratory Quality Assurance Officer also is responsible for monitoring the performance and operations of the analytical laboratories to ensure their adherence to quality assurance procedures. Included in this activity is verifying that all analyses are conducted in accordance with the proper method and level of QA/QC to ensure the required precision and accuracy, and verifying the acceptability of all laboratory data and the associated QA/QC evaluation. Dr. Caruso is with Baker Environmental, Inc., Coraopolis, Pennsylvania, and can be reached at (412) 269-2018.

5. The Phase I RI Project Manager is also the Project Geologist, Mr. John Barone, P.G., who will also serve as the Site Manager for the field studies and will provide supervision of all field activities associated with the Phase I RI. He is with the Coraopolis office and can be reached at (412) 269-2034.
6. The Risk Assessment Manager is Ms. Lynne Srinivasan. Ms. Srinivasan will receive the data and analyses of the Phase I RI, and will prepare the evaluation of risk according to the description of the Baseline Risk Assessment in the Work Plan. She is with Baker Environmental's Coraopolis office and can be reached at (412) 269-2010.
7. The Community Relations Manager is Ms. Melissa Davidson. Ms. Davidson will be responsible for Community Relations activities including the development of the Community Relations Plan, Site Information Brochure, and Site Photograph Album. Her activities will be closely coordinated with LANTDIV and NSRR representatives. Ms. Davidson is at the Coraopolis office and can be reached at (412) 269-2020.
8. The technical staff is responsible for maintaining quality in the tasks in which they are performing. Senior technical staff also may be used for technical review of project documents, as necessary.

5.0 QUALITY ASSURANCE OBJECTIVES FOR DATA MEASUREMENT

The purpose of a QA Program is to establish policies for the implementation of regulatory requirements and to provide an internal means for control and review so that the work performed is of the highest professional standards.

5.1 Project Quality Assurance Objectives

Project QA objectives are:

- Scientific data will be of a quality sufficient to meet scientific and legal scrutiny.
- Data will be gathered/developed in accordance with procedures appropriate for the intended use of the data.
- Data will be of acceptable precision, accuracy, completeness, representativeness, and comparability as required by the project.

The fundamental mechanisms that will be employed to achieve these quality goals can be categorized as prevention, assessment, and correction:

- Prevention of errors through planning, documented instructions and procedures, and careful selection and training of skilled, qualified personnel.
- Assessment of all quality assurance sampling reports furnished by the contract laboratory.
- Correction for prevention of reoccurrence of conditions adverse to quality.

The plan, prepared in direct response to these goals, describes the QA Program to be implemented and the quality control (QC) procedures to be followed by the laboratory during the course of the project.

The plan presents the project organization and specifies technical procedures, documentation requirements, sample custody requirements, audit and corrective action provisions, etc., to be applied to provide confidence that all activities meet the intent of the QA program.

The procedures contained or referred to herein have been taken from:

- "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods," 3rd Edition, November 1986, USEPA (SW-846).
- "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," December 29, 1980, USEPA, (QAMS 005/80).

5.2 Data Quality Objectives

Data Quality Objectives (DQOs) are qualitative or quantitative statements developed by the data users to specify the quality of data needed from a particular data collection activity to support a specific decision. The DQOs are expressed in terms of precision, accuracy, representativeness, completeness, and comparability. Definitions for these terms, as well as for the more general term uncertainty, are given in Table 5-1. The goals for precision, accuracy, and completeness for this project will be assessed using results from internal as well as field quality control samples. Laboratory DQOs for accuracy, precision, and completeness are presented in Tables 5-2 through 5-9. Field data DQOs are presented in Table 5-10.

The Project Manager, in conjunction with the Navy Engineer-in-Charge (EIC), is responsible for defining the DQOs. The intended use of the data, analytical measurements, and the availability of resources are integral in development of DQOs. DQOs define the level of uncertainty in the data that is acceptable for each specific activity during the investigation. This uncertainty includes both field sampling error and analytical instrument error. Ideally, zero uncertainty is the goal; however, the variables associated with sampling and analysis contribute to a degree of uncertainty in any data generated. It is an overall program objective to keep the total uncertainty within an acceptable range, so as not to hinder the intended use of the data. To achieve this objective, specific data quality requirements such as detection limits, criteria for accuracy and precision, sample representativeness, data comparability, and data completeness have been specified.

The DQO level for this project is Level D (when appropriate methods are available), which is defined in Section 1.3.1 of "Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program" (NEESA 20.2-047B). Level D is equivalent to Contract Laboratory Program (CLP) procedures. The laboratory that will be

TABLE 5-1

DEFINITIONS OF DATA QUALITY INDICATORS

PRECISION - A measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is expressed in terms of the standard deviation. Comparison of replicate values is best expressed as the relative percent difference (RPD). Various measures of precision exist depending upon the "prescribed similar conditions".

ACCURACY - The degree of agreement of a measurement (or an average of replicate measurements), X , with an accepted reference or true value, T , expressed as the difference between the two values, $X-T$. Accuracy is a measure of the bias in a system.

REPRESENTATIVENESS - Expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental concern.

COMPLETENESS - A measure of the amount of the valid data obtained from the measurement system compared to the amount that was expected under "normal" conditions.

COMPARABILITY - Expresses the confidence with which one data set can be compared with another.

UNCERTAINTY - The likelihood of all types of errors associated with a particular decision.

TABLE 5-2

VOLATILE DATA QUALITY OBJECTIVES - CLP ANALYSES^A

Parameter	Matrix Spike				Surrogate Spike Accuracy % Recovery		Completeness ^C %
	Precision ^B RPD %		Accuracy % Recovery		Water	Solids	
	Water	Solids	Water	Solids			
1,1-Dichlorobenzene	14	22	61-145	59-172	--	--	95
Trichloroethene	14	24	71-120	62-137	--	--	95
Benzene	11	21	76-127	66-142	--	--	95
Toluene	13	21	76-125	59-139	--	--	95
Chlorobenzene	13	21	75-130	60-133	--	--	95
Toluene-d8	--	--	--	--	88-110	84-138	95
Bromofluorobenzene	--	--	--	--	86-115	59-113	95
1,2-Dichloroethane-d4	--	--	--	--	76-114	70-121	95

A. Data quality objectives for precision and accuracy are as specified in USEPA SOW OLMO1.8 (August 1991). The data quality objectives are highly sample matrix dependent, and will be adversely affected by sample dilutions necessitated by matrix interferences.

B. As relative percent difference (RPD) of matrix spike and matrix spike duplicate.

C. Based on the number of valid measurements compared to the total number of measurements.

TABLE 5-3

SEMI-VOLATILE DATA QUALITY OBJECTIVES - CLP ANALYSES^A

Parameter	Matrix Spike				Surrogate Spike Accuracy		Completeness ^C %
	Precision ^B RPD %		Accuracy % Recovery		% Recovery		
	Water	Solids	Water	Solids	Water	Solids	
Phenol	42	35	12-110	26-90	--	--	95
2-Chlorophenol	40	50	27-123	25-102	--	--	95
1,4-Dichlorobenzene	28	27	36-97	28-104	--	--	95
N-Nitroso-di-n-propylamine	38	38	41-116	41-126	--	--	95
1,2,4-Trichlorobenzene	28	23	39-98	38-107	--	--	95
4-Chloro-3-methylphenol	42	33	23-97	26-103	--	--	95
Acenaphthene	31	39	46-118	31-137	--	--	95
4-Nitrophenol	50	50	10-80	11-114	--	--	95
2,4-Dinitrotoluene	38	47	24-96	28-89	--	--	95
Pentachlorophenol	50	47	9-103	17-109	--	--	95
Pyrene	31	36	26-127	35-142	--	--	95
Nitrobenzene-d5	--	--	--	--	35-114	23-120	95
2-Fluorobiphenyl	--	--	--	--	43-116	30-115	95
Terphenyl-d14	--	--	--	--	33-141	18-137	95
Phenol-d5	--	--	--	--	10-110	24-113	95
2-Fluorophenol	--	--	--	--	21-110	25-121	95
2, 4, 6-Tribromophenol	--	--	--	--	10-123	19-122	95

- A. Data quality objectives for precision and accuracy are as specified in USEPA SOW OLM01.8 (August 1991). The data quality objectives are highly sample matrix dependent, and will be adversely affected by sample dilutions necessitated by matrix interferences.
- B. As relative percent difference (RPD) of matrix spike and matrix spike duplicate.
- C. Based on the number of valid measurements compared to the total number of measurements.

TABLE 5-4

TCL POLYCHLORINATED BIPHENYLS (PCBs) AND PESTICIDES DATA QUALITY OBJECTIVES - CLP ANALYSES

Parameter	Matrix Spike				Surrogate Spike Accuracy ^B		Completeness ^C %
	Precision ^A RPD %		Accuracy % Recovery		% Recovery		
	Water	Solids	Water	Solids	Water	Solids	
Decachlorobiphenyl	--	--	--	--	60-150	60-150	95
Tetrachloro-m-xylene	--	--	--	--	60-150	60-150	95
gamma-BHC	15	50	56-123	46-127	--	--	95
Heptachlor	20	31	40-131	35-130	--	--	95
Aldrin	22	43	40-120	34-132	--	--	95
Dieldrin	18	38	52-126	31-134	--	--	95
Endrin	21	45	56-121	42-139	--	--	95
4, 4'-DDT	27	50	38-127	23-134	--	--	95

A. As relative percent difference (RPD) of matrix spike and matrix spike duplicate.

B. Data quality objectives for surrogate spike accuracy are as specified for pesticides/PCBs in USEPA SOW OLMO1.8 (August 1991). These limits are considered to be advisory, and surrogate recoveries outside these limits will not require reanalysis of samples.

C. Based on the number of valid measurements compared to the total number of measurements.

TABLE 5-5

TAL METALS AND CYANIDE DATA QUALITY OBJECTIVES^A

Parameter	Precision ^B RPD %	Accuracy ^C % Recovery	Completeness ^D (%)
Aluminum	20	75-125	95
Antimony	20	75-125	95
Arsenic	20	75-125	95
Barium	20	75-125	95
Beryllium	20	75-125	95
Cadmium	20	75-125	95
Calcium	20	75-125	95
Chromium	20	75-125	95
Cobalt	20	75-125	95
Copper	20	75-125	95
Iron	20	75-125	95
Lead	20	75-125	95
Magnesium	20	75-125	95
Manganese	20	75-125	95
Mercury	20	75-125	95
Nickel	20	75-125	95
Potassium	20	75-125	95
Selenium	20	75-125	95
Silver	20	75-125	95
Sodium	20	75-125	95
Thallium	20	75-125	95
Tin	20	75-125	95
Vanadium	20	75-125	95
Zinc	20	75-125	95
Cyanide	20	75-125	95

- A. Data quality objectives for precision and accuracy are as specified in USEPA SOW ILMO2.1 (September 1991) and are applicable for liquid and solid analyses.
- B. As relative percent difference (RPD) of laboratory duplicate. If the original and/or duplicate result is less than 5x the CRDL, a control limit of \pm the CRDL is used.
- C. As percent recovery of laboratory pre-digestion spike. If the sample concentration exceeds the spike concentration by a factor of four or more, these limits may be exceeded according to USEPA SOW ILMO2.1 (September 1991). Post-digestion spikes will be analyzed using procedures and limits specified in USEPA SOW ILMO2.1 (September 1991).
- D. Based on the number of valid measurements, compared to the total number of measurements.

TABLE 5-6

HERBICIDES DATA QUALITY OBJECTIVES - TCLP LEACHATES^A

Parameter	Matrix Spike		Surrogate Spike Accuracy % Recovery	Completeness ^D %
	Precision ^B RPD %	Accuracy ^C % Recovery		
	Water	Water	Water	
2,4-D	50	50-150	--	95
2,4,5-TP (Silvex)	50	50-150	--	95
2,4-Dichlorophenylacetic acid	--	--	50-150	95

- A. Where available, data quality objectives for precision and accuracy are as specified in USEPA SOW OLM1.8 (August 1991). Where unavailable in USEPA SOW OLM01.8, objectives for matrix spike recoveries (50-150%) are based on Method 1311, Federal Register Part 261, Appendix II, March 29, 1990.
- B. As relative percent difference (RPD) of matrix spike and matrix spike duplicate.
- C. Matrix spike recoveries below the lower control limit will necessitate bias correction of all measured sample results in the associated batch.
- D. Based on the number of valid measurements compared to the total number of measurements.

TABLE 5-7

PESTICIDES DATA QUALITY OBJECTIVES - TCLP LEACHATES^A

Parameter	Matrix Spike		Surrogate Spike Accuracy ^D % Recovery	Completeness ^E %
	Precision ^B RPD %	Accuracy ^C % Recovery		
	Water	Water	Water	
gamma-BHC (lindane)	15	56-123	--	95
Heptachlor	20	40-131	--	95
Endrin	21	56-121	--	95
Heptachlor epoxide	--	50-150	--	95
Methoxychlor	--	50-150	--	95
Toxaphene	--	50-150	--	95
Dichlorobiphenyl	--	--	60-150	95
Decachlorobiphenyl	--	--	60-150	95
Tetrachloro-m-xylene	--	--	60-150	95

- A. Where available, data quality objectives for precision and accuracy are as specified in USEPA SOW OLM1.8 (August 1991). Where unavailable in USEPA SOW OLM01.8, objectives for matrix spike recoveries (50-150%) are based on Method 1311, Federal Register Part 261, Appendix II, March 29, 1990.
- B. As relative percent difference (RPD) of matrix spike and matrix spike duplicate.
- C. Matrix spike recoveries below the lower control limit limit will necessitate bias correction of all measured sample results in the associated batch.
- D. Data quality objectives for surrogate spike accuracy are as specified in USEPA SOW OLM01.8 (August 1991). These limits are advisory, and surrogate recoveries outside these limits will not require reanalysis of samples.
- E. Based on the number of valid measurements compared to the total number of measurements.

TABLE 5-8

ETHYLENE BROMIDE DATA QUALITY OBJECTIVES - SW-846 METHOD^A

Parameter	Matrix Spike		Surrogate Spike Accuracy % Recovery	Completeness ^C %
	Precision ^B RPD %	Accuracy % Recovery		
	Solids	Solids	Solids	
Ethylene bromide	25	60-140	--	95
Bromofluorobenzene	--	--	59-113	95

- A. Data quality objectives for precision and accuracy are as specified in SW-846. The data quality objectives are highly sample matrix dependent, and will be adversely affected by sample dilutions necessitated by matrix interferences.
- B. As relative percent difference (RPD) of matrix spike and matrix spike duplicate.
- C. Based on the number of valid measurements compared to the total number of measurements.

TABLE 5-9

**ADDITIONAL INORGANIC PARAMETERS DATA QUALITY OBJECTIVES -
SW 846 METHODS**

Parameter	Matrix	Precision^A	Accuracy % Recovery	Completeness^B %
Cyanide	Solids	20	75-125	95
Arsenic/Zinc	Solids	20	75-125	95
TOC	Solids	20	75-125	95

A. As relative percent difference of sample and duplicate.

B. Based on the number of valid measurements compared to the total number of measurements.

N/A Not applicable.

TABLE 5-10

SUMMARY OF QA/QC SAMPLES AND CRITERIA

Media ⁽¹⁾	Parameter	Analysis	Field Duplicates		Equipment Rinsates		Trip Blanks ⁽²⁾		Field Blanks	
			Frequency	Criteria	Frequency	Criteria	Frequency	Criteria	Frequency	Criteria
Soils, Sediments, and Structural Chip	TCL Volatiles	CLP	1 in 20	Within 35% RPD	1 in 20	Less than the CRQL	1 per sampling event	Less than the CRQL	1 per source per 20 samples	Less than the CRQL
	TCL Semivolatiles	CLP	1 in 20	Within 60% RPD	1 in 20	Less than the CRQL	N/A	N/A	1 per source per 20 samples	Less than the CRQL
	TCL PCBs/Pesticides	CLP	1 in 20	Within 60% RPD	1 in 20	Less than the CRQL	N/A	N/A	1 per source per 20 samples	Less than the PQL
	TAL Metals and Cyanide	CLP	1 in 20	Within 30% RPD	1 in 20	Less than the CRQL	N/A	N/A	1 per source per 20 samples	Less than the CRQL
	TOC	9060	1 in 20	Within 60% RPD	1 in 20	Less than the CRQL	N/A	N/A	1 per source per 20 samples	Less than the CRQL
	Ethylene Bromide	8240	1 in 20	Within 35% RPD	1 in 20	Less than the CRDL	1 per sampling event	Less than the CRQL	1 per source per 20 samples	Less than the CRQL
	Arsenic/Zinc	6010	1 in 20	Within 30% RPD	1 in 20	Less than the CRQL	N/A	N/A	1 per source per 20 samples	Less than the CRQL
Groundwater/ Surface Water	TCL Volatiles	CLP	1 in 20	Within 25% RPD	1 in 20	Less than the CRQL	1 per sampling event	Less than the CRQL	1 per source per 20 samples	Less than the CRQL
	TCL Semivolatiles	CLP	1 in 20	Within 60% RPD	1 in 20	Less than the CRDL	N/A	N/A	1 per source per 20 samples	Less than the CRDL
	TCL PCBs/Pesticides	CLP	1 in 20	Within 35% RPD	1 in 20	Less than the CRQL	N/A	N/A	1 per source per 20 samples	Less than the CRQL
	TAL Metals and Cyanides	CLP	1 in 20	Within 30% RPD	1 in 20	Less than the CRQL	N/A	N/A	1 per source per 20 samples	Less than the CRQL
	pH	Field	1 in 20	Within 20% RPD	N/A	N/A	N/A	N/A	N/A	N/A
	Specific Conductivity	Field	1 in 20	Within 20% RPD	N/A	N/A	N/A	N/A	N/A	N/A

N/A Not applicable.

(1) Field QA/QC samples are not required for waste sample analyses or for VOA monitoring by the HNu.

(2) Trip blanks pertain only to volatile organic analyses

contracted to conduct these analyses will be NEESA approved, i.e., the laboratory must successfully analyze a performance sample, undergo an on-site audit, correct any deficiency found during the audit, and provide Monthly Progress Reports to the NEESA. The DQO level for non-CLP analyses is Level C.

In Level D and C, a matrix spike and a matrix spike duplicate are required for volatiles, semivolatiles, and all gas chromatographic (GC) analysis for every 20 samples of similar matrix. For metals analysis, a duplicate and a matrix spike are required for every 20 samples of similar matrix. The analytical procedures to be used for this project along with the Practical Quantitation Limits are presented in Section 9.0 of this plan.

The data set deliverables for Level C and D are given in NEESA 20.2-047B.

All measurements will be made so that results are representative of the media and conditions being measured. All data will be calculated and reported in units consistent with the practice for reporting similar data to allow comparability of data bases among organizations.

The data collected during the course of the site investigation will be used to:

- Monitor health and safety conditions during field activities.
- Identify releases or suspected releases of hazardous waste and/or constituents.
- Characterize the wastes contained and/or managed.
- Screen from further investigation those areas which do not pose a threat to human health or environment.

6.0 SAMPLING PROCEDURES

Descriptions of the procedures to be used for sampling the groundwater, surface water, sediment and soil at the site are provided in Appendix B of the Field Sampling Plan (FSP) Part I of the Sampling and Analysis Plan (SAP). The number of samples, sampling locations, and sampling rationale by media also are presented in the FSP. Sample handling procedures, including sample containers, preservatives, holding times, etc., are discussed in Section 7.1 and summarized in Table 7-1.

Both filtered and unfiltered samples of water for metals analyses will be collected. This will require a filtration in the field with the acid preservative added to the filtrate. The appropriate procedure is presented in the SAP, as SOP F104.

The reagents used for preservatives must be of the highest purity and are provided by the laboratory contracted to analyze the samples. The laboratory will also provide the high purity water and solvents required in the field (e.g., decontamination of sampling equipment).

The Project Manager has the responsibility for coordination of all activities required to achieve the objectives of this project. This includes the sampling activities and the required analytical services. The Project Manager or his designee will coordinate sample collection and delivery to the laboratory.

7.0 SAMPLE AND DOCUMENT CUSTODY PROCEDURES

Sample custody procedures outlined in this section have been developed from "User's Guide to the Contract Laboratory Program," December 1986, OSWER Directive No. 9240.0-01. These procedures are in accordance with "EPA NEIC Policies and Procedure Manual," May 1978, revised November 1984, EPA 330-78-001-R and "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," December 29, 1980, QAMS-005/80.

The purpose of this section is to outline the sample handling and sample documentation procedures to be used during implementation of the Sampling and Analysis Plan. The objective of the sample handling procedures is to deliver representative samples to the laboratories for analysis. The objectives of the sample documentation procedures are to: (1) ensure complete analysis of the requested parameters within the required turnaround times and (2) document the sample from the point of collection to the final data report.

7.1 Sampling Handling

New polyethylene or glass bottles containing the proper preservatives will be provided by the laboratory for sample collection. In addition to the chemical preservatives, samples will be stored on ice at four degrees Celsius in a waterproof metal or sturdy plastic cooler, if required (see Table 7-1 for summary of containers, preservation, and holding times for water, soils, sediment, and structural chip samples).

7.2 Chain-of-Custody Procedures

A sample is considered to be in an individual's possession if:

- It is in the sampler's possession or it is in the sampler's view after being in his(her) possession.
- It was in the sampler's possession and then locked or sealed to prevent tampering.
- It is in a secure area.

TABLE 7-1

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

Media	Parameter	Analysis	Container	Preservation	Holding Time ⁽¹⁾
Soils and Sediments	TCL Volatiles	CLP	One four-ounce wide-mouth glass jar with teflon-lined lid	Cooled to 4°C with ice	10 days
	TCL PCBs/Pesticides and Semivolatiles	CLP	One eight-ounce wide-mouth glass jar with teflon-lined lid	Cooled to 4°C with ice	10 days before extraction; 40 days after extraction
	TAL Metals	CLP	One eight-ounce wide-mouth glass jar with teflon-lined lid	Cooled to 4°C with ice	6 months; mercury 26 days
	Cyanide	CLP	One eight-ounce wide-mouth glass jar with teflon-lined lid	Cooled to 4°C with ice	12 days
	TOC	9060	One eight-ounce wide-mouth glass jar with teflon-lined lid	Cooled to 4°C with ice	28 days
Groundwater and Surface Water	TCL Volatiles	CLP	Two 40-milliliter glass vials with teflon-lined lid	Cooled to 4°C with ice HCL to pH < 2	10 days
	TCL PCBs/Pesticides and Semivolatiles	CLP	Four one-liter amber glass bottle with teflon-lined lid	Cooled to 4°C with ice	5 days before extraction; 40 days after extraction
	TAL Metals ⁽²⁾	CLP	Two one-liter polyethylene bottles	Cooled to 4°C with ice HNO ₃ to pH < 2	6 months; mercury 26 days
	Cyanide	CLP	One 1/2-liter polyethylene bottle	0.6 g ascorbic acid ⁽³⁾ NaOH to pH > 12 cooled to 4°C with ice	12 days
Soil and Structural Chip (Site 21 only)	Ethylene Bromide	8240	One four-ounce wide-mouth glass jar with teflon-lined lid	Cooled to 4°C with ice	14 days
	TCLP Herbicides/ Pesticides	1311/8080 (pesticides) 1311/8150 (herbicides)	One four-ounce wide-mouth glass jar with teflon-lined lid	None	14 days before TCLP extraction; 7 days before prep extraction; 40 days after extraction
	Arsenic/Zinc	6010	One eight-ounce wide-mouth glass jar with teflon-lined lid	None	6 months
	Cyanide	9010	One eight-ounce wide-mouth glass jar with teflon-lined lid	Cooled to 4°C with ice	14 days

- From the verified time of sample receipt.
- For dissolved metals, samples must be filtered through 0.45-micron filter on-site at the time of sample collection and preserved immediately after collection.
- Only used in the presence of residual chlorine.

Five kinds of documentation will be used in tracking and shipping the analytical samples:

- Field log book
- Sample labels
- Chain-of-Custody (COC) records
- Custody seals
- Commercial carrier airbills

At a minimum, the label for each sample bottle will contain the following information (see Figure 7-1):

- Name of sampling organization
- Preservative
- Remarks
- Sample description
- Site name
- Site location
- Sample ID number
- Date and time of collection
- Sample type (grab or composite)
- Matrix
- Sampler's initials

The sample information, as well as the analysis to be performed on the sample, will be entered in the field log book for each sampling point. Additionally, the following items will be entered:

- Dates and times of entry
- Names of field personnel on site
- Names of visitors on site
- Field conditions
- Description of activities
- Sampling remarks and observations
- QA/QC samples collected
- List of photographs taken
- Sketch of site conditions

Custody of the samples will be maintained by field personnel from the time of sampling until the time they are forwarded to the analytical laboratory.

The sample custody is documented using Chain-of-Custody (COC) records. Field personnel will complete a COC record, in waterproof ink, to accompany each cooler forwarded from the site to the laboratory. Any errors on the COC records will not be erased; instead, a line will be drawn through the error and initialed by the person completing the form. The original copy

FIGURE 7-1

EXAMPLE SAMPLE LABEL

Baker	Baker Environmental Inc. Airport Office Park, Bldg. 3 420 Rouser Road Coraopolis, PA 15108
Project: _____	CTO No.: _____
Sample Description: _____	
Date: ____/____/____	Sampler: _____
Time: _____	
Analysis: _____	Preservation: _____
Project Sample No.: _____	

will be placed in a sealable plastic bag and put inside the appropriate cooler, secured to the cooler's lid. A sample chain-of-custody form is shown on Figure 7-2.

If the sample cooler is to be shipped by commercial air carrier, the cooler must be secured with custody seals so that the seals would be broken if the cooler was opened (see Figure 7-3). The commercial carrier is not required to sign the COC record as long as the custody seals remain intact and the COC record stays in the cooler. The only other documentation required is the completed airbill.

If the sample shipment is hand delivered to the laboratory by field personnel or retrieved by laboratory personnel at the site, then the custody seals are not necessary. The laboratory sample custodian, or his/her designee accepting the sample shipment, whether it is from the air carrier or the field personnel, signs and dates the COC record upon sample receipt. The original COC record will be returned along with the final data report. The laboratory will be responsible for maintaining internal log books and records that provide a custody record during sample preparation and analysis.

Laboratory Chain-of-Custody Procedures

Upon sample receipt, the procedures outlined below are performed.

- Samples are received and unpacked in the laboratory where the staff checks for bottle integrity (loose caps, broken bottles, etc.).
- Samples are verified with incoming paperwork (packing slip, etc.) by type of bottle and stabilizer. The paperwork is either signed or initialed.
- Information concerning the sample (from the sampling record, Chain-of-Custody, and observation) is recorded along with parameters to be analyzed, date of sampling, and date the sample is received in the laboratory.
- Samples are placed in an appropriate secured storage area, e.g. refrigeration, until analysis.
- When analysis is complete, samples are stored for a 30-day period unless otherwise specified.

FIGURE 7-2

CHAIN-OF-CUSTODY RECORD	Sampler: _____ (Print) Signature: _____	Sheet _____ of _____ BAKER ENVIRONMENTAL, INC. Airport Office Park - Bldg No. 3 420 Rouser Road Coraopolis, PA 15108 (412) 269-6000
Location Name: _____ S. O. Number: _____		

Baker Sample I.D. No.	Sample Type	Sampled		Sample Storage and Preservation Details*										
				Cooling		HNO ₃		H ₂ SO ₄ Cooling		Other		Other		
				No. of Contr.	Type/Volume Contr.	No. of Contr.	Type/Volume Contr.	No. of Contr.	Type/Volume Contr.	No. of Contr.	Type/Volume Contr.	No. of Contr.	Type/Volume Contr.	
		Date	Time											

General Remarks: _____	*NOTES: Record type of container used with abbreviation P (plastic) or G (glass) Record volume of containers in liters
------------------------	---

Relinquished By (Sign): _____ Date: _____ Time: _____ Remarks: _____	Received By (Sign): _____ Date: _____ Time: _____ Remarks: _____
--	--

Shipment/Transportation Details: _____

Relinquished By (Sign): _____ Date: _____ Time: _____ Remarks: _____	Received By (Sign): _____ Date: _____ Time: _____ Remarks: _____
--	--

Shipment/Transportation Details: _____

Relinquished By (Sign): _____ Date: _____ Time: _____ Remarks: _____	Received By (Sign): _____ Date: _____ Time: _____ Remarks: _____
--	--

Shipment/Transportation Details: _____

FIGURE 7-3
EXAMPLE CUSTODY SEAL

Baker	____/____/____ Date
	_____ Signature
	CUSTODY SEAL
Baker	____/____/____ Date
	_____ Signature
	CUSTODY SEAL

If collected samples arrive without Chain-of-Custody or incorrect Chain-of-Custody records, the following steps are taken:

- The laboratory prepares a nonconformance form stating the problem.
- The site supervisor and Project Manager are notified.
- If the missing information cannot be reconstructed by the Project Manager or field staff, the samples affected are removed from the sampling program.

Primary considerations for sample storage are:

- Secured storage.
- Maintain prescribed temperature, if required, which is typically four degrees Celsius.
- Extract and/or analyze samples within the prescribed holding time for the parameters of interest.

The Laboratory Quality Assurance Plan will provide more detail concerning procedures for dispersment of samples for analysis, procurement of chemicals, and lab disposal practices.

7.3 Document Custody Procedures

Project records are necessary to support the validity of the work, to allow it to be recreated if necessary, and to furnish documentary evidence of quality. The evidentiary value of data is dependent upon the proper maintenance and retrieval of quality assurance records. Therefore, procedures are established to assure that all documents attesting to the validity of work are accounted for when the work is completed.

Records are legible, filled out completely, and adequately identified as to the item or activity involved. Records are considered valid only if initialed, signed, or otherwise authenticated and dated by authorized personnel. These records may either be originals or reproduced copies. Records submitted to the files, with the exception of correspondence, are bound, placed in folders or binders, or otherwise secured for filing.

Associated records are submitted to the proper file following receipt of information from external sources, completion of analyses, and issuance of reports or other transmittals. In addition, records transmitted are adequately protected from damage and loss during transfer (e.g, hand carrying or making copies prior to shipment).

The following reference materials are transferred to the proper file: calculations and checkprints; reports and other data transmittals; copies of proposals, purchase orders for project services, and contracts; and correspondence including incoming and outgoing letters, memoranda, and telephone records.

All individuals on the project staff are responsible for reporting obsolete or superseded project-related information to the Project Manager. In turn, the Project Manager notifies the project and laboratory staffs of the resulting status change in project documents, such as drawings and project procedures.

In general, outdated drawings and other documents are marked "void." However, the Project Manager may request the copies be destroyed. One copy of void documents is maintained in the project files with the reasons for, and date of voiding, clearly indicated.

Documents are marked "preliminary" to denote calculations and other material which have not been formally checked, or based on information which has not been checked, or do not contribute to final project information.

8.0 CALIBRATION PROCEDURES AND FREQUENCY

8.1 Field Instruments

One field instrument will be used for health and safety monitoring: the HNu System portable photoionizer. These instruments will be calibrated on site daily according to the manufacturer's instructions in addition to the factory calibration it will receive prior to the start of site sampling. The calibration standards will be recorded in the field log book along with any corrective actions taken.

A pH meter and a conductivity meter will be used to analyze groundwater and surface water samples. Procedures given in Appendix A, Field Water Quality Instruments, will be used to calibrate these meters.

All standards used for calibration must be from the national Institute of Standards and Technology (NIST), traceable to NIST standards, or other accepted standards (e.g., USEPA).

8.2 Laboratory Instruments

The laboratory's procedures for calibration and related quality control measures are to be in accordance with the protocols presented in the CLP Statement of Work (SOW) and "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods," USEPA, SW-846, November 1986, 3rd Edition. Formal calibration procedures are established to ensure that instrumentation and equipment used for sample analysis are accurately calibrated and properly functioning. These procedures apply to all instruments and equipment quantities. All calibrations are performed by laboratory personnel or external agencies using standard reference materials per method specifications. The LQAP will provide more detail on procedures and frequency. This will be available when the laboratory subcontractor is obtained for this project.

All calibrations are recorded on in-house calibration forms or instrument vendor forms or in dedicated bound notebooks. The following data are recorded for all calibrations: the date, target readings, actual readings, instrument identification number, and the analyst's initials. Other data may be recorded depending upon the calibration performed.

Only properly calibrated and operating equipment and instrumentation are used. Equipment and instrumentation not meeting the specified calibration criteria are to be segregated from active equipment whenever possible. Such equipment is repaired and recalibrated before reuse.

All equipment is uniquely identified, either by serial number or internal calibration number, to allow traceability between equipment and calibration records. Recognized procedures (ASTM, USEPA, or manufacturer's procedures) are used for calibration whenever available.

8.2.1 Method Calibration

Method calibration is performed as part of the laboratory analytical procedure (calibration curves, tuning). Calibration curves are prepared using five standards in graduated amounts across the appropriate range of analysis. New calibration curves are prepared whenever new reagents or standards are prepared or yearly, whichever is more frequent.

8.2.2 GC/MS System Calibration Procedure

This section outlines the requirements for the calibration of GC/MS (or GC/MSD) systems for the determination of organic compounds. The following operations are performed in support of these requirements:

- Documentation of GC/MS mass calibration and abundance pattern.
- Documentation of GC/MS response factor stability.
- Internal standard response and retention time monitoring.

Tuning and Mass Calibration

It is necessary to establish that a given GC/MS system meets the standard mass spectral abundance criteria prior to initiating data collection. This is accomplished through the analysis of p-bromofluorobenzene (BFB) for volatile compounds or decafluorotriphenylphosphine (DFTPP) for semivolatile compounds. The BFB or DFTPP criteria are met before any blanks, standards, or samples are analyzed.

A GC/MS system used for organic compound analysis is tuned to meet the criteria specified in SW-846 for BFB analysis (volatile compounds) or DFTPP (semivolatile compounds) for an

injection of 50 nanograms (ng) of BFB or DFTPP. The analysis is performed separately from standard or blank analysis. These criteria are demonstrated every 12 hours of operation. Background subtraction, if required, is straight forward to eliminate column bleed or instrument background ions. Calibration documentation is in the form of a bar graph spectrum and a mass listing.

GC/MS System Calibration

After tuning criteria have been met and prior to sample analysis, the GC/MS system is initially calibrated at five concentrations utilizing the compounds to be analyzed to determine the linearity of response. Internal and surrogate standards are used with each calibration standard. Standards are analyzed under the same conditions as the samples.

- **Relative Response Factor (RRF) Calculation** - The USEPA specifies the internal standard to be used on a compound-by-compound basis for quantification. The relative response factor (RRF) is calculated for each compound at each concentration level.
- **System Performance Check** - A system performance check is performed and the minimum average relative response factors are met before the calibration curve is used.
- **Calibration Check** - A calibration check is performed and the criteria are met before the calibration curve is used. The percent relative standard deviation (%RSD) is calculated using the relative response factors (RRF) from the initial calibration.
- **Continuing Calibration** - A calibration check standard containing all semivolatile or volatile compounds and surrogates is run each 12 hours of analysis. A system performance check is performed. The criteria are the same as for the initial calibration system performance check. A calibration check is also performed. The percent difference is determined for each CCC.

The % Difference for each CCC must be less than or equal to 25 percent. The system performance check and calibration check criteria must be met before sample analysis can be performed. The continuing calibration is recorded on the continuing calibration forms.

8.2.3 System Calibration Procedure for Metals Analysis

This section outlines the requirements for the calibration of atomic absorption (AA) and Inductively Coupled Plasma (ICP) systems for the determination of metals. The following are performed in support of these requirements:

- Documentation of standard response.
- Correlation coefficient monitoring.

The AA or ICP system is initially calibrated with a calibration blank and five calibration standards. The standard concentrations are determined as follows. One standard is at a concentration near, but above, the MDL. The other concentrations correspond to the expected range of concentrations found in the actual samples. For AA systems, the calibration standards are prepared fresh each time an analysis is to be performed and discarded after use. The standards contain the same reagents at the same concentrations as will result in the samples following preparation.

This five point calibration is performed daily or before each use for metals analysis by ICP. For metals analysis by AA, the five point calibration is performed whenever new calibration standards are prepared.

Correlation Coefficient Calculation

The data points of the blank and the five calibration standards are utilized to calculate the slope, the intercept, and the correlation coefficient of the best fit line. An acceptable correlation coefficient must be achieved before sample analysis may begin. An acceptable correlation coefficient is >0.997 for AA analyses and >0.9999 for ICP analysis.

Calibration Verification

The initial calibration curve is verified on each working day by the measurement of one mid-range calibration standard. For analysis by AA or ICP, the acceptance criterion for the recovery of the verification standards is within 15 percent of the expected recovery for all metal standards except for the standard for mercury. The acceptance criterion for the recovery of the mercury standard is within 20 percent of the expected recovery. When measurements

exceed the control limits, the analysis is terminated, the problem corrected, the instrument recalibrated, and the calibration reverified.

8.2.4 System Calibration Procedure for Inorganic Analyses

This section outlines the requirements that are used for calibration of colorimetric systems for analyses of inorganic parameters. The following are performed in support of these requirements:

- Documentation of standard response.
- Correlation coefficient monitoring.

The system is initially calibrated with a blank and five calibration standards. Standard concentrations are one standard at a concentration near, but above, the MDL with additional concentrations corresponding to the expected range of concentrations found in actual samples. Standards contain the same reagents at the same concentrations as will be present in samples following preparation.

Correlation Coefficient Calculation

Data points of the blank and five calibration standards are utilized to calculate slope, intercept, and correlation coefficient of a best fit line. An acceptable correlation coefficient is achieved before sample analysis may begin. An acceptable correlation coefficient is less than 0.99 for all systems.

Calibration Verification

The initial calibration curve is verified on each working day by the measurement of two calibration standards. One standard is at a concentration near the low end of the calibration curve and one standard is at the high end of the curve. The acceptance criteria for recovery of verification standards is within 10 percent of the expected recovery. When measurements exceed control limits, analysis is terminated, the problem is corrected, the instrument is recalibrated, and the calibration is reverified.

8.2.5 Periodic Calibration

Periodic calibration is performed on equipment required in analyses but not routinely calibrated as part of the analytical methodology. Equipment that falls within this category includes ovens, refrigerators, and balances. The calibration is recorded either on specified forms or in bound notebooks. Discussed below are the equipment, the calibration performed, and the frequency at which the calibration is performed.

- Balances are calibrated weekly with class S weights.
- The pH Meter meter is calibrated daily with pH 4 and 7 buffer solutions and checked with pH 10 buffer solution.
- The temperatures of the refrigerators are recorded daily.
- All liquid in glass thermometers are calibrated annually with the N.B.S. certified thermometer. Dial thermometers are calibrated quarterly.
- The N.B.S. certified thermometer is checked annually at the ice point.

The following equipment must maintain the following temperatures:

- Sample Storage and Refrigerators - within 2 degrees of 4 degrees Celsius
- Water Bath, Mercury - within 2 degrees of 4 degrees Celsius

9.0 ANALYTICAL PROCEDURES

9.1 Field Analysis

An HNu PI-101 will be used to analyze ambient air for health and safety monitoring, as well as to screen each matrix during sampling. The HNu PI-101 detects total organic vapor. This instruments will be operated in accordance with the manufacturer's instructions.

The pH and specific conductivity of groundwater samples will also be measured in the field. These analyses will be obtained in accordance with "Handbook for Sampling and Sample Preservation of Water and Wastewater," USEPA, September 1982, EPA/600/4-82-029. Specific instructions regarding field analysis for pH and specific conductivity are provided in Appendix A, Field Water Quality Instruments.

9.2 Laboratory Analysis

The samples that will be collected during the investigation will be analyzed for constituents listed in Tables 9-1 through 9-8. Parameters will be analyzed using approved USEPA methods as noted in the tables. Compounds and the corresponding reporting, quantitation, or detection limits are listed in Tables 9-1 through 9-8.

The laboratory that will be contracted to perform the analyses will be NEESA Approved. The NEESA Approval process is described in the NEESA 20.2-047B document. As part of this process, the laboratory must furnish their Laboratory Quality Assurance Plan (LQAP). This LQAP will provide a description of the laboratory facilities, laboratory credentials, laboratory equipment, and source of supplies. In addition, the QA/QC procedures the laboratory will use to ensure the generation of scientifically valid and defensible data will be presented. The LQAP will also contain the necessary SOPs which describe the analytical procedures in sufficient detail to allow selection of the methods that will meet the Data Quality Objectives of the project.

The credentials of the analytical laboratory identified in Section 4.0 are kept on file with the Laboratory Quality Assurance Officer. A copy can be supplied upon request.

TABLE 9-1

TCL VOLATILE ORGANIC COMPOUNDS CONTRACT REQUIRED QUANTITATION LIMITS
IN SOIL, SEDIMENT, GROUND WATER, SURFACE WATER, AND RINSATE SAMPLES

Parameter	Prep ^B Method	Analytical ^B Method	CRQL ^A	
			Water ug/L	Low Soil/Sediment ug/kg
Acetone	CLP	CLP	10	10
Bromomethane	CLP	CLP	10	10
Bromodichloromethane	CLP	CLP	10	10
Benzene	CLP	CLP	10	10
Chloroethane	CLP	CLP	10	10
Chloromethane	CLP	CLP	10	10
Carbon disulfide	CLP	CLP	10	10
Chloroform	CLP	CLP	10	10
Carbon tetrachloride	CLP	CLP	10	10
Chlorobenzene	CLP	CLP	10	10
1, 1-Dichloroethene	CLP	CLP	10	10
1, 1-Dichloroethane	CLP	CLP	10	10
trans-1, 2-Dichloroethene	CLP	CLP	10	10
1, 2-Dichloroethane	CLP	CLP	10	10
Dibromochloromethane	CLP	CLP	10	10
1, 2-Dichloropropane	CLP	CLP	10	10
cis-1, 3-Dichloropropene	CLP	CLP	10	10

A. Contract Required Quantitation Limits (CRQLs) are as specified in USEPA SOW OLMO1.8 (August 1991). CRQLs are matrix dependent and may not always be achievable due to required dilutions or other matrix problems.

B. USEPA Statement of Work of Organic Analysis, OLMO1.8 (August 1991).

TABLE 9-1

TCL VOLATILE ORGANIC COMPOUNDS CONTRACT REQUIRED QUANTITATION LIMITS
IN SOIL, SEDIMENT, GROUND WATER, SURFACE WATER, AND RINSATE SAMPLES

Parameter	Prep ^B Method	Analytical ^B Method	CRQLA	
			Water ug/L	Low Soil/Sediment ug/kg
trans-1, 3-Dichloropropene	CLP	CLP	10	10
Ethylbenzene	CLP	CLP	10	10
2-Hexanone	CLP	CLP	10	10
Methylene chloride	CLP	CLP	10	10
2-Butanone	CLP	CLP	10	10
4-Methyl-2-pentanone	CLP	CLP	10	10
Styrene	CLP	CLP	10	10
1, 1, 1-Trichloroethane	CLP	CLP	10	10
Trichloroethene	CLP	CLP	10	10
1, 1, 2-Trichloroethane	CLP	CLP	10	10
Bromoform	CLP	CLP	10	10
Tetrachloroethene	CLP	CLP	10	10
1, 1, 2, 2-Tetrachloroethane	CLP	CLP	10	10
Toluene	CLP	CLP	10	10
Vinyl chloride	CLP	CLP	10	10
Vinyl acetate	CLP	CLP	10	10
Xylenes (Total)	CLP	CLP	10	10

A. Contract Required Quantitation Limits (CRQLs) are as specified in USEPA SOW OLM01.8 (August 1991). CRQLs are matrix dependent and may not always be achievable due to required dilutions or other matrix problems.

B. USEPA Statement of Work of Organic Analysis, OLM01.8 (August 1991).

TABLE 9-2

TCL SEMIVOLATILE ORGANIC COMPOUNDS CONTRACT REQUIRED QUANTITATION LIMITS
IN SOIL, SEDIMENT, GROUND WATER, SURFACE WATER, AND RINSATE SAMPLES

Parameter	Prep ^B Method	Analytical ^B Method	CRQL ^A	
			Water ug/L	Low Soil/Sediment ug/kg
Acenaphthylene	CLP	CLP	10	330
Acenaphthene	CLP	CLP	10	330
Anthracene	CLP	CLP	10	330
Benzyl alcohol	CLP	CLP	10	330
4-Bromophenyl phenylether	CLP	CLP	10	330
Butylbenzylphthalate	CLP	CLP	10	330
Benzo(b)fluoranthene	CLP	CLP	10	330
Benzo(k)fluoranthene	CLP	CLP	10	330
Benzo(a)pyrene	CLP	CLP	10	330
Benzo(g,h,i)perylene	CLP	CLP	10	330
Benzo(a)anthracene	CLP	CLP	10	330
bis(2-Chloroethyl)ether	CLP	CLP	10	330
2-Chlorophenol	CLP	CLP	10	330
bis(2-Chloroethoxy)methane	CLP	CLP	10	330
4-Chloroaniline	CLP	CLP	10	330
4-Chloro-3-methylphenol	CLP	CLP	10	330
4-Chlorophenylphenylether	CLP	CLP	10	330

A. Contract Required Quantitation Limits (CRQLs) are as specified in USEPA SOW OLMO1.8 (August 1991). CRQLs are matrix dependent and may not always be achievable due to required dilutions or other matrix problems.

B. USEPA Statement of Work of Organic Analysis, OLMO1.8 (August 1991).

TABLE 9-2

TCL SEMIVOLATILE ORGANIC COMPOUNDS CONTRACT REQUIRED QUANTITATION LIMITS
IN SOIL, SEDIMENT, GROUND WATER, SURFACE WATER, AND RINSATE SAMPLES

Parameter	Prep ^B Method	Analytical ^B Method	CRQLA	
			Water ug/L	Low Soil/Sediment ug/kg
2-Chloronaphthalene	CLP	CLP	10	330
Chrysene	CLP	CLP	10	330
1, 3-Dichlorobenzene	CLP	CLP	10	330
1, 4-Dichlorobenzene	CLP	CLP	10	330
1, 2-Dichlorobenzene	CLP	CLP	10	330
2, 4-Dimethylphenol	CLP	CLP	10	330
2, 4-Dichlorophenol	CLP	CLP	10	330
Dimethylphthalate	CLP	CLP	10	330
2, 6-Dinitrotoluene	CLP	CLP	10	330
Dibenzofuran	CLP	CLP	10	330
2, 4-Dinitrotoluene	CLP	CLP	10	330
2, 4-Dinitrophenol	CLP	CLP	25	800
Diethylphthalate	CLP	CLP	10	330
4, 6-Dinitro-2-methylphenol	CLP	CLP	25	800
Di-n-butylphthalate	CLP	CLP	10	330
3, 3'-Dichlorobenzidine	CLP	CLP	10	330
Di-n-octylphthalate	CLP	CLP	10	330

A. Contract Required Quantitation Limits (CRQLs) are as specified in USEPA SOW OLMO1.8 (August 1991). CRQLs are matrix dependent and may not always be achievable due to required dilutions or other matrix problems.

B. USEPA Statement of Work of Organic Analysis, OLMO1.8 (August 1991).

TABLE 9-2

**TCL SEMIVOLATILE ORGANIC COMPOUNDS CONTRACT REQUIRED QUANTITATION LIMITS
IN SOIL, SEDIMENT, GROUND WATER, SURFACE WATER, AND RINSATE SAMPLES**

Parameter	Prep ^B Method	Analytical ^B Method	CRQLA	
			Water ug/L	Low Soil/Sediment ug/kg
Dibenz(a,h)anthracene	CLP	CLP	10	330
bis(2-Ethylhexyl)phthalate	CLP	CLP	10	330
Fluorene	CLP	CLP	10	330
Fluoranthene	CLP	CLP	10	330
Hexachloroethane	CLP	CLP	10	330
Hexachlorobutadiene	CLP	CLP	10	330
Hexachlorocyclopentadiene	CLP	CLP	10	330
Hexachlorobenzene	CLP	CLP	10	330
Indeno(1,2,3-cd)pyrene	CLP	CLP	10	330
Isophorone	CLP	CLP	10	330
2-Methylphenol	CLP	CLP	10	330
4-Methylphenol	CLP	CLP	10	330
2-Methylnaphthalene	CLP	CLP	10	330
N-Nitrosodimethylamine	CLP	CLP	10	330
N-Nitrosodipropylamine	CLP	CLP	10	330
Nitrobenzene	CLP	CLP	10	330
2-Nitrophenol	CLP	CLP	10	330

A. Contract Required Quantitation Limits (CRQLs) are as specified in USEPA SOW OLMO1.8 (August 1991). CRQLs are matrix dependent and may not always be achievable due to required dilutions or other matrix problems.

B. USEPA Statement of Work of Organic Analysis, OLMO1.8 (August 1991).

TABLE 9-2

**TCL SEMIVOLATILE ORGANIC COMPOUNDS CONTRACT REQUIRED QUANTITATION LIMITS
IN SOIL, SEDIMENT, GROUND WATER, SURFACE WATER, AND RINSATE SAMPLES**

Parameter	Prep ^B Method	Analytical ^B Method	CRQLA	
			Water ug/L	Low Soil/Sediment ug/kg
Naphthalene	CLP	CLP	10	330
2-Nitroaniline	CLP	CLP	25	800
3-Nitroaniline	CLP	CLP	25	800
4-Nitrophenol	CLP	CLP	25	800
4-Nitroaniline	CLP	CLP	25	800
N-Nitrosodiphenylamine	CLP	CLP	10	330
Phenol	CLP	CLP	10	330
Pentachlorophenol	CLP	CLP	25	800
Phenanthrene	CLP	CLP	10	330
Pyrene	CLP	CLP	10	330
2, 4, 5-Trichlorophenol	CLP	CLP	25	800
1, 2, 4-Trichlorobenzene	CLP	CLP	10	330
2, 4, 6-Trichlorophenol	CLP	CLP	10	330

A. Contract Required Quantitation Limits (CRQLs) are as specified in USEPA SOW OLMO1.8 (August 1991). CRQLs are matrix dependent and may not always be achievable due to required dilutions or other matrix problems.

B. USEPA Statement of Work of Organic Analysis, OLMO1.8 (August 1991).

TABLE 9-3

TCL POLYCHLORINATED BIPHENYLS (PCBs) AND PESTICIDES CONTRACT REQUIRED QUANTITATION LIMITS IN SOIL, SEDIMENT, GROUND WATER, SURFACE WATER, AND RINSATE SAMPLES

Parameter	Prep Method	Analytical Method	CRQL ^A	
			Water ug/L	Low Soil/Sediment ug/kg
PCB-1016	CLP	CLP	1.0	33
PCB-1221	CLP	CLP	2.0	67
PCB-1232	CLP	CLP	1.0	33
PCB-1242	CLP	CLP	1.0	33
PCB-1248	CLP	CLP	1.0	33
PCB-1254	CLP	CLP	1.0	33
PCB-1260	CLP	CLP	1.0	33
alpha-BHC	CLP	CLP	1.0	33
beta-BHC	CLP	CLP	1.0	33
delta-BHC	CLP	CLP	0.05	1.7
gamma-BHC (lindane)	CLP	CLP	0.05	1.7
Heptachlor	CLP	CLP	0.05	1.7
Aldrin	CLP	CLP	0.05	1.7
Heptachlor epoxide	CLP	CLP	0.05	1.7
Endosulfan I	CLP	CLP	0.05	1.7
Dieldrin	CLP	CLP	0.10	3.3
4, 4'-DDE	CLP	CLP	0.10	3.3
Endrin	CLP	CLP	0.10	3.3

A. Contract Required Quantitation Limits (CRQLs) are as specified in USEPA SOW OLMO1.8 (August 1991). CRQLs are matrix dependent and may not always be achievable due to required dilutions, moisture content (of soils), and other matrix problems..

TABLE 9-3

TCL POLYCHLORINATED BIPHENYLS (PCBs) AND PESTICIDES CONTRACT REQUIRED QUANTTTATION LIMITS IN SOIL, SEDIMENT, GROUND WATER, SURFACE WATER, AND RINSATE SAMPLES

Parameter	Prep Method	Analytical Method	CRQLA	
			Water ug/L	Low Soil/Sediment ug/kg
Endosulfan II	CLP	CLP	0.10	3.3
4, 4'-DDD	CLP	CLP	0.10	3.3
Endosulfan sulfate	CLP	CLP	0.10	3.3
4, 4'-DDT	CLP	CLP	0.10	3.3
Methoxychlor	CLP	CLP	0.50	17.0
Endrin ketone	CLP	CLP	0.10	3.3
Endrin aldehyde	CLP	CLP	0.10	3.3
alpha-chlordane	CLP	CLP	0.05	1.7
gamma-chlordane	CLP	CLP	0.05	1.7
Toxaphene	CLP	CLP	5.0	170.0

A. Contract Required Quantitation Limits (CRQLs) are as specified in USEPA SOW OLM01.8 (August 1991). CRQLs are matrix dependent and may not always be achievable due to required dilutions, moisture content (of soils), and other matrix problems..

TABLE 9-4

**TAL METALS AND CYANIDE CONTRACT REQUIRED DETECTION LIMITS
IN SOIL, SEDIMENT, GROUND WATER, SURFACE WATER, AND RINSATE SAMPLES**

Metal	Method ^B	CRDLA	
		Water ug/L	Low Soil/Sediment mg/kg
Aluminum	200.7 CLP-M	200	20
Antimony	200.7 CLP-M	60	6
Arsenic	206.2 CLP-M	10	1.0
Barium	200.7 CLP-M	200	20
Beryllium	200.7 CLP-M	5	0.5
Cadmium	200.7 CLP-M	5	0.5
Calcium	200.7 CLP-M	5000	500
Chromium	200.7 CLP-M	10	1.0
Cobalt	200.7 CLP-M	50	5
Copper	200.7 CLP-M	25	2.5
Iron	200.7 CLP-M	100	10
Lead	239.2 CLP-M	3	0.3
Magnesium	200.7 CLP-M	5000	500
Manganese	200.7 CLP-M	15	1.5
Mercury	245.1 CLP-M	0.2	0.02
Nickel	200.7 CLP-M	40	4.0
Potassium	200.7 CLP-M	5000	500
Selenium	270.2 CLP-M	5	0.5
Silver	200.7 CLP-M	10	1.0
Sodium	200.7 CLP-M	5000	500
Thallium	279.2 CLP-M	10	1.0
Vandium	200.7 CLP-M	50	5.0
Zinc	200.7 CLP-M	20	2.0
Cyanide	335.2 CLP-M	10	1.0

A. Contract Required Detection Limits (CRQLs) are as specified in USEPA SOW OLM01.8 (August 1991). CRQLs are matrix dependent and may not always be achievable due to required dilutions or other matrix problems.

B. USEPA Statement of Work of Inorganic Analysis, ILM02.1 (September 1991).

Note: Sample preparation will follow CLP protocol. See Footnote B.

TABLE 9-5

HERBICIDE COMPOUNDS REPORTING LIMITS - TCLP LEACHATES

Parameter	Prep^B Method	Analytical^B Method	Reporting Limit^A Water ug/L
2,4-D	8150	8150	10
2,4,5-TP (Silvex)	8150	8150	2

- A. Sample reporting limits are highly matrix-dependent. The reporting limits listed herein are provided for guidance and may not always be achievable due to required dilutions or similar matrix problems.
- B. USEPA SW-846 3rd edition. TCLP extract prepared according to Method 1311 (SW-846).

TABLE 9-6**PESTICIDES COMPOUNDS REPORTING LIMITS -
TCLP LEACHATES**

Parameter	Prep^B Method	Analytical^B Method	Reporting Limit^A Water ug/L
gamma-BHC (lindane)	3510	8080	0.05
Endrin	3510	8080	0.2
Heptachlor	3510	8080	0.1
Heptachlor epoxide	3510	8080	0.05
Methoxychlor	3510	8080	0.5
Toxaphene	3510	8080	5.0

A. Sample reporting limits are highly matrix-dependent. The reporting limits listed herein are provided for guidance and may not always be achievable due to required dilutions or other matrix interferences.

B. USEPA SW-846 3rd edition. TCLP extract prepared according to Method 1311 (SW-846).

TABLE 9-7

ETHYLENE BROMIDE ORGANIC COMPOUNDS CONTRACT REPORTING LIMIT
IN SOIL, SEDIMENT, SOLIDS, AND RINSATE SAMPLES

Parameter	Prep ^B Method	Analytical ^B Method	CRQL ^A	
			Low Soil/Sediment ug/kg	Water ug/L
Ethylene bromide	5030	8240	10	10

A. Reporting limits are matrix dependent and may not always be achievable due to required dilutions or other matrix problems.

B. USEPA SW-846 3rd Edition.

TABLE 9-8**ADDITIONAL INORGANIC PARAMETERS REPORTING LIMITS -
IN SOIL, SEDIMENT, SOLID, AND RINSATE SAMPLES**

Compound	Matrix	Method ⁽¹⁾	Reporting Limit ^A	
			Soil (mg/kg)	Water (mg/L)
Cyanide	Soil	9010	1.0	10
Arsenic	Soil	6010	1.0	10
Zinc	Soil	6010	2.0	20
TOC	Soil	9010	10	10
TCLP Extraction	Soil	1311	N/A	N/A

A. Sample reporting limits are matrix dependent. The reporting limits listed herein are provided for guidance and may not always be achievable due to required dilutions or other matrix interferences.

N/A Not applicable.

(1) "Test Methods for Evaluating Solid Waste," USEPA, SW-846, November 1986 (unless otherwise noted).

10.0 DATA REDUCTION, VALIDATION AND REPORTING

10.1 Field Data Procedures

Data validation practices as described by "Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses," USEPA, June 1988, and "Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses," USEPA, February 1988 will be followed to insure that raw data are not altered and that an audit trail is developed for those data which require reduction. The documentation of sample collection will include the use of bound field log books in which all information on sample collection will be entered in indelible ink. Appropriate information will be entered to reconstruct the sampling event, including: site name (top of each page), sample identification, brief description of sample, date and time of collection, sampling methodology, field measurements and observations, and sampler's initials (bottom of each page, and dated).

A rigorous data control program will insure that all documents for the investigations are accounted for when they are completed. Accountable documents include items such as log books, field data records, correspondence, chain-of-custody records, analytical reports, data packages, photographs, computer disks, and reports. The project manager is responsible for maintaining a project file in which all accountable documents will be inventoried. The project records will be retained for a period of three years after project close-out; then the files will be forwarded to the Navy.

All the field data, such as those generated during field measurements, observations and field instrument calibrations, will be entered directly into a bound field notebook. Each project team member will be responsible for proofing all data transfers made, and the Project Manager or his designee will proof at least ten percent of all data transfers.

10.2 Laboratory Data Procedures

The following procedures summarize the practices routinely used by laboratory staff for data reduction, validation, and reporting. Numerical analyses, including manual calculations, are documented and subjected to quality control review. Records of numerical analyses are legible and complete enough to permit reconstruction of the work by a qualified individual other than the originator. The equations and procedures used for calculations, as well as the units, are specified in the referenced analytical protocols.

Laboratory Data Review

Data review begins with data reduction and continues through to the reporting of data.

Data processing is checked by an individual other than the analyst who performed the data processing. The checker reviews the data for the following:

- Utilization of the proper equations.
- Correctness of numerical input.
- Correctness of computations.
- Correct interpretation of raw data (chromatographs, strip charts, etc.).
- Data is transferred to the proper forms and checked for transcription errors.

The checking process is thorough enough to verify the results. This must be approved by the Laboratory Quality Assurance Officer.

All entries made in benchbooks, data sheets, computation sheets, input sheets, etc. are made in ink. No entry will be rendered unreadable.

Data validation, if required, will be performed by a third party (not laboratory personnel) according to the guidelines referenced above.

Analytical Reports

The information listed below are required of analytical reports:

- Data is presented in a tabular format.
- Analytical reports are approved by appropriate laboratory personnel.
- The following information is included on the report: client name and address, report date, sample date, analysis dates, number of samples, purchase order number, project number, and project type. All pages are numbered.
- The sample numbers and corresponding laboratory numbers are identified.

- The parameters analyzed, report units, and values are identified.
- Method, trip, and field blank results are reported.
- Matrix spike, matrix spike duplicate, and replicate recoveries are reported.
- Surrogate recoveries are reported.
- Holding times and sample analysis dates are reported.
- The detection limit of the procedure is identified.
- Consistent significant figures are used.
- Referenced footnotes are used when applicable.
- Blank results are not subtracted from sample results; they are treated according to the data validation guidelines referenced above.
- A letter of transmittal accompanies the report if any anomalies are associated with the data. The letter specifies these anomalies.

Samples analyzed by CLP procedures will be accompanied with a CLP package as required by the CLP SOW.

All laboratory procedures for data reduction, validation, and reporting will be presented in the Laboratory Quality Assurance Plan (LQAP). The laboratory selected for this project will be NEESA approved. The subcontractor's LQAP shall describe the mechanism for periodic reporting to management on the performance of measurement systems and data quality. These reports should include:

- Periodic assessment of analytical data accuracy, precision, and completeness.
- Performance audits results.
- System audits results.

- Significant QA problems and recommended solution.
- Corrective action results.

The analytical laboratory shall maintain detailed procedures of laboratory recordkeeping in order to support the validity of all analytical work. Each data set report submitted to the Project Manager should contain the laboratory Project Manager's and QA Officer's written verification that the approved analytical method (without modification) was performed and all QA/QC checks were within the established protocol limits on all samples. If any QA problems are encountered during sample analysis, the laboratory will inform the Project Manager in writing. The laboratory QA Officer will provide the Project Manager reports of their QA audits by external agencies and of internal audits by their QA department upon request.

The Field Team Leader will report to the Project Manager on a frequent basis regarding progress of the field work and quality control issues associated with the field activities. All reports will be documented in a field logbook.

After the field work has been completed and the final analyses have been performed and checked, a final quality assurance report will be prepared for inclusion into the project final report. The report will summarize the quality assurance and audit information, indicating any corrective actions taken and the overall results of QA compliance. The Project Manager or his/her designate will prepare this final summary in coordination with the contract laboratory.

11.0 INTERNAL QUALITY CONTROL CHECKS

11.1 Field Internal Quality Control Checks

Field internal quality control checks to be used during the Phase I RI include field duplicates, equipment rinsates, field blanks, and trip blanks. The results from the field quality control samples will be used by the data validator to determine the overall quality of the data.

11.2 Types of QC Samples

Documentation of the analyses of the following types of QC samples is maintained in the laboratory bench notebooks and/or the specific client or project files.

Trip Blank

Analysis of trip blanks is performed to monitor possible contamination during shipment and collection of samples. Trip blanks are initiated in the laboratory prior to the shipping of sample packs. A corresponding trip blank is prepared for each set of samples to be analyzed for volatile organic compounds.

Trip blank samples are prepared by adding four drops of concentrated hydrochloric acid and then filling the container with deionized water (ASTM Type II). The trip blanks accompany the samples through shipment to the sample site, sample collection, shipment to the laboratory, and storage of the samples.

If the analyses indicate contamination of the trip blank, the sample sources may be resampled. If the extent and nature of the contamination does not warrant such actions, the data will be accepted as valid.

Method Blank

Analysis of method blanks is performed to verify that method interferences caused by contamination in reagents, glassware, solvents, etc. are minimized and known.

Method blanks are initiated by the analyst prior to the preparation and/or analysis of the sample set. A method blank consists of a volume of deionized water or organic-free water

equal to the sample volume which is carried through the entire analytical procedure. For solid samples to be analyzed by GC/MS, the method blank consists of a purified solid matrix approximately equal to the sample weight. A method blank is analyzed with each set of samples or at the very least, daily. If the analytical data of the method blank indicates excessive contamination, the source of contaminant will be determined. The samples may be reanalyzed or the data may be processed as is depending upon the nature and extent of the contamination.

Replicate Sample Analysis

Replicate sample analysis is performed to demonstrate the precision of an analysis. An interlaboratory replicate sample is initiated by the analyst prior to sample preparation and carried through the entire analytical procedure. The frequency of interlaboratory replicate analysis for each analyte is specified in the LQAP.

Spike Analysis

Spike analysis is performed to demonstrate the accuracy of an analysis. The analyst initiates the spike prior to sample preparation and analysis by adding a known amount of analyte(s) to a sample. The spike sample is carried through the entire analytical procedure. The frequency of spike analysis for each analyte(s) is summarized in the LQAP.

Surrogate Standards

Surrogate standard analysis is performed to monitor the preparation and analyses of samples. All samples and blanks analyzed by GC/MS are fortified with a surrogate spiking solution prior to extraction or purging.

Internal Standards

Internal standard analyses are performed to monitor system stability. Prior to injection or purging, internal standards are added to all blanks and samples analyzed by GC/MS.

11.3 Laboratory Control Limits

Control limits are established for QC checks (spikes, duplicates, blanks, etc.). CLP control limits for surrogate standards spikes, and duplicates associated with GC/MS analyses and Pesticide/PCB analyses are adopted. Control limits for spikes, duplicates, and reference samples are determined internally through statistical analysis.

Whenever an out-of-control situation occurs, the cause is determined. Any needed corrective actions are taken.

Method Blanks

For metals analyses, the criteria given below are used for method blank analysis.

- If the concentration of the method blank is less than or equal to the detection level, no correction of sample results is performed.
- If the concentration of the blank is above the detection level for any group of samples associated with a particular blank, the concentration of the sample with the least concentrated analyte must be 10 times the blank concentration, or all samples associated with the blank and less than 10 times the blank concentration must be redigested (reprepared) and reanalyzed.

The sample value is not corrected for the blank value unless, for AA and ICP analysis, a sufficient amount of sample is not available for reanalysis. In this case, the sample value is corrected for the blank value.

For GC/MS analyses, the criteria listed below are used for method blank analysis.

- A method blank for volatiles analysis must contain no greater than five times the detection limit of common laboratory solvents (common laboratory solvents are: methylene chloride, acetone, toluene, 2-butanone, and chloroform).
- A method blank for semivolatiles analysis must contain no greater than five times the detection limit of common phthalate esters.

- For all other compounds not listed above, the method blank must contain less than the detection limit of any single compound. If a method blank exceeds the criteria, the analytical system is considered to be out of control. The source of the contamination is investigated and appropriate corrective measures are taken and documented before sample analysis proceeds. All samples processed with a method blank that is out of control (i.e., contaminated) are reextracted/repurged and reanalyzed. Sample values are corrected for the blank value.

Surrogate Standards

For method blank surrogate standard analysis, corrective action is taken if any one of the following conditions exist:

- Recovery of any one surrogate compound in the volatile fraction is outside the required surrogate standard recovery limit.
- Recovery of any one surrogate compound in either of the semivolatile fractions is outside surrogate standard recovery limits.

Corrective action will include the procedures provided below.

- A check of the calculations for errors; a check of the internal standard and surrogate spiking solutions for degradation, contamination, etc.; and a check of instrument performance.
- Recalculation or reinjection/repurging of the blank or extract if the above corrective actions fail to solve the problem.
- Reextraction and reanalysis of the blank. For sample surrogate standard analysis, corrective action is taken if any one of the following conditions exist.
 - ▶ Recovery of any one surrogate compounds in the volatile fraction is outside the surrogate spike recovery limits.
 - ▶ Recovery of any one surrogate compound in either semivolatile fraction is below 10 percent.

- ▶ Recoveries of two or more surrogate compounds in either semivolatile fraction are outside surrogate spike recovery limits.

Corrective action will include the steps given below.

- A check of the calculations for errors; a check of the internal standard and surrogate spiking solutions for degradation, contamination, etc.; and a check of instrument performance.
- Recalculating or reanalysis the sample or extract if the above corrective action fails to solve the problem.
- Reextraction and reanalysis of the sample if none of the above are a problem.

11.4 Quality Assurance Review of Reports, Plans, and Specifications

Prior to issuance of a final report, it is reviewed by knowledgeable members of the project staff, the Project Manager, or a designated representative. This review addresses whether:

- The report satisfies the scope of work, client requirements, and pertinent regulatory requirements.
- Assumptions are clearly stated, justified, and documented.
- A reference is cited for any information utilized in report preparation that was originated outside the project.
- The report correctly and accurately presents the results obtained by the work.
- The tables and figures presented in the report are prepared, checked, and approved according to requirements.
- The report figures are signed and dated by the appropriate members of the project staff and project management.

- The typed report has been proofread and punctuation, grammar, capitalization, and spelling are correct.

11.4.1 Laboratory Quality Assurance

Field Quality Assurance

Four types of field quality assurance/quality control samples will be submitted to the laboratory: trip blanks, equipment rinsates, field blanks, and field duplicates. A breakdown by type of sample with which the QA/QC samples will be submitted to the laboratories is given in Table 5-10. A summary of the frequency of environmental and QA/QC samples to be submitted for analysis is given in the Sampling and Analysis Plan.

12.0 PERFORMANCE AND SYSTEM AUDITS

A field audit will be conducted during the field investigation to verify that sampling is being performed according to the plan. A report will be submitted within 30 calendar days of completion of the audit. Serious deficiencies will be reported within 24 hours of the time of discovery of the deficiency, including actions taken or to be taken to correct such deficiencies.

The following is used for field audits. At the appropriate time, the Project Manager or his designee will conduct field audits.

The analytical subcontractor's LQAP must describe the external and internal performance evaluation tests and audits required to monitor the capability and performance of the total measurement process. These include system audits as required by Federal and State regulatory agencies to obtain and maintain laboratory certifications, commercial clients with auditing programs, and subscription to commercial auditing agencies. In addition, performance audits such as USEPA's Performance Evaluation Studies (drinking water and wastewater series), client sponsored performance evaluations, various government proficiency test samples to maintain laboratory certifications, and internal blind quality assurance samples should be discussed. In addition, the LQAP should define the acceptance criteria for the laboratory.

Laboratories that participate in the CLEAN Installation Restoration Program are required to obtain NEESA approval. This process consists of on-site laboratory audits, submittal of the LQAP, monthly reports, and periodic analyses of performance evaluation samples. Baker's responsibility is to ensure that the laboratory subcontractors selected have current NEESA certification. The NEESA Approval Process is described in the NEESA 20.2-047B document.

TABLE 12-1

SYSTEM AUDIT CHECKLIST - FIELD OPERATIONS

Project No. _____ Date _____

Project Name & Location _____ Name & Signature of Auditor _____

Team Members _____ Name & Signature of Field Team _____

Yes _____ No _____ 1. Is there a set of accountable field documents checked out to the Site Manager?
Comments: _____

Yes _____ No _____ 2. Is the transfer of field operations from the Site Manager to field participants documented in a log book?
Comments: _____

Yes _____ No _____ 3. Is there a written list of sampling locations and descriptions?
Comments: _____

Yes _____ No _____ 4. Are samples collected as stated in the project plan or as directed by the Site Manager?
Comments: _____

Yes _____ No _____ 5. Are samples collected in the type of container specified in the project plan or as directed by the Site Manager?
Comments: _____

Yes _____ No _____ 6. Are samples preserved as specified in the project plan or as directed by the Site Manager?
Comments: _____

**TABLE 12-1
SYSTEM AUDIT CHECKLIST - FIELD OPERATIONS
PAGE TWO**

- | | | | |
|-----------|----------|-----|---|
| Yes _____ | No _____ | 7. | Are the number, frequency and type of samples collected as specified in the project plan or as directed by the Site Manager?
Comments: _____

_____ |
| Yes _____ | No _____ | 8. | Are the number, frequency and type of measurements taken as specified in the project plan or as directed by the Site Manager?
Comments: _____

_____ |
| Yes _____ | No _____ | 9. | Are samples identified with sample labels?
Comments: _____

_____ |
| Yes _____ | No _____ | 10. | Are blank and duplicate samples properly identified?
Comments: _____

_____ |
| Yes _____ | No _____ | 11. | Are sample and serial numbers for samples split with other organizations recorded in a log book or on a chain-of-custody record?
Comments: _____

_____ |
| Yes _____ | No _____ | 12. | Are samples listed on a chain-of-custody record?
Comments: _____

_____ |
| Yes _____ | No _____ | 13. | Is chain-of-custody documented and maintained?
Comments: _____

_____ |
| Yes _____ | No _____ | 14. | Are quality assurance checks performed as directed?
Comments: _____

_____ |

**TABLE 12-1
SYSTEM AUDIT CHECKLIST - FIELD OPERATIONS
PAGE THREE**

- Yes _____ No _____ 15. Are photographs documented in logbooks as required?
Comments: _____

- Yes _____ No _____ 16. Are all documents accounted for?
Comments: _____

- Yes _____ No _____ 17. Have any documents been voided or destroyed?
Comments: _____

13.0 PREVENTIVE MAINTENANCE

13.1 Field Maintenance

The HNu PI-101 is to be used in site characterization and will be maintained as described by the manufacturer's instructions. The pH and specific conductance meters to be used during sampling will be maintained according to Appendix A, Field Water Quality Instruments. The manufacturers' instructions contain a spare parts list to be kept by the user and the manufactures provide a repair/maintenance service.

13.2 Laboratory Maintenance

Preventive maintenance is an organized program of actions to prevent instruments and equipment from failing during use and to maintain proper performance of equipment and instruments. A comprehensive preventive maintenance program is implemented to increase the reliability of the measurement system. The preventive maintenance program addresses the following:

- Schedules of important preventive maintenance tasks that are carried out to minimize downtime.
- Lists of critical spare parts that are available to minimize downtime.

The laboratory maintains histories, in instrument/equipment logs, of all major equipment. Trouble shooting, maintenance, and spare parts inventory are recorded in the logs. Instruments and equipment are maintained periodically according to SW-846, third edition requirements, manufacturer's recommendation, and/or service contracts.

The modern analytical laboratory depends heavily upon instrumentation and equipment; therefore, cleaning and preventive maintenance are primary considerations in the sustained production of satisfactory data. Specific requirements for proper care of laboratory instrumentation and equipment are contained in the manufacturer's instructions; however, some general guidelines are considered:

- **Special precautions are taken to avoid spillage of corrosive chemicals on or around equipment and instrumentation not only to extend the life of the item, but also to eliminate contamination.**
- **Where available, covers are placed on instrumentation when not in use.**
- **Instrument parts are cleaned as required (i.e., mirrors, probes, detector cells).**

The analytical subcontractor has not been identified at this time. The Laboratory Quality Assurance Plan for the selected laboratory should contain a section concerning Preventive Maintenance, which will include a spare parts list, as well as the source(s) of spare parts and repairs.

14.0 DATA MEASUREMENT ASSESSMENT PROCEDURES

14.1 Overall Project Assessment

Overall data quality will be assessed by a thorough understanding of the data quality objectives which are stated during the design phase of the investigation. By maintaining thorough documentation of all decisions made during each phase of sampling, performing field and laboratory audits, thoroughly reviewing the analytical data as they are generated by the laboratory, and providing appropriate feedback as problems arise in the field or at the laboratory, data accuracy, precision, and completeness will be closely monitored.

14.2 Field Quality Assessment

To assure that all field data are collected accurately and correctly, specific written instructions will be issued to all personnel involved in field data acquisition by the Project Manager. The Project Manager will perform field audit(s) during the investigation to document that the appropriate procedures are being followed with respect to sample (and blank) collection. These audits will include a thorough review of the field books used by the project personnel to insure that all tasks were performed as specified in the instructions. The field audits will necessarily enable the data quality to be assessed with regard to the field operations.

The evaluation (data review) of field blanks, and other field QC samples will provide definitive indications of the data quality. If a problem that can be isolated arises, corrective actions can be instituted for future field efforts.

14.3 Laboratory Data Quality Assessment

As part of the analytical QA/QC program, the laboratory applies precision and accuracy criteria for each parameter that is analyzed. When analysis of a sample set is completed, QC data generated are reviewed and evaluated to ensure acceptance criteria are met. These criteria are method and matrix specific.

QA/QC data review is based on the criteria provided below.

- **Method Blank Evaluation** - The method blank results are evaluated for high readings characteristic of background contamination. If high blank values are observed,

laboratory glassware and reagents are checked for contamination and the analysis of future samples halted until the system can be brought under control. A high background is defined as a background value sufficient to result in a difference in the sample values, if not corrected, greater than or equal to the smallest significant digit known to be valid. A method blank must contain no greater than two times the parameter detection limit for most parameters.

- **Trip Blank Evaluation** - Trip blank results are evaluated for high readings similar to the method blanks described above. If high trip blank readings are encountered (i.e. a value sufficient to result in a difference in sample values, if not corrected, greater than or equal to the smallest significant digit known to be valid), procedures for sample collection, shipment, and laboratory analysis are reviewed. If both the method and the trip blanks exhibit significant background contamination, the source of contamination is probably within the laboratory. Ambient air in the laboratory and reagents are checked as possible sources of contamination.
- **Standard Calibration Curve Verification** - The calibration curve or midpoint calibration standard (check standard) is evaluated daily to determine curve linearity through its full range and that sample values are within the range defined by the low and high standards. If the curve is not linear, sample values are corrected. If average response factors are used to calculate sample concentrations, these factors are verified on a daily basis. Verification of calibration curves and response factors is accomplished when the evaluated response for any parameter varies from the calibrated response by less than ranges specified in Section 7.0.
- **Duplicate Sample Analyses** - Duplicate sample analyses are used to determine the precision of the analytical method for the sample matrix. Two types of duplicate samples are analyzed for this project, field and interlaboratory. Duplicate results are used to calculate precision as defined by the RPD. If interlaboratory duplicate values exceeds the control limit, the sample set are reanalyzed for the parameter in question. Precision limits are updated periodically following review of data.

$$\text{RPD} = \frac{S(1) - S(2)}{M} \times 100$$

Where: S(1) is the result of sample 1 of duplicate pair
S(2) is the result of sample 2 of duplicate pair
M is the mean of S(1) and S(2)

- Reference Sample Analyses - The results of reference sample analysis are compared with true values, and the percent recovery of the reference sample is calculated. If correction is required (excessive or inadequate percent recovery), the reference sample is reanalyzed to demonstrate that the corrective action has been successful.
- Surrogate Standard Analyses - Surrogate standard determinations are performed on all samples and blanks for GC/MS analyses. All samples and blanks are fortified with surrogate spiking compounds before purging or extraction to monitor preparation and analysis of samples. Recoveries must meet specific criteria. If acceptance criteria are not met, corrective action is taken to correct the problem and the affected sample is reanalyzed.
- Matrix Spike Analyses - The observed recovery of a spike added to a sample versus theoretical spike recovery is used to calculate accuracy as defined by the percent recovery (% R). If the accuracy value exceeds the control limit for the given parameter, the appropriate laboratory personnel are notified and corrective action is taken before the sample set is reanalyzed for the parameter in question.

$$\%R = \frac{T - B}{S} \times 100$$

Where: T is the total amount of analyte
B is the background concentration of analyte
S is the amount of analyte spiked into a sample or blank

For completeness, it is expected that the methodology proposed for chemical characterization of the samples will meet QC acceptance criteria for at least 95 percent of all sample data. To ensure this completeness goal, sample data that does not meet the established criteria will be recollected, reextracted, or reanalyzed. Completeness is the percentage of the total measurements made which are judged to be valid measurements.

Data representativeness will be ensured through the use of appropriate analytical procedures, and analysis of samples performed within the allowed holding times.

Comparability is a qualitative characteristic of the data. By using standard methods for sampling and analyses, data generated in past or future investigations will be comparable with this investigation data.

14.4 Laboratory Data Validation

Review of analyses will be performed. A preliminary review will be performed by the project manager to verify all necessary paperwork (e.g., chain-of-custodies, traffic reports, analytical reports, and laboratory personnel signatures) and deliverables are present. A detailed quality assurance review will be performed by a data validation subcontractor to verify the qualitative and quantitative reliability of the data presented. This review will include a detailed review and interpretation of all data generated by the laboratory. The primary tools which will be used by experienced data validation personnel will be guidance documents, established criteria, and professional judgement.

A quality assurance report stating the qualitative and quantitative reliability of the analytical data will be prepared for NEESA. This report will consist of a general introduction section, followed by qualifying statements that should be taken into consideration for the analytical results to be best utilized. The report will reference NEESA 20.2-047B for applicable guidance, format, and standards.

During the data review, a data support documentation package will be prepared which will provide the back-up information that will accompany all qualifying statements present in the quality assurance review.

Level D analytical methods are specified where applicable. However, it should be noted that the Level D designation applies only to CLP protocol analyses, and thus are limited to TCL organic and TAL inorganic parameters. Some of the analytical methods that will be used, by definition, fall into the Level C designations.

Quality control data provided by the laboratory will be used to evaluate the validity of the analytical data in terms of accuracy, precision, and environmental significance. The

validation subcontractor will apply validation criteria specific to the analytical level determined for the project.

All analytical Level D data (CLP Protocols) will be validated following applicable guidelines.

A CLP data package will be included with Level D data. The following information, as appropriate to the analysis, will be validated for Level D analyses.

- Initial calibration;
- Continuing calibration;
- Matrix spikes/matrix spike duplicates;
- Duplicates;
- Method blanks;
- Raw data;
- Field blanks and duplicates;
- Holding times;
- Surrogates;
- Instrument tuning;
- Retention time;
- Degradation check;
- Compound identification and quantitation; and
- Internal standards.

Parameters analyzed by SW-846 methods will be reported as Level C analyses. Level C analyses will also be reviewed and validated to ensure that it meets the data objectives specified in the work plan. The following information, as appropriate to the analysis, will be validated for Level C analysis.

- Initial calibration;
- Continuing calibration;
- Matrix spikes/matrix spike duplicates;
- Duplicates;
- Method blanks;
- Field blanks and duplicates;

- Holding times; and
- Surrogates.

The categories listed above have identical criteria for evaluation. The criteria identified in the above referenced documents will be used.

- **Blanks:** Blanks are to have less than five times the CRQL for the common contaminants and less than the CRQL for all other compounds. If common contaminants are detected in a sample at a concentration of less than ten times (five times for other compounds) the concentration in the blank, results are flagged as not substantially above the blank level (B). Common contaminants are follows: methylene chloride, acetone, 2-butanone, toluene, and common phthalate esters. The same criteria will apply to Level C and Level D data.
- **Instrument Tuning:** If a tune does not meet the criteria specified in CLP SOW, the data are flagged as unreliable (R). An expanded tune of 25 percent below the low limit and 25 percent above the high limit will be used for Level C analyses.
- **Surrogates:** If two or more surrogates in either of the base/neutral or acid fraction are outside of the criteria and above ten percent or one of the surrogates in the volatile fraction is outside of the criteria and above ten percent, positive results and quantitation limits are flagged as estimate (J and UJ). If the outliers are biased low, positive results and quantitation limits are flagged biased low (L and UL). Positive results are flagged as biased high (K) if outliers are biased high. If one or more surrogates in any fraction is less than ten percent, positive results are flagged as estimate (J) or biased low (L). Quantitation limits may be flagged as unreliable (R) if severe analytical problems are suspected. The same control limits will apply to Level C and Level D data.
- **Internal Standards:** If internal standards are outside of criteria, positive results and quantitation limits are flagged as estimates (J and UJ). Quantitation limits may be flagged as unreliable (R) if reported areas are extremely low, a severe change in performance is indicated, or a severe loss of sensitivity is suspected. This criteria applies to Level D data only.

The following are typical actions to be implemented for data outside the control criteria:

- **Holding Times:** If the holding time is exceeded, all positive results will be flagged as estimated (J) and all non-detects will be flagged as estimated (UJ). If the holding times are greatly exceeded, the data may be rejected. The same holding times will be used for Level C and Level D data validation.
- **Calibration:** If the calibration criteria are exceeded, all positive results will be flagged as estimated (J) and all non-detects will be flagged as estimated (UJ). If the calibration criteria are grossly exceeded, all non-detects may be flagged as usable or rejected (R). The same control criteria will be used for Level C and IV data.
- **Duplicate or Matrix Duplicate:** If laboratory or field duplicate analyses result in a relative percent difference (RPD) greater than the specified criteria, all positive results will be flagged as estimated (J) and all non-detects will be reported unqualified. If one value is non-detected and the other is above the detection limit, all positive results will be flagged as estimated (J) and all non-detects will be flagged as estimated (UJ). The same control limits will apply to Level C and Level D data.
- **Matrix Spike:** If the final analysis results of the matrix spike are greater than the upper criteria limit, all positive results will be flagged as estimated (J) and all non-detects will be reported unqualified. If the final analysis results of the matrix spike are below the lower criteria limit, all positive results will be flagged as estimated (J) and all non-detects will be flagged as estimated (UJ). If the final analysis results of the matrix spike are less than 10 percent of the true concentration, all positive results will be flagged as estimated (J) and all non-detects will be flagged as unusable or rejected (R). The same control limits will apply to both Level C and Level D data.

In addition, field QA/QC samples will be evaluated.

- **Equipment and Trip Blank Evaluation -** Equipment and trip blank results are evaluated for high readings similar to the blanks described above. If high equipment/trip blank readings are encountered (i.e., a value sufficient to result in a difference in sample values, if not corrected, greater than or equal to the smallest significant digit known to be valid), procedures for sample collection, shipment, and laboratory analysis are reviewed. If both the method and the trip blanks exhibit

significant background contamination, the source of contamination is probably within the laboratory. Ambient air in the laboratory and reagents are checked as possible sources of contamination. High equipment blank readings may be due to contaminated sample bottles or cross contamination due to sample leakage and poorly sealed sample containers.

15.0 CORRECTIVE ACTION

Corrective action is taken whenever a nonconformance occurs. A nonconformance is defined as an event which is beyond the limits established for a particular operation by the plan. Nonconformances can occur in a number of activities. Such activities include sampling procedures, sample receipt, sample storage, sample analysis, data reporting, and computations.

The following personnel are responsible for detecting and reporting nonconformances:

- Project Staff - during testing and preparation and verification of numerical analyses.
- Laboratory Staff - during the preparation for analyses, performance of analytical procedures, calibration of equipment and quality control activities.

15.1 Corrective Action

Nonconformances are documented by the person originating or identifying it. Documentation includes the following:

- Identification of the individual(s) originating or identifying the nonconformance.
- Description of the nonconformance.
- Any required approval signatures (initials).
- Corrective action taken.
- Corrective action completion date.

Documentation of the nonconformance and corrective action taken is kept by the analyst and become part of the QA/QC files for the project.

The NEESA contract representative (NCR), along with the contract project director, will be notified of a nonconformance and corrective action taken, if one of the following is true:

- A nonconformance causes a delay in work beyond the schedule completion date.
- A nonconformance affects information already reported.
- A nonconformance affects the validity of the data.

15.2 Limits of Operation

The limits of operation that are used to identify nonconformances are established by the contents of the plan and by control limits produced by statistical analyses. The quality control check samples must compare favorably to the published USEPA or laboratory method performance criteria. For example, the analytical process is out of control and unacceptable if the recovery value is outside the laboratory control limits established by analyzing many standards and performing a statistical analysis of the data. Generally, the control limits are set at plus or minus three times the standard deviation.

16.0 QUALITY ASSURANCE REPORTING PROCEDURES

The Project Manager will be responsible for assessing the performance of measurement systems and data quality related to the Phase I RI. A written record will be maintained of: the results of laboratory QC reports and other periodic assessments of measurement, data accuracy, precision and completeness; performance and system audits; and any significant QA problems and recommended solutions. Each deliverable will contain a QA/QC assessment section. Also, a QA/QC assessment will be performed any time a significant problem is identified. A timetable for the project is presented in the Work Plan.

The contractor's Project Manager will keep in contact with the LANTDIV Engineer-in-Charge and the NSRR Public Works Department/Environmental Engineering Division through informal, verbal reports during the project as well as through monthly progress reports. These reports will include any changes in the QAPP. The final report for the project will include a separate QA section which summarizes data quality information contained in the periodic reports submitted to management and the client.

All reports are managed and secured in accordance with Baker's document control system (DCS). The documents to be managed by the DCS include CTO work plans, cost estimates, design documents, data and reports generated by CTO technical teams, results of laboratory analyses, agency file documents, QA reports, and status reports. The DCS system also provides accountability for field documentation including such items as field logbooks, field data records, sample tags, chain-of-custody records, and photographs.

APPENDIX A
FIELD WATER QUALITY INSTRUMENTS

APPENDIX A
FIELD WATER QUALITY INSTRUMENTS

A. Calibration and Preventive Maintenance

Activity Before Site Visit

Field meters to be used during sampling, specifically the pH and specific conductance/thermistor meters will be checked against the contractor laboratory meters to insure proper calibration and precision response. Thermometers will be checked against a precision thermometer certified by the National Bureau of Standards. These activities will be performed by the contractor laboratory manager. In addition, buffer solutions and standard KCl solutions to be used to field calibrate the pH and conductivity meters will be laboratory tested to insure accuracy. The preparation date of standard solutions will be clearly marked on each of the containers to be taken into the field. A log which documents problems experienced with the instrument, corrective measures taken, battery replacement dates, when used and by whom for each meter and thermometer will be maintained by the contractor's laboratory manager. Appropriate new batteries will be purchased and kept with the meters to facilitate immediate replacement, when necessary in the field.

All equipment to be utilized during the field sampling will be examined to certify that it is in operating condition. This includes checking the manufacturer's operating manuals and the instructions with each instrument to ensure that all maintenance items are being observed. A spare electrode will be sent with each pH meter that is to be used for field measurements. Two thermometers will be sent to each field site where measurement of temperature is required, including those sites where a specific conductance/thermistor meter is required.

Activity at Site

The pH meter must be calibrated a minimum of twice each day using at least two different pH buffer solutions expected to bracket the pH range of field samples. Rinse the probe thoroughly between buffer measurements with distilled water and again after calibration is completed. Record in the field log book what buffer solutions were used. When the meter is moved, check pH reading by measuring the pH value of the buffer solution closest to the expected range of the sample. If the reading deviates from the known value by more than 0.1 standard units,

recalibrate the instrument as described above. If unacceptable deviations still occur, consult the operating manual for remedial course of action.

The specific conductance/thermistor meter is less likely to exhibit random fluctuations and will only require daily checks against a known KCl solution, which should be chosen to be within the expected conductivity range. Note that specific conductance is temperature-dependent and, therefore, the meter readings must be adjusted to reflect the temperature of the standard solution. Thoroughly rinse the probe with distilled water after immersing in KCl standard solution. In addition to daily checks of the conductivity readings, the thermistor readings must also be checked daily. This is accomplished by taking a temperature reading of the KCl standard solution with both the conductivity probe and a mercury thermometer.

Before use, visually inspect the thermometer to assure there is no break in the mercury column. If there is a break, visually inspect the spare thermometer. If both thermometers have a break in the mercury, neither can be used until the break is corrected. This may be done by cooling the bulb until the mercury is all contained in the bulb.

B. Analytical Methods

All field measurements will be obtained in accordance with "Handbook for Sampling and Sample Preservation of Water and Wastewater," EPA-600/4-82-029, September 1982 or "Test Methods for Evaluating Solid Wastes," SW-846, November 1986. The quality assurance procedures for field analysis and equipment are detailed in these documents cited.

APPENDIX B
RESUMES OF KEY PERSONNEL

William D. Trimbath, P.E.
Engineering Manager

EDUCATION: University of Pittsburgh
MSCE, Hydrology and Water Pollution Control, 1978
West Virginia University
BSCE, Civil Engineering, 1974

University of Pittsburgh
Completed Graduate Courses toward Ph.D. in Civil Engineering

REGISTRATION: Professional Engineer, Pennsylvania, 1978

EXPERIENCE:**General Qualifications**

Mr. Trimbath has used his experience in environmental and geotechnical engineering to manage a number of investigation and remediation projects focused on controlling the migration of hazardous wastes. Acting as project manager he has lead multi-disciplined teams to conduct site investigations and feasibility studies of landfills, lagoons, waste impoundments, and contaminated aquifers. These services were performed on RI/FS projects for the USEPA Superfund program, the Department of Defense Installation and Restoration Program, (U.S. Air Force and Navy), the Department of Energy at the Savannah River Plant and Oak Ridge Tennessee, and for the closure of industrial facilities such as the Allied Chemical Baltimore, Maryland Works.

Mr. Trimbath also has served as Project Manager on geotechnical engineering projects for industrial and governmental clients. This work has involved performing engineering analysis based on field testing results and and laboratory testing, in order to present conclusions and recommendations on soil and rock slope stability, settlement, consolidation, mine subsidence, subgrade support, foundation bearing capacities and also on dewatering schemes. A partial listing of other projects is as follows:

Management Experience

- **Program Management:** Managed the Navy CLEAN Program (\$100 million program) for Baker Environmental's work for the U.S. Department of the Navy, Atlantic Division. This entailed providing comprehensive environmental services to investigate, remediate hazardous waste problems at all Navy and Marine facilities that support the Atlantic Fleet. This Program involved developing an office, obtaining a staff of 36 people, managing subcontractors, and developing numerous Program guidance documents.
- **Program Management:** Managed the site investigation and risk assessment activities of five project managers for the remediation of petroleum, oil, lubricant wastes, landfills, and buried fuel tanks at six military bases in Texas and Oklahoma. This involved controlling a budget of \$4 million, the schedules of six projects, maintaining contact on the program level with the client, and also being responsible for the technical content of all deliverables.

- **Staff Management:** Managed both the civil and geotechnical engineering staffs of an environmental engineering firm which contained at a maximum, thirteen professionals. Was responsible for personnel administration, interviewing, scheduling, maintaining quality assurance/quality control measures, overall group budgets, technical quality of deliverables, and also instructing junior level engineers.
- Managed environmental and transportation divisions. Responsibilities included supervising a construction inspection crew, preparing and maintaining a client contact program, preparing technical and financial proposals, coordinating field and laboratory work, managing design personnel, and monitoring project budgets. This work was performed for state and local transportation departments in western Pennsylvania.

Project Management

- Managed the risk assessment and site investigation activities to prepare recommendations for the siting of a composite medical/dental facility at an abandoned disposal site in San Antonio, Texas. The site was previously used for the disposal of petroleum, oil, and lubricant wastes. This project involved studying the migration potential of toluene, xylene, and benzene along with the potential effect of lead as a wind borne contaminant.
- Managed an investigation and feasibility study (RI/FS) of a 60 acre abandoned landfill in New Jersey containing seven million cubic yards of municipal, industrial, and hazardous waste. This landfill was a source of contamination of the underlying aquifer, nearby streams, and conceptual atmosphere. Remediation measures progressed into pre-final design and included preparing design plans for a multi-media cap to withstand settlement of about 6 feet, a groundwater collection and treatment system to extract and treat volatile organics and heavy metals, dredging of a nearby stream to remove contaminated sediments, the capture of landfill gases, and plans to extinguish the fire occurring within the landfill. This work culminated in the preparation of pre-bid documents, construction specifications, plan drawings, quantity tabulations, and process flow diagrams.
- Managed the Berks Sand Pit RI/FS Project to study methods to remediate the groundwater contaminated from the previous disposal of 1,1,-dichloroethylene and 1,1,1-trichloroethane. The project required the investigation of complex groundwater flow paths encountered in the fractured metamorphic bedrock, and the design of a treatment method using airstripping and carbon adsorption techniques.
- Managed the pre-design investigation and conceptual design of a preparation for the remediation of a battery recycling facility in Arcanum, Ohio. This project, performed for the Corps of Engineers and EPA Region V, required the use of a grid system to sample for lead contamination in the soils and groundwater in the site vicinity. A conceptual design is being prepared based on the information contained during the site investigation.

Hazardous Waste Management

- Supervised the construction management and inspection activities for the installation of a clay cap over a former site of a chemical processing facility (Woburn, Massachusetts) demolished under the EPA Superfund Program. This involved soil cap material selection, testing, and installation.
- Prepared closure plans in accordance with CERCLA Guidelines for four waste impoundments containing a mixture of low level radioactive and hazardous wastes at a Department of Energy facility. The pond sediments were designed to be excavated, solidified, and reburied in the original impoundment area.

- Managed the preparation of the engineering design and subsequent construction drawings to excavate and remove five buried 10,000 gallon tanks and adjacent soils as part of a Superfund initial remedial measure (IRM) for a site in Eastern Pennsylvania. This also involved the preparation of bidding documents, construction specifications, design drawings, and also of recommending the qualified bidder.
- Managed the site investigation for the review of petroleum spills resulting from use of a fueling facility at a major international airport. This investigation required the tracking of a petroleum groundwater plume and presenting recommendations and costs for remediation.
- Provided technical assistance and review comments on more than twenty feasibility studies prepared for state and federal agencies in EPA Regions I, II, III, and IV. The reviews covered groundwater contamination, atmospheric emissions, impoundments, stream rehabilitation, leachate treatment, in-situ treatment techniques and incineration methods.
- Managed the sampling, testing, and removal of the contents of ninety-six drums including paint sludges, buffing compounds, and solvents at an abandoned hazardous waste site in South Carolina for disposal by industrial incineration and placement in a landfill cell.

Environmental Assessment

- Developed and conducted a comprehensive environmental audit in preparation of a "tiger team" review at a DOE facility in Pennsylvania.
- Prepared a remediation matrix to demonstrate to an industrial client (Allied Chemical) the various remediation alternatives available in order to close a chromium ore processing facility located along the Chesapeake Bay. The matrix demonstrated how various closure options could satisfy state and federal regulations, and the associated costs for complying with those regulations.
- Prepared final design drawings and specifications for a sanitary landfill for the Department of the Navy. This involved not only the landfill construction drawings, but also electrical, mechanical, and piping plans for auxiliary services such as a truck washing facility, weighing station, and administration building.
- Prepared an environmental assessment of an electronics and metal plating facility in northern Ohio for an industrial client. This assessment included sampling the plant structures, ventilation systems, sewer systems, and soil for the presence of contamination. The environmental condition of the plant will be based on comparing the encountered quantities to the concentrations of those constituents set by federal and state regulations.

Geotechnical Engineering

- Prepared dewatering plans for the construction of a 12' x 6" box culvert to be installed as a storm sewer as part of the East Street Valley Expressway in Pittsburgh, Pennsylvania. The final 500' of this sewer was constructed below the water level of the Allegheny River. Dewatering was performed using a combination of well points and deep wells.
- Conducted investigations to compare the effectiveness of various groundwater containment systems such as slurry walls, sheet pile walls, pumping systems, grouting mixtures, and clay barriers.
- Prepared geotechnical reports based on test boring results and laboratory analysis for highway improvement projects designed to remediate poor subsoil conditions resulting from landslides, mine subsidence, and poor drainage conditions.

- Prepared foundation recommendations for buildings and support structures which involved retaining walls, bridge abutments and piers, parking lots, and deep foundations.

Construction Inspection and Design

- Prepared highway plans and specifications for various projects involving roadway construction over geotechnical problem areas caused by mine subsidence, colluvial material, embankment and excavation stability problems, poor subgrade conditions, and poor drainage areas.
- Served as project manager on six highway construction inspection projects for state, county and municipal agencies. The scope of these projects involved complete pavement base drain replacement, resurfacing, concrete bridge replacement, earthwork, drainage, bridge deck repair, and project documentation.
- Performed the engineering design for 1.3 miles of storm sewers. Prepared a cost analysis of culvert alternatives, prepared a contour and drainage design, and prepared a soil erosion control plan for a proposed highway interchange in central Pennsylvania.
- Prepared hydrologic and hydraulic designs for 66 culverts; calculation of four backwater curves and trackside drainage structures; and preparation of an erosion control plan for a 17 milé rail spur.

Groundwater Investigation

- Managed a groundwater investigation to track the subsurface migration of gasoline and diesel fuel from an underground storage tank.
- Participated in a report to study the detrimental effects on groundwater quality resulting from siting landfills containing power plant ash over drinking water quality aquifers. This study required the use of various groundwater models to estimate the effect of the landfill on the water quality of down gradient receptors.
- Prepared a comparative study of the advantages and disadvantages of using finite differences and finite element groundwater modeling methods to estimate the drawdowns of a partially penetrating well in an unconfined aquifer.
- Participated in an environmental assessment of the impact of thirty-four disposal facilities at an active DOE facility to demonstrate the effect that various closure methods would have on the aquifers located below the site. This required a search of currently available remediation measures to assess their effectiveness in removing heavy metals (mercury), and volatile organics that could migrate into the groundwater.

MEMBERSHIPS:

American Society of Civil Engineers
American Society of Civil Engineers, Pittsburgh Geotechnical Group
Chairman, 1986-1987
Project Management Institute
National Society of Professional Engineers
Pennsylvania Society of Professional Engineers
Society of American Military Engineers, Environmental Action Committee
Pittsburgh Geological Institute

William D. Trimbath, P.E.
Page 5

PRESENTATIONS:

"Retrofitting Existing Hazardous Waste Disposal Facilities to Comply With RCRA Regulations," Technology Transfer Seminar, Oak Ridge, Tennessee.

"Effect of RCRA and CERCLA Regulations on Real Estate Transfers," Technology Transfer Seminar, Baltimore, Maryland.

"Case Study: RI/FS of a 60 Acre Landfill," U.S. Air Force Affirm Committee Meeting, Rockville, Maryland.

"Effect of 1984 RCRA Amendments on Existing Disposal Facilities," Pennsylvania Chamber of Commerce, Harrisburg, Pennsylvania.

PUBLICATIONS:

"Site Investigation and Remediation of a Fuel Oil Spill," Mid-Atlantic Hazardous Waste Conference, 1990.

PROFESSIONAL AFFILIATIONS:

**American Society of Civil Engineers
American Society of Civil Engineering, Pittsburgh Section**

John W. Mentz
Project Manager

EDUCATION: Pennsylvania State University
B.S., Geology, 1972

EXPERIENCE:**General Qualifications**

Mr. Mentz is a Senior Project Manager with over 20 years experience in project and program management. He has gained extensive experience and progressive responsibility in a variety of geotechnical areas, including evaluation and remediation of contamination of soil, surface water, and groundwater by hazardous and mining waste; geological investigations to assess/predict groundwater conditions, evaluate mining problems, and define coal and other mineral resources; underground well injection; inventories of various mining-related features with potential adverse health, safety, and environmental consequences; regulatory assessment and compliance; and impact assessments. His program and project management experience is summarized below by technical area:

Hazardous Waste Experience

- Deputy Program Manager for Baker's Comprehensive Long-Term Environmental Action Navy (CLEAN) Program, providing technical leadership, program and administrative guidance, and program-level quality assurance/quality control for over 100 active and pending tasks. Program activities address CERCLA, RCRA, UST, and a variety of other issues throughout the Atlantic Division, Naval Facilities Engineering Command stateside and in the Caribbean, Atlantic, and Mediterranean.
- Project Manager for Installation Restoration Program Stage 2 Remedial Investigation at Dover AFB, Delaware. Conducted for the U.S. Air Force Occupational and Environmental Health Laboratory, this program included 12 individual sites -- fuel spills/leaks, former landfill and construction rubble fills, fire training areas, and hazardous material storage areas.
- Project Manager for Installation Restoration Program Remedial Investigation/Feasibility Study and UST Removal Program at Lowry AFB, Denver, Colorado. This program included 7 sites - landfills, fire training areas, former coal and fly ash disposal areas, an auto hobby shop, and an UST area.
- Project Manager for Installation Restoration Program Phase II, Stage 1 Confirmation/ Quantification Study at Charleston AFB, South Carolina. Ten sites here included landfills, hazardous material spill and storage areas, and PCB spill sites.
- Task Manager for soil, surface water and sediment characterization survey at the U.S. Department of Energy's Pittsburgh Energy Technology Center.
- Led the effort to develop and summarize potential site characterization costs for 81 mixed-waste CERCLA sites at DOE's Hanford, Washington Reservation, and coordinated a prioritization and scheduling analysis of the Hanford CERCLA sites.

- Managed studies at several Superfund sites, including feasibility study field support for an industrial facility/Superfund site in southeastern Pennsylvania with contaminants emanating from leaking underground TCE and fuel oil storage tanks.
- Managed a hydrogeologic testing program that generated data necessary for implementation of a groundwater recovery/treatment program.
- Evaluated the feasibility of various alternatives for cleanup of TCE-contaminated soils and groundwater at an abandoned solvent recovery facility near Dover, Delaware.
- Participated in cleanup of TCE-contaminated soils via excavation and removal at one site, excavation and soil aeration (shredding) at another site. Both projects included pre- and post-remediation groundwater monitoring.
- Designed and completed a groundwater monitoring program at an industrial research facility to identify the presence and movement of contaminants toward two adjacent municipal pumping wells.
- Evaluated a subsurface gasoline spill and subsequent implementation of a recovery program.
- At Lowry AFB, coordinated location and sampling of contents of 19 abandoned USTs. Managed completion of UST removal pre-design survey and preparation of draft plans and specifications for UST removal.

Underground Injection Control

As Program Manager for a USEPA/ODW, Groundwater Protection Branch technical support contract, Mr. Mentz gained valuable experience with the Agency's Underground Injection Control Program, which was initiated to ensure proper regulation of underground injection of both hazardous and nonhazardous wastes. That contract provided technical and training support to EPA Headquarters and a number of the Agency's regional offices. Mr. Mentz coordinated all contract efforts and provided technical input during execution of tasks.

Mining Related Studies

A broad range of studies designed and conducted by Mr. Mentz were aimed at assessing surface water and groundwater resources to quantify mining-related pollutants (chemical and sediment), pinpoint sources of those pollutants and project pollution production potential, and recommend pollution abatement/control strategies. Such projects have included:

- Investigation of methods to improve performance of surface mine sedimentation basins.
- Technical and economic evaluation of available mine closure alternatives.
- Assessment of partial inundation of abandoned sections of underground mines to reduce pollution formation.
- Portions of an Office of Surface Mining "Abandoned Mined Lands Reclamation Control Technology Handbook," which discussed mine drainage control and sealing of underground openings.
- Investigation of a borehole dewatering system to control fracture-dominated groundwater inflow into active underground mines.

Mr. Mentz has extensive experience in planning and conducting inventories of various active and inactive mining-related features. He has conducted inventories of abandoned surface and underground coal mines and resultant pollution, waste piles, subsidence, and other hazardous features in Pennsylvania, West Virginia, Maryland, Ohio, Kentucky, and western Colorado (non-coal mines). Mr. Mentz managed an inventory of active coal waste embankments in West Virginia, Maryland, Virginia, and Eastern Kentucky. He also coordinated a nationwide assessment of off-site coal-handling facilities.

In addition, Mr. Mentz led the team that developed content requirements and format guidelines of state abandoned mined land reclamation plans for the U.S. Office of Surface Mining in compliance with 30 CFR 884.13. That effort included development of a model state plan to guide state reclamation agencies in the preparation of their state plans for OSM submission.

Mr. Mentz has extensive experience in the area of mineral resource evaluation. He has conducted or participated in many site-specific coal resource evaluations throughout Appalachia and in Texas. He also conducted analyses of all four Pennsylvania anthracite fields and a 3,700-square mile portion of central Pennsylvania's bituminous coal fields. In addition, he has managed or participated in numerous non-coal resource evaluations at specific sites for limestone, sandstone, and uranium.

John Barone, P.G.
Senior Geohydrologist

EDUCATION: University of Delaware
Master of Science, Geology, 1978
Bachelor of Science, Geology, 1975
Bachelor of Arts, Philosophy, 1969

REGISTRATION: Certified Professional Geologist:
Indiana
North Carolina

EXPERIENCE:**General Qualifications**

Mr. Barone has served as a professional geologist active in programs involving physical geology, geohydrology, geochemistry and geophysics for over 17 years. During that time, he has performed in various capacities, including: Principal Technical Investigator for development of general groundwater supplies and of protection for groundwater supplies threatened by salt-water intrusion along coasts and elsewhere; Project Manager and Project Director for multidisciplinary scientific and geotechnical programs addressing contaminated environments related to Remedial Investigations and Feasibility Studies for action at Navy CLEAN, CERCLA, RCRA, UMTRAP, FUSRAP and USATHAMA sites; Project Manager and Project Consultant for major geoscience and regulatory response programs; and Project Director for preparation of environmental permit applications for large industrial operations.

His dominant specialization is in the field of environmental geology and engineering, and regulatory affairs, although he also has considerable experience in traditional geologic practices (particularly in the development and protection of groundwater supplies) and in engineering geology. During his career, he has performed investigations of and provided site management for interdisciplinary scientific and engineering programs concerning the presence and effect of hazardous chemicals and radioisotopes in ground and surface waters, and in soils. His representation for consultation and technical services includes a variety of clients: Large and small industrial corporations; federal and local governmental administrations; legal firms and regulatory agencies; and nuclear and conventionally fueled power stations. These services range through preparation of programs for regulatory compliance, design of remedial action programs, technical Quality Assurance/Quality Control, design and evaluation of secure (chemical and radiological) and sanitary landfills, evaluation of groundwater resources, and precision investigation of natural and artificial subsurface structures for geotechnical stability. His responsibilities extend across all phases of projects, beginning with the preparation of the technical program and budget, and continuing through the detailed execution of the program to the preparation and presentation of the final report, both to the client and to any government agency concerned with the program. The major emphasis of this practice continues its focus on field investigation and the development of environmental response, based on the results of those investigations.

Contaminant Investigation and Remedial Design**Responsibilities**

Technical QA Officer for Navy CLEAN site investigations; Principal Technical Investigator, Project Manager and Principal Author for CERCLA and RCRA programs of site characterization and of investigation for

engineering design for remedial action involving contamination by inorganic and synthetic organic compounds; participation requires extensive interaction with various disciplines as the coordinator and executant of the project administration and the technical program, including performance of the investigation leading to characterization of the environment, engineering design and preparation of the various documents controlling the program and reporting its findings; these disciplines include geology, geohydrology, geochemistry, geophysics, geotechnical engineering, analytical chemistry, toxicology, and site health and safety

Major Programs

- U.S. Navy: Various Stations - Principal Investigator for site investigations and preparation of responses at facilities adversely affected by hazardous materials.
- U.S. Navy: Various Stations - Technical QA Officer for environmental investigations performed by Baker, Roy F. Weston, Inc., and Foster Wheeler Enviresponse, Inc., under the Navy CLEAN Program.
- Clean Sites, Inc.: MSGS Superfund site - Principal Geologist and Principal Site Investigator for final remedial design and implementation at a site characterized by inorganic and organic contamination of the groundwater environment, dealing with the industries principally responsible for the remedial action
- USX/USS: Fairfield Works - Project Manager and Principal Investigator for a multi-phase compliance program dealing with groundwater contamination around a closure area for disposal of organic and inorganic chemical compounds
- USX/USS: Clairton Works - Project Geologist and Principal Investigator for a multi-disciplinary geologic and engineering implementation of closure of a disposal area, including geotechnical characterization of the construction area and characterization of the groundwater environment contaminated by organic compounds
- USX/USS: Gary Works - Investigating Geologist for siting of a slag fill area and for dredging operations of an adjacent river
- USX/USS: Various Locations - Project Geologist for a variety of RCRA permit applications and compliance programs
- Bethlehem Steel: Bethlehem Plant - Principal Investigator and Project Manager for Clean Streams investigations of RCRA closure systems associated with contaminated groundwater
- Bethlehem Steel: Various Locations - Project Geologist for closure of disposal facilities adversely affecting groundwater quality; site characterization of groundwater contamination deriving from manufacturing and disposal operations
- Buckeye Pipeline: Fairfield, Pennsylvania - Principal Geologist for groundwater investigation and remediation of a catastrophic fuel spill, including the geotechnical engineering response
- LTV Steel: Aliquippa Plant - Project Geohydrologist for examination of the effectiveness of groundwater recovery by pumping of a contaminated regime

- **Celanese Fibers: Various Locations - Project Consultant for Geohydrology and Principal Author for CERCLA Remedial Investigations and Feasibility Studies of extensive contamination by inorganic and synthetic organic compounds associated with chemical manufacturing**
- **Department of Energy: Oak Ridge National Laboratory - Project Consultant for Geohydrology in assessing groundwater quality adversely affected by plant disposal operations**
- **Department of Energy: Canonsburg Site - Site Manager for final, multidisciplinary investigations leading to remedial design and implementation of corrective action at a low-level radiation site affecting soils and groundwater quality**
- **Department of Energy: Largo Site - Project Consultant for Geohydrology characterizing the groundwater regime at a low-level radiation site and developing the remedial response measure of groundwater extraction and treatment**
- **US Army Corps of Engineers: Various Locations - Project Geohydrologist for characterization of groundwater environments degraded by creosote disposal at wood-processing sites**
- **General Electric: Hudson River - Site Manager for groundwater and surface water investigations of degradation by PCB releases during manufacturing and disposal**
- **United State Environmental Protection Agency, Region III: Geohydrologist for Regional RCRA compliance programs**
- **New Jersey Department of Environmental Protection - L&D Facility - Project Geohydrologist for site characterization of a State Superfund Remedial Investigation**
- **Pennsylvania Department of Environmental Resources - Berks Site - Project Geohydrologist for characterization of aquifer parameters leading to remedial design at a State Superfund Site**
- **Pennsylvania Department of Environmental Resources - GTAC: Various Locations - Project Consultant for Geohydrology for various State Superfund locations dealing with groundwater resources and contamination**

Client Representation

- USS Division of USX:	various locations
- Bethlehem Steel:	various locations
- LTV Steel:	Aliquippa Plant Massillon Plant
- Clean Sites:	MSGS Site, Elkton, Maryland
- DuPont:	coastal Virginia
- Upjohn Pharmaceuticals:	western Michigan
- Celanese Fibers Operations:	various locations
- Eastman Kodak:	eastern Tennessee
- EM-S/MCB:	southern Ohio
- Aristech:	Haverhill, Neville Island
- Morton-Thiokol:	Plumsted CERCLA Sites
- Northern Petrochemical:	southern Illinois
- General Electric/NYDEC:	upstate New York
- Peoples Gas:	southern Florida

- Florida Power and Light: southern Florida
- NYS Electric and Gas: Finger Lakes, New York
- General Electric/DOE-FUSRAP (weapons): western Florida
- National Lead/DOE-UMTRAP (research): western Pennsylvania
- DOE: Oak Ridge, Paradox Basin
- US Army, Corps of Engineers: various locations
- Marathon Oil: eastern Michigan
- CPS Chemical: coastal New Jersey
- Colonial Pipeline: central Virginia
- Buckeye Pipeline: western Pennsylvania
- Freeport Mineral: southern Louisiana
- Square D: western North Carolina
- RJ Reynolds: western North Carolina
- USEPA: various locations
- Pennsylvania DER-GTAC: various CERCLA locations
- Illinois DEM: central Illinois
- New Jersey DEP-CERCLA: L&D site, Berks site
- B.F. Goodrich: eastern Pennsylvania
- Champion Spark Plug: eastern Pennsylvania
- Cessna Aircraft: northern New Jersey
- IBM: eastern New York
- Maxwell House: coastal New Jersey

Environmental Audits

Responsibilities

Preparation of preliminary environmental audits of soils and groundwater for purchase and sale of industrial properties

Client Representation

- Carrier: various locations, Georgia
- Bridgestone/Firestone: various locations
- TLI: South Carolina
- USPCI: northern Pennsylvania
- Goodyear: eastern Ohio
- Pennsylvania Power and Light: Pennsylvania
- Post Properties: central Georgia

Groundwater Supply

Responsibilities

Traditional geohydrology services (not related to contamination) for municipal water supplies

Client Representation

- Fairfax County, Virginia
- Holland Township, New Jersey
- New Jersey Department of Natural Resources, various locations

- Stanhope, New Jersey
- Elizabethtown Water Company, New Jersey
- Delaware Department of Water Resources, various locations
- Delaware Geological Survey, various locations
- Collegeville, Pennsylvania
- Longwood Gardens, Pennsylvania

Groundwater Protection

Responsibilities

Design and conduct investigations of salt-water intrusion in coastal zones; design and implement protection programs for groundwater resources threatened in the coastal zone.

Client Representation

- Sussex County, coastal Delaware
- SME, coastal Georgia and South Carolina
- DER - Biscayne Aquifer, Florida
- Naples, Florida

Geotechnical Structure and Groundwater Programs

Responsibilities

Design and implementation of programs for subsurface protection of Category I structures at a nuclear power station; geologic and structural geologic analysis of rock stability for construction; visual investigations of exposed and underwater dam and saddle-dike structures

Client Representation

- Davis-Besse NPS: northern Ohio
- Convention Center/West Way: New York City
- Merrill Creek Dam: western New Jersey
- New Jersey Department of Natural Resources - Artificial Lakes
- Greater Pittsburgh International Airport: geotechnical exploration for construction

Additional Technical Qualifications

Hazardous Site Investigation Course - 40-Hour
Hazardous Site Management Qualification - 8-Hour
Cardiopulmonary Resuscitation Course - Red Cross
Basic First Aid - Red Cross
Private Pilot (ASEL): Federal Aviation Administration
SCUBA (Basic): PADI

S. Charles Caruso**Senior Chemist and
Laboratory Quality Assurance Officer**

EDUCATION: University of Pittsburgh
Ph.D., Organic Chemistry
Alfred University
B.A., Chemistry

EXPERIENCE:**General Qualifications**

Mr. Caruso has had more than 35 years experience in environmental chemistry. This experience includes: the development of analytical methods for monitoring contaminants present in environmental media including the associated quality assurance/quality control (QA/QC) elements, the supervision of an environmental analytical laboratory used in support of environmental research projects for the iron and steel industry, as well as several water quality surveys of river basins and lakes.

As a consulting chemist with a consulting engineering firm, he participated in environmental surveys and compliance audits of major facilities of the U. S. Department of Energy. His specific responsibilities included the review of QA/QC procedures for the sampling and analysis of environmental samples with on-site audits of the analytical chemistry laboratories, as well as the evaluation of national laboratories and defense facilities for compliance with the Toxic Substances Control Act and the Superfund Amendments and Reauthorization Act. He also validated data from Superfund sites and Air Force bases.

In his current position, Mr. Caruso has written a Laboratory Quality Assurance Plan for the Navy CLEAN Program, assisted in the preparation of Quality Assurance Project Plans, evaluated laboratory data, and prepared the Statements of Work to establish Basic Ordering Agreements with analytical laboratories to provide analytical services for the Underground Storage Tank and Installation Restoration Programs. His responsibilities include monitoring the performance of the analytical laboratories to ensure their adherence to QA/QC procedures, verifying that all analyses are conducted in accordance with the proper methods and level of QA/QC to obtain the required precision and accuracy, as well as verifying the acceptability of the laboratory data.

Project Experience

- Participated in the DOE/OEA Environmental Surveys conducted at the Fermi National Accelerator Laboratory, the Paducah Gaseous Diffusion Plant, the Oak Ridge Gaseous Diffusion Plant, and the Santa Susana Field Laboratory with responsibility for the QA/QC (sampling and monitoring) and toxic substance control aspects of the surveys.
- Participated in the DOE Tiger Team Environmental Assessments conducted at the Lawrence Livermore National Laboratory, the Sandia Livermore National Laboratory, the West Valley Demonstration Project, and the Argonne National Laboratory with responsibility for the QA/QC (sampling and monitoring) and the toxic and chemical materials aspects of the assessments.

- Participated in the DOE Environmental Audits of the Western Area Power Administration-Phoenix Division, and the EG&G Environmental Measurement facilities at Santa Barbara, California, as well as Nellis Air Force Base, and North Las Vegas, Nevada.
- Prepared Toxic Chemical Release Inventory Forms (Form Rs) in accordance with 40 CFR 372 (SARA) for three chemical plants. The releases were estimated using mass balance calculations, published emission factors, and engineering estimates.
- As a Senior Scientist and Manager of an environmental research group at Mellon Institute, supervised and directed many studies concerned with water pollution abatement, air pollution control, and the management of hazardous wastes.
- Served as an advisor to an industrial committee of analytical chemists and assisted in the preparation of a QA/QC manual.
- Supervised and participated in a study concerned with the significance of forest vegetation and soil type to the acidification of soil and surface waters.
- Conducted a study to evaluate used oils for the presence of hazardous substances. Many types of process and lubricating oils used in industrial plants were analyzed for toxic compounds. Also, became familiar with the proposed and promulgated regulations concerning used oils.
- Conducted a research study to control the emission of nitrogen oxides from industrial processes utilizing nitric acid mixtures. Some oxidation/reduction reactions were evaluated to prevent or minimize the NO_x emissions.
- Directed a program for the development of processes to detoxify or encapsulate hazardous wastes prior to storage or disposal. Also, characterized many industrial wastes by approved EPA methodology and assisted plants in the delisting of some wastes.
- Directed a program concerned with fugitive dust control at industrial plants. This study led to the formulation of two new generic dust suppressants that were field-tested on unpaved roads at an industrial plant. One of these products is being used at several locations.
- Supervised the development of biological treatment processes for industrial wastewaters to control phenols, cyanides, and nitrogen compounds. This project consisted of laboratory and pilot plant studies.
- Directed a survey of the wastewaters generated by a major industry for "priority pollutants." This project included the qualitative and quantitative determinations of organic and inorganic substances. The organic compounds were determined by gas chromatographic/mass spectrometric techniques. The required quality assurance/quality control procedures were followed to ensure valid data.
- Supervised the evaluation of air pollution control equipment for sinter plants, basic oxygen furnaces, and processes for the desulfurization of coke oven gas.
- Evaluated physical/chemical methods for the control of pollutants in some industrial wastewaters. Processes were evaluated to control ammonia, solids, cyanides, phenols, and metals to comply with the EPA effluent limitations guidelines.
- Developed analytical methods for monitoring cyanides and trace organic compounds in surface waters and in industrial wastewaters. These methods were required by industrial plants for monitoring

purposes, were necessary for a specific research study, or were required for a water quality survey. These methods included appropriate QA/QC procedures.

- Conducted feasibility studies for the combined treatment of industrial and municipal wastes by physical chemical methods. This study was carried out with a sewage treatment plant in the Cleveland, Ohio area.
- Assisted in the evaluation of a prototype larry car to reduce emissions during the coal-charging phase of coke making. The emissions were collected and analyzed for polynuclear aromatic hydrocarbons and coal-tar-pitch volatiles.
- Conducted a series of studies relating to taste-and-odor problems at potable water treatment plants in the Ohio River basin. These studies were concerned with the identification of organoleptic compounds, a determination of their source, and the measurement of the kinetics of the chlorination of phenols during water disinfection.
- Planned and participated in many water quality surveys of rivers and lakes in the Ohio River basin, and of southern Lake Michigan, over a period of years. A mobile laboratory was designed and equipped to carry out many types of chemical analyses for organic and inorganic pollutants at the survey sites.

MEMBERSHIPS

American Association for the Advancement of Science
American Chemical Society
 Chairman, Pittsburgh Section, 1978-1980
 Chairman, Division of Environmental Chemistry, 1967-1968
American Society for Testing and Materials
Pittsburgh Chemists' Club
Sigma Xi
Society of Analytical Chemists of Pittsburgh

PUBLICATIONS

Authored or coauthored more than 70 technical papers and major reports to industrial and government sponsors.