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EPA CONTRACT NO. 68-W6-0042
EPA WORK ASSIGNMENT NO. 032-TATA-0105

EPA Project Officer: Diana King
EPA Remedial Project Manager: Richard Goehlert

FINAL SAMPLING AND ANALYSIS PLAN FOR TECHNICAL ASSISTANCE

Ottati and Goss/Kingston Steel Drum Superfund Site
Kingston, New Hampshire

May 1999

Prepared By:

M&E
AQUA ALLIANCE

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FINAL SAMPLING AND ANALYSIS PLAN
TECHNICAL ASSISTANCE
OTTATI AND GOSS/KINGSTON STEEL DRUM SUPERFUND SITE

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KINGSTON, NEW HAMPSHIRE

FINAL SAMPLING AND ANALYSIS PLAN
FOR TECHNICAL ASSISTANCE

DISTRIBUTION LIST

EPA Remedial Project Manager: Mr. Richard Goehlert

EPA Project Chemist: Mr. Andrew Beliveau

M&E Work Assignment Manager: Ms. Karen Wedlock-Hunt

M&E Project Scientist: Mr. William Buelow

M&E RAC Lead Chemist: Mr. Bruce Livingston

M&E Field Sampling Team

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TITLE AND APPROVAL PAGE

OTTATI AND GOSS/KINGSTON STEEL DRUM SUPERFUND SITE
KINGSTON, NEW HAMPSHIRE

FINAL SAMPLING AND ANALYSIS PLAN
FOR TECHNICAL ASSISTANCE

EPA Contract No. 68-W6-0042
EPA Work Assignment No. 032-TATA-0105

Prepared By:

Metcalf & Eddy, Inc.
May 1999

Revision No. 1

Approved By:

M&E Work Assignment Manager: Ms. Karen Wedlock-Hunt	Signature and Date
M&E RAC Lead Chemist: Mr. Bruce Livingston	Signature and Date
M&E Quality Assurance Manager: Mr. Steven Johnson	Signature and Date
EPA Remedial Project Manager: Mr. Richard Goehlert	Signature and Date
EPA Quality Assurance Chemist:	Signature and Date

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1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) has been prepared to ensure that all sample collection and data generation activities associated with Metcalf &Eddy's (M&E) performance of technical assistance activities at the Ottati and Goss/Kingston Steel Drum Superfund Site yield data that are of adequate quality for their intended use. The necessary components of the Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP) have been incorporated in conjunction with the guidelines outlined in EPA's Requirements for Quality Assurance Project Plans (U.S. EPA, 1997) to serve as the foundation for this plan.

1.1 Project/Task Organization

The project organization chart for field and related activities is presented in Appendix A (Figure A-1). The key individual responsible for quality assurance (QA) at M&E is the Program QA Manager. For this project, analytical results will be reported directly to the M&E Lead Chemist who is in contact with the M&E Work Assignment Manager. If necessary, QA issues will be discussed with the Program QA Manager, Work Assignment Manager, and Lead Chemist. The Field Team Leader is responsible for overseeing the implementation of the project objectives during field activities. The Field Team Leader reports directly to the Work Assignment Manager. Other key roles of responsibility are described in Appendix A.

1.2 Problem Definition/Background

The Ottati & Goss/Kingston Steel Drum Superfund Site is located in Kingston, New Hampshire, west of state highway Route 125 (Figure 1-1). The site is approximately 35 acres in size and is divided into two sections; 28 acres owned by the Senter Transportation Company and 5.88 acres owned by the Kingston Steel Drum (KSD)/Great Lakes Container Corporation (GLCC). In 1978, the Senter Transportation Company leased a one-acre parcel to Ottati & Goss, Inc. Portions of the site have been used for storage and/or reclamation of barrels containing solvents and other organic chemicals.

A number of studies have been conducted since the 1980s to investigate contamination at the site. In the early 1990s the site was taken over by EPA and NHDES, who have worked to design two areas for Remedial Action: groundwater and soils/sediments. The design for groundwater Remedial Action was completed in 1996 and the design for the Remedial Action for the soils/sediment was completed in December 1997 and both will be implemented by the U.S. Army Corps of Engineers.

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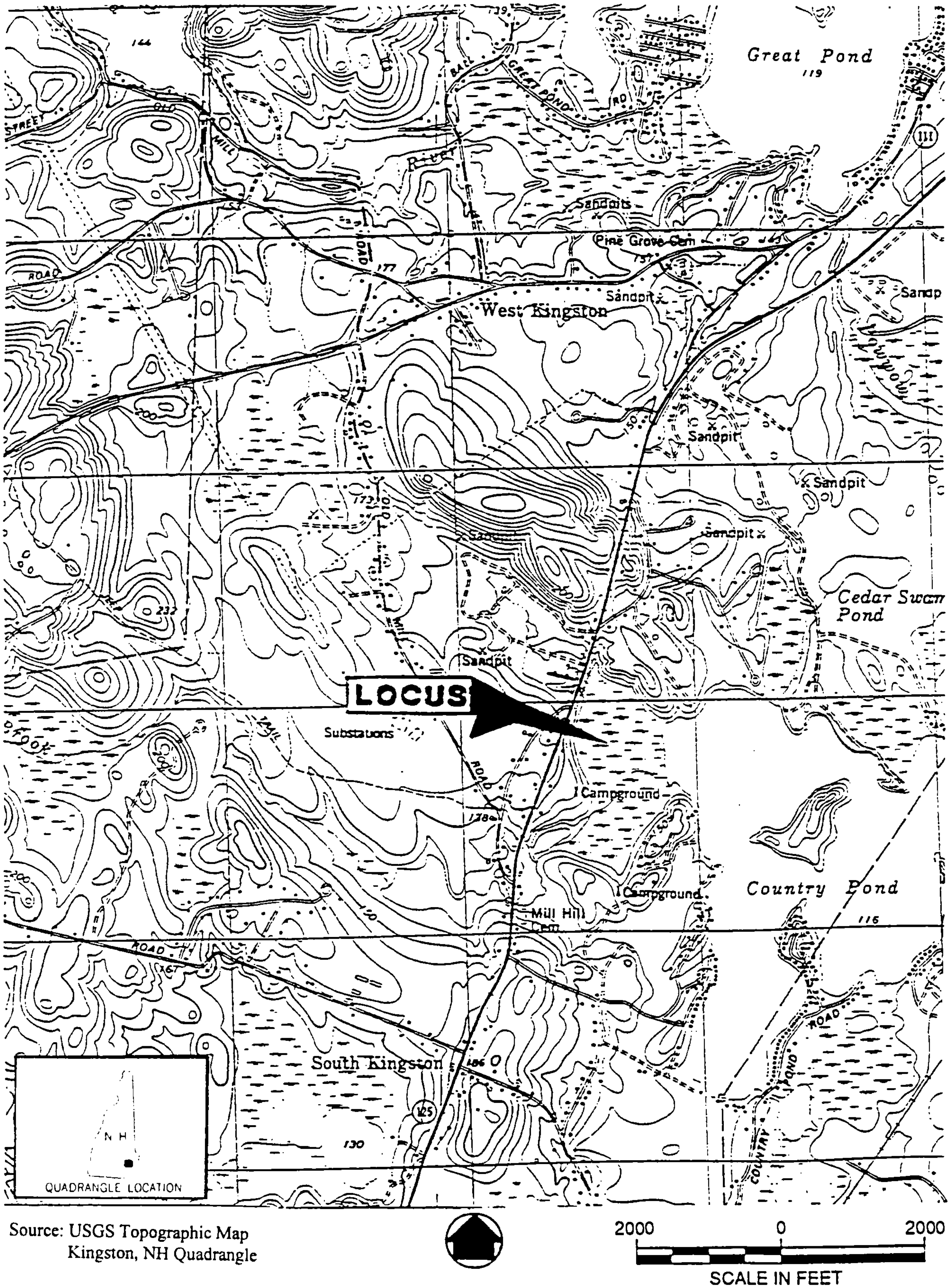

Source: USGS Topographic Map
Kingston, NH Quadrangle

FIGURE 1-1. SITE LOCATION MAP

The objective of this work assignment is to provide technical assistance to EPA and U.S. Army Corps of Engineers (USACE) during Explanation of Significant Differences (ESD) or Record of Decision (ROD) Amendment. Issues to be addressed during technical assistance may include: a change from incineration to thermal desorption, assessment of future use of the KSD portion of the site, increasing the area of the marsh to be remediated, east of Route 125, to be remediated, and a reassessment of the cleanup level for the marsh/sediment.

1.3 Project Task/Description and Schedule

In response to the completion of the design for groundwater remedial action and the reactivation of the design for soils and sediment remediation, which will be performed by the Corps of Engineers, M&E has been requested to provide technical assistance to support the U.S. EPA and the Corps of Engineers during several changes that will require a formal change to the ROD signed in 1987.

As a result, M&E has been tasked with various sample collection activities, the results of which will fill data gaps and provide necessary information to assist U.S. EPA and the Corps of Engineers during ESD or ROD Amendment. In addition, another objective of the sample collection activities is to provide data to prepare a FS Addendum Report and perform an evaluation of the potential for natural attenuation at the site.

Three field activities will require the services of subcontractors to support field work: test pit excavation, surveying, and waste disposal. The specific requirements of the services are outlined in M&E's Draft Work Plan for Technical Assistance (M&E, 1998).

The following schedule is anticipated for field activities, all of which are expected to occur before December 1999:

- Surface and Subsurface Soil Sampling -- August 1998 (1 week)
- Piezometer Installation -- September 1998 (less than 1 week)
- Piezometer Water Elevation Measurements -- One round in 1998 and three rounds in 1999 (1 day each)
- Sediment Sampling (Phase 1) -- September/October 1998 (less than 3 weeks)
- Sediment Sampling (Phase 2) -- December 1998 (2 weeks)
- First Round of Groundwater Elevation Measurements and Sampling -- June 1999 (2 weeks)
- Second Round of Groundwater Elevation Measurements and Sampling -- October 1999 (2 weeks)

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1.4 Quality Objectives and Criteria for Measurement Data

Comprehensive quality assurance (QA) objectives have been developed to provide guidelines for field and laboratory procedures conducted in support of the technical assistance program for the site. The intention of the field program is to produce data of acceptable quality to provide usable data for characterizing current contamination, hydrogeologic and other site conditions.

The primary QA objective for the field program is that all measurements be representative of the actual site conditions and that all data resulting from field, sampling, and analysis activities be comparable. The use of accepted, published sampling and analysis methods as well as the use of standardized units aid in ensuring the comparability of the data.

As is described in Section 2.4, two types of analytical services will be used to analyze samples collected by M&E: EPA Contract Laboratory Program (CLP) Routine Analytical Services (RAS) and Delivery of Analytical Services (DAS). For RAS analyses, the laboratory methods will be performed in accordance with the current CLP Statements of Work (SOWs):

- *Contract Laboratory Program, Statement of Work for Organics Analysis (Multi-Media/Multi-Concentration). Document No. OLM01.0 including revisions OLM01.1 through OLM03.2.* (U.S. EPA, 1994b) and subsequent revisions
- *Contract Laboratory Program, Statement of Work for Low Concentration Water Analysis (Multi-Media/Multi-Concentration). Document No. OLC02.1.* (U.S. EPA, 1996a)
- *Contract Laboratory Program, Statement of Work for Inorganics Analysis (Multi-Media/Multi-Concentration). Document No. ILM01.0 including revisions ILM01.1 through ILM04.0.* (U.S. EPA, 1993) and subsequent revisions

For DAS analyses, DAS specifications describing the laboratory method requirements and reporting limits are provided in the Appendix B. Reporting limits for the RAS analyses are presented in Appendix R. A description of the field test kit methods are presented in Appendix P and the reporting limits for the field analytical methods are presented in Appendix O.

The following Data Quality Objectives (DQOs) have been set for this sampling project:

- To obtain groundwater analytical data that is of sufficient quality and quantity to supplement previously collected groundwater data which will be used to determine current trends in the nature and extent of groundwater contamination at the site. In addition, the samples will provide adequate data for a risk assessment addendum and evaluation of the potential for natural attenuation of contaminated groundwater at the site. The laboratory analytical parameters include: methane, ethane, ethene, selected water quality parameters, volatile organic compounds, and pesticides/PCBs.

- To obtain soil analytical data that is of sufficient quality and quantity to supplement previously collected soil data, perform a risk assessment addendum, and determine the horizontal and vertical limits of contamination in support of evaluating the limits of excavation in the remedial design. The analytical parameters for soil samples include volatile and semivolatile organic compounds, pesticides/PCBs, and metals, including hexavalent chromium.

- To obtain sediment analytical data that is of sufficient quality and quantity, which addresses high moisture content, to provide usable data to perform a risk assessment addendum and determine the horizontal and vertical limits of contamination in support of evaluating the limits of excavation in the remedial design. The moisture content of the sediment samples will be reduced in the field, prior to sample shipment to the laboratory. Combinations of: decanting, sample dewatering (on absorbent paper), and sieving will be employed to reduce the moisture content. The analytical parameters for sediments include pesticides/PCBs and metals, including hexavalent chromium.

In order to achieve the DQOs, a combination of laboratory services and field testing will be used. These methods are described in detail in Section 2.0. A summary of the field screening and laboratory services are discussed below:

- Field screening will provide the least rigorous data quality, but the fastest results, and will be used at the site for health and safety monitoring, preliminary screening of excavation soils/sediments and well headspace, and analysis of the natural attenuation parameters which, by their nature, require immediate analysis. A flame ionization detector (FID) and/or a photoionization detector (PID) will be used to monitor organic vapor levels. Field measurements of pH, oxidation-reduction potential (ORP), conductivity, and dissolved oxygen (DO) will also be obtained using a flow-thru cell meter, and measurements of turbidity will be made using a turbidimeter. Ferrous iron and sulfide will be measured in groundwater and PCBs will be measured in soil, using field test kits. The field test kit which will be used for the PCB soil analysis will be the Strategic Diagnotics Inc. ENSYS PCB Extraction and Soil Test Kit which will have a detection limit of 2 ppb. Ferrous iron and sulfide will be measured using colorimetric analyses in test kits from HACH Company of Loveland, Colorado. Detection ranges for ferrous iron and sulfide using the HACH test kits are listed by the manufacturer as 0-3.00 mg/L and 0-0.600 mg/L, respectively. Test kit procedures to be used are outlined in

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Appendix P. In addition, groundwater elevation measurements will also be obtained.

- CLP RAS analysis, which provides the highest level of data quality, will be used for risk assessment and either ESD or ROD Amendment. Included are standard CLP RAS methods. All environmental samples analyzed through the CLP RAS system will be laboratory reported and validated to provide the highest data quality.

- Non-CLP methods will be used for the DAS analysis of volatile organic compounds, methane, ethane, ethene, pesticides/PCBs, toxic PCB congeners and total homologues, metals, hexavalent chromium, sulfate, nitrate, nitrite, chloride, total organic carbon, and alkalinity. The DAS analyses will require laboratory deliverables that are detailed in the DAS specifications (Appendix B). All DAS analyses will have report deliverables that meet or exceed CLP data requirements and will be validated to provide the highest data quality.

All RAS and DAS analytical data will be validated to either Tier I or Tier II in accordance with Region I EPA-New England Data Validation Functional Guidelines (U.S. EPA, 1996d). Section 4.0 further describes the validation activities. Approximately 25% of the groundwater and sediment data will be validated to Tier I. The remaining groundwater and sediment data will be validated to Tier II. All of the soil data will be validated to Tier II. In addition to those activities, DAS data receiving only Tier I validation will be further evaluated, to ensure that the laboratories have met minimum data acceptance criteria established under M&E's DAS Corrective Action Program. The additional evaluation consists of completing Organic/Inorganic Data Quality Assessment Forms (I/ODQAFs) for each sample delivery group (SDG) validated to Tier I to ensure compliance with the data requirements in the DAS specifications (Appendix B) and to determine if any Tier I validated data could be potentially rejected based on Tier II data validation criteria. Field screening data (i.e., field parameters such as pH, turbidity, etc.) will be reviewed in terms of the following: data usability to determine if it is appropriate for its intended use; and if the field screening data QA objectives have been met.

1.5 Special Training Requirements/Certification

All M&E personnel entering the site will be in compliance with M&E's Site Safety and Health Plan (SSHP; 1998), which has been developed to cover all field activities. At a minimum, all M&E personnel on the site will have received training in accordance with Occupational Safety and Health Administration (OSHA) 29 CFR 1910.120(e).

Subcontractors conducting work for M&E as part of the technical assistance field program are required as part of their subcontract to provide M&E with a SSHP specific to the tasks that they are performing that meets or exceeds the requirements outlined in M&E's SSHP (1998). At a minimum, all subcontractor personnel on the site and under contract to M&E will have received training in accordance with OSHA 29 CFR 1910.120(e).

1.6 Documentation and Records

Records of field and laboratory activities will be required for the duration of the work assignment. Documentation such as field log books, field data forms, laboratory reports, tabulation of results and narratives will be used to evaluate the usability of the collected data.

Documentation will be initiated in the field during each of the technical assistance sampling events. As described in Section 2.2 and Appendix C, field logbooks and field data forms will be used to document on-site conditions, field measurements, sample collection information, and other pertinent site-related information during monitoring activities. Section 2.3 and Appendix D describe the tracking of samples from collection through shipment and laboratory custody.

For all samples that are received by the RAS and DAS laboratories, the laboratories submit data reports in the form of SDGs, which provide the analytical results for each sample. Each SDG contains up to 20 samples, including environmental and field QC samples and the corresponding laboratory QC samples and requirements. For RAS analyses, the laboratory methods will be performed in accordance with the current CLP SOWs for organic and inorganic analyses.

The RAS laboratories analyzing the samples are responsible for preparing the SDGs and providing the information in printed and electronic formats concurrently to the Contract Laboratory Analytical Support Services (CLASS) contractor and EPA's Office of Environmental Measurement and Evaluation (OEME). The OEME then submits to M&E printed copies of the SDG packages. A normal turn-around time of 35 days from laboratory receipt of the last sample for each SDG is required. The RAS laboratories provide the raw data (including instrument printouts, calibration curves, results of QC checks, etc) and standard data reporting forms, including QC summary forms, as required by the current CLP SOWs for organic and inorganic analyses.

For DAS analyses, the M&E-procured laboratories provide the analytical raw data and standard reporting forms required by the DAS specifications (Appendix B) to the M&E Laboratory/Tracking Coordinator. A normal turn-around time of 35 days from laboratory receipt of the last sample for each SDG is required for all DAS data with the exception of the Pesticides/PCB data for upland soils and the high moisture content Pesticides/PCB data for the sediment samples from the marsh. These two types of analyses will require a 14 day turn-around time from laboratory receipt of the last sample for each SDG. The DAS specifications require that the laboratories report CLP-like data deliverables. In general, the DAS specifications require that the laboratory submit the following deliverables:

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- Tabulated sample results; positive results and detection limits for nondetects; and for sediment samples, results reported on a dry weight basis, and sample weight and percent moisture content must be reported
- Laboratory analysis notebook pages or bench sheets; all raw sample data
- Tabulated results of duplicate and matrix spike analyses; tabulations of blank results; and raw data for these analyses
- Standard curve raw data; plotted standard curves; linear regression equations
- Examples of sample result calculations for each analysis including all equations, dilution factors, and information required to reproduce the laboratory results
- Sample preparation logs
- Copies of the DAS specifications, M&E chain-of-custody forms, telephone logs, and shipping air bills
- Narrative explaining all anomalies and corrective action(s) taken, and included in the narrative, a tabulation of the DAS sample numbers with the corresponding laboratory numbers

All RAS and DAS laboratory reports will be kept along with their respective original traffic report/chain-of-custody (TR/COC) forms and M&E COC forms in project files at M&E or with readily accessible archival services maintained by M&E. At work assignment close-out, only copies of the DAS laboratory reports will be provided to EPA. Neither the RAS laboratory reports, TR/COC forms, nor M&E COC forms will be provided as EPA will have already received original copies of these materials. In addition to laboratory reports, data validation reports will be generated as described in Section 4.0 for each of the RAS and DAS SDGs received over the course of this work assignment. Copies of the validation reports are provided to EPA approximately 21 days following receipt of each SDG as required by EPA Region I data validation guidelines (U.S. EPA, 1996d).

2.0 MEASUREMENT AND DATA ACQUISITION

This section describes the overall design of the field program and includes the specific information necessary to conduct the monitoring and sampling components of the program. Presented in this section and the associated appendices are the monitoring and sampling procedures, sample handling and custody requirements, analytical method requirements, and the quality control (QC) requirements associated with the compliance monitoring program.

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2.1 Field Investigation (Monitoring and Sampling) Process Design

The field investigation activities and analyses being conducted in support of technical assistance consist of the following:

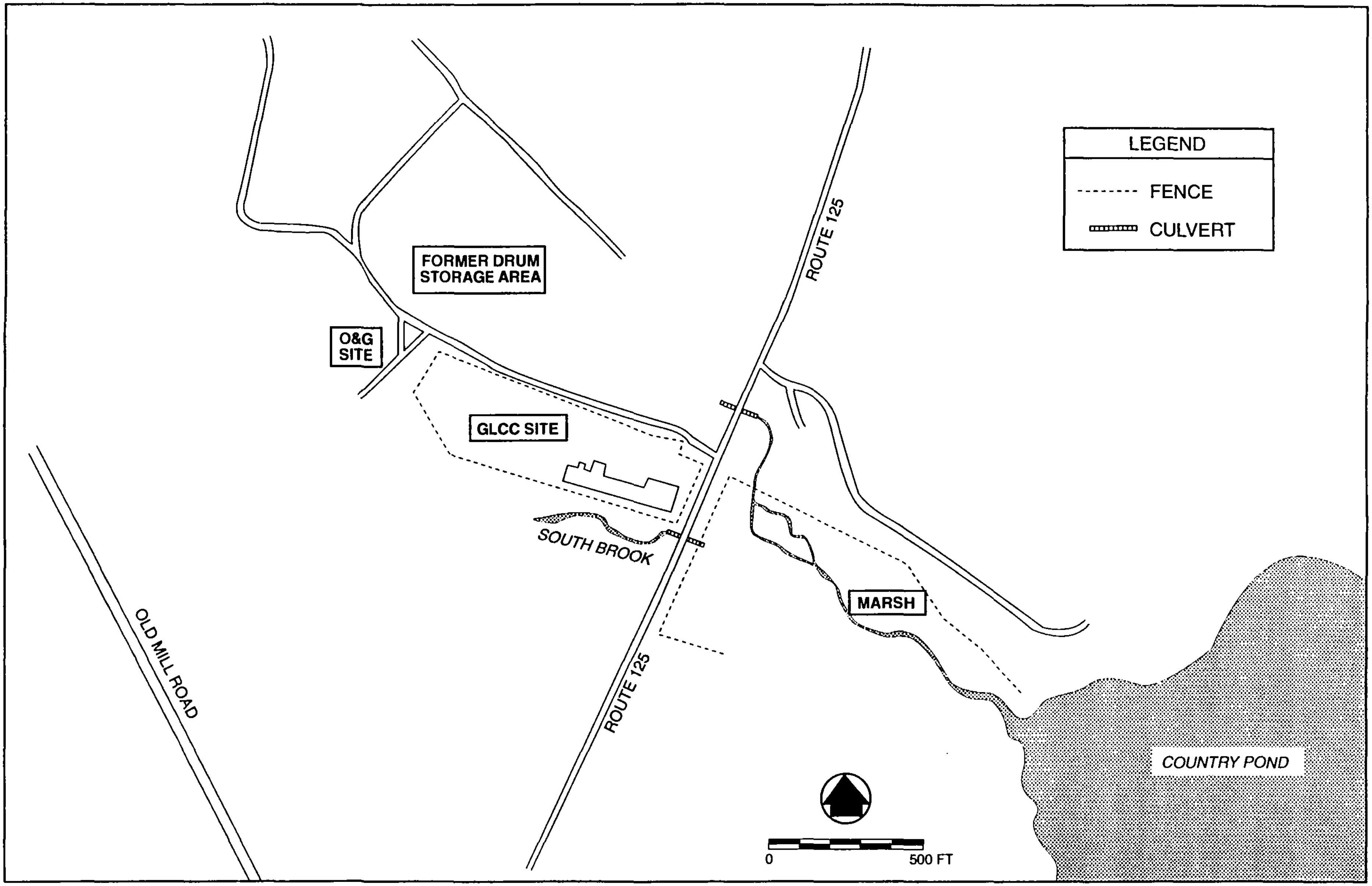
- Surface and Subsurface Soil Sampling
- Piezometer Installation
- Piezometer Water Elevation Measurements
- Sediment Sampling
- Groundwater Elevation Measurements and Sampling

Figure 2-1 presents the site detail map. Figures 2-2 through 2-6 present the locations of different field activities including the groundwater monitoring well locations, the test pit sampling locations, the soil sampling locations, the sediment sampling locations, and the piezometer installation locations, respectively. Tables 2-1 and 2-2 summarize the samples per location where the above field activities will be conducted.

2.1.1 Groundwater Elevation Measurements and Sampling. Two rounds of groundwater sampling will be performed. Groundwater samples will be collected from approximately 35 onsite monitoring wells, including the 3 BARCAD wells, using the EPA low flow sampling technique (Appenidx T). Prior to collecting samples, synoptic groundwater elevations will be measured at each of the monitoring wells.

2.1.1.1 Water Level Measurements. Synoptic water level measurements will be obtained at approximately 35 groundwater monitoring locations. Using these data, water level measurements will be related to previously established measuring point elevations to determine groundwater elevations. The procedure that will be used for measuring water levels is described in Section 2.2.1.

2.1.1.2 Groundwater Sampling. Monitoring wells will be sampled using EPA's low flow purging and sampling guidelines (Appendix T) (U.S. EPA, 1996c) to collect groundwater samples for analysis of Volatile Organic Compounds (VOCs), methane, ethane, ethene, metals, sulfate, nitrate, nitrite, chloride, Total Organic Carbon (TOC), and alkalinity. In addition, based on subsequent scoping meetings, a subset of the thirty-five wells will be sampled for PCBs during the first round of sampling: Ten wells will be sampled for toxic PCB congeners and total homologues, and an additional five wells will be sampled for RAS pesticides/PCB analysis. A summary of the sample quantities and analyses for the groundwater sampling is presented in Table 2-1. The monitoring wells will be sampled using a peristaltic pump, unless it is not feasible based on field conditions, in which case a dedicated inertial sampling pump (i.e., Wattera) or a bottom-filling/bottom-emptying bailer will be used to purge and sample the wells.



SOURCE: ADL, Sept. 1990

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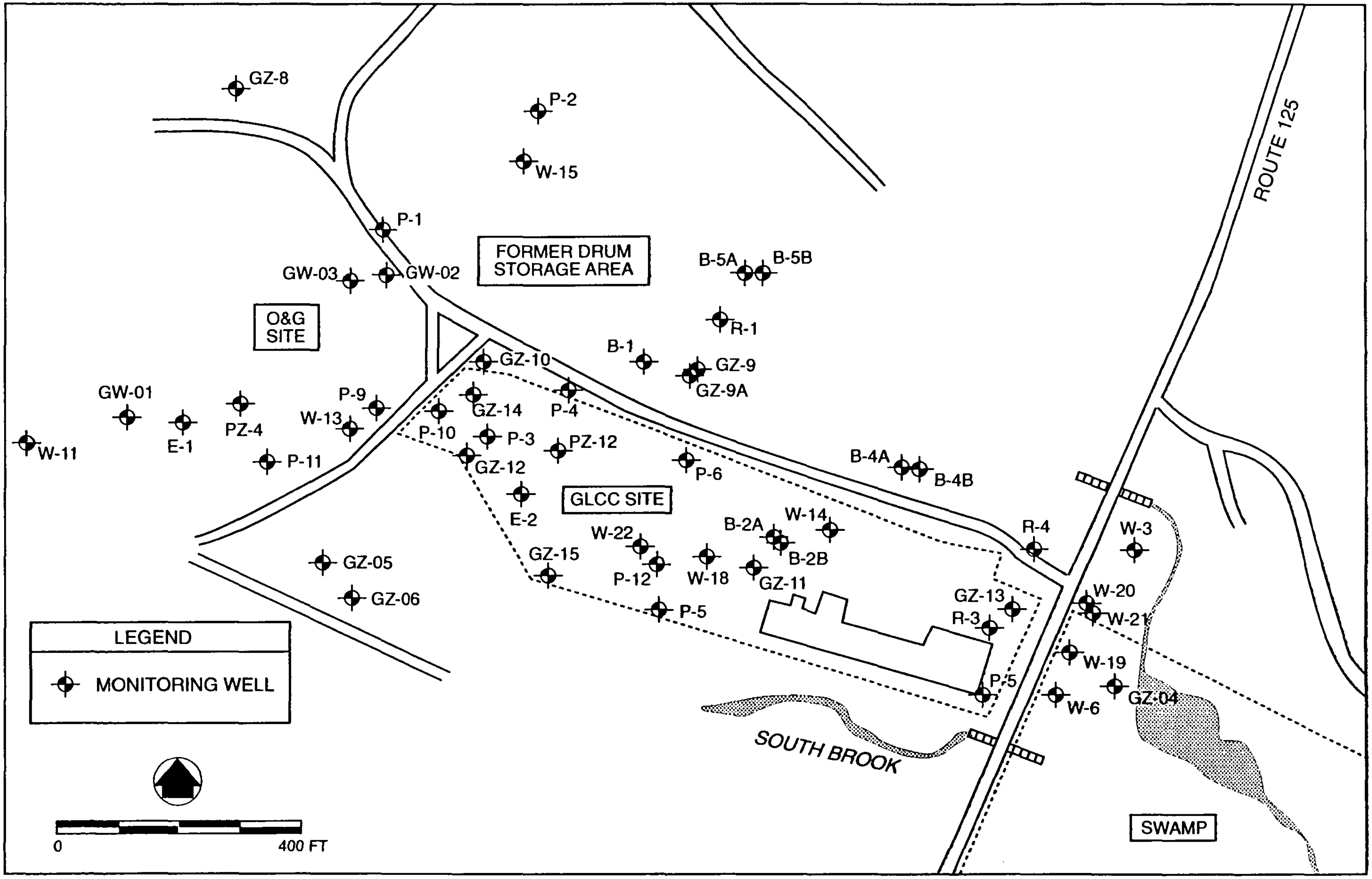
FIGURE 2-1. SITE DETAIL MAP - OTTATI AND GOSS SUPERFUND SITE



SOURCE: ADL, Sept. 1990

FIGURE 2-2. GROUNDWATER MONITORING WELL LOCATIONS - OTTATI AND GOSS SUPERFUND SITE

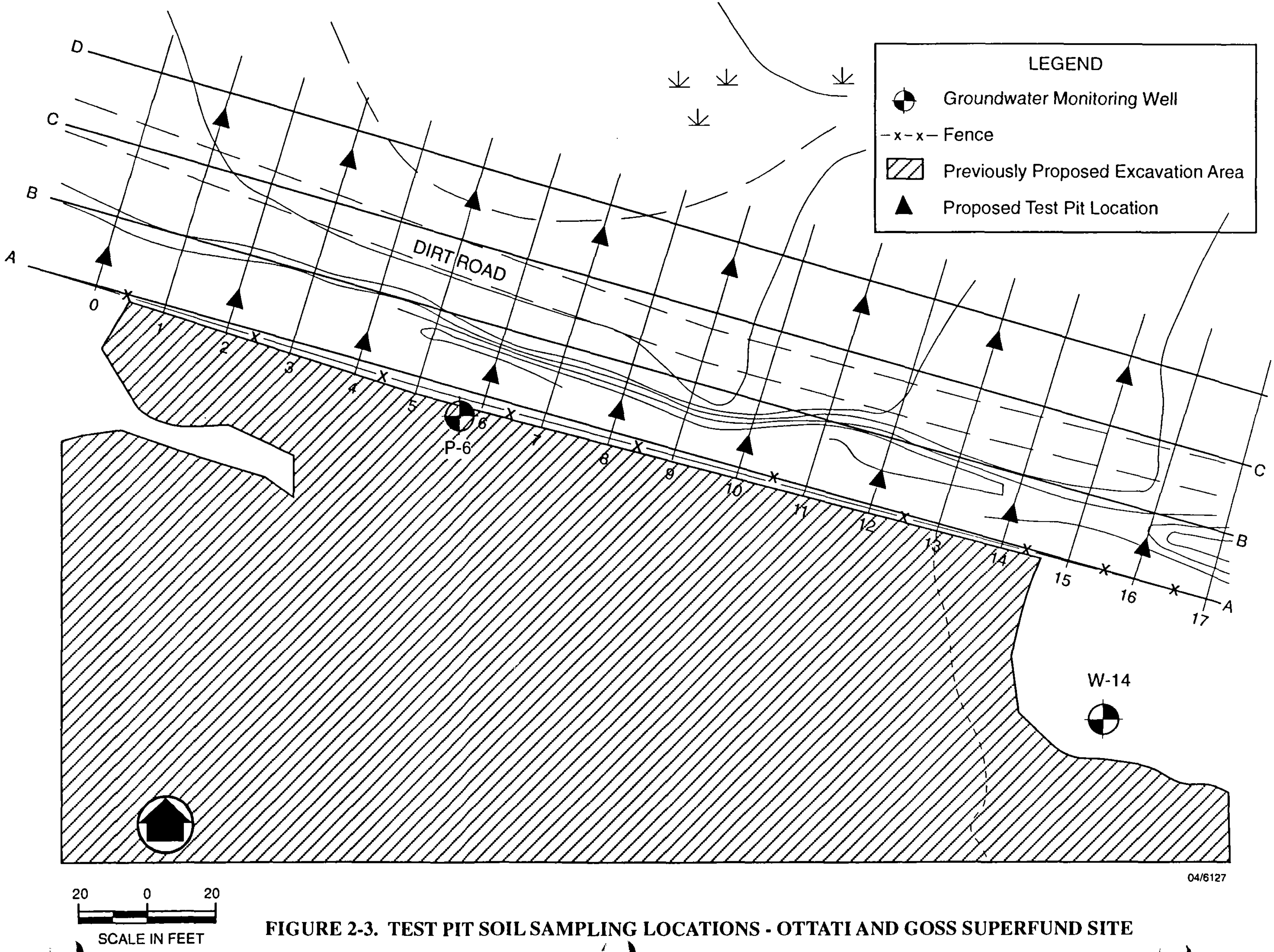
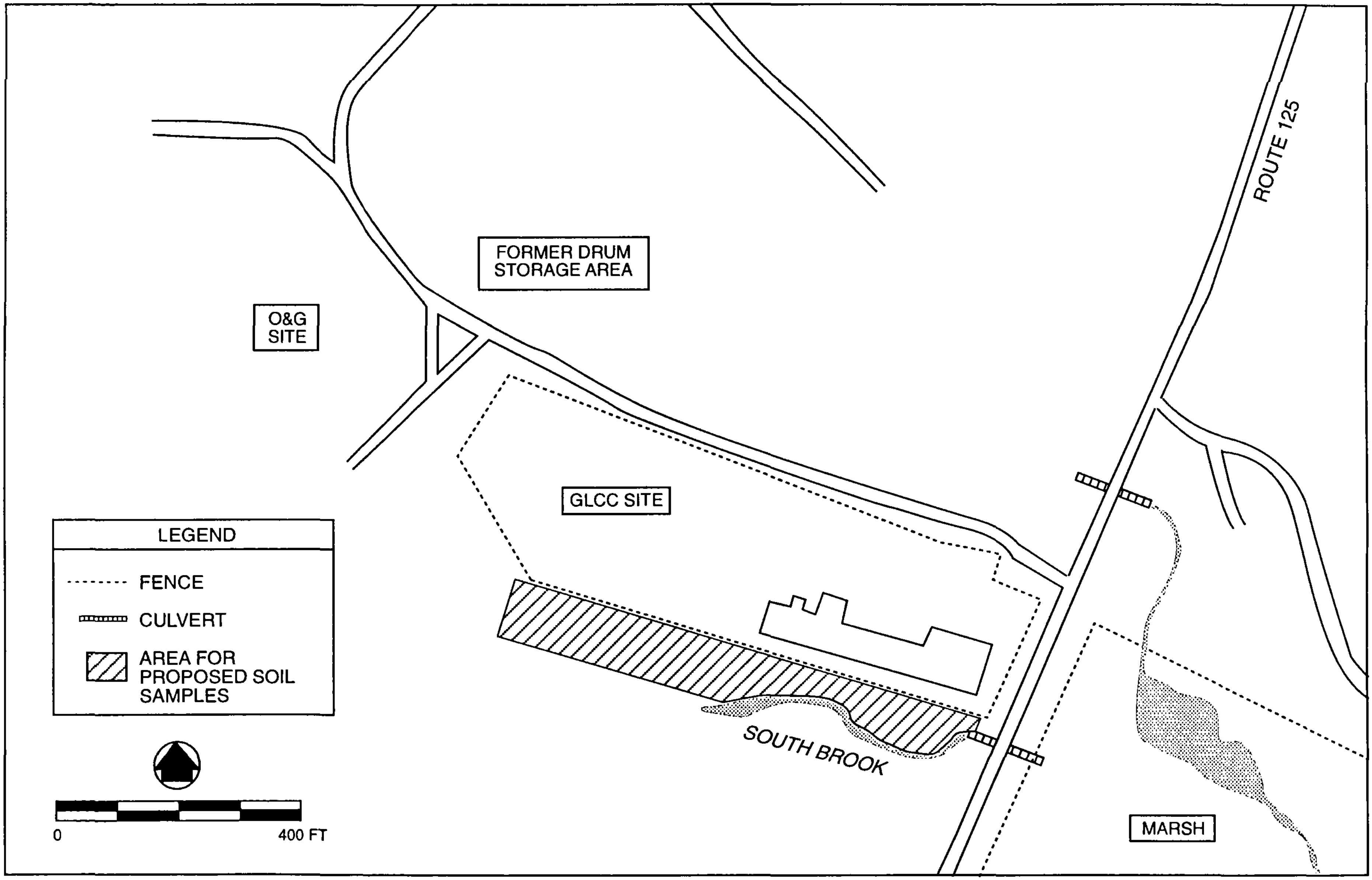


FIGURE 2-3. TEST PIT SOIL SAMPLING LOCATIONS - OTTATI AND GOSS SUPERFUND SITE



SOURCE: ADL, Sept. 1990

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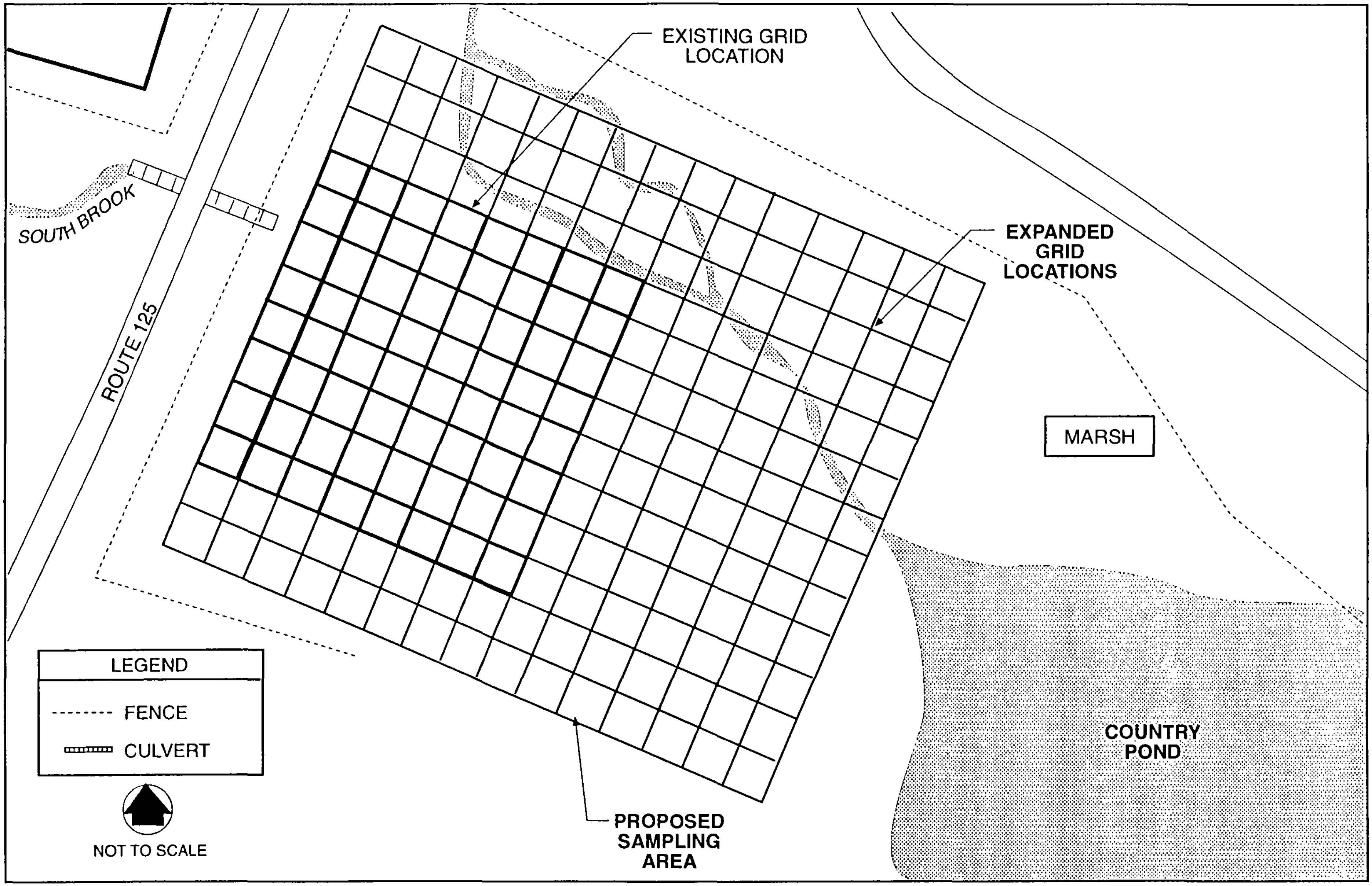
FIGURE 2-4. SURFACE AND SUBSURFACE SOIL LOCATION - OTTATI AND GOSS SUPERFUND SITE



SOURCE: ADL, 1997

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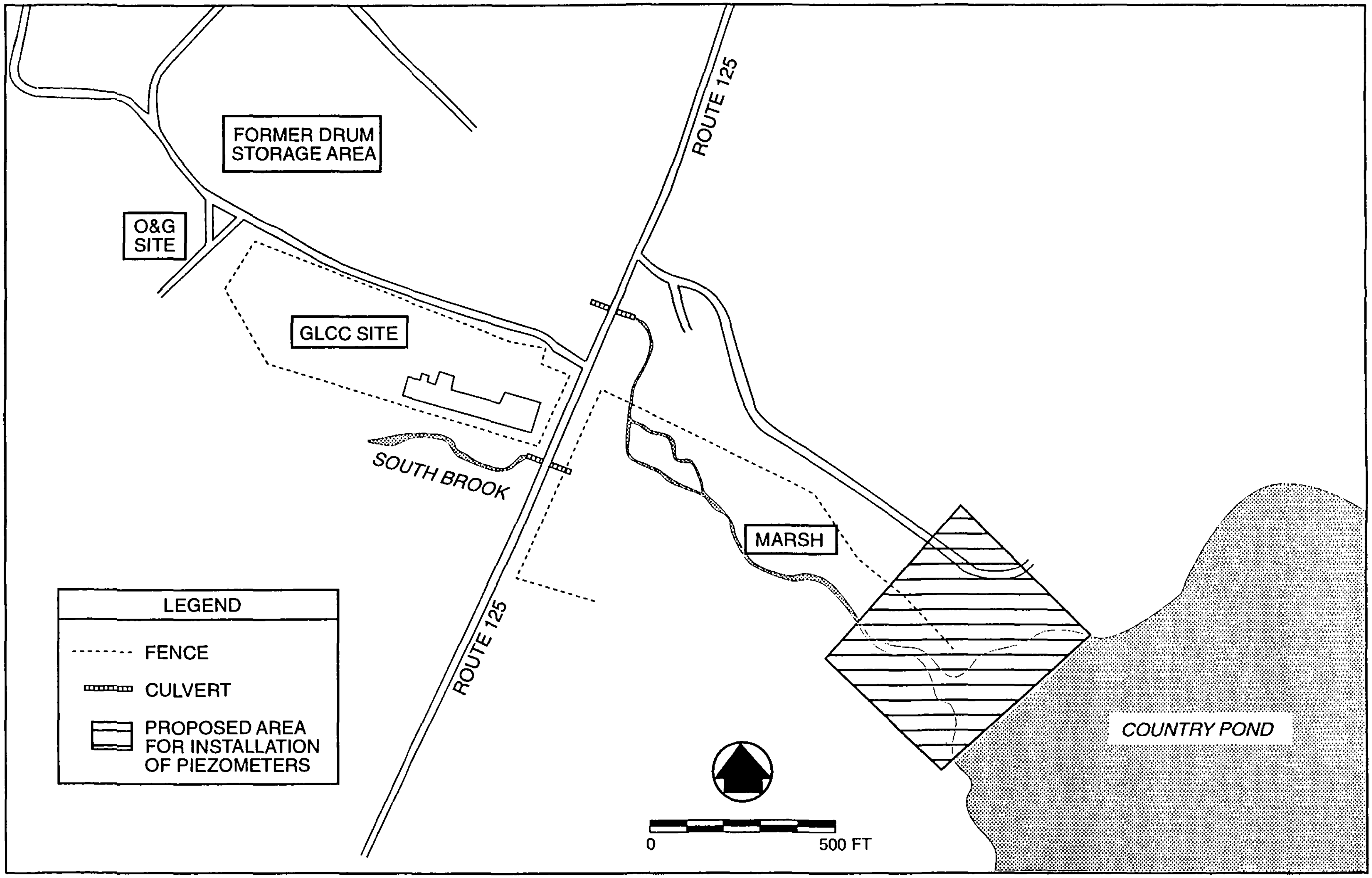
FIGURE 2-5. SEDIMENT SAMPLING LOCATIONS - OTTATI AND GOSS SUPERFUND SITE



SOURCE: ADL, Sept. 1990

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FIGURE 2-6. PIEZOMETER INSTALLATION LOCATIONS - OTTATI AND GOSS SUPERFUND SITE

TABLE 2-2. SUMMARY OF SAMPLE ANALYSES AND QUANTITIES FOR THE SURFACE AND SUBSURFACE SOIL AND SEDIMENT SAMPLING LOCATIONS

	DAS Analyses					RAS Analyses	
	14 day TAT	High Moisture Method					
	Pesticides/ PCBs	Volatile Organics	Pesticides/ PCBs (14-day TAT)	Metals	Hexavalent Chromium	Semivolatile Organics	Metals
ENVIRONMENTAL SAMPLES:							
Surface and Subsurface Soil Sampling:							
Upland Soil Locations							
Test Pits	60	60				60	60
Additional Test Pits					6		35
South of the Fence Area							
Surface Samples	100	100				100	100
Additional Surface Samples					6		6
Field Collected QC Samples [1]:							
Trip Blanks		10					
Equipment Blanks	5	5			1	5	8
Field Duplicates	11	11			1	11	14
PE Samples	11	11				11	14
Matrix Spike	11	11			1	11	14
Matrix Spike Duplicate	11	11				11	
Subtotal:	**209**	**219**	**0**	**0**	**15**	**209**	**251**
Number of SDGs:	**11**	**11**	**0**	**0**	**1**	**11**	**14**
Sediment Sampling:							
Phase 1							
Marsh Locations			100	100			
Field Collected QC Samples [1]:							
Equipment Blanks			7	7			
Field Duplicates			7	7			
PE Samples			7	7			
Matrix Spike			7	7			
Matrix Spike Duplicate			7	0			
Subtotal:	**0**	**0**	**135**	**128**	**0**	**0**	**0**
Number of SDGs:	**0**	**0**	**7**	**7**	**0**	**0**	**0**
Phase 2							
Marsh Locations			50	50			
Field Collected QC Samples [1]:							
Equipment Blanks			4	4			
Field Duplicates			4	4			
PE Samples			4	4			
Matrix Spike			4	4			
Matrix Spike Duplicate			4	0			
Subtotal:	**0**	**0**	**70**	**66**	**0**	**0**	**0**
Number of SDGs:	**0**	**0**	**4**	**4**	**0**	**0**	**0**
GRAND TOTAL:	**209**	**219**	**205**	**194**	**15**	**209**	**251**

NOTES:

1. Trip blank quantities are based on the number of collection days and estimated number of coolers being shipped. All other field QC sample quantities are estimated assuming that one per SDG package (typically) will be collected

DAS - Delivery of Analytical Services	PE - Performance Evaluation	RAS - Routine Analytical Services
PCBs - Polychlorinated Biphenyls	QC - Quality Control	SDG - Sample Delivery Group

TABLE 2-1. SUMMARY OF SAMPLE ANALYSES AND QUANTITIES FOR THE GROUNDWATER SAMPLING LOCATIONS

	DAS Analyses									RAS Analyses	
	Total Organic Carbon	Alkalinity	Methane	Ethane	Ethene	Homolog/ Cong Spec PCBs	Sulfate	Nitrate/ Nitrite	Chloride	Low Conc. Volatile Organics	Pesticides/ PCBs
ENVIRONMENTAL SAMPLES:											
Groundwater Sampling:											
Round 1											
Existing Wells	35	35	35	35	35	10	35	35	35	35	10
Field Collected QC Samples [1]:											
Trip Blanks										5	
Equipment Blanks	2	2	3	3	3	1	3	3	3	3	1
Field Duplicates		2	3	3	3	1	3	3	3	3	1
PE Samples						1				3	1
Matrix Spike			3	3	3	1	3	3	3	3	1
Matrix Spike Duplicate			3	3	3	1				3	1
Subtotal:	**37**	**39**	**47**	**47**	**47**	**15**	**44**	**44**	**44**	**55**	**15**
Number of SDGs:	**2**	**2**	**2**	**2**	**2**	**1**	**3**	**3**	**3**	**3**	**1**
Round 2											
Existing Wells	35	35	35	35	35		35	35	35	35	
Field Collected QC Samples [1]:											
Trip Blanks										5	
Equipment Blanks	2	2	3	3	3		3	3	3	3	
Field Duplicates		2	3	3	3		3	3	3	3	
PE Samples										3	
Matrix Spike			3	3	3		3	3	3	3	
Matrix Spike Duplicate			3	3	3					3	
Subtotal:	**37**	**39**	**47**	**47**	**47**	**0**	**44**	**44**	**44**	**55**	**0**
Number of SDGs:	**2**	**2**	**2**	**2**	**2**	**0**	**3**	**3**	**3**	**3**	**0**
GRAND TOTAL:	**74**	**78**	**94**	**94**	**94**	**15**	**88**	**88**	**88**	**110**	**15**

NOTES:

1. Trip blank quantities are based on the number of collection days and estimated number of coolers being shipped. All other field QC sample quantities are estimated assuming that one per SDG package (typically) will be collected

DAS - Delivery of Analytical Services
Cong Spec - Congener Specific
Homolog - Homologue
PCBs - Polychlorinted Biphenys
PE - Peformance Evaluation
QC - Quality Control
RAS - Routine Analytical Services
SDG - Sample Delivery Group

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The three onsite BARCAD wells will be purged and sampled using the required sampling equipment which will be obtained from the NHDES and the samples will be analyzed for VOCs only. In addition to the samples collected for laboratory analysis, M&E will also field screen the groundwater locations for pH, ORP, conductivity, DO, temperature, and turbidity using field meters; and for ferrous iron and sulfide using field test kits. Sampling procedures for groundwater sampling are described in Section 2.2.2.

2.1.2 Surface and Subsurface Soil Sampling. The surface and subsurface soil sampling will consist of collecting soil samples from two areas of the site. Approximately 40 locations will be sampled, with samples collected from four discrete depths per location. The samples collected north of the fenced area of the site will be collected from test pits, excavated by a drilling contractor. The area to be sampled will be approximately 40 x 300 feet in area. The soil samples collected from the southern portion of the site will be collected using hand digging techniques. Additional surface and subsurface soil sampling, included during subsequent discussions with the EPA RPM, will be conducted to collect samples for metals and hexavalent chromium analyses.

2.1.2.1 Soil Sampling. Soil samples will be collected from the 40 locations at 4 depths per location, for a total of 160 onsite locations. Sampling will be performed to collect soil samples for VOCs, Semivolatile Organic Compounds (SVOC), pesticides/PCB (14-day turnaround time), and metals analyses. A summary of the sample quantities and analyses for the soil sampling is presented in Table 2-2. In addition to the soil sample collection, M&E will also perform field test kit analyses for the presence or absence of PCBs. A description of the sampling procedures is presented in Section 2.2.3.

2.1.2.2 Additional Soil Sampling. The additional surface and subsurface soil sampling for metals and hexavalent chromium analyses will consist of collecting soil samples from test pits and hand augered locations at the site. ASoil samples will be collected using a test pit excavator from 5 locations. At each location, samples will be collected from 6 different depths (0, 2, 4, 6, 8, and 10 foot depths), with a composite sample being collected from the total depth. In addition, 3 locations will be sampled using hand augering techniques and sampled at 2 depths (0 and 2 foot depths), for a total of 41 sample locations.

2.1.3 Sediment Sampling. The sediment sampling will consist of collecting samples from the marsh area located between Route 125 and Country Pond. Sediment samples will be collected from the 150 locations in the wetlands using hand digging techniques established for the Wells G&H project (M&E, 1997). Sampling will be performed to collect sediment samples for pesticides/PCB (14-day turnaround time) and metals analyses. A summary of the sample quantities and analyses for the sediment sampling is presented in Table 2-2.

2.1.4 Piezometer Installation and Water Level Elevation Measurements. Twenty-five piezometers will be installed using the shallow installation specification provided by EPA

(AFBCA, 1997). The piezometers will be installed in the wetland to evaluate the transitional zone between surface water and groundwater in the wetland area. The groundwater elevations in the piezometers will be measured four times during the field program.

2.1.4.1 Piezometer Installation. Twenty-five shallow piezometers will be installed in the wetlands area, near the anticipated work area for sediment remediation, to assess the transitional zone between surface water and groundwater. The piezometers will be installed following the procedure in Appendix M.

2.1.4.2 Water Elevation Measurements. Four rounds of water level measurements will be obtained at the 25 piezometer locations. The procedure that will be used for measuring water levels is described in Section 2.2.1.

2.2 Monitoring and Sampling Procedures

The following sections describe the measurement and sampling procedures that will be used in conjunction with the field activities described in Section 2.1.

2.2.1 Water Elevation Measurements. For measurement of groundwater elevations in the monitoring wells and the piezometers (Sections 2.1.1 and 2.1.4), the determination of the depth to the static water level will be made to the nearest 0.01 foot using an electronic water level indicator. Synoptic measurements at all locations will be taken within a 24-hour period and prior to the initiation of purging and/or sampling activities.

For groundwater monitoring wells, measurements will be made from the top of the protective steel or PVC casing. For the piezometers, depth to water will be measured from the top of the PVC casing. The piezometers are scheduled to be surveyed after installation and will be re-surveyed in the spring to assure consistency between water-level measurements.

All down-well measuring devices will be thoroughly decontaminated between measurements in all groundwater monitoring wells and piezometers as described in Appendix E. Water elevation measurements will be recorded in the field logbook and/or on field forms located in Appendix C. The following procedure will be used to measure the synoptic water level at each location. Any variances to the following procedures will be documented in the field logbook.

1. Record the weather conditions and other relevant site conditions.

2. Record the monitoring location identification number and check and record its condition for damage or evidence of tampering.

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3. Place polyethylene sheeting on the ground and assemble all necessary water level measurement equipment on top of it.

4. Unlock the outer casing (if present) and remove the protective/locking cap on the well or piezometer.

5. Measure the headspace of the monitoring location for organic vapors using a photoionization detector (PID) and record readings.

6. Measure and record the static water level in the well using a decontaminated electronic water level indicator.

7. Replace the protective cap and lock the outer casing (if present).

2.2.2 Groundwater Sampling Procedures. The purging and sampling procedures that will be used to collect groundwater samples from approximately 35 monitoring wells described in Section 2.1.1 are presented in this section. The procedures are adapted from EPA's low flow purging and sampling guidelines (Appendix T) (1996c). All wells will be purged and sampled using a peristaltic pump. However, should field conditions prohibit use of a peristaltic pump, then a dedicated inertial pump or bottom-filling/bottom emptying bailer will be used. Procedures for purging and sampling are presented for both types of pumps. The type of pump used will be documented in the field logbook. The BARCAD wells will be sampled using the equipment and sampling procedure provided by NHDES.

Sample containers and preservation methods are presented in Appendix F. Purging and sampling information and field parameter measurements will be recorded in the field logbook and/or on field forms located in Appendix C. The following procedure will be used for groundwater sample collection. Any variances to the following procedures will be documented in the field logbook.

1. Record the weather conditions and other relevant site conditions.

2. Record the well identification number and check and record the condition of the well for damage or evidence of tampering.

3. Place polyethylene sheeting on the ground and assemble all necessary sampling equipment on top of it.

4. Unlock the outer casing (if present) and remove the protective cap on the well.

5. Measure the headspace of the well for organic vapors using a PID and record the readings.

3. Place polyethylene sheeting on the ground and assemble all necessary water level measurement equipment on top of it.

4. Unlock the outer casing (if present) and remove the protective/locking cap on the well or piezometer.

5. Measure the headspace of the monitoring location for organic vapors using a photoionization detector (PID) and record readings.

6. Measure and record the static water level in the well using a decontaminated electronic water level indicator.

7. Replace the protective cap and lock the outer casing (if present).

2.2.2 Groundwater Sampling Procedures. The purging and sampling procedures that will be used to collect groundwater samples from approximately 35 monitoring wells described in Section 2.1.1 are presented in this section. The procedures are adapted from EPA's low flow purging and sampling guidelines (Appendix T) (1996c). All wells will be purged and sampled using a peristaltic pump. However, should field conditions prohibit use of a peristaltic pump, then a dedicated inertial pump or bottom-filling/bottom emptying bailer will be used. Procedures for purging and sampling are presented for both types of pumps. The type of pump used will be documented in the field logbook. The BARCAD wells will be sampled using the equipment and sampling procedure provided by NHDES.

Sample containers and preservation methods are presented in Appendix F. Purging and sampling information and field parameter measurements will be recorded in the field logbook and/or on field forms located in Appendix C. The following procedure will be used for groundwater sample collection. Any variances to the following procedures will be documented in the field logbook.

1. Record the weather conditions and other relevant site conditions.

2. Record the well identification number and check and record the condition of the well for damage or evidence of tampering.

3. Place polyethylene sheeting on the ground and assemble all necessary sampling equipment on top of it.

4. Unlock the outer casing (if present) and remove the protective cap on the well.

5. Measure the headspace of the well for organic vapors using a PID and record the readings.

6. Calculate the screen volume, in gallons of water, of the well using the installation specifications for the well (i.e. well radius [r, in feet], screen length or measured depth of standing water, whichever is less [L, in feet], and the conversion factor of 1 ft^3 = 7.48 gallons) as follows:

   screen volume (gallons) = πr^2 L (7.48 gallons/ft^3)

7. Initiate purging of approximately one to three well screen volumes. Slowly lower the pumping equipment (peristaltic pump or dedicated inertial pump) so that the intake is located at the midpoint of the well screen. If the water level is lower than the top of the well screen, position the pump intake at the midpoint of the standing water. The intake should be at least 1 foot above the bottom of the well to minimize mobilization of settled sediment, the risk of the pumping suction being broken, or the entrainment of air in the sample. The following are procedures for sampling using a peristaltic and inertial pump, respectively.

   Peristaltic Pump: Connect the necessary tubing to the pump. Measure a new section of pharmaceutical-grade, 3/16" internal diameter (I.D.) silicon tubing and attach it to the peristaltic pump. Connect a piece of 3/16" I.D. Teflon® tubing to the outflow, taking care to use a section long enough to collect samples easily, and to reach into the purge bucket. Using short pieces of silicon tubing, connect the outlet end of the Teflon® tubing to the HDPE "T" and tension fitting through which samples for turbidity will be collected, and connect the "T" to the intake of the flow-through cell on the water quality meter. Measure a new section of Teflon® tubing to extend from the midpoint of the well screen to the intake side of pharmaceutical-grade, silicon tubing. Attach the Teflon® tubing and lower the end of the tubing to the depth of the middle of the well screen. As described above, lower the Teflon tubing to the appropriate depth within the well. Commence purging at the slowest possible rate and slowly increase the speed until discharge occurs. Measure the flow rate using a plastic graduated cylinder and time piece. Adjust the pump speed to maintain a drawdown of less than 0.3 feet. Monitor the drawdown as described in Section 2.2.1. Continue to monitor the water level during the purging and sampling. Note any flow rate adjustment(s). Under no circumstances should the well be pumped dry and once pumping is begun, it should not be interrupted until all sample volume has been collected. Collect all purge water in a bucket.

   Inertial Pump: Attach the dedicated or decontaminated check valve to the dedicated inertial pump. As described above, lower the pump to the appropriate depth within the well. Commence manual pumping at a slow rate and gradually increase the rate until discharge occurs. Adjust the pumping rate to maintain a drawdown of less than 0.3 feet. Monitor the drawdown as described in Section 2.2.1. Once pumping is begun, it should not be interrupted until all sample volume has been collected. Collect all purge water in a bucket.

8. Prevent the flow-through cell and all sample tubing protruding from the well from exposure to direct sunlight by shading and/or insulating the exposed tubing.

9. During purging and sampling, observe the flow of groundwater in the sample tubing and keep the tubing filled with groundwater, removing all air pockets and bubbles, to the extent possible. Gas bubbles are often a problem with extremely low flows and/or warming sunlight. Air pockets may be minimized by clamping the sections where two pieces of tubing join. Gas bubbles may be reduced by increasing flow, if possible, and keeping tubing and flow-through cells shaded.

10. Initially, turbidity may be elevated. Once visual estimates indicate that turbidity has decreased to a measurable range, begin monitoring indicator parameters: temperature, pH, specific conductance, dissolved oxygen (DO), turbidity, and oxidation/reduction potential (ORP). Monitor these parameters as frequently as possible (approximately every 3 to 5 minutes or as appropriate).

11. Stop purging when pH and specific conductance have stabilized. Parameters are considered to have stabilized if, over three consecutive readings, the following criteria are met:

    pH ± 0.1 unit
    specific conductance and temperature within 3%
    turbidity within 10%, and less than 5 NTU
    DO ± 10%
    ORP ± 10 mv

    However, if parameters do not stabilize, or turbidity remains greater than 5 NTU, technical judgement will be used to ascertain when sampling should be commenced. Achieving low turbidity will be especially important for those wells where samples will be collected for analysis of toxic PCB congeners and total homologues, as the method is extremely sensitive.

12. Once purging has been completed, test for oxidants as described in Appendix F.

13. If gas bubbles in the tubing due to very low flow are not apparent, samples should be collected in order of decreasing volatility:

Methane
Ethane
Ethene
Volatile organics
Alkalinity
Chloride / Sulfate / Nitrate / Nitrite
Pesticides/PCBs
Total organic carbon

During sample collection, allow the water to flow directly down the side of the sample container without allowing the tubing to touch the inside of the sample container or lid, in order to minimize aeration and maintain sample integrity.

Samples for methane, ethane, ethene, alkalinity, and volatile organics will be collected first, and the sample vial must contain no air bubbles after it has been capped; ensure this by turning the vial upside down and tapping it lightly. If any bubbles are observed, discard the sample and collect a new sample. Fill the remaining sample containers at least 3/4 full for all other analyses.

14. If bubbling is present in the tubing, cannot be removed, and the apparatus is protected from sunlight, bubbling is likely being exacerbated by extremely low flow. In this case, the less volatile samples (pesticide/PCBs, total organic carbon, chloride, sulfate, and nitrate/nitrite) are collected first. Prior to collecting the remaining samples, increase flow just enough to remove gas bubbles from the tubing. Collect the remaining samples, and record the new flow, the new drawdown level, and the new parameters. Note the change in the field logbook.

15. Preserve the samples (Appendix F). Immediately label the sample containers and place them on ice. Complete an M&E COC form as soon as possible. For those samples collected for analysis of toxic PCB congeners and total homologues, note that concentrations may be elevated for any samples for which low turbidity could not be achieved.

16. Upon completion of sampling and prior to terminating pumping, samples for ferrous iron and sulfide analysis, using field test kits, will be collected. The samples will be collected and immediately analyzed in the field for ferrous iron and sulfide using a portable spectrophotometer/colorimeter.

17. After completing the field test kit analyses, measure and record the final water level, temperature, pH, specific conductance, DO, turbidity, and ORP readings.

After measuring for final indicator parameters, cease pumping and disassemble the purging and sampling equipment.

18. Replace the protective/locking cover on the well and lock the outer casing (if present).

19. Dispose of all purged water according to the procedures described in Appendix H.

The degree of contamination is not a factor in the sampling order of monitoring locations since dedicated tubing and dedicated or disposable bottom-filling/bottom-emptying bailers will be used for purging and sampling. All non-dedicated down-well measuring devices will be thoroughly decontaminated between measurements in all groundwater monitoring wells as described in Appendix E. A list of equipment typically used is provided in Appendix G.

2.2.3 Surface and Subsurface Soil Sampling Procedures. The surface and subsurface soil sampling will consist of collecting soil samples from test pits, which will be excavated by a subcontractor, between the north side of the fence and the dirt access road. Soil samples from the "drum and barrel area" along the southern side of the fence will be collected using hand digging techniques.

Additional surface and subsurface soil sampling will be performed to collect soil samples for metals and hexavalent chromium analyses. The additional soil sampling will also consist of collecting samples from test pits and hand augered locations at the site. Sampling procedures for the additional sampling are included as their own sections, as the depths sampled will differ from those selected for the soil sampling scoped in the initial work assignment.

2.2.3.1 Test Pit Soil Sampling. Soil samples will be collected from four discrete sampling depths from approximately 15 test pits. Prior to excavation of the test pits, M&E personnel will measure and stake a grid pattern in the area for excavation.

Sample containers and preservation methods are presented in Appendix F. All excavation equipment will be thoroughly decontaminated between test pit locations as described in Appendix E. Test pits will be advanced in two foot increments to a depth of six feet. Samples will be obtained from the bottom of the excavation, at each increment, using a decontaminated hand auger or similar device. Decontamination of the backhoe bucket will not take place between sample depths because the excavation equipment will not be coming in contact with the soil horizon which will be sampled. Excavation details, soil observations, and other pertinent information will be recorded in the field logbook and/or on field forms located in Appendix C. The following procedure will be used for test pit excavation and soil sampling. Any variances to the following procedures will be documented in the field logbook.

1. Record the weather conditions and other relevant site conditions.

2. Sketch or record the sampling locations in relation to landmarks or distance to other sampling locations. Photograph the locations (optional).

3. Verify that the excavation equipment is properly decontaminated and situated at the intended test pit location.

4. Prior to excavation, a surface soil sample will be collected using hand digging techniques or an auger following the sample collection procedure outlined below.

5. Initiate excavation of the test pit with a backhoe to a depth of 2 feet. During excavation, monitor the soil contained in the backhoe with a PID or FID. When a depth of approximately 2 feet is obtained by the backhoe, collect a sample from the bottom of the test pit, using a two-winged, hand auger or similar device while standing on the ground surface. At no point during sampling will personnel be entering the test pit. The first auger-full of soil will be used for the collection of a sample for VOC analysis using an EnCore sampler (Appendix N). The EnCore sampler will be pressed into the bottom end of the auger until it is full, the sampler will be withdrawn from the auger, and the cap placed on the EnCore sampler. Three EnCore samplers per location will be filled; two samplers will be submitted to the laboratory for low concentration VOC analysis and a third sampler will be provided for high concentration analysis, if necessary. The samples from the 2, 4, and 6 foot depths will be collected using a two-winged, hand auger, which will minimize disturbance to the soil. For these depths, VOC samples will be collected by pressing the EnCore sampler into the exposed soil between the auger wings. After the VOC sample is collected, additional volume of soil will be collected using the auger and placed into a stainless steel bowl. The sample will be composited and bottles filled for semivolatile organics, PCB, and metals analysis. For the PCB analyses a total of three bottles will be filled. One bottle will be used for onsite PCB test kit analysis, the results of which will be used in the selection of additional sampling locations, one bottle will be used for onsite PCB split-sampling test kit analysis for research purposes not directly related to the project, and one bottle will be collected for offsite pesticides/PCB analysis. One additional sample volume will be collected for percent moisture analysis. Once samples have been collected from the two foot depth, the backhoe bucket will advance to depths of four and six feet, where additional samples will be collected using the same procedure.

5a. Duplicate samples will be collected following the procedure listed above. If not enough sample volume is available from the first auger-full of sample, then a second auger-full of sample will be collected for use in duplicate sample collection.

6. The geologist will use the test pit log form (Appendix C) to record the dimensions of the test pit and describe the materials encountered.

7. Under the direction of the geologist, the test pit will then be backfilled and the backhoe and sampling equipment decontaminated.

8. All decontamination water will be disposed of according to the procedures described in Appendix H.

9. After sample collection, all samples will be placed in plastic bags and placed on ice prior to shipping. The EnCore samplers will be packaged following the procedure presented in Appendix O. The samples will be placed in the EnCore zipper bag, provided with the sampler, sealed and placed on ice prior to shipping. The samplers will be sent directly to the laboratory where they will be prepped by the laboratory for analysis within 48 hours.

2.2.3.2 Soil Sampling. Surface and subsurface soil samples will be collected from four discrete sampling depths from approximately 25 locations using hand digging techniques.

All sampling equipment will be thoroughly decontaminated between each sample depth and each location as described in Appendix E. Descriptions of soils and other pertinent information will be recorded in the field logbook and/or on field forms located in Appendix C. The following procedure will be used for soil sampling. Any variances to the following procedures will be documented in the field logbook.

1. Record the weather conditions and other relevant site conditions.

2. Sketch or record the sampling locations in relation to landmarks or distance to other sampling locations. Photograph the locations (optional).

3. Initiate hand digging or augering at the location using decontaminated equipment. During digging, monitor the location with a PID or FID. Collect a surface soil sample by removing the soil surface with a decontaminated shovel. Sample collection for VOC analysis will be performed by pressing the EnCore sampler into the exposed soil. When the sampler is full, it will be withdrawn from the soil and the cap placed on the EnCore sampler. Three EnCore samplers per location will be filled; two samplers will be submitted for low concentration VOC analysis and a third sampler will be provided for high concentration analysis, if necessary. The samples from the 2, 4, and 6 foot depths will be collected using a two-winged auger, which will minimize disturbance to the soil. For these depths, VOC samples will be collected by pressing the EnCore sampler into the exposed soil

between the auger wings. After the VOC sample is collected, an additional volume of soil will be collected using the auger and will be placed into a stainless steel bowl. The sample will be composited and bottles filled for semivolatile organic, pesticides/PCB, and metals analyses. One additional sample volume will be collected for percent moisture analysis. This procedure will be used for the samples collected from depths of 2, 4, and 6 feet.

6. After sample collection, the area will be backfilled and the sampling equipment decontaminated.
7. All decontamination water will be disposed of according to the procedures described in Appendix H.
8. After sample collection, all samples will be placed in plastic bags and placed on ice prior to shipping. The EnCore samplers will be packaged following the procedure presented in Appendix O. The samples will be placed in the EnCore zipper bag, provided with the sampler, sealed and placed on ice prior to shipping. The samplers will be sent directly to the laboratory where they will be prepared by the laboratory for analysis within 48 hours.

2.2.3.3 Additional Test Pit Soil Sampling. Soil samples will be collected using a test pit excavator from 5 locations. At each location, samples will be collected from 6 different depths (0, 2, 4, 6, 8, and 10 feet below ground surface), with a composite sample being collected from the total depth.

Sample containers and preservation methods are presented in Appendix F. All excavation equipment will be thoroughly decontaminated between test pit locations as described in Appendix E. Test pits will be advanced in two foot increments to a depth of ten feet. Samples will be obtained from the bottom of the excavation, at each increment, and composited along the total depth, using a decontaminated hand auger or similar device. Decontamination of the backhoe bucket will not take place between sample depths because the excavation equipment will not be coming in contact with the soil horizon which will be sampled. Excavation details, soil observations, and other pertinent information will be recorded in the field logbook and/or on field forms located in Appendix C. The following procedure will be used for test pit excavation and soil sampling. Any variances to the following procedures will be documented in the field logbook.

1. Record the weather conditions and other relevant site conditions.
2. Sketch or record the sampling locations in relation to landmarks or distance to other sampling locations. Photograph the locations (optional).

3. Verify that the excavation equipment is properly decontaminated and situated at the intended test pit location.

4. Prior to excavation, a surface soil sample will be collected using hand digging techniques or an auger following the sample collection procedure outlined below.

5. Initiate excavation of the test pit with a backhoe to a depth of 2 feet below ground surface. During excavation, monitor the soil contained in the backhoe with a PID or FID. When a depth of approximately 2 feet is obtained by the backhoe, collect a sample from the bottom of the test pit, using a two-winged, hand auger or similar device while standing on the ground surface. At no point during sampling will personnel be entering the test pit. The sample will be then be composited and bottles filled for hexavalent chromium and metals analyses. Once samples have been collected from the two foot depth, the backhoe bucket will advance to depths of four, six, eight, and ten feet below ground surface, where additional samples will be collected using the same procedure.

5a. Duplicate samples will be collected following the procedure listed above. If not enough sample volume is available from the first auger-full of sample, then a second auger-full of sample will be collected for use in duplicate sample collection.

6. The geologist will use the test pit log form (Appendix C) to record the dimensions of the test pit and describe the materials encountered.

7. Under the direction of the geologist, the test pit will then be backfilled and the backhoe and sampling equipment decontaminated.

8. All decontamination water will be disposed of according to the procedures described in Appendix H.

9. After sample collection, all samples will be placed in plastic bags and placed on ice prior to shipping. The COC will be completed as soon as possible.

2.2.3.4 Additional Soil Sampling. Surface and subsurface soil samples will be collected from two discrete sampling depths (0 and 2 feet below ground surface) from three locations using hand digging techniques.

All sampling equipment will be thoroughly decontaminated between each sample depth and each location as described in Appendix E. Descriptions of soils and other pertinent information will be recorded in the field logbook and/or on field forms located in

Appendix C. The following procedure will be used for soil sampling. Any variances to the following procedures will be documented in the field logbook.

1. Record the weather conditions and other relevant site conditions.
2. Sketch or record the sampling locations in relation to landmarks or distance to other sampling locations. Photograph the locations (optional).
3. Initiate hand digging or augering at the location using decontaminated equipment. During digging, monitor the location with a PID or FID. Collect a surface soil sample by removing the soil surface with a decontaminated shovel, and placing the surface soil into a stainless steel bowl. Collect sufficient soil to fill all sample jars. Composite the sample, and fill the appropriate sample jars.
4. The samples from the 2 foot depth will be collected using a two-winged auger, which will minimize disturbance to the soil. Collect sufficient soil to fill all sample jars, composite the sample, and fill the appropriate sample jars.
5. After sample collection, the area will be backfilled and the sampling equipment decontaminated.
6. All decontamination water will be disposed of according to the procedures described in Appendix H.
7. After sample collection, all samples will be placed in plastic bags and placed on ice prior to shipping. The COC will be completed as soon as possible.

2.2.4 Sediment Sampling Procedures. The procedures that will be used to collect sediment samples from the marsh are presented in this section. Sediment samples will be collected following the Wells G&H procedure for collecting sediment samples with a high percent moisture (M&E, 1997). Sample containers and preservation methods are presented in Appendix F. Sampling equipment will be thoroughly decontaminated between sampling locations as described in Appendix E. As described in Appendix C, documentation of field observations and collection activities will be kept in the field logbook and/or on field forms.

Sediment samples will be collected according to the following procedure. Changes to the procedures must be justified and recorded in the field logbook.

1. Record the weather conditions and other relevant site conditions.

2. Record the physical characteristics of the location, including any standing water, odor, color, presence of any dead vegetation and surface sheens, etc.

3. Sediment samples will be collected with a conical bulb planting device from the top 6 to 12 inches of sediment from the marsh bottom. A twisting motion will be used to withdraw the planter. The bottom of the planter should be covered with a gloved hand and the standing/surface water on top gently drained off.

   Sediment will be removed from the sampling device and placed into a pre-cleaned stainless steel bowl. Several sampling devices full of sediment may be required to collect a sufficient amount of sample for the required bottles. Additional sediment will be collected from areas directly adjacent to the initial sample to provide sufficient volume. Any large material (rocks, sticks, leaves, etc.) will be removed from the sample prior to homogenization. The sample will then be allowed to settle. After settling, as much standing/surface water as possible will be decanted without losing solids. Depending on the nature of the sediment, additional steps may be required to reduce the moisture content of the sample. These procedures include drying the sediments on a large piece of filter paper, or sieving the sediment through progressively smaller sieves to remove excess water.

4. Once the water is removed utilizing one or more of the specified techniques, the sediment will be throughly homogenized. Bottles will be filled in the order of highest to lowest sample volatility beginning with pesticides/PCB and then metals. One additional sample volume will be collected for percent moisture analysis.

5. The appearance and odor of the sediment, depth sampled, number of adjacent samples collected, water column depth, material removed, and any other observations noted during sampling will be recorded in the field logbook and photographs may be taken.

2.2.5 Piezometer Installation and Water Level Elevation Measurements. Twenty-five piezometers will be installed using the shallow installation specification provided by EPA (AFBCA, 1997) (Appendix M). The piezometers will be installed in the wetland to evaluate the transitional zone between surface water and groundwater in the wetland area. The groundwater elevations in the piezometers will be measured four times during the field program.

2.2.5.1 Piezometer Installation. Twenty-five shallow piezometers will be installed in the wetlands area, near the anticipated work area for sediment remediation, to assess the transitional zone between surface water and groundwater. The piezometers will be installed following the procedure in Appendix M.

1. Record the weather conditions and other relevant site conditions.
2. Record the physical characteristics of the location, including any standing water, odor, color, presence of any dead vegetation and surface sheens, etc.
3. Using a decontaminated auger, advance a hole approximately 2.5 feet deep into the sediment. Place approximately 6 inches of the specified well sand into the hole.
4. Insert the assembled piezometer screen and riser into the hole with the vented point into, but not through, the sand.
5. Fill the annular space around the slotted screen and riser with well sand to within 6 inches of ground surface and at least 6 inches above the top of the slotted screen. Fill the remaining annular space with bentonite pellets. Mound the bentonite pellets around the riser to induce surface water flow away from the completed installation.
6. The appearance and odor of the sediment, material removed, and any other observations noted during installation will be recorded in the field logbook and photographs may be taken.

2.2.5.2 Water Elevation Measurements. For measurement of groundwater elevations in the piezometers, the determination of the depth to the static water level will be made to the nearest 0.01 foot using an electronic water level indicator. Synoptic measurements at all locations will be taken within a 24-hour period.

For the piezometers, depth to water will be measured from the top of the PVC casing. The piezometers are scheduled to be surveyed after installation and will be re-surveyed in the spring to assure consistency between water-level measurements.

All down-well measuring devices will be thoroughly decontaminated between measurements in all piezometers as described in Appendix E. Water elevation measurements will be recorded in the field logbook and/or on field forms located in Appendix C. The following procedure will be used to measure the synoptic water level at each location. Any variances to the following procedures will be documented in the field logbook. Four rounds of water level measurements will be obtained at the 25 piezometer locations. The procedure that will be used for measuring water levels is described in Section 2.2.1.

2.3 Sample Handling and Custody Requirements

All samples collected during each of the field events will be tracked from collection, through shipment, until laboratory receipt and laboratory custody. Labels will be affixed to sample containers with the following types of information: sample number, sample location, date/time of collection, and samplers initials. In addition, RAS and DAS sample numbers will be affixed to each sample container being submitted to a laboratory. For samples submitted for RAS analyses, an EPA-CLP tag will also be completed and attached to each sample container. For RAS analyses a traffic report/chain-of-custody (TR/COC) form will be completed, and for DAS analyses a M&E COC form will be completed for all samples submitted for laboratory analysis. The TR/COC and M&E COC forms are signed by individuals responsible for sampling, laboratory receipt, and laboratory analysis. The original TR/COC and M&E COC forms are maintained until the project is complete and are kept in the project files .

Appendix D provides examples of sample container labels, RAS and DAS sample numbers, RAS sample tags, and TR/COC and M&E COC forms, as well as further description of typical sample handling and custody procedures. Sample packaging and shipping procedures are also described in Appendix D.

2.4 Analytical Method Requirements

As described in Section 1.4, the two types of analytical services that will be used to analyze environmental samples are RAS and DAS. For RAS analyses the laboratory methods will be performed in accordance with the current CLP SOWs:

- *Contract Laboratory Program, Statement of Work for Organics Analysis (Multi-Media/Multi-Concentration). Document No. OLM01.0 including revisions OLM01.1 through OLM03.2.* (U.S. EPA, 1994b) and subsequent revisions

- *Contract Laboratory Program, Statement of Work for Low Concentration Water Analysis (Multi-Media/Multi-Concentration). Document No. OLC02.1.* (U.S. EPA, 1996a)

- *Contract Laboratory Program, Statement of Work for Inorganics Analysis (Multi-Media/Multi-Concentration). Document No. ILM01.0 including revisions ILM01.1 through ILM04.0.* (U.S. EPA, 1993) and subsequent revisions

For DAS analyses, DAS specifications describing the laboratory method requirements are provided in the Appendix B. All project-related DAS specifications detail the analytical procedure(s), detection limits, laboratory reagents, and laboratory QC criteria that are required for the DAS analytical methods.

All environmental and associated field QC samples will be submitted to EPA-approved CLP laboratories for RAS analyses and to M&E-procured (and EPA-approved) laboratories for DAS analyses. The RAS laboratories will be assigned by EPA's CLASS contractor prior to any field work involving sample collection. M&E-procured laboratories that have been approved by the EPA Contracting Officer will be assigned for DAS analyses, and analytical issues will be handled as part of the analytical services work assignment (#001-ANLA-01ZZ).

2.5 Quality Control Requirements

The QC requirements that will be used during field and laboratory activities will utilize both known and unknown (or "blind") QC samples. Laboratory QC requirements will adhere to specifications outlined in the current CLP SOWs for RAS organics and inorganics analyses (U.S. EPA, 1994b and 1993) and in the DAS specifications (Appendix B).

The various types of field and laboratory QC samples that are typically required are described in Appendix I. The type and frequency of analyses for each QC sample is shown in Table I-1. The field QC samples that will be collected during the field events were presented in Tables 2-1 and 2-2.

The number of field duplicates to be collected is dependent upon the number of types of sampling equipment to be used during sample collection. Each piece of sampling equipment used during sample collection will require an equipment-specific duplicate sample. Therefore, whenever possible, the types of equipment to be used during sample collection will be minimized. The procedure for collecting field duplicates is outlined in Appendix I.

2.6 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Inspection and maintenance of instrumentation is performed to ensure that the instruments are properly operating and thereby provide accurate results. The typical inspection and maintenance requirements are described in Appendix J. As is discussed in Section 2.7, instrument calibration is a primary indicator of instrument performance.

2.7 Instrument Calibration and Frequency

Calibration of laboratory, field parameter measurement, and other field testing instrumentation is essential to ensure the highest quality data possible.

2.7.1 Laboratory Instrumentation. The calibration procedures, inspection, and preventative maintenance performed in EPA CLP RAS laboratories are controlled by a formal calibration and maintenance program. Calibration and maintenance are defined through contracts with EPA and checked by EPA laboratory audits. Laboratories procured by M&E to perform DAS analyses have been approved by EPA and are required to follow calibration procedures and other analytical procedures as detailed in the DAS specifications, located in Appendix B.

2.7.2 Field Instrumentation. All field instrumentation necessary for field monitoring and health and safety purposes will be calibrated according to the manufacturer's specifications that are presented in the manufacturer's manual for each instrument. For instruments used to monitor temperature, pH, dissolved oxygen, conductivity/specific conductivity, oxidation/reduction potential, and turbidity, whenever practical, calibration will be performed using the procedures described in the U.S. EPA *Region I Draft Calibration of Field Instruments* (U.S. EPA, 1998), which is included in Appendix S. Calibration solutions will be selected based upon historical monitoring data collected from the site in order to bracket the range of values likely to be encountered. At a minimum, all field instruments will be calibrated daily prior to initiating field activities, typically in the morning, and at the conclusion of field activities, typically the end of the day. Appendix J describes the calibration and maintenance procedures for field instrumentation.

2.8 Inspection/Acceptance Requirements for Supplies and Consumables

Sample containers, sampling equipment, sample preservatives, and solvents used for decontamination must meet all applicable QA/QC requirements prior to acceptance and use in the field. All supplies will be purchased from laboratory and other applicable supply vendors.

Sample containers used for sample collection will be pre-cleaned (U.S. EPA, 1992) and laboratory-certified. A copy of the laboratory certification, which accompanies each case of sample bottles, will be maintained with field records in the project files. In addition, each case will be inspected for an expiration date; a minimum of approximately four weeks will be left between sample collection and the expiration date.

Pre-cleaned tubing, bottom-filling/bottom emptying bailers, and inertial samplers will be used for purging and groundwater sampling activities. These items will be either Teflon or Teflon-coated polyethylene. Bailers used will be of the bottom-filling, bottom-emptying type. Acids, bases, and other chemicals used in sample preservation will be reagent-grade. Solvents used for decontamination will be pesticide-grade. Two types of water will be used for decontamination: tap water and deionized ultra-filtered (DIUF) water. Tap water used for decontamination will be obtained from a potable water source. DIUF water will be purchased from a vendor (not store bought distilled water). Certifications that accompany these supplies will be maintained with other field records in the project files.

2.9 Data Acquisition Requirements For Non-Direct Measurements

Potential sources of non-direct measurement data typically include data base searches, federal and state agency provided information, and literature sources. A reasonable effort will be made to evaluate each of these sources in terms of their usability, accuracy, and integrity. It is anticipated that the only other data that will be used in association with field-collected and analytical data generated by M&E during each of the field events will consist of previously collected data and information from the EPA ARCS program.

2.10 Data Management

Collection and recording of field observations, field measurements, analytical data, and other data management activities have been described in Section 2.0 and Appendix C. Data reduction consists of compiling and summarizing data collected during field activities. Field and analytical data typically will be summarized in a tabular or other appropriate format. All information and data will be reported and verified for accuracy with the original sources of data. For analytical data, units designated by the analytical method will be reported. Whenever transcribed, analytical data will be verified with the original sources of laboratory data.

Laboratory data produced for internal records are reported as part of a SDG include laboratory worksheets and notebooks, sample tracking system forms, instrument logs, standards records, maintenance records, calibration records, and associated QC data. Non-laboratory sources of data typically include field logbooks, sample tracking sheets, and instrumentation and calibration logs. These data are generated during field activities, and where relevant, are summarized for interpretation or use throughout the data evaluation process. Other sources of data have been described in Section 2.9.

The document control system for project reports varies with each report. For SAPs and SSHPs the control system is presented at the top of each page and typically includes the site name and location, the document title, revision number, and date submitted. An electronic copy of each document is stored to disk and is stored along with a printed copy of the document in the project files.

3.0 ASSESSMENT/OVERSIGHT

This section describes activities that facilitate assessment of the effectiveness of data collection and reporting activities.

3.1 Assessments and Response Actions

An audit is a systematic check to assess the quality of operation of some function or activity. Quality assurance audits play an important role in the RAC QA/QC program. The QA auditor selected by the RAC Program QA Manager is the person who designs and/or performs audits. Since QA audits represent, by definition, independent assessments of a measurement system and associated data quality, the auditor must be functionally independent of the measurement effort to ensure objectivity. However, the auditor must be sufficiently familiar with the objectives, principles, and procedures of the measurement efforts to be able to perform a thorough and effective evaluation of the measurement system. Especially important is the ability of the auditor to identify components of the system that are critical to overall data quality. For this reason, the audit focuses heavily upon those components. The auditor's technical background and experience should also provide a basis for appropriate audit standard selection, audit design, and data interpretation.

The M&E organizational structure (Section 1.1) has been set up to ensure the independence of the QA function. The RAC Program QA Manager sets the corporate QA policies and oversees implementation of these policies, and is responsible for management, scheduling, and overseeing of audit activities for the RAC program. The RAC Program QA Manager notifies the specific Project Manager of discrepancies and potential problems discovered during RAC program audits.

The Project Manager then initiates corrective action as described below.

The following audits may be conducted during the course of this work assignment:

- Health and Safety (including decontamination of personnel)
- Field Activities (Sampling and Monitoring)
- Laboratory Activities (including QA/QC procedures)

Audits of RAS laboratories are performed on a regular basis by EPA as part of their CLP program. Audits of DAS laboratories are performed as part of the analytical services work assignment (#001-ANLA-01ZZ).

Following each of the above field-related audits, the auditor is responsible for drafting an audit report to be sent to the audit participants. A post-audit communications session is then scheduled and conducted to discuss the preliminary audit results, and a final audit report is written and submitted to the audit participants. If the audit reveals an activity which does not conform to documented plans, the audit participants will issue a corrective action report to the auditor to be kept on file with other pertinent auditing information and to state that the prescribed corrective action has been implemented. The RAC Program QA Manager will review documentation of corrective actions furnished by the Work Assignment Manager as a follow-up to ensure effective resolution is taken.

In addition, indirect audits for the assessment and QA review of field data are performed on an on-going basis as data are generated, reduced, and evaluated. For example, indicators of the level of field performance are the analytical data for QC samples such as the results of the equipment blanks and field duplicates. Each blank analysis is an indirect audit of the effectiveness of measures taken in the field to ensure sample integrity (e.g., field decontamination procedures). The results of the field duplicates may provide an indirect audit of the ability of each field team to collect representative sample portions of each matrix type. These assessments are performed in relation to the validation and data usability reviews described in Section 4.0.

In addition, all numerical manipulations, including manual calculations, will be documented. All records of numerical analyses must be legible, of reproduction quality, and sufficiently complete to permit logical reconstruction by a qualified individual other than the originator.

3.2 Reports to Management

As part of the RAC program and this work assignment, a number of reports are expected to be generated. In response to program activities the following reports are submitted by M&E to EPA:

- Monthly progress reports
- Data Trend Evaluation Technical Memoranda
- Data Evaluation Summary Reports
- CLP and non-CLP monthly reports
- Results of performance audits of all field sampling performed during the subject reporting period

The monthly progress reports include project status updates and a summary of QA document reviews that have been conducted during the respective reporting period.

For project-related activities the following reports are submitted to EPA for data collected by M&E:

- Validation letter reports for all SDGs
- Data Trend Evaluation Technical Memoranda
- Data Evaluation Summary Reports
- FS Addendum Report
- Natural Attenuation Evaluation Report

4.0 DATA VALIDATION AND USABILITY

Described below are the types of procedures that are followed by M&E during the reduction, validation, and reporting of field and analytical data. The usability of field and analytical data that are reported is assessed based on validation and field information.

4.1 Data Review, Validation, and Verification Requirements

The QA criteria used to review and validate data for organic and inorganic RAS analyses are detailed in the CLP SOWs and the most recent EPA validation guidelines as described in Section 4.2. For DAS analyses, the QA criteria used to review data include the RAS criteria and any additional criteria listed in the DAS specifications, located in Appendix B.

In addition, to the precision and accuracy criteria specified in the method references, a completeness goal of 90% has been set since sampling of some monitoring locations may not be possible; samples may not be properly analyzed due to laboratory or field personnel error, sample loss (i.e., container breakage), or matrix interferences. The QC samples that will be used to assess QA objectives have been presented in the Section 2.0 tables and are described in Appendix I.

4.2 Validation and Verification Procedures

All RAS and DAS analytical data will be validated to either Tier I or Tier II. RAS and DAS data generated from the each of the field events will be validated in accordance with EPA Region I data validation guidelines:

- *Region I EPA-New England Data Validation Functional Guidelines for Evaluating Environmental Analyses* (U.S. EPA, 1996d)

In addition, M&E will incorporate the DAS analytical specifications (Appendix B) acceptance criteria along with the EPA validation guidelines to perform the data validation. Actions implemented during validation of analytical data are described in Appendix K.

In addition to those activities, DAS data receiving only Tier I validation will be further evaluated to ensure that the laboratories have met minimum data acceptance criteria established under M&E's DAS Corrective Action Program (1995). The additional evaluation consists of completing Organic/Inorganic Data Quality Assessment Forms (I/ODQAFs) for each SDG validated to Tier I to ensure compliance with the data requirements in the DAS specifications and to determine if any Tier I validated data could be potentially rejected based on Tier II data validation criteria. Field screening data (i.e., field parameters such as pH, turbidity, etc.) will be reviewed in terms of its usability to determine if it is appropriate for its intended use and if its QA objectives have been met.

4.3 Reconciliation With User Requirements

Data generated from each of the field events, will be assessed prior to its being reported or used in subsequent evaluations. The primary objectives for assessing the usability of field and analytical data are: (1) to collect data that is representative of site conditions and (2) to produce data of the highest quality possible in order to accurately characterize site conditions. Quality control data provided by the laboratory will facilitate the evaluation of analytical data in terms of accuracy and precision. Coupled with field information, QC data (Section 2.0 tables and Appendix I) will be used to determine the usability of data. The QA objective criteria that will be applied have been described in Section 4.2.

Field-collected data will be reviewed in terms of its usability to determine if it is appropriate for its intended use and if its QA objectives have been met. All analytical data will be validated (Section 4.2) in relation to the QA objectives described in Section 4.1. However, further review of field-collected and validated data may be needed once initial data evaluations are performed, since data outliers or anomalies may become apparent following data compilation and manipulation. Additional reviews are conducted on a case-by-case basis and may consist of not using suspicious data points or additional treatment of data prior to its use. Data that are deemed not usable or that can be used, but with limitations, will be discussed when the data are presented and evaluated in the Data Evaluation Reports (Section 3.2).

5.0 REFERENCES

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APPENDIX A. PROJECT ORGANIZATION AND RESPONSIBILITIES

APPENDIX A. PROJECT ORGANIZATION AND RESPONSIBILITIES

The key Metcalf & Eddy individuals responsible for implementation of Quality Assurance (QA) procedures (as shown in Figure A-1) under the Response Action Contract (RAC) program and this work assignment and their typical QA responsibilities are as follows:

M&E RAC Program QA Manager

- Implements technical document review of the Sampling and Analysis Plan (SAP)
- Oversees periodic performance audits of field activities and data collection activities
- Conducts periodic program QA audits and reports to EPA
- Follows up on corrective action and ensures resolution of any technical advisory team (TAT) concerns
- Oversees the maintenance of RAC QA file for documentation of all of the above
- Directs and coordinates periodic performance and systems audits of environmental data collection activities
- Prepares monthly reports summarizing any unresolved corrective action recommendations for laboratory and field activities
- Prepares the monthly progress reports on program activities and related QA activities

M&E Work Assignment Manager

- Initiates and receives communication from the EPA Remedial Project Manager (RPM) for this work assignment
- Reports to the RAC Program Manager
- Assures that approved procedures meet project objectives
- Responsible for implementation of recommendations made by Program QA Manager
- Responsible for initiating corrective actions
- Reviews and approves all sampling procedures
- Coordinates field and office activities with Project Scientist
- Monitors schedules for field, analytical, and data validation activities associated with the field sampling program

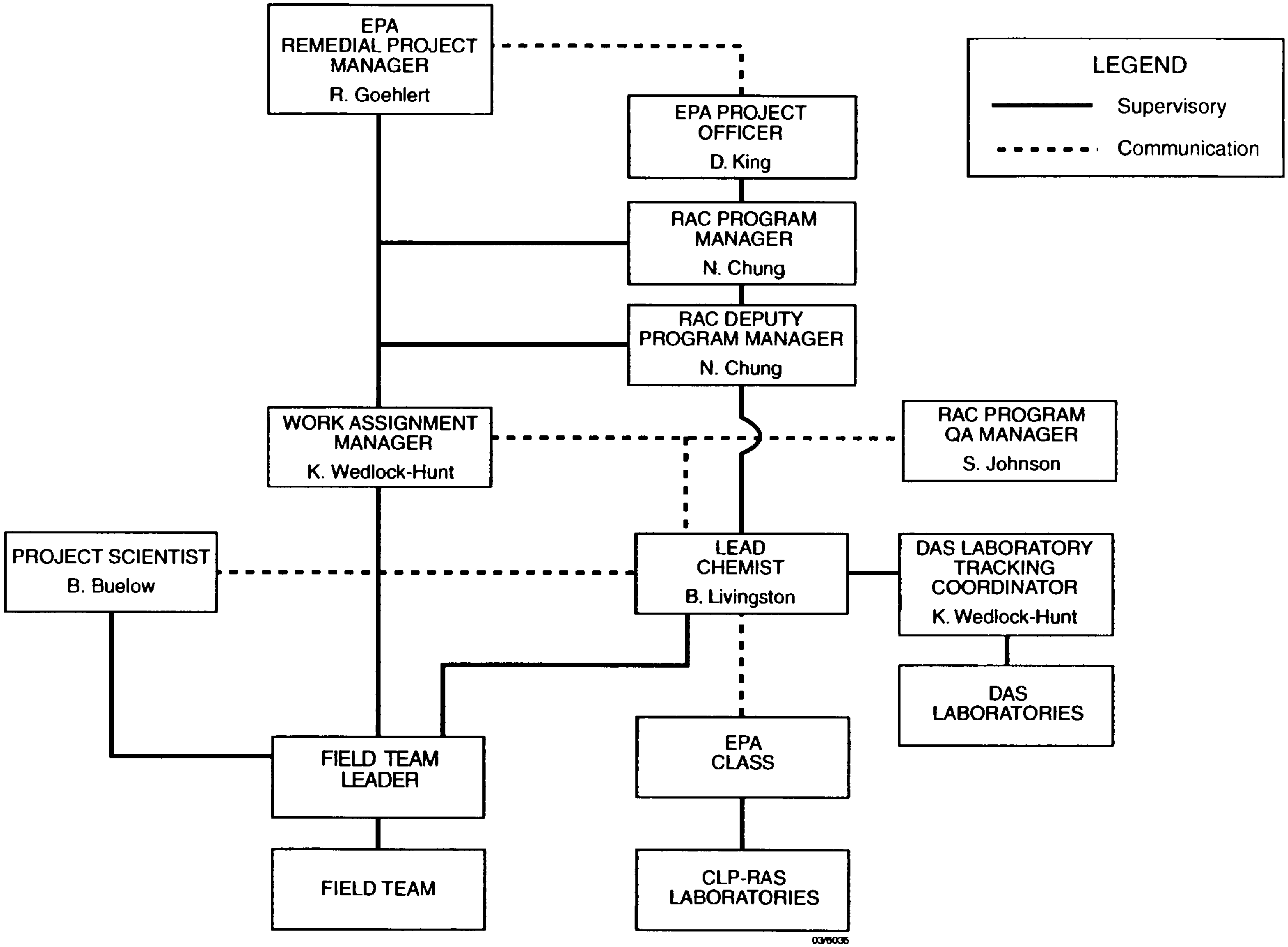


FIGURE A-1. PROJECT ORGANIZATION CHART FOR TECHNICAL ASSISTANCE FIELD ACTIVITIES AT THE OTTATI AND GOSS SUPERFUND SITE, KINGSTON, NEW HAMPSHIRE

- Prepares the SAP
- Coordinates analytical and sampling activities with Lead Chemist and Project Scientist
- Coordinates and oversees all sampling and analytical data assessment activities
- Ensures that all sampling and analytical procedures are followed
- Reviews M&E procured Delivery of Analytical Services (DAS) laboratory invoices for accuracy and approves invoices for payment
- Ensures that all data validation activities are complete and validation deliverables are submitted to EPA

M&E Project Scientist

- Reports to the Work Assignment Manager
- Coordinates and oversees all geological and hydrogeological assessment activities
- Coordinates field activities with Field Team Leader

M&E Lead Chemist

- Reports to RAC Program Manager
- Performs technical document review of the SAP
- Reviews sampling and analytical procedures and ensures that they adhere to EPA or other applicable protocols
- Coordinates procurement of Contract Laboratory Program (CLP) Routine Analytical Services (RAS) laboratories with Contract Laboratory Analytical Support Services (CLASS) prior to field effort and interacts with CLASS regarding laboratory issues
- Oversees M&E's DAS program and ensures assignments with M&E-procured laboratories are complied with
- Receives Sample Delivery Group (SDG) packages from CLP-RAS and DAS laboratories
- Ensures validity of analytical data generated from field activities
- Prepares CLP and non-CLP monthly reports
- Reconciles quarterly RAS/DAS data package reports and DAS activity reports

M&E DAS Laboratory/Tracking Coordinator

- Reports to the Lead Chemist
- Ensures proper sample and data tracking through initialization of sample identification, chain-of-custody, and receipt of SDG packages

- Coordinates DAS laboratory assignments and tracks samples from collection through data validation

M&E Field Team Leader

- Coordinates sampling and field activities with Project Scientist
- Responsible for on-site coordination of field monitoring and sampling activities
- Responsible for collection of representative field samples
- Assures that samples are collected in accordance with the SAP and approved QA procedures
- Responsible for sample chain-of-custody protocols and sample shipments to CLP-RAS and M&E-procured DAS laboratories
- Coordinates equipment for field activities

APPENDIX B. DAS ANALYTICAL SERVICES

(Under Separate Cover)

APPENDIX C. DOCUMENTATION

APPENDIX C. DOCUMENTATION

A simple program designed to ensure that field performed analyses yield valid, useful data is summarized in Table C-1. In all cases, the field team will maintain a concise, detailed field logbook containing pertinent field activities and actions taken as well as documentation of observations made.

TABLE C-1. FIELD SAMPLING TEAM DOCUMENTATION OBJECTIVES TO ENSURE VALID DATA COLLECTION

Objective	Action	Responsible Person
Verify sample and location information conforms to conditions and requirements specified	Review labeled samples and in-process samples using daily sample inventory	Field sampling team
Verify incoming field data and sample completeness	Maintain daily count of incomplete items	Field sampling team
Verify completeness of field logbooks	Review daily	Field team leader (or designee)
Review field calibration criteria and record test calibration acceptance	Perform as necessary	Field team leader (or designee)
Ensure all data forms are properly completed	Review and check off during each sample collection	Field team leader (or designee)
Verify all field generated QC samples were collected as required	Review requirements and confirm sample collection	Field team leader (or designee)

Sampling procedures, instrument calibration, field-collected data, and information pertinent to sampling and installation conditions and progress must be documented following a prescribed set of guidelines. The documentation serves as a permanent and traceable record of all activities related to a specific field investigation. The record must be legible and accessible to allow ease in verifying sampling activities and addressing future questions that may arise concerning such issues as sample integrity, sample traceability, etc. All documentation that is generated during the field investigation program will be put in the project files upon completion of field work.

C.1 Sample Designation/Identification

The establishment of a standard sample designation/labeling protocol is essential to ensure adequate quality assurance/quality control (QA/QC) in regards to the traceability of samples and their associated analytical data. Proper labeling allows for the tracking of samples beginning from the time of sample collection, through analysis, and following project completion should future data correlation be deemed necessary. The proper labeling of samples is also critical in ensuring that samples are analyzed within the required sample holding times.

All samples will be identified using a unique sample identification scheme suitable to the project and the sampling protocol. The numbering scheme will be devised by the field sampling team and approved by the Work Assignment Manager prior to sampling activities. The sample identification number and the RAS and/or DAS sample number will be recorded on the TR/COC or M&E COC forms accompanying each sample shipment submitted for analysis. The sample identification number will also be recorded on the M&E COC for subcontracted analyses.

C.2 Corrections to Documentation

All documentation must be recorded in permanent ink. Corrections to errors in documentation or recorded calculations will be made by first striking out the error with a single line so as not to obliterate the original entry. Then the replacement entry or value will be inserted where appropriate. The person originating the change will initial each separate change. All revisions, deletions, and changes must be made in indelible ink.

C.3 Photographs

The field team will document, through the use of color photographs where possible, various on-site conditions and field activities as deemed necessary for the work assignment. Examples of items that may require photographic documentation include:

- General site topography
- Sampling locations

- Newly-installed or existing monitoring locations
- Physical appearance of environmental samples
- Physical appearance of groundwater, surface or subsurface soils, and sediment

C.4 Records

The field team leader has the responsibility to maintain the daily field documents pertaining to sample identification and control. Special emphasis is placed on the logbook completeness and accuracy. Field logbooks, field data forms, CLP tracking forms, and COC forms must contain entries made with indelible ink and that are dated, signed, and contain statements that are legible, accurate, and inclusive documentation of project activities. The daily log will contain a diary of all pertinent project activities. Entries into the log typically include weather conditions, samples collected, and difficulties encountered and how such difficulties were resolved. Because the logbook, field data forms, and chain of custody forms provide the basis for future reports, they must contain accurate facts and observations. Language must be objective, factual, and free of personal interpretations or other terminology that may prove inappropriate.

C.5 Field Logbooks

A field logbook will be maintained by each field team. The logbook will be comprised of a bound book with consecutively numbered pages. The integrity of field documentation is further ensured by the use of field logbooks containing paper treated to repel the rain or any other aqueous splashings experienced during field documentation. Should more than one field logbook be required, they will be numbered sequentially.

The front of each field logbook typically contains the following information:

- Project name and number
- Types of field activities recorded in the contents of the logbook
- Date(s) of use

The field logbook will contain a diary of all pertinent field activities. Standard information recorded in the field logbook typically includes: general observations made in the field, identification and calibration of instruments used, and field data. An example of typical information that may be included at the beginning of each field logbook is shown in Figure C-1. Figures C-2 and C-3 serve as guidelines for field logbook data entries for groundwater and surface and subsurface soil and sediment sample collection procedures, respectively.

Instrument Calibration

Include a brief description of the calibration procedures used for each instrument utilized in the field and the designated pages on which daily calibration entries are made. The field instruments may include:

- pH/ORP meter
- Conductivity meter
- Flow-thru cells
- Top-loading balance
- PID
- Turbidity meter
- portable spectrophotometer
- FID
- DO meter

Decontamination Procedures

Include a brief description of the decontamination procedures used to clean all sampling equipment that may come in direct contact with the sample and designated pages on which daily decontamination procedure entries are made. The equipment may include:

- Bailers
- Water level measuring tapes
- Shovels, augers, hand trowels, and mixing bowls
- Drilling/excavation equipment

Quality Control Sample Preparation

Include a brief description of all QC samples prepared in the field for both aqueous and soil sampling and the designated pages on which daily QC samples preparation entries are made. The QC samples may include:

- Trip blanks
- Field duplicates
- Equipment blanks
- PE samples

Field Water

Include a brief description of the field water sources for tap, DIUF, and HPLC-grade water.

FIGURE C-1. FIELD LOGBOOK INFORMATION

Date ______________ Location ____________________________

Sampling Apparatus Used ______________________________________
____
____

Description of sampling location ________________________________

Weather ____
____

Water parameters/measurements:
  pH ____
  ORP ____
  Conductivity ____
  Dissolved Oxygen ____________________________________
  Turbidity ____
  Temperature ____
  Depth of well _______________________________________
  Static groundwater level collection ______________________
  Well water volume ___________________________________
  Well volume purged __________________________________

Air monitoring (list equipment used as well as the measured reading):
  In well ____
  In personnel breathing area ____________________________

Sample description ____
____
____

Field preservation ____

Decontamination (page number reference):

Photograph frame numbers _____________________________________

FIGURE C-2. FIELD LOGBOOK INFORMATION - GROUNDWATER SAMPLING

Date ______________ Location ____________________________

Sampling Apparatus Used_______________________________________
____
____

Description of sampling location ______________________________
____
____

Weather ____
____
____

Soil/Sediment sampling parameters:
Depth to water _______________________________
Depth of standing water _________________________
Depth of sample (below surface) ___________________

Sample description:
Color _____________________________________
Grain size __________________________________
Organic materials _____________________________
Other _____________________________________

Sample collection method ______________________________

Field preservation ____________________________________

Decontamination (page number reference):
Sampling Apparatus_______________________________

Photograph frame numbers _____________________________

FIGURE C-3. FIELD LOGBOOK INFORMATION - SOIL/SEDIMENT SAMPLING

The field logbook contains the following information:

- Date and time of personnel entries on site, weather conditions, and temperature
- List of start/stop times of all subcontractors hired for activities such as surveying, drilling, excavation, geophysical surveys, etc.
- List of the personnel present on the site during each sampling day to include all M&E personnel, subcontractors, and visitors
- List of the equipment decontaminated along with a reference to the procedures used
- Description of the sampling locations in reference to permanent landmarks
- List of any changes from standard operating procedures, decisions made in the field, and other pertinent information
- QC samples associated with the samples collected, and QC sample collection procedures
- Equipment and/or instrument identification numbers (if available) for those used
- Sample preservation techniques performed
- Air monitoring information gathered (e.g., PID and FID readings, etc.)
- Level of personnel protection mandated (e.g., Level B, C, D) and record of pertinent time intervals spent by each field team member at each level (e.g., time spent in Level C developing a well, time spent in Level C sampling soil from a backhoe, etc.)
- Other logs/paperwork used to document activities
- Instrument calibration information including the instruments calibrated during the day and the individual who performed the calibration (Note: Instrument calibration information should be documented in the field logbook as well as on the instrument calibration log kept with each instrument and serving to document instrument response over time.)
- List of the samples collected by media (i.e., soil, sediment, water, etc.)

- Comments relative to any problem areas that occurred during the day's activities, their final resolution, and any anticipated impact on the outcome of the field investigation

C.6 Field Data Forms

Along with the completion of data entry in each of the above-mentioned logbooks, field data forms may also be completed and filed in a three-ring notebook that are maintained for different field activities.

The field data forms may include the following:

- Site health and safety log(s) - to maintain accurate health and safety records for each team member
- Groundwater elevation data sheets
- Monitoring well sampling data sheets
- Surface and subsurface soil sampling data sheets
- Sediment sampling data sheets
- Piezometer installation sheets

An example of the Site Health and Safety Log is presented in M&E's Site-Safety and Health Plan (SSHP; 1998). Examples of the sampling field forms are presented in Figures C-4 through C-6.

C.7 Chain-of-Custody Record

Possession of samples will be traceable from the time a sample is collected until it is used as evidence in legal proceedings, if applicable. To adequately track sample possession, a documented chain-of-custody form must be maintained. See Appendix D for more detailed guidelines concerning sample custody.

C.8 Variances

A variance is a deviation from project requirements. All variances from procedural and other project requirements will be documented in the field logbook. The M&E Project Manager for this assignment will approve field changes that have a major impact on cost, schedule, and/or technical performance prior to incorporation. Field changes and deviations from project planning documents will be reviewed and approved by the project manager. Any variance that will affect project cost, schedule, or scope will require approval from the EPA Remedial Project Manager (RPM) prior to implementation. All other changes will be reported to the EPA RPM as soon as possible.

MONITORING WELL SAMPLING WORKSHEET

Job Name: ____________ Job No.: ____________ Samplers: ____________

Well ID: ____________ Date Sampled: ________ Arrival Time: ______ Depart. Time: ______

Well secure upon arrival? Yes / No PID Readings (ppm) ____________ Breathing Zone ____________ Well Headspace

Well Diameter: ________inches ÷ 12 = ________ ft (dia)

Depth of well from T.O.C. ________ ft		Depth of well from T.O.C. ________ ft	
Depth of water from T.O.C. ________ ft		Depth of water from T.O.C. ________ ft	
Feet of standing water ________ ft		Feet of standing water ________ ft	
Volume of standing water ________ gal		Volume of standing water ________ gal	
Purging Method ____________		Purge: Time Start ______ End ______	

	Time	Water Level (feet)	pH	Eh (mV)	Sp. Cond. (μs/cm)	Temp (°C)	DO (mg/l)	Turbidity (NTU)	Flow Rate (ml/min)
Initial Reading									
Final Reading									

Sample Collection: Time Start: ______ End: ______ Samples Preserved: Yes / No

Sample Characteristics (circle all applicable)

Describe odor:	none	sulfide	fishy	musty	petroleum		______
Describe color:	colorless	black	brown	orange	red		______
Describe appearance:	turbid	silty	sand	clay	floaters	sheen	______
	clear	multiphase	foaming	slimy	algae		______

Organic Layer? ________ Length? ________ Floating or Sinking or Other? ________

Comments ____

____

____

____

Refer to page ____________ of the corresponding field log book.

FIGURE C-4. MONITORING WELL SAMPLING FORM (PAGE 1 of 2)

Metcalf & Eddy, Inc.
Engineers

Sediment Sampling Sheet

PROJECT:

DATE: J# SAMPLE ID:

LOCATION DIAGRAM: SAMPLE ID:

SEDIMENT SAMPLE DESCRIPTION:

SURFACE WATER CONDITIONS:

WATER BODY ID:

SAMPLES COLLECTED:

NOTES:

SAMPLERS: DATE:

FIGURE C-6. SEDIMENT SAMPLING WORKSHEET

MONITORING WELL SAMPLING WORKSHEET (ADDITIONAL PAGES)

Job Name: ____________________ Job No.: ______________________ Samplers: ________________

Well ID: _____________________ Date Sampled: _________________________

Time (military)	Water Level (feet)	pH	Eh (mv)	Conductivity (µs/cm)	Temp (°C)	DO (mg/L)	Turbidity (NTU)	Flow Rate (mi/min)

FIGURE C-4. (Continued). MONITORING WELL SAMPLING FORM (PAGE 2 of 2)

Metcalf & Eddy, Inc.
Engineers

Excavation Profile Log

PROJECT:		SHEET: OF	TEST PIT NO.:
SITE LOCATION:	JOB NO.:		
	GRID LOCATION:	GROUND ELEV.:	TOTAL DEPTH:

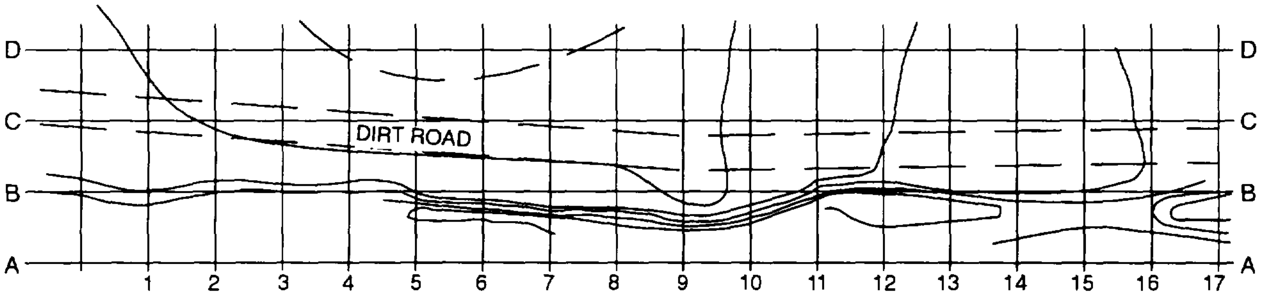
CONTRACTOR:	ENG/GEO:	BEGUN:
EQUIPMENT:	OPERATOR:	FINISHED:
PIT/TRENCH DIMENSIONS:	WEATHER:	GROUNDWATER (DEPTH):
SAMPLING METHOD:	DECON. USED:	TOP OF ROCK (DEPTH):

TEST PIT EXCAVATION PROFILE:

SCALE:

LOCATION OF TEST PITS:

SAMPLE COORDINATES:



SAMPLES TAKEN:

FIGURE C-5. EXCAVATION PROFILE LOG

6133/tk

APPENDIX D. SAMPLE CUSTODY AND HANDLING PROCEDURES

APPENDIX D. SAMPLE CUSTODY AND HANDLING PROCEDURES

Sampling handling is an important part of the field investigation program since samples that are incorrectly handled can affect the quality of data. Sample handling begins at the collection of the samples and continues until the sample has been analyzed. Described in this section are sample preservation requirements for the samples, sample custody, and documentation protocols.

D.1 SAMPLE CUSTODY

An overriding consideration essential for the validation of environmental measurement data is the necessity to demonstrate that samples have been obtained from the locations stated and that they have reached the laboratory without alteration. Evidence of the sample traceability from collection to shipment, laboratory receipt, and laboratory custody (until proper sample disposal and the introduction of field investigation results as evidence in legal proceedings when pertinent) must be documented. A sample is considered to be in a person's custody if the sample is:

- In a person's actual possession
- In view after being in a person's possession
- Locked so that no one can tamper with it after having been in physical custody
- In a secured area, restricted to authorized personnel

The field team leader (or designee) is responsible for overseeing and supervising the implementation of proper sample custody procedures in the field. The field team leader or designee are also responsible for ensuring sample custody until the samples have been transferred to a courier or directly to the laboratory. Once received by the laboratory, the samples proceed through an orderly processing sequence specifically designed to ensure continuous integrity of both the sample and its documentation.

D.1.1 Chain-of-Custody

The chain-of-custody procedures are initiated in the field immediately following sample collection. The procedures consist of: (1) preparing and attaching a unique sample label and tag (RAS analyses only) to each sample collected, (2) completing the traffic report/chain of custody (TR/COC) form for RAS analyses and the M&E COC for DAS analyses, and (3) preparing and packing the samples for shipment. The standard operating procedures for the DAS program, including procurement of analytical services, sample tracking, and overall management of the program can be found in EPA's Regional Sample Control Center Guidance for the CLP and DAS (1996b), which contains the current guidelines that are applicable to this section.

D.1.1.1 Sample Labels. Field personnel are responsible for uniquely identifying and labeling all samples collected during a field investigation program. All labeling must be completed in indelible/waterproof ink and securely affixed to the sample container.

For RAS analyses, all sample bottles will be labeled with both an M&E label and an EPA-CLP sample number designated for RAS analyses. Similarly, for all DAS analyses, sample bottles will be labeled with an M&E label and a DAS sample number. The M&E label typically contains the following information:

- Unique sample identification number
- Sample location/description number
- Type of analysis to be performed
- Sample volume, container type, and the type of chemical preservation used
- Sampling date and time
- Sampler's initials

The RAS sample number is a unique number that identifies each sample analyzed through the CLP system. The DAS sample number is also a unique number; however, DAS samples are not routed through the EPA-CLP process, but are generated and tracked through the analytical services work assignment (#001-ANLA-01ZZ). Both the RAS and DAS sample numbers are preprinted on adhesive labels. The RAS sample number labels are provided by the Regional Sample Control Center (RSCC) for EPA Region I, and DAS sample number labels are provided by the M&E DAS Laboratory/Tracking Coordinator. It is the field personnel's responsibility to assign the RAS or DAS sample number correctly, transcribe it accurately on the appropriate documentation, place the labels on the correct bottles, and transcribe it accurately to the bottle tag.

The RAS sample number label contains the following information:

- An alpha-numeric sample identification number as assigned by the RSCC.
- Type of analysis to be performed

The DAS sample number label will contain only an alpha-numeric sample identification number as assigned by the M&E Laboratory/Tracking Coordinator and can be used for any type of DAS analyses. If a sample number is used but there are additional sample stickers with that number remaining, the extra stickers will be destroyed. Unused numbers may be retained for future use. An attempt should be made to use the numbers consecutively to avoid confusion. An example of the RAS and DAS sample number labels are shown in Figure D-1.

D.1.1.2 Sample Tags. Field personnel are responsible for tagging all samples that are collected and submitted for RAS analyses. An EPA-CLP sample tag must be completed in indelible/water-

AAL96 - EXTRACTABLE
AAL96 - EXTRACTABLE
AAL96 - EXTRACTABLE
AAL96 - EXTRACTABLE
AAL96 - VOA
AAL96 - VOA
AAL96
AAL96
AAL96
AAL96

ORGANIC SAMPLE NUMBERS

MAX699 - TOTAL METALS
MAX699 - TOTAL METALS
MAX699 - CYANIDE
MAX699 - CYANIDE
MAX699
MAX699
MAX699

INORGANIC SAMPLE NUMBERS

DAS Sample No. DAM 678
DAS Sample No. DAM 678
DAS Sample No. DAM 678
DAS Sample No. DAM 678

DAS SAMPLE NUMBERS

FIGURE D-1. EPA CLP RAS AND DAS SAMPLE NUMBERS

proof ink and securely attached to each sample container. The EPA-CLP sample tag contains the following information:

- Project Code (work assignment number)
- Unique sample identification number (also called the station location)
- Sampling date and time
- Designate: composite or grab sample
- Preservative: yes or no
- Type of analysis to be performed
- Signature of the person packaging the sample
- RAS sample number
- Case number

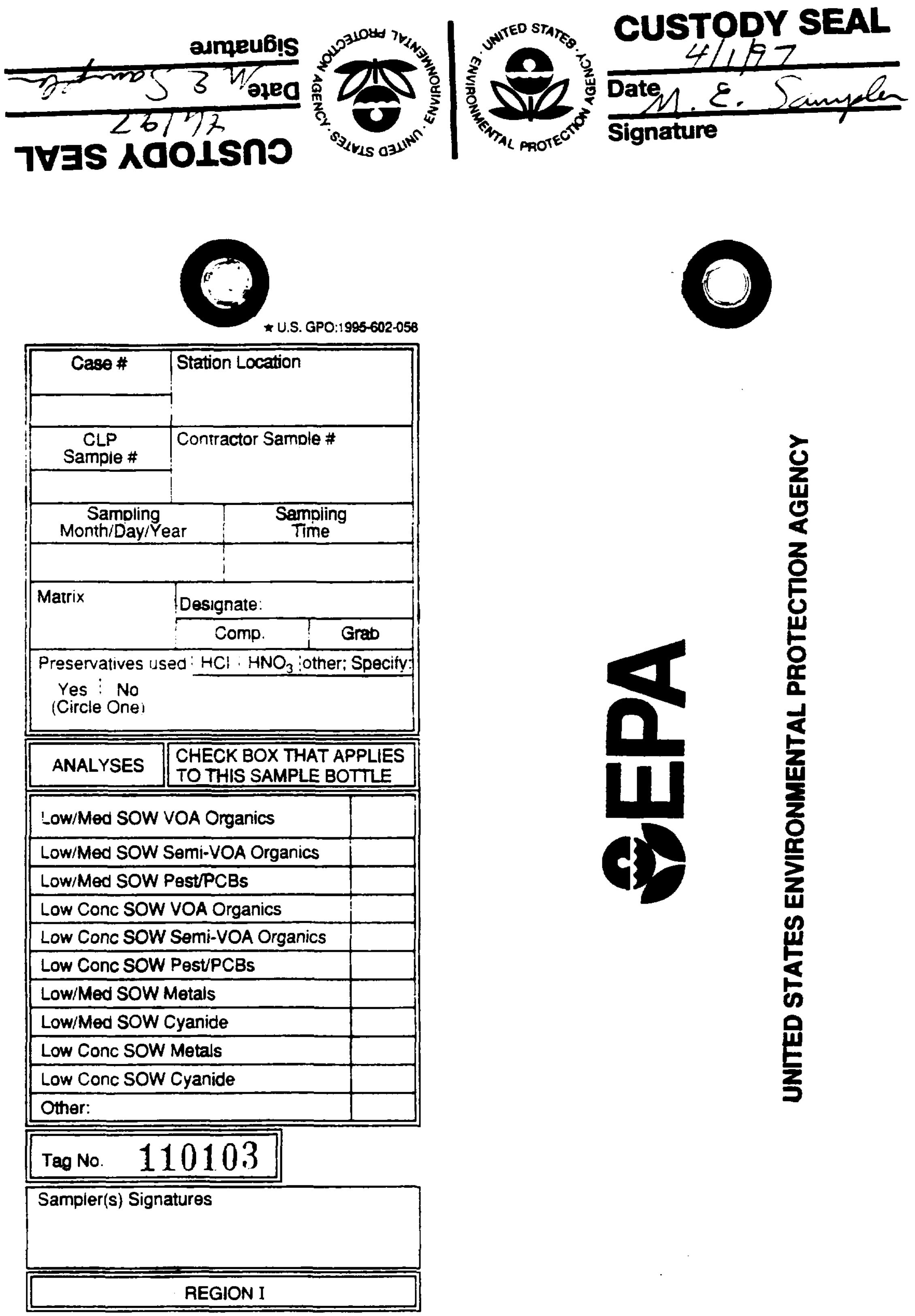
An example of an EPA-CLP sample tag is shown in Figure D-2. Sample tags are not necessary for samples submitted for DAS analyses.

For each sampling event, a case number is assigned by the EPA Contract Laboratory Analytical Support Services (CLASS) contractor for RAS samples and by the M&E Laboratory/Tracking Coordinator for DAS samples. Although the DAS case number is assigned by the M&E Laboratory/Tracking Coordinator, the RSCC is notified of the assigned case number and the anticipated number of samples to be collected prior to sample collection, and a Region I summary form is submitted to the RSCC. From this point on the tracking of DAS samples is the responsibility of the M&E Project Chemist.

The RAS case number is five digits in length. The DAS case number is a four digit number followed by an assigned letter (M for M&E). The case number allows for tracking of samples and maintains site confidentiality. No reference to the site name will be shown on paper work.

D.1.1.3 Custody Seal. Custody seals will be secured across the shipping container to ensure content integrity. The seals contain both the date and the signature of the person affixing them and must be completed in indelible/waterproof ink. An example of a custody seal is shown in Figure D-2.

D.1.1.4 Traffic Report/Chain of Custody and Chain of Custody. For inorganic and organic analyses, TR/COCs (Figures D-3 and D-4, respectively) must be completed for each sample set submitted for RAS analyses. An M&E COC (Figure D-5) must be completed for each sample set submitted for DAS analyses. These forms are maintained as a record of sample collection, transfer, shipment, and receipt by the laboratory. These forms also contain pertinent information



CUSTODY SEAL

Date 4/1/97

Signature M. E. Sampler

CUSTODY SEAL

Date 4/1/97

Signature M. E. Sampler

★ U.S. GPO:1995-602-058

Case #	Station Location
CLP Sample #	Contractor Sample #

Sampling Month/Day/Year	Sampling Time

Matrix	Designate:			
	Comp.	Grab		
Preservatives used	HCl	HNO$_3$	other; Specify:	

Yes : No (Circle One)

ANALYSES	CHECK BOX THAT APPLIES TO THIS SAMPLE BOTTLE
Low/Med SOW VOA Organics	☐
Low/Med SOW Semi-VOA Organics	☐
Low/Med SOW Pest/PCBs	☐
Low Conc SOW VOA Organics	☐
Low Conc SOW Semi-VOA Organics	☐
Low Conc SOW Pest/PCBs	☐
Low/Med SOW Metals	☐
Low/Med SOW Cyanide	☐
Low Conc SOW Metals	☐
Low Conc SOW Cyanide	☐
Other:	☐

Tag No. 110103

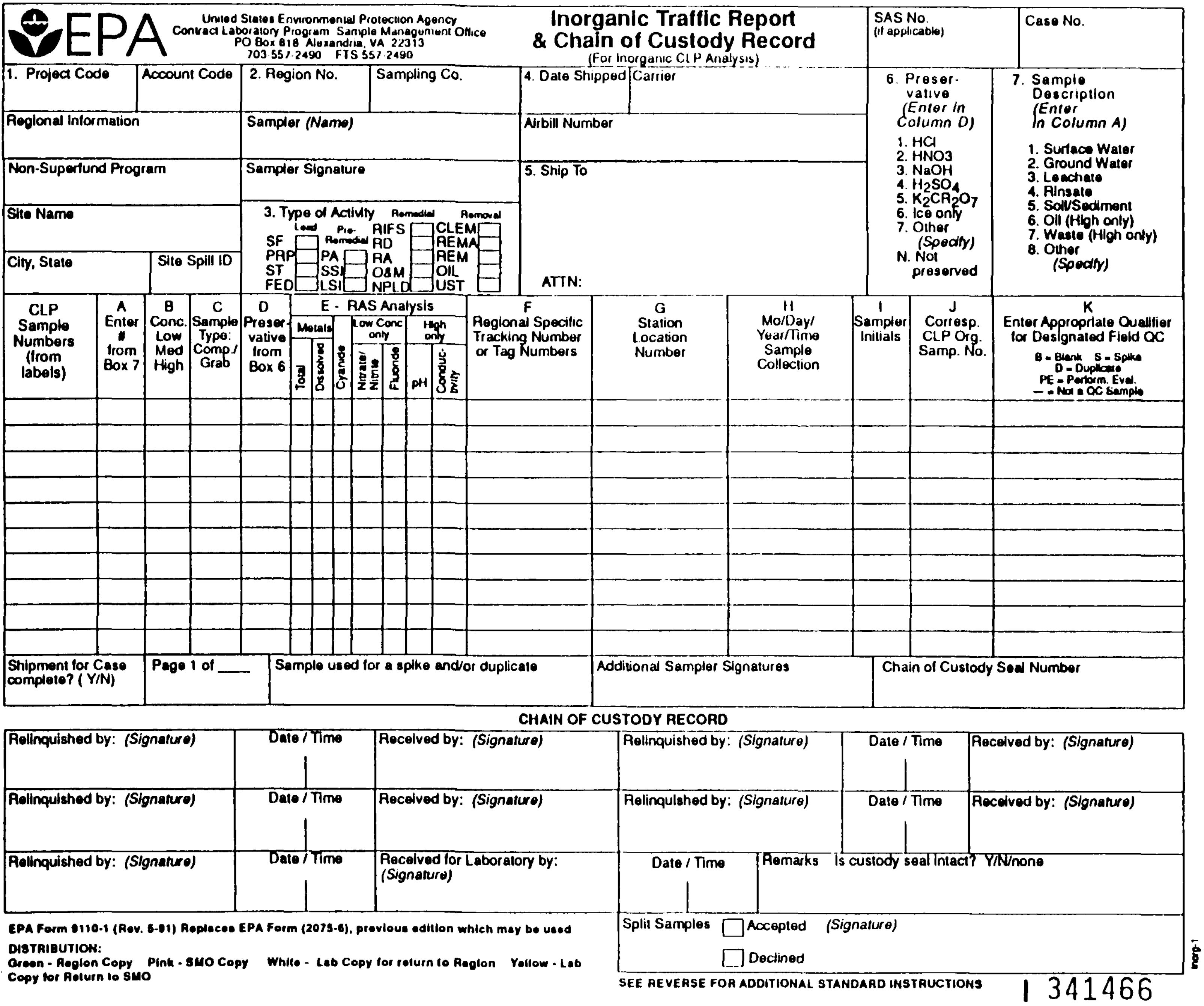
Sampler(s) Signatures

REGION I

EPA

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

FIGURE D-2. EPA CLP SAMPLE TAG AND CUSTODY SEAL



United States Environmental Protection Agency
Contract Laboratory Program Sample Management Office
PO Box 818 Alexandria, VA 22313
703 557-2490 FTS 557-2490

Inorganic Traffic Report & Chain of Custody Record
(For Inorganic CLP Analysis)

SAS No. (if applicable)

Case No.

1. Project Code | Account Code | 2. Region No. | Sampling Co. | 4. Date Shipped | Carrier

Regional Information | Sampler *(Name)* | Airbill Number

Non-Superfund Program | Sampler Signature | 5. Ship To

Site Name

City, State | Site Spill ID

3. Type of Activity

Lead	Pre-Remedial	Remedial	Removal
SF ☐		RIFS ☐	CLEM ☐
PRP ☐	PA ☐	RD ☐	REMA ☐
ST ☐	SSI ☐	RA ☐	REM ☐
FED ☐	LSI ☐	O&M ☐	OIL ☐
		NPLD ☐	UST ☐

ATTN:

6. Preservative *(Enter in Column D)*
1. HCl
2. HNO3
3. NaOH
4. H_2SO_4
5. $K_2CR_2O_7$
6. Ice only
7. Other *(Specify)*
N. Not preserved

7. Sample Description *(Enter in Column A)*
1. Surface Water
2. Ground Water
3. Leachate
4. Rinsate
5. Soil/Sediment
6. Oil (High only)
7. Waste (High only)
8. Other *(Specify)*

					E - RAS Analysis												
CLP Sample Numbers (from labels)	A Enter # from Box 7	B Conc. Low Med High	C Sample Type: Comp./ Grab	D Preservative from Box 6	Metals: Total	Metals: Dissolved	Cyanide	Low Conc only: Nitrate/ Nitrite	Low Conc only: Fluoride	High only: pH	High only: Conductivity	F Regional Specific Tracking Number or Tag Numbers	G Station Location Number	H Mo/Day/ Year/Time Sample Collection	I Sampler Initials	J Corresp. CLP Org. Samp. No.	K Enter Appropriate Qualifier for Designated Field QC B = Blank S = Spike D = Duplicate PE = Perform. Eval. — = Not a QC Sample

Shipment for Case complete? (Y/N) | Page 1 of ____ | Sample used for a spike and/or duplicate | Additional Sampler Signatures | Chain of Custody Seal Number

CHAIN OF CUSTODY RECORD

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time	Remarks	Is custody seal intact? Y/N/none

Split Samples ☐ Accepted ☐ Declined *(Signature)*

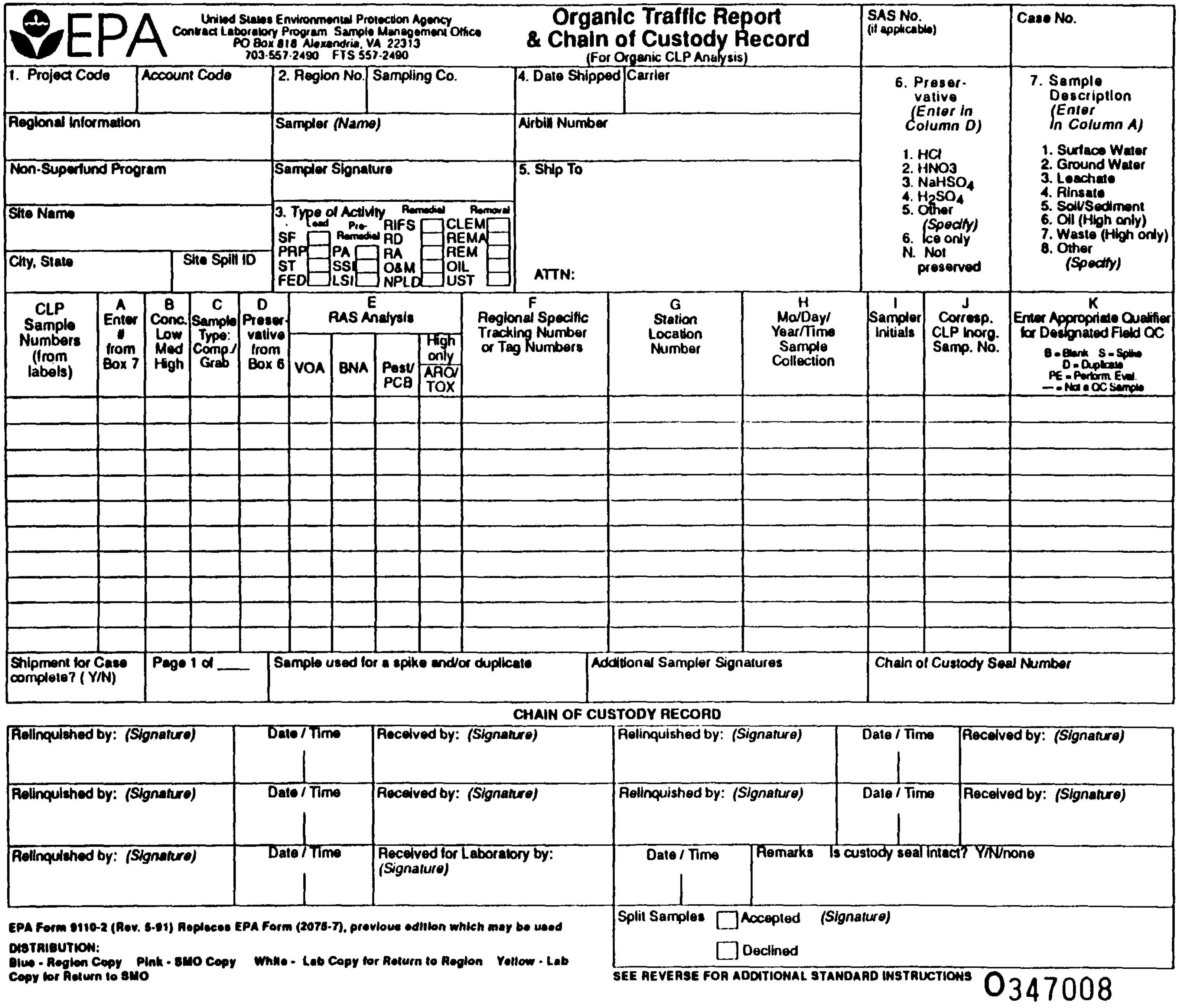
EPA Form 9110-1 (Rev. 5-91) Replaces EPA Form (2075-6), previous edition which may be used

DISTRIBUTION:
Green - Region Copy Pink - SMO Copy White - Lab Copy for return to Region Yellow - Lab Copy for Return to SMO

SEE REVERSE FOR ADDITIONAL STANDARD INSTRUCTIONS

I 341466

FIGURE D-3. RAS INORGANIC TRAFFIC REPORT / CHAIN-OF-CUSTODY FORM



EPA United States Environmental Protection Agency
Contract Laboratory Program Sample Management Office
PO Box 818 Alexandria, VA 22313
703-557-2490 FTS 557-2490

Organic Traffic Report & Chain of Custody Record
(For Organic CLP Analysis)

SAS No. (if applicable)

Case No.

1. Project Code
Account Code
2. Region No.
Sampling Co.
4. Date Shipped
Carrier
Regional Information
Sampler *(Name)*
Airbill Number
Non-Superfund Program
Sampler Signature
5. Ship To
ATTN:
Site Name
City, State
Site Spill ID

3. Type of Activity

Lead		Pre-Remedial		Remedial		Removal	
SF	☐			RIFS	☐	CLEM	☐
PRP	☐	PA	☐	RD	☐	REMA	☐
ST	☐	SSI	☐	RA	☐	REM	☐
FED	☐	LSI	☐	O&M	☐	OIL	☐
				NPLD	☐	UST	☐

6. Preservative *(Enter in Column D)*
1. HCl
2. HNO3
3. $NaHSO_4$
4. H_2SO_4
5. Other *(Specify)*
6. Ice only
N. Not preserved

7. Sample Description *(Enter in Column A)*
1. Surface Water
2. Ground Water
3. Leachate
4. Rinsate
5. Soil/Sediment
6. Oil (High only)
7. Waste (High only)
8. Other *(Specify)*

CLP Sample Numbers (from labels)	A Enter # from Box 7	B Conc. Low Med High	C Sample Type: Comp./Grab	D Preservative from Box 6	E RAS Analysis				F Regional Specific Tracking Number or Tag Numbers	G Station Location Number	H Mo/Day/Year/Time Sample Collection	I Sampler Initials	J Corresp. CLP Inorg. Samp. No.	K Enter Appropriate Qualifier for Designated Field QC B = Blank S = Spike D = Duplicate PE = Perform. Eval. — = Not a QC Sample
					VOA	BNA	Pest/PCB	High only ARO/TOX						

Shipment for Case complete? (Y/N)
Page 1 of ____
Sample used for a spike and/or duplicate
Additional Sampler Signatures
Chain of Custody Seal Number

CHAIN OF CUSTODY RECORD

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time	Remarks Is custody seal intact? Y/N/none	

Split Samples ☐ Accepted *(Signature)*
☐ Declined

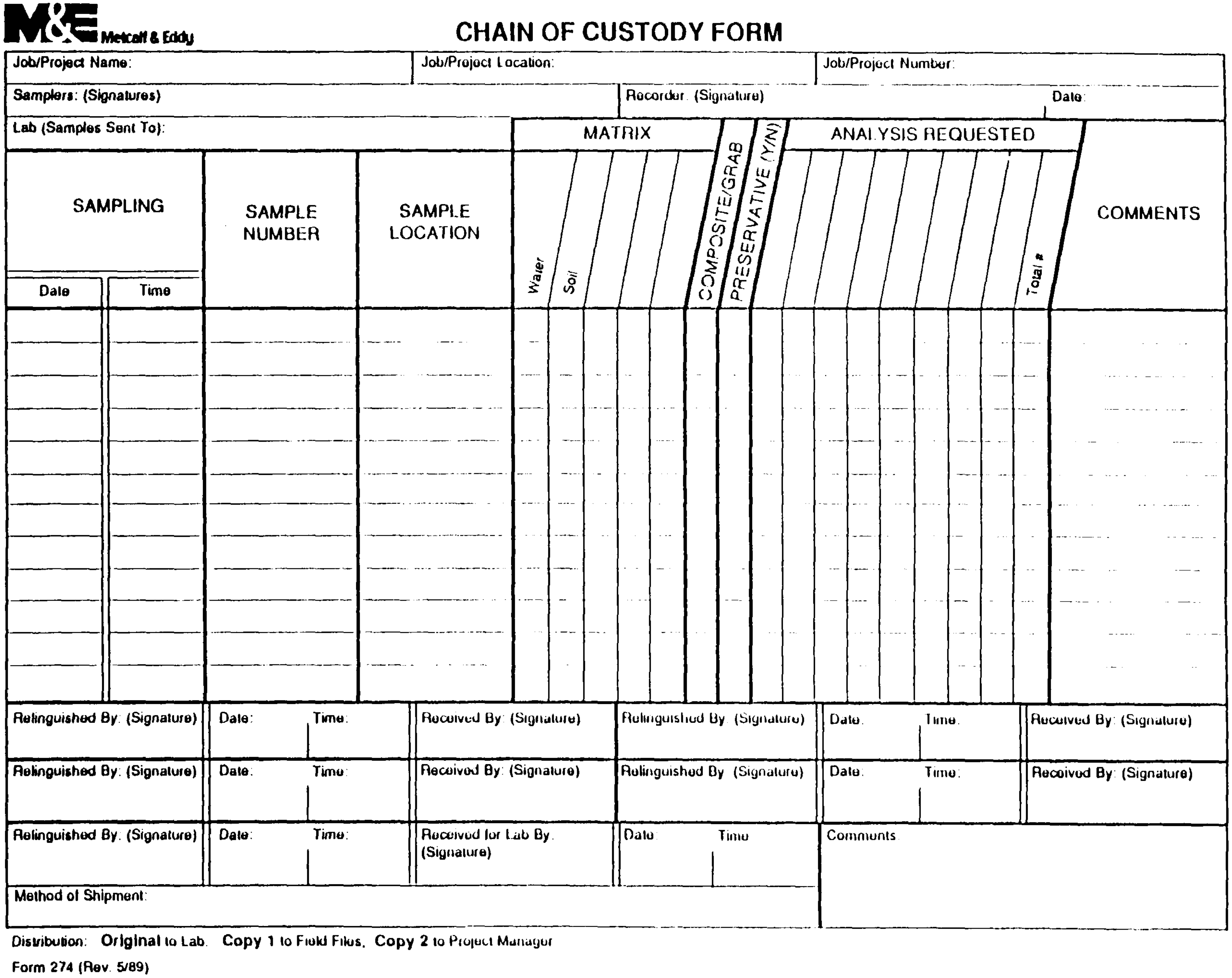
EPA Form 9110-2 (Rev. 5-91) Replaces EPA Form (2075-7), previous edition which may be used

DISTRIBUTION:
Blue - Region Copy Pink - SMO Copy White - Lab Copy for Return to Region Yellow - Lab Copy for Return to SMO

SEE REVERSE FOR ADDITIONAL STANDARD INSTRUCTIONS

0347008

FIGURE D-4. RAS ORGANIC TRAFFIC REPORT / CHAIN-OF-CUSTODY FORM



Metcalf & Eddy

CHAIN OF CUSTODY FORM

Job/Project Name: | Job/Project Location: | Job/Project Number:

Samplers: (Signatures) | Recorder: (Signature) | Date:

Lab (Samples Sent To):

SAMPLING		SAMPLE NUMBER	SAMPLE LOCATION	MATRIX					COMPOSITE/GRAB	PRESERVATIVE (Y/N)	ANALYSIS REQUESTED									COMMENTS
Date	Time			Water	Soil														Total #	

Relinquished By: (Signature)	Date: Time:	Received By: (Signature)	Relinquished By: (Signature)	Date: Time:	Received By: (Signature)
Relinquished By: (Signature)	Date: Time:	Received By: (Signature)	Relinquished By: (Signature)	Date: Time:	Received By: (Signature)
Relinquished By: (Signature)	Date: Time:	Received for Lab By: (Signature)	Date: Time:	Comments:	
Method of Shipment:					

Distribution: **Original** to Lab. **Copy 1** to Field Files, **Copy 2** to Project Manager

Form 274 (Rev. 5/89)

FIGURE D-5. METCALF & EDDY CHAIN-OF-CUSTODY FORM concerning sampling locations, dates, and times; signatures of at least one sampling team member; types of samples collected along with a unique sample identification number; the number of samples collected and shipped for analysis in each lot; the project name and number; and the name of the laboratory to which the samples are being sent. They must be completed to ensure proper transfer of custody from the time of sample collection to analysis. The appropriate copies must be sent to the CLASS contractor, RSCC, and the laboratory.

D.1.1.5 Transfer of Custody. Samples will be accompanied by an approved and completed TR/COC or M&E COC form during each step of custody transfer and shipment. When physical possession of samples is transferred, both the individual relinquishing the samples and the individual receiving them will sign, date, and record the time on the COC form. In the case of sample shipment by an overnight courier, a properly prepared air bill (Section D.1.2.2) will serve as an extension of the TR/COC or M&E COC form while the samples are in transit.

At the start of business the day following shipment, field personnel will either notify the CLASS contractor or RSCC of RAS sample shipments, by telephone. This notification enables the CLASS contractor to track the shipment of samples from the field to the laboratory and ensure timely receipt of the samples at the laboratory. The following information should be reported to the CLASS contractor and documented:

- Field Team Person's name, phone number, and EPA region
- Case number of the project
- Batch numbers (dioxin only)
- Exact number(s), matrix(ces), and concentration(s) of samples shipped
- Laboratories to which samples were shipped
- Analyses required
- Carrier name and air bill number(s) for the shipment
- Method of shipment (e.g., overnight)
- Date of shipment
- Information on completions, changes, delays, continuations, etc., pertinent to the Case and sampling project

If the RAS sample shipment is made after 5:00 p.m. eastern standard time (EST), the CLASS contractor will be notified at the start of business the next day (8:00 a.m. EST). The CLASS contractor will also be notified by 3:00 p.m. EST Friday for RAS sample shipments that will be received at the laboratory on Saturday. Appropriate copies of the TR/COC must be sent to the RSCC and CLASS contractor to document collection of RAS samples to be analyzed through the EPA CLP system Upon completion of a sampling event, copies of all TR/COC and a copy of the appropriate data quality objectives (DQO) summary form (Figure D-6) will be sent to the following addresses:

EPA-NE - DQO SUMMARY FORM

Page_____ of _____

A separate Form should be completed for each sampling event. Refer to Attachment A for instructions on completing this form. Attachment B for a complete list of the parameter codes and Attachment C for an example of a completed form.

1\.

EPA Program: TSCA CERCLA RCRA DW NPDES CAA
Other:____________________
Projected Date(s) of Sampling____________________
EPA Site Manager____________________
EPA Case Team Members____________________
____
____

Site Name____________________
Site Location____________________
Assigned Site Latitude/Longitude____________________
CERCLA Site/Spill Identifier No. 01 _____ ________(Include Operable Unit)
Phase: ERA SA/SI pre-RI RI (phase I, etc.) FS RD RA post-RA
(circle one) Other:____________________

2\.

QAPjP Title and Revision Date____________________
____
Approved by:____________________Date of Approval:____________________
Title of Approving Official:____________________Organization*:____________________
*If other than EPA, record date approval authority was delegated:____________________

EPA Oversight Project (circle one) Y N
Confirmatory Analysis for Field Screening Y N
Are comparability criteria documented? Y N

Type of EPA Oversight (circle one) PRP or FF Other:____________________
If EPA Oversight or Confirmatory: % splits____________________

3. a.	Matrix Code^1								
b.	Parameter Code^2								
c.	Preservation Code^3								
d.	Analytical Services Mechanism								
e.	No. of Sample Locations								
	Field QC:								
f.	Field Duplicate Pairs								
g.	Equipment Blanks								
h.	VOA Trip Blanks								
i.	Cooler Temperature Blanks								
j.	Bottle Blanks								
k.	Other:__________ __________								
l.	PES sent to Laboratory								
	Laboratory QC:								
m.	Reagent Blank								
n.	Duplicate								
o.	Matrix Spike								
p.	Matrix Spike Duplicate								
q.	Other:__________ __________								

4\.

Site Information
Site Dimensions____________________
List all potentially contaminated matrices____________________
Range of Depth to Groundwater____________________
Soil Types: Surface Subsurface Other:____________________
Sediment Types: Stream Pond Estuary Wetland Other:__________ Expected Soil/Sediment Moisture Content: High Low

When multiple matrices will be sampled during a sampling event, complete Sections 5-10 for each matrix. Matrix Code^1________

5\. Data Use (circle all that apply)
Site Investigation/Assessment
Nature and Extent of Contamination
Engineering Design
Post-Remedial Action (quarterly monitoring)
PRP Determination
Human and/or Ecological Risk Assessment
Remedial Action
Removal Actions
Remediation Alternatives
Other:____________

FIGURE D-6. DQO SUMMARY FORM (PAGE 1 OF 2)

6. Summarize DQOs:____

____

____

____

____

____

____

____

____

Complete Table if applicable

COCs	Action Levels	Analytical Method-Quantitation Limits

7. Sampling Method (circle technique) Bailer Low flow pump (Region I method: Yes No) Peristaltic Pump
Positive Displacement Pump Faucet or Spigot Other:____________________
Split Spoon Dredge Trowel Other:____________________

Sampling Procedures (SOP name, No., Rev. #, and date)______________________________
List Background Sample Locations______________________________
Circle: Grab or Composite
"Hot spots" sampled: Yes No

8. Field Data (circle) ORP pH Specific Conductance Dissolved O_2 Temperature Turbidity

Other:____

9. Analytical Methods and Parameters

Method title/SOP name	Method/SOP Identification number	Revision Date	Target Parameters (VOA, SV, Pest/PCB, Metals, etc.)

10. Validation Criteria (circle one) 1. Region I, EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part II, III or IV
2. Other Approved Validation Criteria:______________________________
Validation Tier (circle one) I II III Partial Tier III:______________________________
Company/Organization Performing Data Validation______________________________Prime or Subcontractor (circle one)

11. Company Name______________________________Contract Number______________________________
Contract Name (e.g. START, RACS, etc.)______________________________Work Assignment No.______________________________
Person Completing Form/Title______________________________Date of DQO Summary Form Completion______________________________

Matrix Codes[1] - Refer to Attachment B, Part I
Parameter Codes[2] - Refer to Attachment B, Part II

Preservation Codes[3]

1. HCl to pH ≤ 2
2. HNO_3
3. $NaHSO_4$
4. H_2SO_4
5. Cool @ 4°C (± 2°)
6. NaOH
7. $K_2Cr_2O_7$
8. Freeze
9. Room Temperature (avoid excessive heat)
10. Other (Specify)
N. Not preserved

* - To supplement Matrix Codes and/or Parameter Codes contact the QA Unit

FIGURE D-6 (CONT'D). DQO SUMMARY FORM (PAGE 2 OF 2)

Ms. Christine Clark
US EPA Region I OEME
60 Westview Street
Lexington, MA 02421
(781) 860-4615

Ms. Nicole Coene
U.S. EPA CLASS / Dyn Corp.
Information & Engineering Tech. Inc.
200 Edmund Halley Drive
Reston, VA 20191-3436
703-264-0330

For DAS analyses it is not necessary to contact the CLASS contractor, but rather the M&E Project Chemist is informed of the sample shipment information by the Field Team Leader the day following shipment; copies of the M&E COC forms are then provided to the M&E Laboratory/Tracking Coordinator within a short period of time. Notification of sample shipment enable the M&E Laboratory/Tracking Coordinator to track the shipment of DAS samples from the field to the laboratory and ensures timely receipt of the samples at the laboratory. Within one day of sample receipt, the laboratory is required to transmit (via facsimile) a confirmation of sample receipt to the M&E Project Chemist. In addition, a copy of the COCs and an EPA Region I Weekly DAS Summary Form (Figure D-7) will be forwarded to the RSCC. Upon receipt of SDG packages from the laboratory, a Data Receipt Notification Form (Figure D-8) is filled out and submitted to the RSCC by facsimile.

D.1.2 Sample Packaging and Shipping

Following sample collection, all samples will be brought to an on-site location for batching and paperwork checks. At this central location, like sample types are matched (i.e., solids, liquids, etc.) with similar sample types from all sample locations. Labels and logbook information are checked to ensure there is no error in sample identification. The samples are packaged to prevent breakage and/or leakage, and the shipping containers are labeled in accordance with the Department of Transportation (DOT) regulations for transport.

All samples will be shipped directly to the laboratories via an overnight carrier. For each sample shipment to a specific laboratory, an overnight air bill must be properly completed. In order to ensure the safe and secure delivery of all collected samples to the laboratories, packaging and shipping procedures have been developed so that resulting shipment will comply with applicable DOT regulations for air or surface transportation.

Prior to shipping samples, M&E field personnel will evaluate whether the samples are considered to be non-hazardous or hazardous based on M&E's sample shipment procedures (Appendix L). Note that the definitions of hazardous and non-hazardous, as used in regards to sample packaging and shipment are based on DOT regulations described in 49 CFR parts 172 and 173. Based on M&E's sample packaging and shipment procedures, all environmental samples being shipped are considered to be hazardous unless proven non-hazardous.

EPA Region I Weekly DAS Summary Form

Summary for the week of:

DAS # / Laboratory Code Turn Around Time	Site ID# / Action Code / Operable Unit / Site Name / Location	Number of Samples	Matrix	Parameters	QC Sample Numbers	Contractor / Contract
DAS# LAB: TAT:	Site ID: Action Code: Operable Unit: Name: Location: Durham, CT					
Comments:	CERCLIS#					

FIGURE D-7. EPA REGION I WEEKLY DAS SUMMARY FORM

DAS DATA RECEIPT NOTIFICATION

Site Name:

Contractor/Contract: M&E/

DAS No: 00

SGD No. DAM

Lab Code:

Lab Name/Location:

Number of Samples: (Inc. PE & Blanks)

DAS Sample Numbers: DAM

Ship to Lab Date:

Data Package Receipt Date:

CSF Receipt Date:

Parameter (from Look up Table)	Matrix (from Look up Table)	Sample Count *	Associated PE Sample Numbers	Associated Field Duplicates	Associated Lab Spike/ Duplicates	Associated MS/MSD	Associated Blanks (Inc. Type)

* Not including QC

FIGURE D-8. DAS DATA RECEIPT NOTIFICATION FORM

Unless field-collected information indicates otherwise for this assignment, environmental samples collected as part of the field investigation program will be treated as non-hazardous aqueous or solid samples for packaging and shipping purposes. Pre-existing data (i.e., previous investigations) can also be used to evaluate whether the samples are hazardous or non-hazardous. Other guidelines to considered when evaluating whether a sample should be considered hazardous include: 1) is the sample a hazardous material, 2) does the sample possess hazardous characteristics, or 3) is the sample a hazardous substance with a reportable quantity? However, the final determination of how to ship the sample must be made using M&E's sample packaging and shipment procedures (Appendix L).

D.1.2.1 Non-Hazardous Packaging Procedures. The general packaging procedures will be as follows:

- Place a layer of cushioning material (e.g., vermiculite) in the bottom of the watertight insulated metal or equivalent strength plastic shipping containers.
- Wrap the properly labeled and secured glass sample containers and/or vials with plastic bubble wrap. Place the wrapped containers into watertight zip lock bags and seal the bags closed. Plastic sample containers must also be placed in zip lock bags, although no bubble wrap is needed.
- Whenever possible, place sample bottles (top side up) into the shipping container arranging the bottles so that the glass bottles are surrounded by plastic bottles.
- Using the necessary packing/cushioning material, pack the sample bottles to ensure that they do not shift during transport.
- Place a temperature blank vial in the cooler.
- Place a sufficient amount of ice (packed in zip lock bags) into the shipping container so that the samples will reach the lab at 4°C or less.
- Fill any void spaces of the shipping container, around and on top of the sample bottles, with packing/cushioning material.
- Seal the appropriate COCs (i.e., TR/COCs or M&E COC) in a zip lock plastic bag, and tape it securely to the inside of the shipping container lid.

- Close and lock/latch the shipping container. If the shipping container is a cooler, tape the drain plug closed to prevent any leakage of water since the ice can melt during transport.

- Apply several wraps of M&E COC tape around the shipping containers perpendicular to the seal to ensure that the lid remains closed if the latch is accidentally released or damaged during shipment. Add dated and signed EPA COC seals and wrap at least once around the shipping container with clear tape. Do not obscure any stickers or labels on the shipping container with the chain of custody tape.

- Place a completed overnight carrier air bill (an example Federal Express air bill is shown in Figure D-9) on the lid of the shipping container. Include the name, address, and telephone number of the receiving laboratory and the return address and telephone number of the shipper on the air bill.

- Place a "This End Up" label on the lid and on all four sides of the shipping container.

- If a sample package is to be shipped overnight by Federal Express each shipping container must not weigh more than 150 pounds. Shipping containers over 150 pounds are not guaranteed overnight delivery.

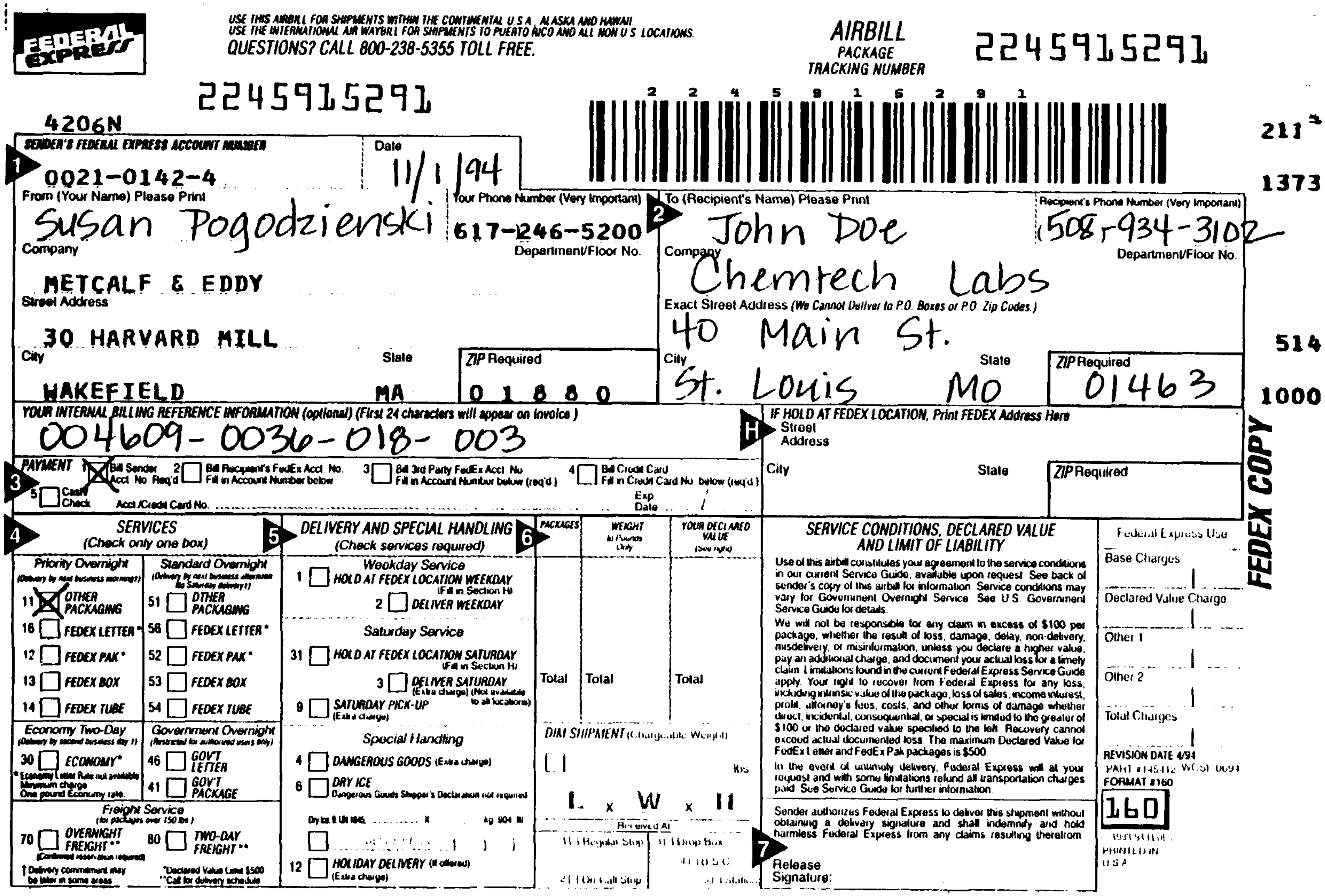
D.1.2.2 Hazardous Packaging and Shipping. Due to the nature of the site and the possibility that environmental samples collected could exhibit hazardous characteristics, it may be necessary to ship some samples as hazardous in accordance with the DOT hazardous shipment requirements. The packaging and shipping of these environmental samples and other chemicals will be in accordance with DOT regulations described in 49 CFR parts 172 and 173 and M&E Standard Operating Procedures (Appendix L) for the shipment of Hazardous Environmental Samples. The packaging procedures will include:

- Proper identification and classification of the hazardous materials

- Proper description and shipping name of the materials

- Usage of DOT approved shipping containers

- Proper marking of the shipping container to include:
  - Commodity description and DOT labeling
  - "This end up" labels for shipping containers of liquid samples



FEDERAL EXPRESS

USE THIS AIRBILL FOR SHIPMENTS WITHIN THE CONTINENTAL U.S.A., ALASKA AND HAWAII
USE THE INTERNATIONAL AIR WAYBILL FOR SHIPMENTS TO PUERTO RICO AND ALL NON U.S. LOCATIONS
QUESTIONS? CALL 800-238-5355 TOLL FREE.

AIRBILL
PACKAGE
TRACKING NUMBER 2245915291

2245915291

4206N

2 2 4 5 9 1 6 2 9 1

211

1373

514

1000

1 SENDER'S FEDERAL EXPRESS ACCOUNT NUMBER: 0021-0142-4
Date: 11/1/94
From (Your Name) Please Print: Susan Pogodzienski
Your Phone Number (Very Important): 617-246-5200
Department/Floor No.
Company: METCALF & EDDY
Street Address: 30 HARVARD MILL
City: WAKEFIELD
State: MA
ZIP Required: 01880

2 To (Recipient's Name) Please Print: John Doe
Recipient's Phone Number (Very Important): (508)-934-3102
Department/Floor No.
Company: Chemtech Labs
Exact Street Address (We Cannot Deliver to P.O. Boxes or P.O. Zip Codes.): 40 Main St.
City: St. Louis
State: MO
ZIP Required: 01463

YOUR INTERNAL BILLING REFERENCE INFORMATION (optional) (First 24 characters will appear on invoice.): 004609-0036-018-003

H IF HOLD AT FEDEX LOCATION, Print FEDEX Address Here
Street Address
City
State
ZIP Required

3 PAYMENT
1 ☒ Bill Sender Acct. No. Req'd
2 ☐ Bill Recipient's FedEx Acct. No. Fill in Account Number below
3 ☐ Bill 3rd Party FedEx Acct. No. Fill in Account Number below (req'd.)
4 ☐ Bill Credit Card Fill in Credit Card No. below (req'd.)
5 ☐ Cash/Check
Acct./Credit Card No.
Exp. Date /

4 SERVICES (Check only one box)

Priority Overnight (Delivery by next business morning†)
11 ☒ OTHER PACKAGING
16 ☐ FEDEX LETTER*
12 ☐ FEDEX PAK*
13 ☐ FEDEX BOX
14 ☐ FEDEX TUBE

Standard Overnight (Delivery by next business afternoon† No Saturday delivery†)
51 ☐ OTHER PACKAGING
56 ☐ FEDEX LETTER*
52 ☐ FEDEX PAK*
53 ☐ FEDEX BOX
54 ☐ FEDEX TUBE

Economy Two-Day (Delivery by second business day †)
30 ☐ ECONOMY*
* Economy Letter Rate not available. Minimum charge One pound Economy rate.

Government Overnight (Restricted for authorized users only)
46 ☐ GOV'T LETTER
41 ☐ GOV'T PACKAGE

Freight Service (for packages over 150 lbs.)
70 ☐ OVERNIGHT FREIGHT** (Confirmed reservation required)
80 ☐ TWO-DAY FREIGHT**
† Delivery commitment may be later in some areas
*Declared Value Limit $500
**Call for delivery schedule

5 DELIVERY AND SPECIAL HANDLING (Check services required)

Weekday Service
1 ☐ HOLD AT FEDEX LOCATION WEEKDAY (Fill in Section H)
2 ☐ DELIVER WEEKDAY

Saturday Service
31 ☐ HOLD AT FEDEX LOCATION SATURDAY (Fill in Section H)
3 ☐ DELIVER SATURDAY (Extra charge) (Not available to all locations)
9 ☐ SATURDAY PICK-UP (Extra charge)

Special Handling
4 ☐ DANGEROUS GOODS (Extra charge)
6 ☐ DRY ICE Dangerous Goods Shipper's Declaration not required
Dry Ice, 9, UN 1845, ... X .... kg 904 III
☐
12 ☐ HOLIDAY DELIVERY (If offered) (Extra charge)

6

PACKAGES	WEIGHT In Pounds Only	YOUR DECLARED VALUE (See right)
Total	Total	Total

DIM SHIPMENT (Chargeable Weight)
lbs
L x W x H
Received At
1 ☐ Regular Stop
3 ☐ Drop Box
4 ☐ B.S.C.
2 ☐ On Call Stop
5 ☐ Station

SERVICE CONDITIONS, DECLARED VALUE AND LIMIT OF LIABILITY

Use of this airbill constitutes your agreement to the service conditions in our current Service Guide, available upon request. See back of sender's copy of this airbill for information. Service conditions may vary for Government Overnight Service. See U.S. Government Service Guide for details.

We will not be responsible for any claim in excess of $100 per package, whether the result of loss, damage, delay, non-delivery, misdelivery, or misinformation, unless you declare a higher value, pay an additional charge, and document your actual loss for a timely claim. Limitations found in the current Federal Express Service Guide apply. Your right to recover from Federal Express for any loss, including intrinsic value of the package, loss of sales, income interest, profit, attorney's fees, costs, and other forms of damage whether direct, incidental, consequential, or special is limited to the greater of $100 or the declared value specified to the left. Recovery cannot exceed actual documented loss. The maximum Declared Value for FedEx Letter and FedEx Pak packages is $500.

In the event of untimely delivery, Federal Express will at your request and with some limitations refund all transportation charges paid. See Service Guide for further information.

Sender authorizes Federal Express to deliver this shipment without obtaining a delivery signature and shall indemnify and hold harmless Federal Express from any claims resulting therefrom.

7 Release Signature:

Federal Express Use
Base Charges
Declared Value Charge
Other 1
Other 2
Total Charges

REVISION DATE 4/94
PART #145412 WCSI 0694
FORMAT #160
160
PRINTED IN U.S.A.

FEDEX COPY

FIGURE D-9. FEDERAL EXPRESS AIRBILL FOR NON-HAZARDOUS MATERIAL

  - Name and address of shipper
  - Characteristics of hazardous materials such as corrosivity, ignitability, or flammability

- Sample container labeling consistent with shipping papers

- Inclusion of proper shipping papers listing the name and classification of the hazardous material and assurance that the labeling is consistent with the shipping papers (An example Federal Express Hazardous air bill is shown in Figure D-10)

- Samples of pure-product material (i.e., gas, fuel, oil, PCB-oil) or highly toxic hazardous materials must be sealed in a paint can prior to shipment to the laboratory

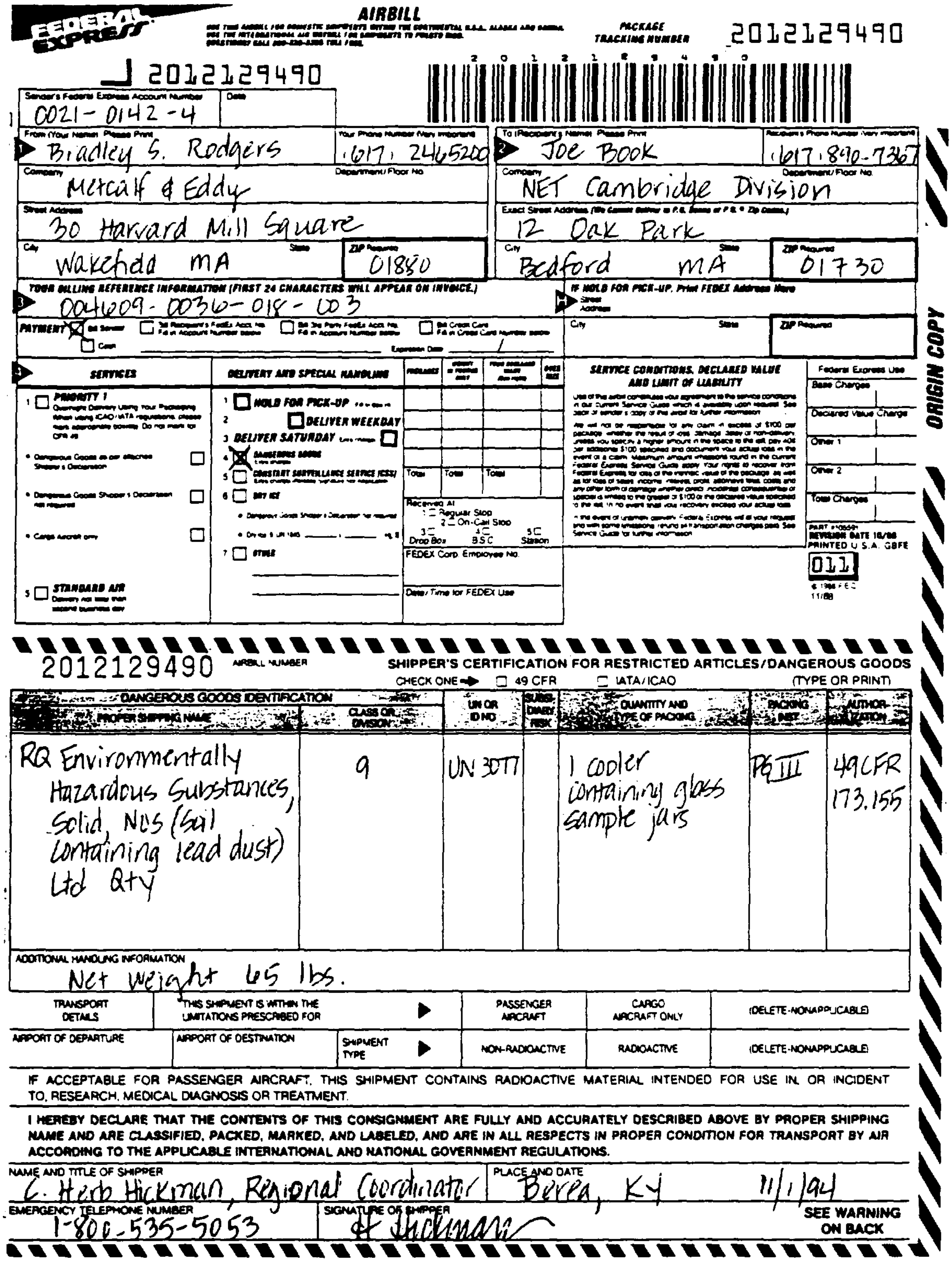
The packaging and shipping criteria have been designed not only to maintain COC protocol as well as to prevent breakage of the sample containers.

D.1.3 Laboratory Sample Custody Procedures

Upon sample receipt, the laboratory representative responsible for accepting incoming sample shipment must compare the samples received against the list on the TR/COC or M&E COC and examine all the samples to determine if the proper temperature was maintained during shipment. If the samples were damaged during transfer, the remaining samples must be carefully examined to determine whether they were affected. Any samples so affected must also be considered damaged and the pertinent information noted on the TR/COC or COC forms (specifying which samples were damaged and that the samples were removed from the sampling program). Field personnel are notified of any damage to RAS samples through the CLASS contractor and/or the RSCC as soon as possible so that resampling can take place or the testing program can be changed. If damage occurs to DAS or subcontracted samples, M&E personnel will be contacted directly by the laboratory.

The laboratory representative must: (1) verify that sample holding times have not been exceeded, (2) sign and date the COC record, and (3) list the received samples in the laboratory sample master log-in book which contains the following information:

- Project identification number
- Sample numbers
- Tag numbers (for RAS samples only)
- Type of samples



FEDERAL EXPRESS

AIRBILL

PACKAGE TRACKING NUMBER 2012129490

2012129490

Sender's Federal Express Account Number: 0021-0142-4	Date

1 From (Your Name) Please Print: Bradley S. Rodgers
Your Phone Number (Very Important): (617) 2465200
Company: Metcalf & Eddy
Department/Floor No.
Street Address: 30 Harvard Mill Square
City: Wakefield State: MA ZIP Required: 01880

2 To (Recipient's Name) Please Print: Joe Book
Recipient's Phone Number (Very Important): (617) 890-7367
Company: NET Cambridge Division
Department/Floor No.
Exact Street Address: 12 Oak Park
City: Bedford State: MA ZIP Required: 01730

3 YOUR BILLING REFERENCE INFORMATION (FIRST 24 CHARACTERS WILL APPEAR ON INVOICE.): 004609-0036-018-003

4 IF HOLD FOR PICK-UP, Print FEDEX Address Here
Street Address
City State ZIP Required

PAYMENT ☒ Bill Sender ☐ Bill Recipient's FedEx Acct. No. Fill in Account Number below ☐ Bill 3rd Party FedEx Acct. No. Fill in Account Number below ☐ Bill Credit Card Fill in Credit Card Number below ☐ Cash
Expiration Date /

5 **SERVICES**

1 ☐ **PRIORITY 1** Overnight Delivery Using Your Packaging. When using ICAO/IATA regulations, please mark appropriate box(es). Do not mark for CFR 49.
- Dangerous Goods as per attached Shipper's Declaration ☐
- Dangerous Goods Shipper's Declaration not required ☐
- Cargo Aircraft only ☐

5 ☐ **STANDARD AIR** Delivery not later than second business day

DELIVERY AND SPECIAL HANDLING

1 ☐ **HOLD FOR PICK-UP**
2 ☐ **DELIVER WEEKDAY**
3 **DELIVER SATURDAY** Extra charge ☐
4 ☒ **DANGEROUS GOODS** Extra charge
5 ☐ **CONSTANT SURVEILLANCE SERVICE (CSS)**
6 ☐ **DRY ICE**
- Dangerous Goods Shipper's Declaration not required
- Dry Ice 9, UN 1845 ___ kg
7 ☐ **OTHER**

Total Total Total

Received At
1 ☐ Regular Stop
2 ☐ On-Call Stop
3 ☐ Drop Box
4 ☐ B.S.C
5 ☐ Station

FEDEX Corp. Employee No.

Date/Time for FEDEX Use

SERVICE CONDITIONS, DECLARED VALUE AND LIMIT OF LIABILITY

Use of this airbill constitutes your agreement to the service conditions in our current Service Guide which is available upon request. See back of sender's copy of this airbill for further information.

We will not be responsible for any claim in excess of $100 per package whether the result of loss, damage, delay or non-delivery, unless you specify a higher amount in the space to the left, pay 40¢ per additional $100 specified and document your actual loss in the event of a claim. Maximum amount limitations found in the current Federal Express Service Guide apply. Your rights to recover from Federal Express for loss of the intrinsic value of the package as well as for loss of sales, income, interest, profit, attorney's fees, costs and any other form of damage whether direct, incidental, consequential or special is limited to the greater of $100 or the declared value specified to the left. In no event shall your recovery exceed your actual loss.

In the event of untimely delivery, Federal Express will at your request and with some limitations refund all transportation charges paid. See Service Guide for further information.

Federal Express Use
Base Charges
Declared Value Charge
Other 1
Other 2
Total Charges

PART #105591 REVISION DATE 10/88 PRINTED U.S.A. GBFE

011

ORIGIN COPY

2012129490 AIRBILL NUMBER

SHIPPER'S CERTIFICATION FOR RESTRICTED ARTICLES/DANGEROUS GOODS

CHECK ONE → ☐ 49 CFR ☐ IATA/ICAO (TYPE OR PRINT)

DANGEROUS GOODS IDENTIFICATION PROPER SHIPPING NAME	CLASS OR DIVISION	UN OR ID NO.	SUBSIDIARY RISK	QUANTITY AND TYPE OF PACKING	PACKING INST.	AUTHORIZATION
RQ Environmentally Hazardous Substances, Solid, NOS (Soil containing lead dust) Ltd Qty	9	UN 3077		1 cooler containing glass sample jars	PG III	49 CFR 173.155

ADDITIONAL HANDLING INFORMATION: Net weight 65 lbs.

TRANSPORT DETAILS	THIS SHIPMENT IS WITHIN THE LIMITATIONS PRESCRIBED FOR ▶		PASSENGER AIRCRAFT	CARGO AIRCRAFT ONLY	(DELETE NONAPPLICABLE)
AIRPORT OF DEPARTURE	AIRPORT OF DESTINATION	SHIPMENT TYPE ▶	NON-RADIOACTIVE	RADIOACTIVE	(DELETE NONAPPLICABLE)

IF ACCEPTABLE FOR PASSENGER AIRCRAFT, THIS SHIPMENT CONTAINS RADIOACTIVE MATERIAL INTENDED FOR USE IN, OR INCIDENT TO, RESEARCH, MEDICAL DIAGNOSIS OR TREATMENT.

I HEREBY DECLARE THAT THE CONTENTS OF THIS CONSIGNMENT ARE FULLY AND ACCURATELY DESCRIBED ABOVE BY PROPER SHIPPING NAME AND ARE CLASSIFIED, PACKED, MARKED, AND LABELED, AND ARE IN ALL RESPECTS IN PROPER CONDITION FOR TRANSPORT BY AIR ACCORDING TO THE APPLICABLE INTERNATIONAL AND NATIONAL GOVERNMENT REGULATIONS.

NAME AND TITLE OF SHIPPER: C. Herb Hickman, Regional Coordinator
PLACE AND DATE: Berea, KY 11/1/94
EMERGENCY TELEPHONE NUMBER: 1-800-535-5053
SIGNATURE OF SHIPPER: H Hickman

SEE WARNING ON BACK

FIGURE D-10. FEDERAL EXPRESS AIRBILL FOR HAZARDOUS GOODS

- Date received by transfer personnel (i.e., by the overnight courier)
- Date received by the laboratory

The laboratory representative must also notify the laboratory manager of sample arrival and any analyses requiring immediate attention due to short holding time and store the samples according to the requirements of the analytical protocols.

D.1.4 Laboratory Sample Tracking Procedures

Following documentation of the receipt of samples in the laboratory, the samples are tracked from storage through the analytical system until analysis is complete and the samples are sent for disposal. Samples are tracked by either the RAS sample number or the DAS sample number and the unique laboratory sample number.

APPENDIX E. DECONTAMINATION PROCEDURES

APPENDIX E. DECONTAMINATION PROCEDURES

Decontamination is the process of removing contaminants that have accumulated on field and sampling equipment. Proper decontamination is essential in minimizing the transfer of harmful materials into clean areas, in the prevention of cross-contamination between samples due to the use of improperly decontaminated field/sampling equipment, and in protecting workers from hazardous substances.

E.1 EQUIPMENT

All equipment involved in field investigation activities will be decontaminated prior to leaving the site. Decontamination of sampling equipment will also be performed before sampling and between collection of samples. Other field equipment or instrumentation that may come into contact with environmental samples or subsurface materials will be decontaminated prior to and following use. The general outline for decontamination procedures is included in the following sections. All liquids or residuals that are generated from decontamination activities will be collected as specified in Appendix H.

E.1.1 Sampling Field Equipment

Sampling field equipment is defined as any equipment that may potentially contact a sample. All equipment and power tools used as sampling equipment (i.e., compressors) will be decontaminated before and following usage as well as prior to removal from the site. Large and heavy equipment (i.e., drilling, excavation) will be steam cleaned. Light or small equipment such as hand tools will be steam cleaned or will be rinsed with tap water, scrubbed with a water/mild soap solution, and rinsed again with tap water. All equipment decontamination will be performed at decontamination stations as specified in the Site Safety and Health Plan (SSHP; M&E, 1998).

All other sampling equipment will be handled to prevent cross-contamination in the field by the use of sawhorses (or equivalent) and plastic ground cloths. No equipment will be placed directly on the ground.

E.1.2 Cleaning Materials. The materials used throughout the cleaning procedures outlined in this document may be dangerous if improperly handled (Table E-1). Caution must be exercised by all personnel, and all applicable safety procedures must be followed. At a minimum, the following precautions need to be taken in the field during these cleaning operations:

- Safety glasses with splash shields or goggles, chemical resistant gloves, and appropriate protective clothing must be worn during all cleaning operations.

TABLE E-1. TYPICAL MATERIALS USED FOR EQUIPMENT DECONTAMINATION

- Aluminum Foil
- Bottle Brushes
- Equipment Decontamination Basin
- 2.5-5-Gallon Carboy (for Tap Water)
- Non-Phosphate Laboratory Detergent Liquid
- Non-Phosphate Laboratory Detergent, Solid
- Organic Solvent (Pesticide Grade)
- Nitric Acid (Reagent Grade)
- DIUF Water
- Personnel Decontamination Soap (for hands and face)
- Personnel Decontamination Brush
- Personnel Decontamination Basin
- Plastic Sheeting
- Polyethylene Wash Bottles
- Tap Water
- Teflon Wash Bottles
- Trash Bags
- Trash Barrels

- All solvent rinsing operations must be conducted under a fume hood or in the open (never in a closed room).
- No eating, smoking, drinking, chewing, or any other hand-to-mouth contact (including application of cosmetics) is permitted during cleaning operations.
- Solvents and acid rinse liquids must be collected and drummed in accordance with Appendix H.

The organic solvents, nitric acid solutions, laboratory detergent solutions, and rinse waters used to clean equipment will not be reused. The cleaning materials referred to throughout this section are defined below:

Phosphate-Free Laboratory Detergent. A standard brand of phosphate-free detergent such as Sparkleen, Liquinox, or Alconox will be used as the standard laboratory detergent for decontaminating field equipment. The use of any other detergent must be justified and documented in the field logbooks.

Nitric Acid Solution. When metals analysis is to be performed on a sample, a nitric acid solution will be used for decontamination of sampling equipment, except for stainless steel. The standard solution is made as a 1:10 dilution of reagent-grade nitric acid in deionized water. The use of any other acid solution must be justified and documented in the field logbooks.

Pesticide-Grade Solvent. Pesticide-grade solvents, such as isopropanol, are to be used as standard cleaning solvents. The use of any other solvents must be justified and documented in the field logbooks.

Tap Water. Tap water from any municipal potable water supply system may be used for initial rinsing of field equipment. Tap water will also be used to steam clean sampling equipment (Section E.1.1). An untreated or non-potable water supply is not an acceptable substitute for tap water. The use of any other water must be justified and documented in the field logbooks.

Deionized Water. Deionized water will be used for the final water rinsing of all field equipment. The reagent water used for this purpose is deionized ultra-filtered (DIUF). (Distilled water purchased from local supply stores or supermarkets is not DIUF reagent water.) The field team will retain the analytical data or manufacturer's lot number which verifies the quality of the reagent water used by the field team. The use of any other water must be justified and documented in the field logbooks.

Brushes. The use of brushes with wire-wrapped bristles should be avoided, if possible, due to potential contamination from the wire. Plastic bristled brushes should be used, if possible.

E.1.2.1 Cleaning Procedures. Guidelines for routine decontamination of equipment used in the collection of samples at hazardous waste sites are outlined in the following sections. (Note: rinse the sampling equipment thoroughly with tap water in the field as soon as possible after use to aid in the ease of future decontamination). Paint or coatings (e.g., rust) must be removed from any part of the equipment that may contact the sample.

Teflon, Polyethylene, and/or Glass Equipment:

1. Wash the equipment thoroughly with phosphate-free laboratory detergent and tap water. Use a brush to remove any particulate matter or surface film.[1]

2. Rinse the equipment thoroughly with tap water.

---

[1] If the sampling equipment has been used to collect samples that contained oil, grease, or other hard-to-remove materials, it may be necessary to rinse the equipment several times with pesticide-grade hexane to remove the materials or to steam clean the equipment prior to washing with the laboratory detergent solution. If the field equipment cannot be cleaned using these procedures, it should be properly discarded.

3. If the sampling equipment is being used to collect samples for metals analysis, rinse the equipment with a nitric acid solution.[2]

4. Rinse the equipment thoroughly with deionized water.

5. Rinse the equipment (Teflon or glass equipment only) with pesticide-grade isopropanol, then rinse with deionized/distilled water, and allow it to air dry.

6. Wrap the equipment completely with aluminum foil to prevent contamination during storage and/or transport to the field.

Stainless Steel Equipment:

1. Wash the equipment thoroughly with phosphate-free laboratory detergent and tap water. Use a brush to remove any particulate matter or surface film.[3]

2. Rinse the equipment thoroughly with tap water.

3. Rinse the equipment thoroughly with deionized water.

4. Rinse the equipment with pesticide-grade isopropanol, then rinse with deionized/distilled water, and allow it to air dry.

5. Wrap the equipment completely with aluminum foil to prevent contamination during storage and/or transport to the field.

Electronic Water Level Indicators and/or Measuring Tapes:

At each sampling location, rinse the equipment thoroughly with deionized water. If necessary, the following procedure can be used:

1. Wash the electronic well sounding tapes and/or measuring tapes with phosphate-free laboratory detergent and tap water.

---

[2] Small and awkward equipment such as bottle-lid inserts and well bailers may be soaked in, rather than rinsed with, the nitric acid solution. Fresh nitric acid solution should be prepared for each cleaning session.

[3] If the sampling equipment was used to collect samples that contained oil, grease, or other hard-to-remove materials, it may be necessary to rinse the equipment several times with pesticide-grade hexane or CitriSolve to remove the materials or to steam clean the equipment prior to washing with the laboratory detergent solution. If the field equipment cannot be cleaned using these procedures, it should be properly discarded.

2. Rinse the equipment thoroughly with tap water.

3. Rinse the equipment thoroughly with deionized water.

Teflon and Silicone Tubing:

Pre-cleaned Teflon-coated polyethylene tubing and/or rigid Teflon or silicone tubing may be used for purging and sampling monitoring locations. The pre-cleaned tubings are either dedicated to each monitoring well or are discarded following use.

Teflon-Disposable Bailers:

Pre-cleaned, Teflon, disposable bottom-filling/bottom-emptying bailers may be used for purging and sampling monitoring locations. The pre-cleaned bottom-filling/bottom-emptying bailers are discarded following use.

E.1.3 Ice Chests and Shipping Containers

Ice chests and reusable shipping containers are washed on the site as needed (interior and exterior) with phosphate-free laboratory detergent, rinsed with tap water, and air dried before storage. In the event that an ice chest or shipping container becomes severely contaminated with waste or other toxic material, it will be cleaned as thoroughly as possible and disposed of properly.

E.1.4 Vehicles

Vehicles that may have been exposed to contamination undergo decontamination procedures at the site vehicle decontamination station (as specified in the Site Safety and Health Plan; M&E, 1998) at the conclusion of each field trip. This routine maintenance minimizes any chance of contamination of equipment, samples, or other sites due to the contamination of vehicles. A thorough interior and exterior cleaning is mandatory at the conclusion of all field activities. This decontamination procedure may consist of steam cleaning, water/mild soap washing of exterior and vacuuming. It is the responsibility of the field team leader to ensure this procedure is followed.

E.2 QUALITY CONTROL PROCEDURES

Equipment that has been used to collect samples will be decontaminated before it is returned from the field. At a minimum, this decontamination will consist of washing the equipment with a phosphate-free laboratory detergent solution and rinsing it with tap water. The effectiveness of sampling equipment decontamination procedures is monitored by collecting equipment blanks as specified in Appendix I.

Field or sampling equipment that requires repair will be identified. Any problems encountered with the equipment during use as well as suggestions/recommendations as to the needed repairs will be noted.

E.3 DOCUMENTATION

All decontamination procedures performed during the course of field activities must be documented in the field logbook. Any deviations from the standard decontamination protocols must be justified and documented in the field logbooks.

APPENDIX F. PRESERVATION METHODS

APPENDIX F. PRESERVATION METHODS

Table F-1 summarizes the sampling parameters, containers, holding times, and preservation requirements that will be followed for samples collected during the field investigation program.

Soil and sediment samples that are submitted for laboratory analysis require no preservation in addition to refrigeration to 4°C. Aqueous samples submitted for laboratory analysis require refrigeration to 4°C, and some parameters also require the addition of chemical fixatives or preservatives (acid or base) to achieve a specific pH. Procedures for chemical preservation of aqueous samples are presented in the following paragraphs.

Preservation of Aqueous Samples. Prior to the addition of the chemical preservatives presented in Table F-1, aqueous samples must be tested for oxidizing agents and sulfides. The presence of oxidizing agents may degrade volatile and semivolatile organic compounds in aqueous samples, while the presence of sulfides can interfere with the analysis of pesticides and PCBs. Consequently, oxidizing agents and sulfides must be eliminated in the field or the laboratory must be alerted in order to properly treat the sample prior to analysis.

Testing for Oxidizing Agents. Analytical parameters sensitive to the presence of oxidizing agents are volatile organics and semivolatile organics. Each monitoring location where samples will be collected for the analysis of these parameters must be tested for oxidizing agents using N,N-diethyl-p-phenylenediamine (DPD) or potassium iodide (KI)-starch paper:

> **DPD Test Method:** A prepared Hach reagent pillow containing DPD and buffering agents is opened and added to 25 ml (or quantity specified by Hach directions) of the aqueous sample; this mixture is shaken for 20 seconds. A slightly pink to red color change in the solution indicates the presence of oxidizing agents.
>
> **KI-Starch Paper Method:** A few drops of aqueous sample are placed onto the KI-starch paper. A blue color change to the paper indicates the presence of oxidizing agents.

If only a slight to moderate (i.e, pink) color change occurs using the DPD-test method, this must be noted on the appropriate chain of custody (COC) forms -- traffic report/chain of custody (TR/COC) for RAS analyses and/or M&E COC form for DAS analyses -- for that sample so that the laboratory can perform the appropriate treatment prior to analysis, although no treatment of the sample in the field is necessary. Either a dramatic color change (i.e., red) using the DPD-test method or any color change using the KI-starch paper method indicates that large quantities of oxidizing agents are present in the sample. In this case it may be deemed necessary, based on the professional judgment of field personnel, to eliminate the oxidizing agents:

TABLE F-1. SAMPLING PARAMETERS, METHODS, CONTAINERS, AND PRESERVATION REQUIREMENTS FOR THE TECHNICAL ASSISTANCE SAMPLES

PARAMETER	CONTAINER [2]	PRESERVATIVE [3]	HOLDING TIME
		GROUNDWATER	
DAS ANALYSES [1]			
METHANE	1 60-ml serum bottle[3,6]	H_2SO_4 pH <2; Cool to 4°C; protect from light	14 Days [4]
ETHANE	1 60-ml serum bottle[3,6]	H_2SO_4 pH <2; Cool to 4°C; protect from light	14 Days [4]
ETHENE	1 60-ml serum bottle[3,6]	H_2SO_4 pH <2; Cool to 4°C; protect from light	14 Days [4]
PCB HOMOLOGUES/CONGENERS	2-1000 ml glass Amber	Cool to 4°C	7 Days to Extraction; 40 Days to Analysis
WATER QUALITY PARAMETERS			
Chloride/Sulfate/Nitrate/Nitrite	1-1000 ml, HDPE[6]	Cool to 4°C	48 hours/48 hours
Total Organic Carbon	1-500 ml, glass [6]	H_2SO_4 pH <2; Cool to 4°C	28 days
Alkalinity	1-1000 ml, HDPE[6]	Cool to 4°C	14 Days
RAS ANALYSES [5]			
LOW CONCENTRATION VOLATILE ORGANICS	2-40 ml glass vials	HCl pH < 2; Cool to 4°C	14 Days [4]
PESTICIDES/PCBS	2-1000 ml glass Amber	Cool to 4°C	7 Days to Extraction; 40 Days to Analysis
		SOIL	
DAS ANALYSES [1]			
14 DAY TAT PESTICIDES/PCBS	1- 8 ounce glass jar	Cool to 4°C	14 Days [4]
HEXAVALENT CHROMIUM	2- 8 ounce glass jars	Cool to 4°C	30 Days to Extraction; 7 Days to Analysis
VOLATILE ORGANICS	3-5 gram EnCore Samplers	Cool to 4°C	48 Hours [5]
RAS ANALYSES [5]			
SEMIVOLATILE ORGANICS	1- 8 ounce glass jar	Cool to 4°C	10 Days VTSR to Extraction; 40 days to Analysis
METALS	1- 8 ounce glass jar	Cool to 4°C	6 Months; 28 days for Mercury
		SEDIMENT	
DAS ANALYSES [1]			
14 DAY TAT PESTICIDES/PCBS (HIGH MOISTURE)	2- 16 ounce glass jars	Cool to 4°C	10 Days VTSR to Extraction; 40 days to Analysis
METALS (HIGH MOISTURE)	1-8 ounce HDPE	Cool to 4°C	6 Months; 28 days for Mercury

NOTES:

1. Methods for DAS analyses are based on DAS analytical specifications (Appendix B).
2. Containers cleaned to meet EPA series 300 requirements. All glass containers have Teflon-lined lids. Serum bottles will be capped and sealed using Teflon-lined silicone septa and aluminum crimp seals.
3. If bubbles form in sample upon addition of HCl, void this sample container, and recollect sample in a new container. Do not add preservative.
4. Samples that are not preserved because of oxidizing agents have holding times of 7 days
5. Methods are all based on EPA RAS Methods.
6. Sample containers must be filled such that no headspace or bubbles remain.

CONC. - Concentration	TAT - Turnaround Time
DAS - Delivery of Analytical Services	RAS - Routine Anaytical Services
HDPE - High Density Polyethylene	VTSR - Validated Time of Sample Receipt

- For volatile organic analyses, ascorbic acid is added, a few crystals at a time, to the same quantity of sample as being collected for analysis. An aliquot of this solution is then retested with DPD or KI-starch paper as described above. If no color forms then the same amount of ascorbic acid should be added to the sample to be submitted for analysis to the laboratory. If a color change occurs, then this step should be repeated until no color forms.

- For semivolatile organic analyses, sodium sulfite ($NaSO_3$) is added, a few crystals at a time, to the same quantity of sample as being collected for analysis. An aliquot of this solution is then retested with DPD or KI-starch paper as described above. If no color forms then the same amount of sodium sulfite should be added to the sample being submitted for analysis to the laboratory. If a color change occurs, then this step should be repeated until no color forms.

Testing for Sulfides. Analytical parameters sensitive to interference from sulfides are pesticides and PCBs. Each monitoring location where samples will be collected for the analysis of these parameters must be tested for sulfides using lead-acetate test paper:

- A few drops of sample are placed onto a piece of lead-acetate paper that has been wetted using either a dilute acetic acid solution or an acetate buffer solution. A color change (or darkening) of the paper to grey or black indicates the presence of sulfides.

If a color change occurs, this **must** be noted on the COC forms -- TR/COC and/or M&E COC -- for that sample so that the laboratory can perform the appropriate treatment prior to analysis, although no treatment of the sample in the field is necessary.

Volatile Organic Analyses. Following testing for the presence of oxidizing agents at each monitoring location, 40 ml of the aqueous sample is pretested to determine the amount of concentrated hydrochloric acid (HCl) needed to bring the pH to less than 2. The number of drops of concentrated HCl needed in the test aliquot is then added to each sample vial prior to collection of the sample. Note that during the pH test, bubbles should not be created by the addition of the concentrated HCl. If bubbles are created during the addition of the acid then carbonates are likely to be present and the sample must not be preserved. It must be noted on the TR/COC and/or M&E COC forms that preservative was not added. In order to meet the required holding time for unpreserved volatile organic samples, the analysis must be completed within seven days.

Methane, Ethane, and Ethene Analyses. Prior to sample collection, 60 ml of the aqueous sample is pretested to determine the amount of sulfuric acid (H_2SO_4) needed to bring the pH to less than 2. The number of drops of concentrated H_2SO_4 needed in the test aliquot is then added to each serum bottle prior to collection of the sample. Note that during the pH test, bubbles should not be created by the addition of the concentrated H_2SO_4. If bubbles are created during the addition of the acid then carbonates are likely to be present and the sample must not be preserved. It must be noted on the TR/COC and/or M&E COC forms that preservative was not added. In order to meet the required holding time for unpreserved methane, ethane, and ethene samples, the analysis must be completed within seven days.

Pesticides/PCBs. No preservation of aqueous samples using acid or base is required. Samples are cooled to 4°C.

Chloride, Nitrate, Nitrite, Sulfate, and Alkalinity. No preservation using acid or base is required. Samples are cooled to 4°C. In addition, samples must be collected such that no headspace remains in the sample bottles.

Total Organic Carbon (TOC) Analysis. Aqueous samples for TOC analysis are gradually preserved to a pH of less than 2 with concentrated sulfuric acid (H_2SO_4). Preservation is performed following collection of the sample into the container. The container is completely filled such that no headspace remains. Several drops of acid (start with approximately 1 ml) are added into the sample container, the container is closed and gently agitated. To check the pH, a few drops of the preserved sample are removed from the container and checked with pH test paper to ensure that the pH is less than 2. This procedure is repeated until the sample reaches a pH less than 2. Additional sample is then added to the container such that no headspace remains. **Do not** dip the pH test paper into the sample bottle. If bubbles are created during the addition of the acid, carbonates are likely to be present and the sample **must not** be preserved. It **must** be noted on the M&E COC forms that preservative was not added.

APPENDIX G. FIELD AND SAMPLING EQUIPMENT

APPENDIX G. SAMPLING EQUIPMENT

Presented below are lists of equipment typically used for compliance monitoring on this work assignment. It should be noted that the list is not inclusive since it only presents the basic equipment requirements needed to perform specific sampling procedures:

Documentation

- Field maps
- Health and safety plan
- Sampling and analysis plan
- Field logbook
- Pens and permanent markers
- Sampling worksheets
- Sample labels
- Chain-of-custody forms

General Sampling Equipment

- Sample containers for field parameters
- Sample bottles and preservatives
- Coolers with ice
- Quick-sealing plastic bags

Groundwater Sampling Equipment

- Photoionization detector (PID) and calibration gas
- Electronic water level indicator
- Groundwater pumps with tubing
- YSI 6820 Water Quality Meter and Flow-through cell with 610DM data manager, or similar model
- Graduated cylinders and watches to monitor flow rate
- Graduated plastic purge buckets
- pH calibration solutions
- DRT-15CE turbidity meter, or similar model, with calibration solutions
- Specific conductivity calibration solutions
- Oxidation-reduction calibration solutions
- HACH Ferrous Iron Test Kit (1,10 Phenanthroline)
- HACH Sulfide Test Kit (Methylene Blue)
- HACH DB2000 or DB2010 Spectrophotometer/Colorimeter

- Bailers (Teflon, stainless steel, bottom-filling and bottom-emptying type)

Surface and Subsurface Soil Sampling Equipment

- Wooden stakes
- Flagging
- Stainless steel bowls and spoons
- Augers
- PID and calibration gas
- Measuring tape (200')

Sediment Sampling Equipment

- Boat and associated safety equipment (refer to Site Specific Health and Safety Plan)
- Measuring pole
- Hand auger or Ekman dredge
- Stainless steel trowels, stainless steel spoons, spatulas, or scoops
- Stainless steel bowls
- Munsell Color Chart
- Particle size chart

Decontamination Equipment

- Non-phosphate detergent
- Nitric acid solution
- Isopropanol
- Deionized water
- Tap water
- Polyethylene sheeting
- Decontamination tubs and brushes
- Teflon squirt bottles
- Steam cleaner

Miscellaneous Equipment

- Keys to site facility
- Keys to well locks
- Personal protective equipment as described in the site-safety and health plan
- Plastic garbage bags

APPENDIX H. DISPOSAL OF STUDY-DERIVED WASTES

APPENDIX H. DISPOSAL OF STUDY-DERIVED WASTES

Wastes derived from the field tasks are expected to include: water from purging and sampling of monitoring wells; water produced from equipment decontamination; field clothes; and assorted trash. Wastes generated during the field event will be disposed of in accordance with the *Guide to Management of Investigation - Derived Wastes* (U.S. EPA, 1992) and the M&E Site Safety and Health Plan (1998) for this site. If hazardous wastes are sent off of the site, both administrative and substantive elements of the RCRA generator requirements of 40 CFR Part 262 and land disposal restrictions and certification requirements of Part 268 will be complied with.

H.1 SOLID WASTE

Field clothes and trash are considered solid waste materials. All solid wastes such as general trash will be disposed of as "non-hazardous" solid waste. Personal protective equipment will be handled and disposed of as either "non-hazardous" or "hazardous" solid waste depending on the results of air monitoring for organic vapors solid wastes using a photoionization device (PID), flame ionization device (FID), or other appropriate detection equipment. If organic vapor levels are detected above 10 ppm in the solid waste, the wastes will be packed in Department of Transportation (DOT) approved drums, the EPA Remedial Project Manager (RPM) notified, and the drums placed in temporary storage within the fenced area of the site. In addition, results of field test kit analyses and historical data will be used to assess the method of disposal of the solid waste.

H.2 LIQUID WASTE

The liquid wastes that may be generated consist of decontamination fluids and purged well and sample water. The disposal of these liquids is discussed below.

H.2.1 Decontamination Fluids

The liquid waste generated on the site during the decontamination of sampling equipment will be drummed and temporary storage arranged prior to transport to a treatment/disposal facility.

H.2.2 Purge and Sampling Water

Water generated from purging of monitoring wells will be screened for organic vapors using a PID, FID, or other appropriate detection equipment. If organic vapors area detected above 10 ppm, or if non-aqueous phase liquid (NAPL) is visually observed, the purged water will be poured into DOT-approved drums, the drum will be labeled and relocated within the fenced area for temporary storage until transport to treatment/disposal facility. If organic vapors are below 10 ppm and no NAPL is present, the water will be slowly discharged back to the ground surface, no closer than 50 feet from any of the groundwater monitoring locations.

APPENDIX I. QUALITY CONTROL REQUIREMENTS

APPENDIX I. QUALITY CONTROL REQUIREMENTS

The Quality Control (QC) requirements implemented during field and laboratory activities for this field investigation program will use both known and unknown (or "blind") QC samples. Laboratory QC requirements will adhere to specifications outlined in the current CLP SOWs for RAS organics and inorganics analyses (U.S. EPA, 1994b and 1993) and in the DAS specifications (Appendix B). The type and frequency of analyses that is typical for each QC sample is shown in Table I-1.

I.1 FIELD GENERATED QC SAMPLES

Quality control samples that will be collected in the field and submitted to the laboratories along with the environmental samples are discussed in this section. The types of QC samples that are typically collected during a field sampling event include the following: trip blanks, equipment blanks, field duplicates, matrix spike/matrix spike duplicates (MS/MSDs), and performance evaluation (PE) samples.

I.1.1 Trip Blanks

For samples submitted for volatile organic analyses, one trip blank will be submitted to the laboratory per cooler or per approximately every 20 samples or batch of samples, whichever is more frequent. The analysis of this blank will provide a baseline measurement of any contamination that the samples may have been exposed to during transport. A trip blank is comprised of a sample bottle filled with high performance liquid chromatography (HPLC)-grade water, preserved, handled like a sample, and sent to the laboratory for analysis. The trip blank for soil/sediment samples is also HPLC-grade water.

I.1.2 Equipment Blanks

One equipment blank will be collected per sampling episode for every group of approximately 20 samples or batch of samples collected for each matrix and submitted for laboratory analysis. The analysis of these blanks serves to verify the cleanliness of the sampling equipment. An equipment blank is collected by rinsing decontaminated field equipment with water, transferring the water to a sample bottle, and sending the sample for analysis. HPLC-grade water is used for QC samples submitted for organic analyses. For other QC samples, deionized ultrafiltration (DIUF) water is used. The equipment blank is analyzed for the same parameters as the samples associated with that equipment.

TABLE I-1. QC SAMPLE TYPES, CRITERIA, AND CORRECTIVE ACTION

Type	Purpose	Frequency	Criteria	Corrective Action
Field Generated QC Samples:				
Trip Blank	Evaluate possibility of contamination during sample transport /storage	1 per shipment of VOC samples or Sample Delivery Group for each VOC method	No compound of interest >CRQL	Qualify data or resample
Equipment Blank	Evaluate effectiveness of field decontamination procedures	1 per 20 samples or Sample Delivery Group	No compound of interest >CRQL /CRDL	Qualify data or resample
Field Duplicate	Evaluate precision taking into account variability of sample matrix	1 per matrix per 20 samples or 1 per matrix per Sample Delivery Group	±30% RPD (aqueous) ±50% RPD (soil)	Compare to lab replicates; check systems for possible matrix interferences or improper sample collection procedure
Matrix Spikes and Duplicates (MS/MSD)	Evaluate precision and accuracy taking into account variability of sample matrix	1 per matrix per 20 samples or 1 per matrix per Sample Delivery Group	Recoveries as specified in the RAS SOW or DAS analytical specifications	Qualify data or recalibrate, reanalyze, and document corrective action
Performance Evaluation (PE) Samples	Evaluate laboratory performance (accuracy) using unknown concentrations from an outside source (EPA)	1 per matrix per 20 samples or 1 per matrix per Sample Delivery Group	EPA Supplied: Determined by EPA; only the evaluation is disclosed Vendor Supplied: Within the 95% confidence interval	Qualify data or resample
Laboratory Generated QC Samples:				

Type	Purpose	Frequency	Criteria	Corrective Action
Laboratory Control Samples (for AA, ICP)	Verifies analyst proficiency with method and instrumentation	1 per 20 samples or 1 per Sample Delivery Group	<20% RSD ±15% recovery or as specified in the RAS SOW or DAS specifications	Check system; require additional operator training
Calibration Check Sample	Verifies calibration curve	minimum of 1 per analytical batch	±20% initial calibration or as specified in the DAS specifications	Recalibrate; check system
Method Blank	Verifies clean reagents, instrument systems, and lab environment	minimum of 1 per analytical batch or 20 samples	No compound of interest >50%CRQL /CRDL	Reanalyze; if second blank exceeds criteria, clean and recalibrate system; document corrective action
Laboratory Replicates (including matrix spike duplicates)	Checks precision of analytical method	1 per 20 samples or 1 per Sample Delivery Group	RPD as specified in the analytical method (RAS or DAS)	Compare with field duplicates; check matrix interferences
Surrogate Standards	Measures recoveries in actual sample matrices	All GC/MS and all GC samples, with few exceptions	Recoveries as specified in the RAS SOW or DAS analytical method	Reanalyze samples; qualify or reject data
Internal Standards	Provides standard for calculating analyte response and concentrations	All GC/MS samples (or other GC samples depending on the method used)	Recoveries as specified in the RAS SOW or DAS analytical method	Reanalyze samples; qualify or reject data

NOTES:
DAS - Delivery of Analytical Services
CRQL - Contract Required Quantitation Limits
CRDL - Contract Required Detection Limit
RAS - Routine Analytical Services (U.S. EPA, 1993 and 1994b)

RPD - Relative Percent Difference
RSD - Relative Standard Deviation
VOC - Volatile Organic Compounds

I.1.3 Bottle Blanks

No bottle blanks will be collected as part of this field investigation program. Instead, other actions are taken to evaluate bottle cleanliness and identify contamination attributable to the bottles. Sample bottles are obtained from commercial suppliers that provide certified pre-cleaned bottles that meet the cleanliness requirements described in *Specifications and Guidance for Contaminant-Free Sample Containers* (U.S. EPA, 1992). Quality control is performed by suppliers and certificates of analysis for organics and metals are provided for each bottle lot. A copy of the laboratory certification, which accompanies each case of sample bottles, will be maintained with field records in the project files. In addition, other field QC samples including trip and equipment blanks serve as a measure of bottle cleanliness, which is evaluated during validation.

I.1.4 Field Duplicates

A field duplicate will be collected for every group of approximately 20 samples or batch of samples collected for each matrix and submitted for laboratory analysis. Duplicates are two samples collected independently from one sampling location during a single episode of sampling. Duplicates provide information about sample variability.

The number of field duplicates to be collected is dependent upon the number of types of sampling equipment to be used during sample collection. Each piece of sampling equipment used during sample collection will require an equipment-specific duplicate sample. Therefore, whenever possible, the types of equipment to be used during sample collection will be minimized.

I.1.5 Matrix Spike/Matrix Spike Duplicates

Matrix spike and matrix spike duplicates (MS/MSDs) are a QC requirement performed by the laboratory as discussed in I.2.5. For aqueous samples to be analyzed as MS/MSDs, it is necessary to collect three times the usual required volume for organic analyses and two times the required volume for inorganic analyses. No additional sample volume is necessary for soil/sediment samples. At a minimum, additional volume for one sample will be provided to the laboratory for every group of approximately 20 samples or batch of samples collected for each matrix.

I.1.6 Performance Evaluation Samples

Performance evaluation (PE) samples are used to evaluate laboratory accuracy for a specific method and matrix using a spiked sample from an outside source, the contents of which are unknown to the laboratory. The PE samples are provided by EPA's Environmental Monitoring Systems Laboratory (EMSL) or if not provided by EMSL, the PE samples are acquired through EPA-listed suppliers (U.S. EPA, 1996d) if available. One PE sample per method will be provided to the laboratory for every group of approximately 20 samples or batch of samples collected for each matrix. The analytical results are then evaluated by EPA, which provides the results of the evaluation for use in data validation.

I.1.7 Documentation and Review of Quality Control Activities

Custody of field QC samples will be documented from the time of QC sample collection throughout transfer of the sample to the laboratory. Documentation of sample collection, shipment, laboratory receipt, and laboratory custody must be maintained in order to accomplish this. Field QC samples will be packed and delivered along with their corresponding environmental samples.

I.2 LABORATORY GENERATED QC SAMPLES

The EPA-CLP RAS laboratories comply with the QC sample requirements for RAS analytical methods as are described below and are referenced in the CLP SOWs for organics and inorganics analyses (U.S. EPA, 1994b and 1993). The M&E subcontracted DAS laboratories comply with the QC sample requirements as specified in the DAS specifications (Appendix B). The type and frequency of analyses that is typical for each QC sample is shown in Table I-1.

I.2.1 Laboratory Control Standard

A laboratory control standard (LCS) is analyzed samples tested for metals and inorganics. The LCS is routinely used to establish the precision and accuracy of an instrument or procedure. The analytical results of the LCS are recorded in the instrument logbook and on the control chart; results must be within the acceptable control limits. A LCS solution is prepared by adding known quantities of an EMSL-Cincinnati Standard, a NIST Standard Reference Material, or a reference-traceable stock material to deionized water or the solvent of interest. A LCS solution is typically carried through the entire sample preparation and analysis procedure. One LCS is analyzed for approximately every 20 samples or every batch of samples supplied from the field.

I.2.2 Calibration Check Sample

One calibration check sample (CCS) is analyzed for all project-specific parameters per day of analysis. A CCS is chosen as one of the mid-range working calibration standards that is reanalyzed periodically throughout the sample analysis to verify that the original calibration is still valid.

I.2.3 Method Blank

One method blank is analyzed with approximately every 20 samples or every batch of samples supplied from the field. A method blank is comprised of laboratory-pure, analyte-free water carried through the entire sample preparation and analysis procedure. Analysis of the method blank provides a check of the background contamination due to sample preparation procedures.

I.2.4 Laboratory Replicates

One sample for approximately every 20 samples or every batch of samples supplied from the field is analyzed in replicate for project-specific parameters. A replicate sample is produced by dividing a single collected sample into two equal parts for the purpose of determining analytical precision.

I.2.5 Matrix Spike/Matrix Spike Duplicates

Matrix spike and matrix spike duplicate analyses are performed for approximately every 20 samples or every batch of samples supplied from the field. The analyte spike is added prior to digestion/distillation of the sample. If the spike recovery is not within the acceptable criteria limits specific to this project, the data of those samples associated with that spiked sample must be qualified appropriately during validation.

I.2.6 Surrogate Spikes

All collected samples requiring organic analysis by GC/MS or GC, with few exceptions, are spiked with an appropriate set of surrogate standards prior to sample preparation. The surrogate standards encompass the full range of types of organics to be analyzed in the sample and serve as checks on any matrix interference exhibited by the samples. If the percent recoveries of the surrogates are outside the acceptable project-specific criteria limits, the associated samples may be reanalyzed if the problem appears to be due to lab error. An independent analyst or laboratory unit leader generally determines whether to reanalyze the sample or qualify the data.

I.2.7 Internal Standards

All collected samples requiring organic analysis by GC/MS (or where appropriate other GC methods) are prepared using internal standards, which of are known concentration. For GC/MS methods, the internal standard areas for each sample are compared to the 12-hour continuing calibration for internal standard areas. If internal standard areas for a sample are outside of the acceptable criteria limits, the samples may be reanalyzed if the problem appears to be due to lab error. An independent analyst or laboratory unit leader generally determines whether to reanalyze the sample or qualify the data. In addition, during data validation, further review is conducted to determine the useability of the data for affected samples.

I.2.8 Documentation and Review of Quality Control Activities

Laboratory QC samples will be documented as specified by RAS methods. A list of the required deliverables for DAS analyses are described in the individual DAS specifications (Appendix B). The QC activities pertinent to the analysis of each shipment of samples from the field will be documented in discrete sections of the RAS and DAS SDG packages and include:

- A case narrative describing any problems encountered with method blanks, matrix spike, and matrix spike duplicates, surrogate recoveries, initial calibration, and continuing calibration
- Compilation of method blanks data
- Compilation of matrix spike and matrix spike duplicates
- Surrogate recoveries data
- Initial calibration and continuing calibration information
- Internal standards data

All quality assurance (QA) activities are documented in the laboratory, but are only delivered upon request of the contracting agency. Delivery of the entire QA/QC package must be contracted prior to sample analysis.

APPENDIX J. FIELD INSTRUMENTATION CALIBRATION AND PREVENTATIVE MAINTENANCE

APPENDIX J. FIELD INSTRUMENTATION CALIBRATION, TESTING, AND PREVENTATIVE MAINTENANCE

Calibration of all instruments will be conducted, at a minimum, at the beginning and end of each sampling day. In addition, should any erratic or illogical readings occur, the offending instrument will be recalibrated in order to ensure that representative measurements are obtained. Should problems with the instrument continue, backup instruments will be calibrated and used in place of the offending instrument. Table J-1 provides a typical schedule of field instrument calibration as well as corrective actions typically required should instruments not meet calibration criteria.

Instruments used for measurement of temperature, pH, dissolved oxygen, conductivity/specific conductivity, oxidation/reduction potential, and turbidity will be conducted using the procedures described in the U.S. EPA *Region I Draft Calibration of Field Instruments* (U.S. EPA, 1998), whenever practical. A copy of the guidance document in presented at the end of this appendix.

Since the anticipated length of each field effort is less than two weeks, major instrument servicing is unlikely to be necessary during the field effort. Should servicing become necessary, backup instruments will be available to replace any instrument which fails to operate properly. Field instruments will then undergo any regularly scheduled or any other necessary maintenance once the field team has returned to M&E. All field test equipment necessary for field monitoring and health and safety purposes will be properly cared for according to the manufacturer's instructions. Should any field service prove necessary despite these measures, they will be conducted according to the manufacturer's instructions on an as-needed basis. Table J-2 summarizes the basic preventative measures that are typically performed.

TABLE J-1. CALIBRATION AND CORRECTIVE ACTION - FIELD INSTRUMENTATION

Instrument	Activity	Frequency	Acceptance Criteria	Corrective Action	Reference
Photoionization Detector	Calibration Check	Beginning and end of the day, and in response to erratic or illogical readings.	± 25% of expected	Reanalyze the standard. If still outside of criteria, use back-up instrument. If necessary, consult owner's manual for manufacturer's instructions regarding repair. If at end of day, use professional judgement in interpreting results previously obtained.	Manufacturer's instructions
Top Loading Balance	Initial Calibration Calibration Check	Beginning of the day. End of the day and in response to erratic readings.	As specified in the Manufacturers' Manual	Recheck the balance. If still outside of criteria, use back-up instrument. If necessary, consult owner's manual for manufacturer's instructions regarding repair. If at end of day, use professional judgement in interpreting results previously obtained	Manufacturer's instructions
Portable Spectrophotometer /Colorimeter	Initial Calibration Calibration Check	Beginning of the day. End of the day and in response to erratic readings.	As specified in the Manufacturers' Manual or for those parameters as listed in this table.	Reanalyze the standard. If still outside of criteria, use back-up instrument. If necessary, consult owner's manual for manufacturer's instructions regarding repair. If at end of day, use professional judgement in interpreting results previously obtained.	Manufacturer's instructions

TABLE J-1 (Continued). CALIBRATION AND CORRECTIVE ACTION - FIELD INSTRUMENTATION

Instrument	Activity	Frequency	Acceptance Criteria	Corrective Action	Reference
Flow Through Cell	Initial Calibration	Beginning of the day.	As specified in the Manufacturers' Manual or for those parameters as listed in this table.	Reanalyze the standard. If still outside of criteria, use back-up instrument. If necessary, consult owner's manual for manufacturer's instructions regarding repair. If at end of day, use professional judgement in interpreting results previously obtained.	Manufacturer's instructions
	Calibration Check	End of the day and in response to erratic readings.			
pH Meter	Initial Calibration	Beginning of the day.	± 0.2 pH units	Reanalyze the standard. If still outside of criteria, use back-up instrument. If necessary, consult owner's manual for manufacturer's instructions regarding repair.	Manufacturer's instructions
	Calibration Check	End of the day and in response to erratic readings.	± 0.2 pH units	Reanalyze the standard. If still outside of criteria, use professional judgement when interpreting the results obtained.	
Turbidity Meter	Initial Calibration	Beginning of the day.	± 25% of expected	Reanalyze the standard. If still outside of criteria, use back-up instrument. If necessary, consult owner's manual for manufacturer's instructions regarding repair.	Manufacturer's instructions
	Calibration Check	End of the day and in response to erratic readings.	± 25 of expected	Reanalyze the standard. If still outside of criteria, use professional judgement when interpreting the results obtained.	

TABLE J-1 (Continued). CALIBRATION AND CORRECTIVE ACTION - FIELD INSTRUMENTATION

Instrument	Activity	Frequency	Acceptance Criteria	Corrective Action	Reference
Specific Conductance Meter	Initial Calibration	Beginning of the day.	± 25 of expected	Reanalyze the standard. If still outside of criteria, use back-up instrument. If necessary, consult owner's manual for manufacturer's instructions regarding repair.	Manufacturer's instructions
	Calibration Check	End of the day, and in response to erratic readings.	± 25 of expected	Reanalyze the standard. If still outside of criteria, use professional judgement when interpreting the results obtained.	
Dissolved Oxygen Meter	Initial Calibration	Beginning of the day.	± 25 of expected	Reanalyze the standard. If still outside of criteria, use back-up instrument. If necessary, consult owner's manual for manufacturer's instructions regarding repair.	Manufacturer's instructions
	Calibration Check	End of the day and in response to erratic readings.	± 25 of expected	Reanalyze the standard. If still outside of criteria, use professional judgement when interpreting the results obtained.	
Oxidation-Reduction Potential (ORP) Meter	Initial Calibration	Beginning of the day.	± 25 of expected	Reanalyze the standard. If still outside of criteria, use back-up instrument. If necessary, consult owner's manual for manufacturer's instructions regarding repair	Manufacturer's instructions
	Calibration Check	End of the day and in response to erratic readings.	± 25 of expected	Reanalyze the standard. If still outside of criteria, use professional judgement when interpreting the results obtained.	

TABLE J-2. PREVENTATIVE MAINTENANCE - FIELD INSTRUMENTATION

Instrument	Activity	Frequency	Reference
Photoionization Detector	Check calibration / response	Daily (See Table J-1)	Manufacturers' Manual
	Check Battery	Before each use	
	Clean Lamp	As needed	
	Replace Lamp	As required	
Top Loading Balance	Check calibration / response	Daily (See Table J-1)	Manufacturers' Manual
Portable Spectrophotometer/ Colorimeter	Check calibration / response	Daily (See Table J-1)	Manufacturers' Manual
Flow Through Cell	Check calibration / response	Daily (See Table J-1)	Manufacturers' Manual
Thermometer	Check with NIST	Annually	Manufacturers' Manual
pH Meter	Check calibration / response	Daily (See Table J-1)	Manufacturers' Manual
	Check electrode	Before and after field event	
	Keep electrode wet	Constantly	
Conductivity Meter	Check calibration / response	Daily (See Table J-1)	Manufacturers' Manual
	Check probe	Before and after field event	
Turbidity Meter	Check calibration / response	Daily (See Table J-1)	Manufacturers' Manual
	Inspect and replace glassware	As needed	
Dissolved Oxygen Meter	Check calibration / response	Daily (See Table J-1)	Manufacturers' Manual
	Clean probe	As needed	
ORP Meter	Check calibration / response	Daily (See Table J-1)	Manufacturers' Manual
	Clean electrodes / refill	As needed	

APPENDIX K. TYPICAL DATA VALIDATION ACTIONS FOR RAS/DAS ANALYTICAL METHODS

APPENDIX K. TYPICAL DATA VALIDATION ACTIONS FOR RAS/DAS ANALYTICAL METHODS

The following are typical actions implemented for analytical data produced from RAS and DAS analyses:

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 holding times are grossly exceeded, the data may be rejected (R).

Calibration: If the continuing calibration criteria are exceeded, all positive results will be flagged as estimated (J) and all nondetects may be flagged as estimated (UJ). If the calibration criteria are grossly exceeded, all non-detects may be flagged as unusable or rejected (R).

Blanks: If any blank contaminants are detected, an action level of 5 times the blank contaminant concentration will be set for most analytes. An action level of 10 times the blank contaminant concentration will be set for common lab contaminants. If the sample analyte concentration is greater than the action level, the concentration will be reported unqualified. If the sample analyte concentration is less than the action level, the concentration will be reported and flagged to be the qualified detection limit (U).

PE Samples: If the final results of the EPA performance evaluation (PE) sample are reported by EPA as "action high", all positive results will be flagged as estimated (J) and all nondetects will be reported unqualified. If the final results of the EPA-PE sample are reported by EPA as "action low", all positive results will be flagged as estimated (J) and all nondetects will be rejected (R). For PE samples obtained from commercial vendors, results that are above or below the 95% confidence interval or other vendor-supplied QC limits will be qualified in the same manner as results(s) rated by EPA as "action high" or "action low," respectively.

Sample Duplicate: If laboratory or field duplicate analyses result in a relative percent difference (RPD) greater than 20% or 30%, respectively, all positive results will be flagged as estimated (J) and all nondetects will be reported unqualified. If one value is nondetected and the other is above the detection limit, all positive results will be flagged as estimated (J) and all nondetects will be flagged as estimated (UJ).

Matrix Spike/Matrix Spike Duplicates: If the final results of the matrix spike are above the QC range, all positive results will be flagged as estimated (J) and all nondetects will be reported unqualified. If the final results of the matrix spike are below the QC range, but greater than 10%, all positive results will be flagged as estimated (J) and all nondetects will be flagged as estimated (UJ). If the final results of the matrix spike are less than 10% of the true concentration, all positive results will be flagged as estimated (J) and all nondetects will be flagged as unusable or rejected (R). If the spike concentration is low relative to the native sample concentration, recovery cannot be assessed, and this will be noted accordingly in the calibration documentation.

APPENDIX L. TECHNICAL GUIDANCE FOR HANDLING, PACKAGING, AND SHIPPING OF ENVIRONMENTAL SAMPLES AND SMALL QUANTITIES OF HAZARDOUS MATERIALS

TECHNICAL GUIDANCE

FOR

HANDLING, PACKAGING AND SHIPPING OF ENVIRONMENTAL SAMPLES AND SMALL QUANTITIES OF HAZARDOUS MATERIALS

604.010

JULY, 1993

REVISION NO. 2

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TECHNICAL GUIDANCE
FOR
HANDLING, PACKAGING, AND SHIPPING OF ENVIRONMENTAL SAMPLES AND SMALL QUANTITIES OF HAZARDOUS MATERIALS

1. PURPOSE

The purpose of this document is to establish standard methods and provide guidance information for the proper handling, packaging, and shipping of environmental samples and small quantities of hazardous materials to ensure adequate sample integrity to meet U.S. Environmental Protection Agency (EPA) requirements and to ensure that the packing and shipping requirements of the U.S. Department of Transportation (DOT), the International Air Transport Association (IATA), and various carrier requirements are met.

This document is intended for use by persons trained in environmental sampling procedures and requirements and/or in hazardous materials transportation, as applicable. It is not intended to substitute for knowledge of the regulations governing the handling, packaging, and shipping of environmental samples or small quantities of hazardous materials. The reader should refer to the applicable regulations when confronted with specific applications and, if necessary, consult with one of the AWT specialists listed in Section 8.

Persons shipping environmental samples or small quantities of hazardous materials must be trained by qualified instructors, and such training must be documented in writing. Training should include a test of proficiency in performing the various aspects of the process of classifying and shipping a material in compliance with regulations.

2. SCOPE

This document establishes guidance for determining the proper control of environmental samples and small quantities of hazardous materials. Environmental samples are small quantities of water, soil, sediment, sludge, air, animal tissue, plant tissue, or chemicals taken expressly for the purpose of chemical analysis, physical analysis, or treatability study. Note that "environmental samples" is not a term used in the shipping regulations that govern transportation of hazardous materials. Environmental samples may sometimes be hazardous materials under the regulations.

Hazardous materials are items that meet the definition for one or more hazard classes defined in the U.S. DOT rules in Title 49 of the Code of Federal Regulations. (Note that the term "hazardous substance" has a meaning very different from "hazardous material," and these terms should not be confused.) Small quantities of acids, bases, alcohols, and other chemicals or solvents, such as are used for sample preservation and decontamination of field equipment during an environmental sampling event, are included in the definition of small quantities of hazardous materials. From time to time there will also be somewhat similar items that are not "hazardous" under the regulations -- a determination must be made in each case. Guidance in this document may be found adequate for quantities up to several gallons or tens of pounds, but there is no intent to provide guidance for bulk shipments, i.e., in containers larger than 119 gallons.

Proper transportation of hazardous materials involves establishing the hazard classification and proper shipping name, handling, packaging, marking, labeling, storage, shipping, and preparing shipping documentation. This document also establishes the responsibility and guidance for ensuring sampling integrity as well as ensuring proper shipping procedures of environmental samples. This document provides guidance for shipping, to include:

- Establishing the proper shipping name (which may require determining the hazard class of a material based on knowledge of its hazards).
- Packaging.
- Marking and labeling.
- Preparation of shipping papers and accompanying information.
- Certain requirements for proper handling, storage, and chain of custody.

All environmental samples must initially be considered hazardous in the general (not regulatory) sense, and must be controlled as such. However, for shipping purposes it is also necessary to determine whether the samples may meet the definition of a DOT hazard class, and are therefore hazardous materials for shipping purposes. The overriding consideration is the assurance that environmental samples (a) have been controlled within DOT and EPA regulations and with the utmost regard for safety and (b) reach their destination without damage. Environmental samples must meet preservation requirements and must agree with accompanying chain-of-custody records.

3. RESPONSIBILITIES

3.1 Quality Assurance Manager

The project Quality Assurance Manager is responsible for:

- Ensuring that personnel are aware of the EPA, DOT, IATA, and carrier requirements for control of (a) environmental samples from the field to the analytical laboratory or (b) small quantities of hazardous materials.
- Ensuring that all paper work related to shipping and chain of custody is properly completed.

3.2 Project Manager

The Project Manager is responsible for:

- Ensuring that project personnel have training in control procedures for environmental samples or small quantities of hazardous materials: hazard classification, proper shipping name, handling, packaging, marking, labeling, storage, shipping, and preparation of shipping papers.
- Ensuring the training of personnel is properly documented
- Ensuring that personnel are aware of the possible hazardous materials that may be encountered in the field.

3.3 AWT Shipping Personnel (Field Sampling Personnel and Others Who Ship Environmental Samples or Small Quantities of Hazardous Materials)

These persons (e.g., field chemist/sampler/engineer) are responsible for:

- Verifying and attaching appropriate traffic reports/chain-of-custody records to accompanying environmental samples or hazardous materials and placing custody seals on shipping containers to ensure sample integrity.
- Determining (with appropriate support from AWT specialists, when necessary) the hazard classifications, proper shipping names, handling methods, packaging, markings, labeling, storage, shipping modalities, and shipping papers for hazardous materials or for environmental samples to be transported from the field to the analytical laboratory.
- Relinquishing the environmental samples to the analytical laboratory via overnight carrier as appropriate.
- Verifying the integrity of the environmental samples or hazardous materials and their containers by visual inspection and, if appropriate, specific air monitoring of the samples or materials prior to packaging and shipment.
- Informing the analytical laboratory of environmental sample shipments and estimated times of arrival.
- Complying with DOT, IATA, and overnight carrier regulations and requirements.

4. REFERENCES

Code of Federal Regulations:

49 CFR 171.8 Hazardous Material Definition and Other Definitions and Abbreviations
49 CFR 171.3 and 171.8 Hazardous Waste and Hazardous Waste Definition
49 CFR 172.101, 171.11 to 171.12a, and 172.201 to 172.203 Proper Shipping Names

49 CFR Parts 173, 178, and 179 Packaging
49 CFR 172.300 to 172.338 Marking
49 CFR 172.400 to 172.450 Labeling
49 CFR 172.200 to 172.205 Shipping Papers
49 CFR 172.500 to 172.560 Placards
49 CFR 171.15 and 171.16 Immediate Reporting of Hazardous Materials Incidents
49 CFR 172.101 to 172.102 Hazardous Materials Table and Special Provisions
49 CFR 172.101 Appendix A, Tables of Hazardous Substances and Reportable Quantities
49 CFR 172.101 Appendix B, Marine Pollutants
49 CFR 173.21 Forbidden Materials and Packages
49 CFR 172.600 to 172.604 Emergency Response Telephone Numbers
49 CFR 172.700 to 172.704 Hazmat Employee Training
40 CFR Parts 302 and 355 Designation of CERCLA Hazardous Substances and Release Notification Requirements
40 CFR Part 355 SARA Extremely Hazardous Substances and Release Notification Requirements

International Air Transportation Association (IATA):

Dangerous Goods Regulations 34th Edition Effective 1 January 1993 (or most current edition).

5. DEFINITIONS

The following are definitions related to sections of this document that are important to understand. More definitions related to DOT regulations can be found in 49 CFR 171.8 and 49 CFR 173.21 through 173.403. An index to the detailed hazard class definitions can be found in 49 CFR 173.2.

Hazard Class

The category of hazard assigned to a hazardous material under the definitional criteria of 49 CFR Part 173 and the provisions of 49 CFR 172.101 Table of Hazardous Materials. A material may meet the defining criteria for more than one hazard class but is assigned to only one hazard class. Detailed definitions of the nine classes and numerous divisions are found in 49 CFR Part 173 and are indexed in a table at 49

CFR 173.2. The defining criteria for the nine DOT hazard classes and various divisions are outlined in brief as follows:

Explosives

Class 1; Detailed definition 49 CFR 173.50

Explosive. For the purpose of this document -- means a substance or article designed to function by explosion.

1.1 explosives that have a mass explosion hazard.

1.2 explosives that have a projection hazard but no mass explosion hazard.

1.3 explosives that have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard.

1.4 explosives that present a minor explosion hazard, largely confined to the package, no projection of fragments of appreciable size or range expected.

1.5 very insensitive explosives, mass explosion hazard but so insensitive there is very little probability of initiation or transition from burning to detonation.

1.6 extremely insensitive articles, no mass explosive hazard -- articles contain only extremely insensitive detonating substances, demonstrate negligible probability of accidental initiation or propagation.

Gases

Class 2; Detailed definition 49 CFR 173.115

2.1 Flammable gas -- material is a gas at 20°C (68°F) or less and 101.3 kPa (14.7 psi) pressure, and ignitable at 14.7 psia in a mixture of 13 percent or less by volume with air or has a flammable range in air of at least 12 percent.

2.2 Non-flammable, non-poisonous Compressed Gas including liquefied gas, pressurized cryogenic gas, or compressed gas in solution.

2.3 Gas Poisonous by Inhalation -- is a gas at 20°C (68°F) or less and pressure of 101.3kPa (14.7 psia) or less, and is known to be so toxic to humans as to pose a hazard to health during transportation or, in absence of adequate data, is presumed to be toxic to humans because of an LC_{50} value not more than 5000 ml/m^3 in animals; must be assigned a hazard zone. Class 2 - Div. 2.3 Hazard Zones assignment:

Hazard Zone A, $LC_{50} \leq 200$ ppm
Hazard Zone B, $LC_{50} > 200$ but ≤ 1000 ppm
Hazard Zone C, $LC_{50} > 1000$ but ≤ 3000 ppm
Hazard Zone D, $LC_{50} > 3000 \leq 5000$ ppm.

Flammable and Combustible Liquids

Class 3; Detailed definition 49 CFR 173.120

Flammable liquid has a flash point ≤141°F or is any liquid with flash point ≥100°F intentionally heated and transported at or above its flash point in bulk. A flammable liquid with flash point at or above 100°F may be reclassed as combustible except by vessel or aircraft.

Combustible liquid -- does not meet the definition of any other hazard class except 9, and has flash point above 141°F (60.5°C) and below 200°F (93°C).

Class 3 Packing Group assignments:

PG I --	boiling point (bp) ≤95°F (35°C)
PG II --	flash point < 73°F (23°C), boiling point > 95°F (35°C)
PG III --	flash point ≥ 73°F (23°C) and ≤141°F (60.5°C), and boiling point > 95°F

Flammable Solid

Class 4; Detailed definition 49 CFR 173.124

4.1 Flammable Solids:

(a) certain wetted explosives (listed in the 49 CFR 172.101 Table),
(b) self-reactive materials - liable to undergo strongly exothermal decomposition caused by high temperature or contamination, and
(c) readily combustible solids -- may cause fire through friction (e.g., matches), burn faster than 2.2 mm per second in test, or certain metal powders that can be ignited and react per test.

4.2 Spontaneously Combustible Material
(a) pyrophoric material, or
(b) self-heating material (by test).

4.3 Dangerous When Wet Material -- a material that by contact with water is liable to become spontaneously flammable or give off flammable or toxic gas per test.

Oxidizer (and Organic Peroxide)

Class 5

5.1 Detailed definition 49 CFR 173.127, Oxidizer -- may, generally by yielding oxygen, cause or enhance combustion.

5.2 Detailed definition 49 CFR 173.128, Organic Peroxide -- contains O--O structure, derivative of H_2O_2 with structure H-O-O-H, one or both of the hydrogen atoms being replaced by an organic material.

Poisonous Materials and Infectious Substances

Class 6

6.1 Detailed definition 49 CFR 173.132. Poisonous Material -- a material, other than a gas, so toxic to humans as to afford a hazard to health during transportation or which, in the absence of adequate data on human toxicity, is presumed to have such toxic hazard because of

acute oral LD_{50} (rat) not more than 500 mg/kg for liquid or not more than 200 mg/kg for a solid. Packing Group assignments:

PG I -- oral $LD_{50} \leq 5$ mg/kg
PG II -- oral $LD_{50} > 5, \leq 50$ mg/kg
PG III -- oral $LD_{50} > 50$ mg/kg

acute dermal LD_{50} (rabbit) not more than 1000 mg/kg. Packing Group assignments:

PG I -- dermal $LD_{50} \leq 40$ mg/kg
PG II -- dermal $LD_{50} > 40, \leq 200$ mg/kg
PG III -- dermal $LD_{50} > 200$ mg/kg

inhalation toxicity --

(A) dust or mist acute LC_{50} (rat, 1 hr) not more than 10 mg/L. Packing Group assignments:

PG I -- < 0.5 mg/L
PG II -- $\geq 0.5, < 2$ mg/L
PG III -- > 10 mg/L

or, (B) material with a saturated vapor concentration in air at 20C of more than one-fifth of the LC_{50}, with LC_{50} not more than 5000 ml/m^3. Packing Group and Hazard Zone based on saturated vapor concentration V, as follows:

PG I Hazard Zone A -- $V \geq 500LC_{50}$ and $LC_{50} \leq 200$ mL/m^3

PG I Hazard Zone B --	$V > 10LC_{50}$ and LC_{50} <1Liter/m^3 and not Zone A
PG II	$V > LC_{50}$ and LC_{50} $<3L/m^3$ and not PG I
PG III	$V\ 0.2LC_{50}$ and LC_{50} $<5L/m^3$ and not PG I or II

Class 6.1 also includes irritating material similar to tear gas.

6.2 Detailed definition 49 CFR 173.134. Infectious Substance -- viable microorganism or its toxin that causes or may cause disease in humans or animals (see list at 42 CFR 72.3) or any other agent that causes or may cause severe, disabling or fatal disease; synonymous with "etiologic agent." Also included:

Diagnostic specimen (human or animal tissue, excreta, secreta, or blood) being shipped for purpose of diagnosis, or

Biological product -- prepared and manufactured in accordance with 9 CFR Part 102, 103, or 104, 21 CFR Part 312, or 21 CFR Parts 600 to 680, or

Regulated medical waste.

Radioactive

Class 7; Detailed definition 49 CFR 173.403.

Corrosive

Class 8; Detailed definition 49 CFR 173.136

Corrosive material -- causes visible destruction or irreversible alterations in human skin tissue at site of contact, or has a severe corrosion rate on steel or aluminum, per criteria.

Other (Miscellaneous Hazardous Materials)

Class 9; Detailed definition 49 CFR 173.140

Miscellaneous Hazardous Material -- presents a hazard during transportation, but does not meet the definition of any other hazard class. Includes:

A material that has an anesthetic, noxious or other similar property which could cause extreme annoyance or discomfort to a flight crew member so as to prevent correct performance of duties, or

Any material which meets the 49 CFR 171.8 definition of:

elevated temperature material
hazardous substance (see definitio below)
hazardous waste (see definition below)
marine pollutant (Appendix B to 49 CFR 172.101)
oil.

[End Definition of Hazard Class]

Hazardous Material (may or may not be also a hazardous substance)

Means a material or substance, including a hazardous substance, which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety and property when transported in commerce and which has been so designated.

Hazardous Substance (may or may not also meet the definition of a DOT hazard class)

Means a material, including mixtures and solution, that:

- Is listed in Appendix A to 49 CFR 172.101,
- Is in a quantity in one package which equals or exceeds the reportable quantity (RQ) listed in Appendix A to 49 CFR 172.101, and

- When in a mixture or solution: for radionuclides, conforms to paragraph 6 of Appendix A to 172.101; for other than radionuclides, is in a concentrations by weight which equals or exceeds the concentration corresponding to the RQ of the material. (See Section 6.3.)

[NOTE: Under DOT practice, a hazardous substance (quantity greater than the RQ) legally becomes a hazardous material, even though it does not meet the definition of any DOT hazard class. In order to avoid excessive confusion and to be consistent with general word usage, the distinction between the two terms is maintained in this document as far as is possible.]

Hazardous Waste

Means any material that is subject to the hazardous waste manifest requirements of the EPA in 40 CFR Part 262.

6. PROCEDURES

6.1 Introduction

This technical guidance will outline and example

(a) the proper shipping of hazardous materials and

(b) the proper control of small quantities of hazardous materials and all environmental samples (soil, water, etc.) to be transported to an analytical laboratory regardless whether the samples meet a hazard class definition that renders them subject to the requirements of the DOT hazard materials rules.

Proper planning of an environmental sampling event includes the review of all data previously produced about the site and all information concerning the site, such as its previous uses, chemical practices thereat, storage of chemicals thereon, and any reported releases. This knowledge will allow the Project Manager (supported by AWT specialists as appropriate) to assign a tentative hazard classification, proper shipping name, and identification number in accordance with 49 CFR 172.101(c)(11) prior to the start of field work. Samples taken at a known CERCLA, RCRA, or state priority site must be initially deemed hazardous until they are compared with the defining criteria and found not to meet the requirements of one of the DOT hazard classes.

Samples containing free-phase chemicals must be controlled as hazardous until determined not to be hazardous, and packaged as would be required for shipping the free-phase chemical in its neat (undiluted) form. Samples that are (a) taken from sites where no information is available and no contaminants are suspected, or (b) are taken to monitor a clean site should be deemed not hazardous and not be shipped under the DOT hazardous materials regulations. All samples must be packaged and shipped without damage to ensure sample integrity. The decision to ship samples as hazardous or nonhazardous must not be taken lightly and must be made with due regard to all DOT regulations. This document will give the user an outline for making those important decisions and lead them to resources that can help them decide on the proper course to take.

6.2 Objectives

The objectives for establishing proper control of environmental samples and small quantities of hazardous materials include:

- Properly executing the methodologies pertaining to hazard classification (or "nonhazardous" classification), proper shipping name selection, handling, packaging, marking, labeling, and shipping documentation.
- Properly packaging environmental samples and hazardous materials to minimize to the greatest extent feasible breakage during transport.
- Properly preserving environmental samples per analytical protocol.
- Properly storing environmental samples and hazardous materials prior to shipment to ensure integrity. Samples should be shipped the day they are taken. More than one day storage of samples is not allowed.
- Complying with DOT, IATA, and overnight carrier regulations and requirements for transportation by surface and/or air.
- Ensuring proper chain-of-custody protocol during sample shipment.

6.3 Classification of Hazardous Materials

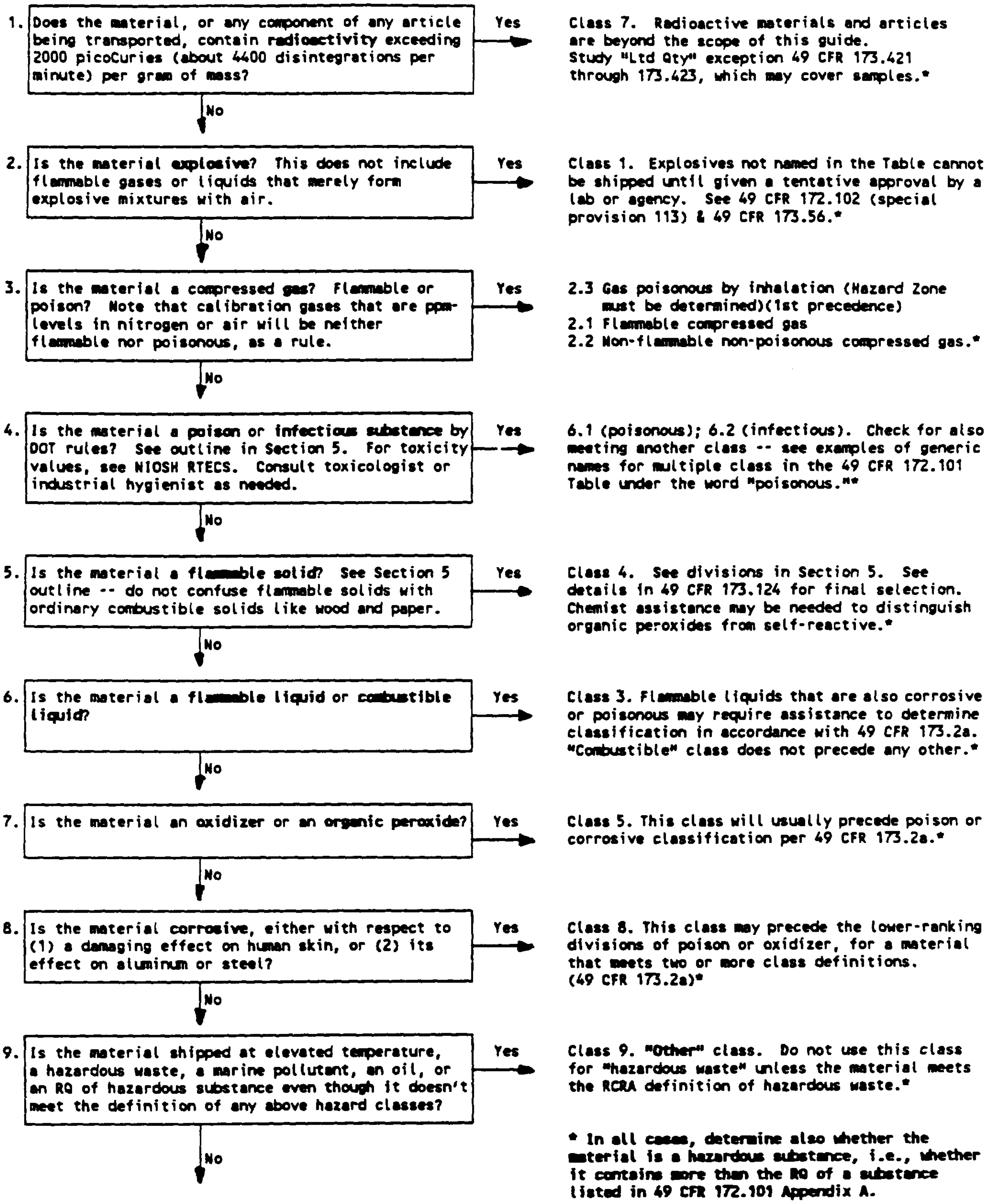
General. For solvents and chemical substances in general, classification is often a matter of looking up in the 49 CFR 172.101 Hazardous Materials Table and its appendices. For environmental samples, the question is often whether the concentration of hazardous contaminant in the samples is so high as to make the samples themselves meet the definition of a DOT hazard class or to cause a package to contain a reportable quantity of a hazardous substance. If during the planning of a project, the AWT Shipping Personnel know the nature of chemical contamination that will be encountered at the project site, then that knowledge can be used to determine if the samples are hazardous. A sample can be deemed a hazardous material (a) by being listed in the Hazardous Materials Table or (b) by meeting the definition of a DOT hazard class. A shipment that is not a hazardous material under the DOT rules can also come under DOT hazardous materials regulation as a hazardous substance. Further, certain compliance steps are required for a hazardous material that is also a hazardous substance. Accordingly, it is always necessary to determine both whether the item is a hazardous material and whether it is a hazardous substance.

If the material to be transported is listed by name in the Hazardous Materials Table at 49 CFR 172.101, the hazard classification is listed there. Figure 1 (Logic Diagram) presents an overview of the decision process to determine the classification for a material that is not listed by name in the Table. (Note: This diagram is not meant to be "the answer" to all situations or a substitute for careful analysis and the exercise of reasoned judgment.)

Determining if a material is a hazardous material for shipping purposes require knowing as far as possible what are the material's chemical, physical, and toxicological characteristics. If AWT Shipping Personnel do not know these characteristics, they should seek help in the characterization process from the AWT specialists listed in Section 8 or other appropriate persons.

The definitions contained in Section 5, above, are helpful when using Figure 1 (Logic Diagram) and the Hazardous Materials Table. Additional definitions and additional detail may be found in 49 CFR 171.8 and other regulatory paragraphs that are referenced there. Refer to the logic diagram in Figure 1 to help guide the hazard classification process. The Hazardous Materials Table (49 CFR 172.101) will be a key tool, after the material is found to be hazardous, for choosing a proper shipping name, hazard class, division

Figure 1. Logic Diagram for Hazard Classification.



1. Does the material, or any component of any article being transported, contain radioactivity exceeding 2000 picoCuries (about 4400 disintegrations per minute) per gram of mass?

Yes → Class 7. Radioactive materials and articles are beyond the scope of this guide. Study "Ltd Qty" exception 49 CFR 173.421 through 173.423, which may cover samples.*

No ↓

2. Is the material explosive? This does not include flammable gases or liquids that merely form explosive mixtures with air.

Yes → Class 1. Explosives not named in the Table cannot be shipped until given a tentative approval by a lab or agency. See 49 CFR 172.102 (special provision 113) & 49 CFR 173.56.*

No ↓

3. Is the material a compressed gas? Flammable or poison? Note that calibration gases that are ppm-levels in nitrogen or air will be neither flammable nor poisonous, as a rule.

Yes →
2.3 Gas poisonous by inhalation (Hazard Zone must be determined)(1st precedence)
2.1 Flammable compressed gas
2.2 Non-flammable non-poisonous compressed gas.*

No ↓

4. Is the material a poison or infectious substance by DOT rules? See outline in Section 5. For toxicity values, see NIOSH RTECS. Consult toxicologist or industrial hygienist as needed.

Yes → 6.1 (poisonous); 6.2 (infectious). Check for also meeting another class -- see examples of generic names for multiple class in the 49 CFR 172.101 Table under the word "poisonous."*

No ↓

5. Is the material a flammable solid? See Section 5 outline -- do not confuse flammable solids with ordinary combustible solids like wood and paper.

Yes → Class 4. See divisions in Section 5. See details in 49 CFR 173.124 for final selection. Chemist assistance may be needed to distinguish organic peroxides from self-reactive.*

No ↓

6. Is the material a flammable liquid or combustible liquid?

Yes → Class 3. Flammable liquids that are also corrosive or poisonous may require assistance to determine classification in accordance with 49 CFR 173.2a. "Combustible" class does not precede any other.*

No ↓

7. Is the material an oxidizer or an organic peroxide?

Yes → Class 5. This class will usually precede poison or corrosive classification per 49 CFR 173.2a.*

No ↓

8. Is the material corrosive, either with respect to (1) a damaging effect on human skin, or (2) its effect on aluminum or steel?

Yes → Class 8. This class may precede the lower-ranking divisions of poison or oxidizer, for a material that meets two or more class definitions. (49 CFR 173.2a)*

No ↓

9. Is the material shipped at elevated temperature, a hazardous waste, a marine pollutant, an oil, or an RQ of hazardous substance even though it doesn't meet the definition of any above hazard classes?

Yes → Class 9. "Other" class. Do not use this class for "hazardous waste" unless the material meets the RCRA definition of hazardous waste.*

No ↓

"Not Hazardous" for shipping purposes.

*** In all cases, determine also whether the material is a hazardous substance, i.e., whether it contains more than the RQ of a substance listed in 49 CFR 172.101 Appendix A.**

ADDITIONAL NOTES ON FIGURE 1

Block 1: A "limited quantity" of radioactive material will be excepted from most requirements. If a limited quantity of radioactive material meets the definition of another hazard class, consult 49 CFR 173.421-2.

Block 2: Explosives are unstable materials. Unknown materials found at a site must be characterized to the degree that an explosive property would be known before they are shipped. Flammable testing would be done initially by use of a very small amount of material at a location well-isolated from the bulk of unknown material.

Block 3: Assistance from an industrial hygienist or a chemist may be needed to determine characteristics of gas mixtures. For flammable or poisonous gas, the definition of "gas" is based on boiling below 20°C. Non-flammable, non-poisonous gases exert a pressure of 41 psia or greater at 20°C.

Block 4: Note that classification is based on acute toxicity -- not on chronic toxicity. For example, soluble lead compounds are poisons (see the generic entry in the Table), whereas the metal and insoluble compounds are not. Additional detail on use of the LD50 and LC50 data is found in 49 CFR 173.132 and 173.133. Note that there are additional hazard communication requirements for Hazard Zones A and B, at 49 CFR 172.203(m)(3), 172.313, and Table 1 (placarding) of 172.504. Note that when a material meets the definition of 6.2 (infectious substance), that class takes precedence over any other hazard class or division. Note that the assignments of entries in the 49 CFR 172.101 Table do not have to agree with the class definitions, as DOT may find that a material does or does not present a given hazard in transportation.

Block 5: In general, flammable solids will be materials known to have substantial and unusual fire hazards associated with them. The term "wetted explosives" refers only to substances so identified in the Table at 49 CFR 172.101.

Block 6: The DOT definition of "flammable liquid" has been modified and now agrees more closely with the definition of the "ignitable" characteristic of hazardous wastes. There is a provision in 49 CFR 173.120 to re-classify a material with flash point >100°F (37.8°C) from "flammable" to "combustible," but not for shipment by air.

Block 7: Note that when a material meets the definition of 5.2 (organic peroxide), that classification precedes all others.

Block 8: The corrosive property for a material not listed in the 49 CFR 172.101 Table will probably be assessed most effectively by comparing the known properties of the material with known corrosive materials that are listed in the Table.

Block 9: The definition of "Other" Class 9 is expressed in general terms but only the types of materials listed in the definition should be assigned to this class. For example, a substance that is listed in 49 CFR 172.101 Appendix A but is present in less than a reportable quantity should not have this hazard class name associated with it. A material with an extreme odor might belong in this class, even though it does not meet any poison or other hazard class definition.

number, packaging, labeling, quantity limitations, and other shipping information.

Uncertainty -- tentative classification. The DOT regulations recognize the possibility of a situation where information is not adequate to determine positively whether an item meets a hazard class definition. [49 CFR 172.101(c)(11).] These situations may arise when a mixture or solution is being transported and there is some uncertainty over the degree to which the mixture retains the hazard properties of its constituents. Environmental samples (e.g. soil, water) are often dilute mixtures or solutions. Conceivably there could be arsenic or cadmium contamination levels so high that the environmental samples themselves might meet a DOT "Poison" definition. Samples that are substances of uncertain makeup (not soil and not water), and samples in which the contaminant concentration is obviously high (evidenced, e.g., by changes in texture, odor, color, or density), are examples of materials that could conceivably belong in a hazard class and must be evaluated. A tentative assignment of hazard class, proper shipping name, and identification number is made by the Project Manager. This tentative decision is based on knowledge of the material and the DOT hazard class definitions (see Section 5 above). In cases where a tentative classification is to be made under this provision, the Project Manager should discuss this action prior to shipping with one of the AWT specialists listed in Section 8.

How the material compares with these hazard classes will determine to which DOT hazard class it belongs, or whether it is a hazardous material at all under the DOT regulations. For example, a solution of naphthalene in toluene and xylene is not listed in the Hazardous Materials Table by name. However, toluene is a flammable liquid, and dissolving the naphthalene into it will not change the flammable liquid property (of toluene), so the flammable liquid definition is met. Such a mixture or solution is not likely to be listed in the Table. A generic name must be used, which is found in the Table as "Flammable liquid, n.o.s." (As discussed in Section 6.4 below, this shipping name will have to be modified to indicate the solution's technical identity.)

In other cases, it may be determined tentatively that a material belongs in a hazard class by analogy with a very similar material that is found in the Hazardous Materials Table. For example, methylnaphthalene (not in the Table) might be classified by its great similarity to naphthalene. Naphthalene is listed in the Table in the "Flammable Solid" class, so the methylnaphthalene (which is known to be similar) might be classified as a flammable solid also, and the proper shipping name "Flammable Solid, n.o.s. (methylnaphthalene)" might be used. If the material is actually an environmental sample with methylnaphthalene present as a contaminant, that is very different. An environmental sample would not meet the definition of "flammable solid" unless the concentration of the flammable material were so high that the sample showed burning characteristics similar to those of the "neat" (undiluted) chemical substance. A sample with parts-per-million levels of methylnaphthalene would be "nonhazardous" for transportation purposes.

Hazardous Substance. Regardless of whether the material (to be transported) is determined to meet the definition of a DOT hazard class, it must also be determined whether it is a hazardous substance. 49 CFR 172.101, Appendix A, must be consulted. Table 1 lists certain substances for which the EPA has established "Reportable Quantities" (RQ) that, in the event they are released into the environment, are to trigger reporting and an appropriate emergency response. To constitute a hazardous substance under the DOT regulations, the material being transported must (1) be listed in Table 1, and (2) be in a reportable quantity (RQ) in one package, and (3) (if a mixture) have a concentration of the listed substance in the mixture that is at or above a triggering concentration. The triggering concentration is ascertained by comparing the RQ set forth in Table 1 with the concentration by weight set forth in the table found under the definition of Hazardous Substance in 49 CFR 171.8. (Note: These minimum concentrations are unlikely ever to be a factor in a shipment made under this guidance document.) The minimum triggering concentrations are:

Reportable Quantity	Concentration
5000 lbs	10% or 100,000 ppm
1000 lbs	2% or 20,000 ppm
100 lbs	0.2% or 2000 ppm
10 lbs	0.02% or 200 ppm
1 lb	0.002% or 20 ppm

A particular material may be (1) a hazardous material and not a hazardous substance, (2) a hazardous substance that does not meet a hazard class definition, (3) both a hazardous material and a hazardous substance, or (4) neither a hazardous substance nor a hazardous material for shipping purposes. In cases (1) and (3), the proper shipping name will be the name appropriate for the hazardous material. In cases (2) and (3), the letters "RQ" will be required on the shipping paper and the package marking to provide notice of the reporting requirement and environmental threat. In case (2), use the proper shipping name of "Environmentally hazardous substance, solid, n.o.s." or "Environmentally hazardous substance, liquid, n.o.s." as appropriate, putting the technical name of the material in parentheses. (These terms replace the former shipping names "Hazardous substance, solid, n.o.s." and "Hazardous substance, liquid, n.o.s.") The dangerous goods airbill in Figure 2 details the proper designation that would be used.

Uncertainty - very highly contaminated samples as hazardous substances. Problems may arise when the AWT Shipping Personnel do not know what will be encountered or what concentration of a known chemical or mixture will be found. In this instance, tentative designations may be made as described above, under the provisions of 49 CFR 172.101(c)(11). For example, dust samples from around electric arc furnaces (baghouse dust) might contain lead in excess of 10,000 ppm or 1%. Lead metal and lower oxides are not listed -- thus apparently not considered to meet a DOT hazard class definition. However, lead dust or powder (particle diameter less than 100 micrometers) is a hazardous substance with RQ of one pound. A shipping container with 50 to 100 pounds or more of this highly-contaminated soil might contain an RQ of lead dust, and might be tentatively assigned the shipping name of "Environmentally hazardous substances, solid, n.o.s. (contains lead dust)" and the corresponding identification number. As with tentative assignments of a material to a DOT hazard class, discussed above under Uncertainty -- tentative classification, a tentative classification of a hazardous substance under this provision should be discussed prior to shipping with one of the AWT specialists listed in Section 8 below.

Free-phase chemicals. As mentioned earlier, a constituent (contaminant or other) that exists as a separate phase may present special problems. In the case of a chemical that can be identified (e.g., petroleum hydrocarbons floating on water or puddled in soil), the proper hazard class and shipping name of that substance must be used. If the chemical substance is mixed with environmental media, e.g., hydrocarbons in soil or solvent contamination in ground water, the characteristics of the sample itself determine the hazard class. Neat (undiluted) free-phase chemicals in principle must be handled and packaged with more care than soil or water. See Section 6.5 below for details.

FEDERAL EXPRESS

USE THIS AIRBILL FOR DANGEROUS GOODS SHIPMENTS ONLY WITHIN THE CONTINENTAL U.S.A., ALASKA AND HAWAII
USE THE INTERNATIONAL AIR WAYBILL FOR SHIPMENTS TO PUERTO RICO AND ALL NON U.S. LOCATIONS
QUESTIONS? CALL 800-238-5355 TOLL FREE

AIRBILL
PACKAGE
TRACKING NUMBER 2863334386

1127r 2863334386

Sender's Federal Express Account Number
1 0021-C142-4
Date

From (Your Name) Please Print: Bradley S. Rodgers
Your Phone Number (Very Important): (617)-246-5200
Company: METCALF & EDDY
Department/Floor No.
Street Address: 30 HARVARD MILL
City: WAKEFIELD
State: MA
ZIP Required: 0 1 8 8 0

2 To (Recipient's Name) Please Print: NET Cambridge Division
Recipient's Phone Number (Very Important): (617) 890-7367
Company
Department/Floor No.
12 Oak Park
Exact Street Address (We Cannot Deliver to P.O. Boxes or P.O. Zip® Codes.)
City: Bedford
State: MA
ZIP Required: 01730

YOUR INTERNAL BILLING REFERENCE INFORMATION (First 24 characters will appear on invoice.)
008603-0093

H IF HOLD FOR PICK-UP, Print FEDEX Address Here (Not available at all locations.)
Street Address
City
State
ZIP Required

3 PAYMENT
1 ☒ Bill Sender Acct. No. Req'd.
2 ☐ Bill Recipient's FedEx Acct. No. Fill in Account Number below
3 ☐ Bill 3rd Party FedEx Acct. No. Fill in Account Number below (Req'd.)
4 ☐ Bill Credit Card Fill in Credit Card Number below
5 ☐ Cash/Check
Acct./Credit Card No.
Exp. Date

4 SERVICES (Check only one box)

Priority Overnight Service (Delivery by next business morning)
11 ☐
Standard Overnight Service (Delivery by next business afternoon)
51 ☐
Economy Two-Day Service
30 ☐
Heavyweight Service
70 ☐ HEAVYWEIGHT
80 ☐ DEFERRED HEAVYWEIGHT

INSTRUCTIONS Mark appropriate boxes:
- Dangerous Goods as per attached Shipper's Declaration ☐
- Dangerous Goods Shipper's Declaration not required ☐
- Cargo Aircraft only ☐

DELIVERY AND SPECIAL HANDLING (Check services required)
1 ☐ HOLD FOR PICK-UP
2 ☐ DELIVER WEEKDAY
3 ☐ DELIVER SATURDAY
4 ☒ DANGEROUS GOODS
6 ☐ DRY ICE
☐ OTHER SPECIAL SERVICE
11 ☐
12 ☐ HOLIDAY DELIVERY

Packages	Weight	Declared Value
1	86 lb	$5,000
Total	Total	Total

DIM SHIPMENT Chargeable Weight ☐ lbs.

Received At
1 ☐ Regular Stop
2 ☐ On-Call Stop
3 ☐ Drop Box
4 ☐ B.S.C.
5 ☐ Station
FedEx Emp. No.
Date/Time

SERVICE CONDITIONS, DECLARED VALUE AND LIMIT OF LIABILITY

SIGNATURE RELEASE UNAVAILABLE

Federal Express Use
Base Charges
Declared Value Charge
Other 1
Other 2
Total Charges

REVISION DATE 10/90
FORMAT #063
063
PRINTED IN U.S.A.

2863334386 AIRBILL NUMBER

SHIPPER'S CERTIFICATION FOR RESTRICTED ARTICLES/DANGEROUS GOODS

CHECK ONE ☒ 49 CFR ☐ IATA/ICAO (TYPE OR PRINT)

DANGEROUS GOODS IDENTIFICATION						
PROPER SHIPPING NAME	CLASS OR DIVISION	UN OR ID NO.	SUBSIDIARY RISK	QUANTITY AND TYPE OF PACKING	PACKING INST.	AUTHORIZATION
RQ Environmentally Hazardous Substances, Solid, NOS (Soil containing lead dust) Ltd Qty	9	UN3077		1 cooler containing glass sample jars	PG III	49 CFR 173.155

ADDITIONAL HANDLING INFORMATION
Net weight 65 lb.

TRANSPORT DETAILS	THIS SHIPMENT IS WITHIN THE LIMITATIONS PRESCRIBED FOR ▶	PASSENGER AIRCRAFT	CARGO AIRCRAFT ONLY	(DELETE NONAPPLICABLE)
AIRPORT OF DEPARTURE	AIRPORT OF DESTINATION	SHIPMENT TYPE ▶	NON-RADIOACTIVE	RADIOACTIVE	(DELETE NONAPPLICABLE)

IF ACCEPTABLE FOR PASSENGER AIRCRAFT, THIS SHIPMENT CONTAINS RADIOACTIVE MATERIAL INTENDED FOR USE IN, OR INCIDENT TO, RESEARCH, MEDICAL DIAGNOSIS OR TREATMENT

I HEREBY DECLARE THAT THE CONTENTS OF THIS CONSIGNMENT ARE FULLY AND ACCURATELY DESCRIBED ABOVE BY PROPER SHIPPING NAME AND ARE CLASSIFIED, PACKED, MARKED, AND LABELED, AND ARE IN ALL RESPECTS IN PROPER CONDITION FOR TRANSPORT BY AIR ACCORDING TO THE APPLICABLE INTERNATIONAL AND NATIONAL GOVERNMENT REGULATIONS.

NAME AND TITLE OF SHIPPER: C. Herb Hickman, Regional Coordinator
PLACE AND DATE: Berea, KY 30 JUNE 1993
EMERGENCY TELEPHONE NUMBER: 1-800-535-5053
SIGNATURE OF SHIPPER: C Herb Hickman
SEE WARNING ON BACK

Hazardous Waste. If samples are taken from a material that has already become a hazardous waste, then special considerations apply. Normally, a "hazardous waste" can be sent only to a RCRA-permitted facility and must be accompanied by a hazardous waste manifest conforming to EPA regulations. Exceptions exist in the EPA rules for samples (1) sent to a laboratory solely for determination of characteristics, or (2) for treatability studies. If no other proper shipping name from the Hazardous Materials Table is appropriate, such samples may apparently be classed in DOT hazard class 9, as:

- Hazardous waste, liquid, n.o.s. NA3082, or
- Hazardous waste, solid, n.o.s. NA3077.

Numerous constraints are placed on these exceptions for hazardous waste samples, which are found in 40 CFR 261.4(d) and (e). These provisions clearly envision that the samples will be sent back from the laboratory to the sample collector, for inclusion in the hazardous waste stream from which they came. (It may also be inferred that the laboratory can manage the hazardous waste as if generated within the laboratory, but the regulations do not address this question specifically). These arrangements must be made by responsible personnel early in the planning process in order to avoid leaving the laboratory in possession of a hazardous waste.

If the material being shipped does not meet any of the criteria described above and is suspected of containing little contamination, then the material should be sent as "nonhazardous."

6.4 Proper Shipping Name

As outlined above, the determination of the DOT hazard class and the determination of proper shipping name (from the Table in 49 CFR 172.101) are closely interrelated. If the material to be shipped is listed in the Table, the Table provides the hazard class, proper shipping name, and other information necessary for labeling, marking, and packaging. All proper shipping names are listed in the Table. If the material is not listed by name in the Table, but meets the definition of a DOT hazard class, the proper shipping name will be some generic name from the Table, with the technical name likely required to be added in parentheses. This remains true whether the material is also a hazardous substance or not; if the material is a hazardous substance (quantity exceeds the RQ), the letters "RQ" are shown on the shipping paper and the package markings as an environmental hazard warning.

Hazardous Substance that does not meet a hazard class definition. If the material is not listed in the Table and does not meet the definition of a DOT hazard class, but is a hazardous substance as described above in Section 6.3, then the proper shipping name will likely be "Environmentally hazardous substance, liquid, n.o.s. (technical name in parentheses)" or "Environmentally hazardous substance, solid, n.o.s. (technical name in parentheses)". As shown in the Table entries, materials that match this shipping name are considered to be in the "Other" Class 9. This proper shipping name will also be needed to satisfy the International Air Transport Association (IATA) naming regulations.

Material not in Table, meets a hazard class definition, is also hazardous substance. 49 CFR 172.101 (c)(8)(ii) is helpful when choosing a shipping name for a hazardous substance that is not listed in the Table, but meets the definition of a DOT hazard class. The proper shipping name will be a generic name from the Table appropriate for the DOT hazard class. If the hazardous substance meets the definitions of more than one hazard class, a precedence of hazard is specified in 49 CFR 173.2a. Figure 1 follows this precedence-of-hazard order so far as is possible. An appropriate generic proper shipping name that represents both classes, for example "Flammable liquid, corrosive, n.o.s." must be selected and modified (see below) by including the technical name in parentheses. Guidance for selection is found in 49 CFR 172.101(c)(8)(ii). Basically, the proper shipping name from the Table that provides the best description is to be selected.

Required modification of generic shipping names from the Table. As spelled out in 49 CFR 172.203(k), the generic shipping names generally must be modified to include the technical name information, also using the word "contains" or the word "mixture" where appropriate. For example, a solution of naphthalene in toluene and xylene would have the generic name "Flammable liquid, n.o.s. (contains toluene, xylene, and naphthalene)". Alternatively, if this solution were predominantly toluene, the word "solution" [see 49 CFR 172.101(c)(10)] might be used to modify "toluene" in the proper shipping name, i.e., "toluene (solution)." However, as explained in 49 CFR 172.101(c)(10), it is not appropriate or permissible to do this in the case where toluene (or some other hazardous material) is a minor contaminant so that the appropriate emergency response is different from the emergency response that is correct for the hazardous material specified (toluene in this case).

The letters RQ are to precede the proper shipping name if there is a reportable quantity of a hazardous substance. This is done so that, in event of a release of the material (see Section 6.9 below), both transportation and emergency personnel will know immediately that an environmental hazard exists and reporting is required. The DOT proper shipping name can also be used to satisfy the IATA naming regulations.

The dangerous goods airbill in Figure 2 illustrates the proper way to record the proper shipping name on a shipping paper. A proper DOT description includes: the proper shipping name, the hazard class, the UN/NA identification number, the packing group number (usually), and the "RQ" designation if the material is a hazardous substance in a reportable quantity. This information is all determined on the basis of information provided in Table 172.101 and its appendices.

6.5 Packaging

After the hazard classification has been performed and the proper shipping name has been determined, the proper packaging can be chosen. (Labeling, marking, and shipping papers are conditioned on packaging as well as shipping name. There are general packaging requirements that apply to all hazardous materials transportation, as well as requirements specific for the hazard class, division, and packing group.

General requirements. Important general requirements for hazardous materials packages are found in 49 CFR 173.21 through 173.25. Of particular general interest, under 49 CFR 173.24, each package must be designed, constructed, maintained, filled, and closed so that under normal conditions:

- there will be no identifiable (without instruments) release of hazardous materials,
- the effectiveness of the package will not be reduced (i.e., impact resistance, strength, and compatibility must be maintained), and
- there will be no mixture of gases or vapors in the package that could reduce the effectiveness of the packaging.

Hazardous materials may not be packed or mixed together in the same outer packaging with other hazardous or nonhazardous materials if the materials are capable of reacting dangerously with each other. Compatibility of materials is the most important factor.

Closures on packages must be designed and closed such that under conditions incident to transportation (including temperature and vibration), the closure is secure and leakproof so that there is no identifiable release.

Inner packagings of combination packagings must be so packed, secured, and cushioned to prevent breakage or leakage and control movement within the outer packaging. Inner packagings that contain liquids must be packed so that closures are upright. Cushioning material must not be capable of either reacting dangerously with the contents or causing any contamination or degradation of environmental samples.

Packagings must not be overfilled so as to cause distortion or overpressure under conditions that may be encountered. Numerous additional performance-based requirements exist to ensure that packagings are used within their design capabilities. [49 CFR 173.24 and 24a]

Additional requirements applicable to shipment by air are found in 49 CFR 173.27. Packing Group II performance is required regardless of a Packing Group III specification in the 49 CFR 172.101 Table. The quantity limitations of Table Column 9, for passenger and cargo aircraft, must be observed and the CARGO AIRCRAFT ONLY label used where appropriate. Packagings must be designed to contain the pressures they will experience. Closures must be secured. Absorbent materials must be sufficient. Inner packaging sizes may be reduced below those indicated in the packaging specification for the material being shipped. Gas cylinders must have valve caps or must be boxed or crated. In case of doubt, see the full detailed regulation at 49 CFR 173.27.

General small-quantity exception. A broad exception is granted at 49 CFR 173.4 for very small amounts of flammable and combustible liquids, flammable solids (not spontaneously combustible, not dangerous when wet), oxidizers and organic peroxides, corrosives, poisonous liquids and solids, limited quantity radioactive materials, and "Other" (DOT Class 9). The materials are packed in inner receptacles of metal, glass, earthenware, or minimum thickness plastic, in suitable cushioning and absorbent packaging capable of absorbing the entire contents if liquid, and in strong outside packaging. The inner receptacles hold no more than 30 mL (1 oz) of liquid or 30 g (1 oz) of solid for other than Packing Group I poisons, and no more than one gram of Packing Group 1 poisons. Removable closures must be positively closed as with tape or wire. The completed package must be demonstrated by prototype testing to sustain free drops, from 5.9 feet onto a hard surface, onto bottom, top, long side, short side, and corner, plus a specified compressive load test, without substantial reduction in package effectiveness. In lieu of shipping papers, labeling, and usual marking, this package may be marked with the statement, "This package conforms to conditions and limitations specified in 49 CFR 173.4."

Specification packagings and exceptions. Columns 5 and 8 of the Hazardous Materials Table provide essential information on proper packaging. The packaging must fit within a description found in the regulations, either as a specification package or an exception, or must be authorized by an exemption obtained through a formal process from the U.S. DOT.

Column 8 (Packaging Authorizations) is generally consulted first. The numbers in this column refer to sections within 49 CFR Part 173. For example, looking under "acetone" the exception identified as "150" refers to 49 CFR 173.150. Similarly, (under "acetone") the nonbulk packaging entry "202" refers to 49 CFR 173.202. These are references detailing the way acetone (in this case) must be packaged. Both the exception at 173.150 and the specification packaging at 173.202 contain packaging information. The exception at 173.150 deals with a "limited quantity" exception for flammable liquids, provided they are packaged in certain ways. This exception can only be used for a particular flammable liquid if the Table entry (49 CFR 172.101) for that liquid shows this number "150" in Column 8. Very often such exceptions are much more convenient than arranging for the alternative "specification" containers.

Also, as directed from Column 8 of the Table, a variety of specification packagings for flammable liquids are found in 173.202, suitable for quantities from small bottles (as inner containers in strong outside packages) to drums and bulk packagings.

Note that the "limited quantity" provision is called an exception, not an exemption. An exemption has specific meaning under the DOT regulations. An exemption, for example, might permit use of a new design plastic packaging in place of a steel drum for a particular material and quantity. Such exemptions are individually granted by the DOT and subject to control by the DOT.

Special concerns in environmental work. The AWT Shipping Personnel must be aware of the materials being packaged and take precautions so that if the contents of the outer package were spilled, that spill would not be considered a release of hazardous waste requiring a clean-up.

Field sampling personnel must be acutely aware of the DOT regulations concerning the small quantities of chemical preservatives that they bring onto the site, such as nitric acid, hydrochloric acid, and sodium hydroxide. These chemicals cannot be packaged/shipped as environmental samples and must be controlled by their specific DOT classifications. The acids and bases used in preservation are corrosive whereas the solvents used for decontamination (such as methanol, isopropanol, and hexane) are flammable.

Procedures for environmental samples. Environmental samples in most cases will not meet the defining criteria for a DOT hazard class. In some cases, a package may contain a reportable quantity of a hazardous substance. The general packaging procedures for environmental samples, either as "nonhazardous" or as Environmentally hazardous substances n.o.s. (solids and liquids) or hazardous wastes n.o.s. (solids and liquids) are as follows:

- The carrier must be notified prior to sampling if it will be necessary to schedule a hazardous material shipment. If the samples are deemed to meet the DOT definition of a hazard class (such as poisons or flammables), discuss the required packaging with the carrier before sampling. Depending on the hazard class, the environmental sample may not be shipped with edible commodities.

- Place a layer of acceptable cushioning material (e.g., vermiculite) in the bottom of the watertight insulated metal or equivalent strength plastic shipping container.

- Sample bottles must be properly sealed by tightening the lids to the point where vibration will not loosen the lids. Sealing tape may be applied but must not contain any volatile or semivolatile analytes that may contaminant the samples. Sealing tape is not recommended but may be required by the client or government agency.

- Wrap the properly labeled and sealed sample bottles (or other sample containers, such as purgeable VOA vials) with plastic bubble wrap. Place the wrapped containers into watertight zip-lock plastic bags and seal the bags closed.

- Placed the sample bottles or containers (top side up) into the shipping container, arranging the bottles so that glass bottles, if any, are surrounded by plastic bottles.

- Using the necessary absorbent cushioning material, pack the sample bottles to ensure that they neither shift nor collide with each other during transport. Ice may not be used as a cushioning material.

- Once the sample bottles have been properly and completely cushioned, fill any void spaces of the shipping containers, between the tops of the sample bottles and the lid of the container, with ice cubes or chips sealed in zip-lock plastic bags or with blue ice packages. Note: Federal Express will not allow the use of ice cubes or chips; only blue ice is allowed. Contact the local carrier being used for its particular regulations with respect to using ice or refrigerated packs. Fill the remainder of the voids with cushioning material.

- Verify and seal the appropriate chain-of-custody forms(s) or Traffic Report(s)/Packing List(s) (used with EPA samples) in a zip-lock bag, and tape the bag securely to the inside of the shipping container lid.

- Close and lock/latch the shipping container. Seal the space between the container body and lid with 2½-inch-wide (minimum) waterproof tape. [If the shipping container used is a camping-type cooler (see further discussion below), tape the drain plug closed to prevent any leakage of water as the ice packs melt during transport.]

- Apply several wraps of chain-of-custody tape around the shipping container, perpendicular to the seal, to ensure that the lid remains closed if the latch is accidentally released or damaged during shipment. Do not obscure any stickers or labels on the shipping container with the chain-of-custody tape.

- Place a completed overnight carrier airbill (see Figure 2 for an example of a properly completed Airborne Express dangerous goods airbill) on the lid of the shipping container. Include the name, address, and telephone number of the receiving analytical laboratory and the return name, address, and telephone number of the shipping location on the airbill.

- Place "This End Up" labels with ISO specification arrow indications on all four sides of the shipping container.

- Place any DOT hazard labels that are required on all four sides of the shipping container. The coolers normally used for environmental samples may not be acceptable for some shipments of specific hazardous materials and the carrier may require some specific packaging or specification drums. The packaging for a material that is hazardous under DOT regulations must be determined to meet the requirements specified in Columns 5 and 8 in the 49 CFR 172.101 Hazardous Materials Table.

- Each shipping container must not weigh more than that allowed by the carrier or the DOT packaging requirements (e.g., currently 150 pounds for Airborne Express). Check the carrier's weight limit prior to commencing sampling.

- In all cases, the packaging must comply with the requirements of 49 CFR 173.27 (see above) for overnight transportation by aircraft.

When field sampling personnel encounter free-phase chemical products in soil, on top of water, or at the bottom of the water column, they must contact the cognizant Project Manager and consult 49 CFR and assure compliance with all parts of the regulation as appropriate. The small quantity known environmental sample, medium to high concentration liquid or solid must be handled with a higher level of care. The sample container or bottle must be left with sufficient headspace to allow for expansion. The sample container must be solid and have good integrity. The sample container must fit inside a standard one-gallon paint can. The following is the procedure to use for known hazardous, medium to high concentration environmental samples:

- Label the sample container and close the sample container tightly leaving a small, though sufficient, headspace for expansion.

- Wrap the sample container in bubble wrap.

- Place the sample container in a polyethylene plastic bag with either a zip-lock or some type of twist-secured closure.
- Place the wrapped sample container (top side up) into a paint can containing 1/3 vermiculite. Fill the remaining void space with vermiculite. No other cushioning material is acceptable.
- Place the lid on the paint can and firmly press the lid into the grooved closure position. If gently tapping with a rubber hammer is necessary to get full closure, then do so. Care must be taken not to dent or ruin the grooved closure.
- Place at least 4 metal spring clips onto the lid and paint can and press into position to lock on the lid.
- Label the paint can with the same information as is on the sample container. Mark the paint can to indicate the hazard. (See Section 5.7 below concerning marking and labeling)
- Pack the paint cans as if they were common samples in a cooler using the same care taken with less toxic environmental samples. See the general packaging procedure set forth above.

If these samples are to be described by a DOT hazard class on the shipping paper and shipped as "hazardous" under DOT regulation, review the DOT rules to ensure that the packaging requirements given in the 49 CFR 172.101 Table, at the selected proper shipping name, are met. Also review the general requirements and those for shipment by air (49 CFR 173.24 through 173.27; see description above.)

The "coolers" used for shipment of most environmental samples are unlikely to be made to DOT specification or marked as required, so a satisfactory substitute (DOT Specification Container) may be required. This must be discussed with the carrier before sampling.

6.6 Marking and Labeling

Each package of environmental samples or hazardous materials must be appropriately marked and labeled. For a material that is subject to the rules of the DOT hazardous materials transportation subchapter, marking and labeling requirement are spelled out in detail in the regulations.

The information that is written or printed on a hazardous materials shipping package is not called labeling; it is called marking. The term labeling refers to affixing DOT prescribed hazard warning stickers on the package.

(a) Markings (49 CFR 172.300 to 172.338)

Markings must be:

- Durable.
- In English.
- On a background of sharply contrasting color.
- Unobscured by label, attachments, or packing tape.
- Away from other markings which could substantially reduce their effectiveness.

Markings on a package include:

- The proper shipping name from the 49 CFR 172.101 Hazardous Materials Table, modified as appropriate and required. The most likely modification is inclusion of the technical name in parentheses when the proper shipping name is a generic one. For example, "Flammable liquid, n.o.s. (chloroneopentane)."
- The UN or NA identification number from the fourth column of the Table 172.101.
- The name, address, and telephone number of the shipper (consignor) and the receiving person (consignee).
- For hazardous liquids the "This End Up" arrows are a required marking. The requirement is for liquid containers to be packaged with their closure upward and arrow markings (referred to as conforming

pictorially to ISO Standard 780-1985) on two opposite vertical sides of the package (with the arrows pointing in the correct upright direction). Package liquids in this same way regardless of whether the liquids are hazardous or not for transportation purposes.

- For materials poisonous by inhalation, the package shall be marked "Inhalation Hazard" in association with the required labels or shipping name when required.
- Marine Pollutants, when sent via water aboard a vessel, may require special marking. (172.322). Materials in this category are listed in Appendix B to the Table at 49 CFR 172.101.
- Hazardous Substance. The letters "RQ" must be marked on a package in association with the proper shipping name, if the package contains a hazardous substance. If a non-bulk package contains a hazardous substance, and the proper shipping name does not identify the hazardous substance by name, the hazardous substance must be identified in parentheses in association with the proper shipping name. If the hazardous substance is a waste, the waste stream number can serve this purpose.

You may not offer or transport a package marked with the proper shipping name or identification number of a hazardous material unless the package contains the identified hazardous material or its residue. See 49 CFR 172.303.

(b) Labeling (40 CFR 172.400 to 172.50)

Labeling is the simplest of the shipping requirements. The required labels are specified in Column 4 of the 49 CFR 172.101 Hazardous Materials Table and are identified after the proper shipping name has been determined. In some cases, there are exceptions identified in Column 8 of the Table; however, there is no requirement to omit the labels in these cases.

The label is placed on the same surface as and near the proper shipping name marking, if possible. Labels must be clearly visible and not obscured by markings.

In cases where the environmental pollutant is gasoline or some other flammable solvent, labeling is very important. Hazard class labels are diamond shaped signs indicating the hazard class of the material being shipped. The proper label for gasoline is 3 FLAMMABLE LIQUID. Note that the "limited quantity" exception for flammable liquids retains the label requirement when shipment is by air.

The subsidiary hazard labels (49 CFR 172.402) specified in the Table are applied in addition to, and within six inches of, the primary hazard label. An example would be benzene, requiring both a FLAMMABLE LIQUID and a POISON label. In some cases these subsidiary labels listed may not actually be required, but their use in those cases is not prohibited. The hazard class (division) number that is displayed in the lower corner of the label must not be used on a label that is a subsidiary hazard label.

The rules relating to Prohibited Labeling are found in 49 CFR 172.401. Unless the labeling is performed in compliance with international guidelines or rules, or Canadian, you may not present or transport a package bearing a DOT label unless the package contains a hazardous material having the hazard that the label refers to. Note that this would require removing a label in some cases when packaging materials are re-used. Labels that could be confused with an official DOT label are also prohibited.

A CARGO AIRCRAFT ONLY label is used on a package to be transported by air when the package contains a quantity that is not permissible for passenger aircraft [49 CFR 172.402(c)]. Column 9 of the Hazardous Materials Table shows the quantities permitted in a package on passenger aircraft and in a package on cargo aircraft. When the package is to go by air and contains more than the quantity allowed for passenger aircraft (Column 9A), the CARGO AIRCRAFT ONLY label is required. This label should not be affixed, and the package should not be offered for shipment by air, if the quantity is greater than that permitted on cargo aircraft (Column 9B). The label must be properly affixed to the shipping container in accordance with 49 CFR 172.406.

6.7 Shipping Papers

Shipping papers are a very important element in the process of shipping hazardous materials. The paper may also be called a Bill of Lading, an Airbill (Dangerous Goods Airbill), or a manifest. "Shipping paper" is the legal term under DOT regulations. Nonhazardous materials must not be offered for transportation with a description on shipping papers that includes a hazard class or an identification number specified in the 49 CFR 172.101 Hazardous Materials Table.

Forms used for a hazardous materials shipping paper generally have a column captioned "HM" to indicate a hazardous material, typically done with an "X" in the column for a hazardous material that is not a hazardous substance and an "RQ" in the column for a hazardous substance. If hazardous and nonhazardous items are described on the same shipping paper, the hazardous items must be listed first or must be marked with contrasting color (often a "highlighter"). If the shipping paper has continuation pages, they must be numbered in the manner "Page 1 of 4 pages." An emergency response telephone number must be listed on the shipping paper (see below), and the name of shipper is customary (required, if shipment by water).

Shipping papers are part of the chain of custody for environmental samples. Environmental samples originating from a hazardous waste site or a suspected hazardous waste site, and determined to be hazardous for shipping purposes as outlined above in Section 6.3, must be shipped as hazardous materials and must have shipping papers that comply with 49 CFR 172.200 to 172.205. The description of the hazardous materials on the shipping paper (49 CFR 172.202) is extremely important when the sampler is sending the hazardous environmental sample to the laboratory. The proper shipping name, hazard class, identification number, packing group, and technical or chemical group name must be in perfect order when the package is offered to the carrier. An overnight express company or other carrier may have its own set of regulations that are more restrictive than those in 49 CFR Parts 171 to 179. The AWT personnel must have those requirements in hand to properly plan a field sampling event. The carrier must be questioned prior to the sampling to ensure that the samples arrive at the laboratory within holding times.

<u>Description on the shipping paper</u>. The description on the shipping paper must follow a long list of rules in a prescribed manner. AWT Shipping Personnel

may prefer to use the regulations at 49 CFR 172.202 and 203, in a checklist fashion. The description must be printed, legible, and in English. Deviations and unauthorized abbreviations are not acceptable. The various required elements of the description are usually separated with commas, so that the result follows the form, e.g., "Gasoline, 3, UN1203, PGII, 1L."

The required elements are:

- The proper shipping name including any required modification.
- The hazard class or division as shown in Column 3 of the 49 CFR 172.101 Table at the entry for the proper shipping name.
- The identification number prescribed in Column 4 of the Table.
- The packing group, in Roman numerals, from Column 5 of the Table (when given), which may be preceded by the letters "PG".
- The total quantity, including the unit of measurement, e.g., "800 lbs"; for gas cylinders, weight is not required, e.g., "2 cylinders."
- Technical and chemical group names may be inserted in parentheses between the proper shipping name and the hazard class, with an appropriate modifier such as "containing" in "Flammable liquids, n.o.s. (contains Xylene)."
- The words "limited quantity" or "Ltd Qty" when a limited quantity exception is being used.
- In the case of a hazardous substance that is not identified in the proper shipping name, in parentheses, the name of the hazardous substance as listed in Appendix A to the 49 CFR 172.101 Table, or the EPA waste stream number if appropriate.
- The letters "RQ" before or after the basic description, for a hazardous substance (usual practice is "RQ" in a column captioned "HM" as mentioned above).
- Special requirements (see 49 CFR 172.203) for radioactive materials shipments.

- Special requirements for shipping empty packagings with hazardous material residue (see 49 CFR 172.203).
- "Dangerous when wet" for a material so identified in 49 CFR 173.124(c);
- The technical name in parentheses when a generic proper shipping name is used for a material not a hazardous waste; for a hazardous waste, the EPA waste number. (This can be viewed as modification of the proper shipping name.)
- The word "poison" if the material meets the definition of DOT Class 6.1, Packing Group I or II, and the name does not identify it as a poison;
- The words "Poison-Inhalation Hazard" and the words "Zone A," "Zone B," "Zone C," or "Zone D," for gases or "Zone A" or "Zone B" for liquids, as appropriate (the word "poison" need not be repeated if already used).
- The word "HOT" preceding the basic description of an "elevated temperature material" as defined in 49 CFR 171.8.

Emergency 24-hour telephone number. All hazardous materials going by air must use a dangerous goods airbill (see Figure 2) that is properly prepared. The dangerous goods airbill has a box to insert an Emergency phone number. The phone number inserted in the box must be manned twenty-four hours a day during shipment of the samples. An appropriate emergency phone number can be found in Appendix A.

M&E subscribes to a twenty-four hour service called INFOTRAC (a chemical emergency response system), 14044 West Petronella Driver, Libertyville, Illinois 60048. During the planning stages or during sampling, the AWT personnel must notify INFOTRAC of what is being shipped and when. If chemicals or known hazardous environmental samples are being shipped, INFOTRAC must receive a MSDS or similar written chemical characterization of the material prior to its being shipped. If an emergency occurs, the carrier can call INFOTRAC 1-800-535-5053 for emergency information.

If hazardous materials are shipped over land, delivered by ground courier, or delivered by AWT Shipping Personnel, then a bill of lading (see Figure 3) or shipping order (see Figure 4) is required. Hazardous materials must have shipping papers, regardless of the mode of transportation.

Shipper's certification. A person who offers hazardous material for transportation must sign a certification stating that the material is offered in compliance with the DOT regulations. Language is prescribed in 49 CFR 172.204.

Emergency response information. As required in 49 CFR 172.602, emergency response information essentially equivalent to a Material Safety Data Sheet (MSDS) is required to accompany a hazardous materials shipment and be available in accordance with certain prescribed rules. As a practical matter, this requirement is met by including an MSDS for the material with the shipping paper.

6.8 Placards

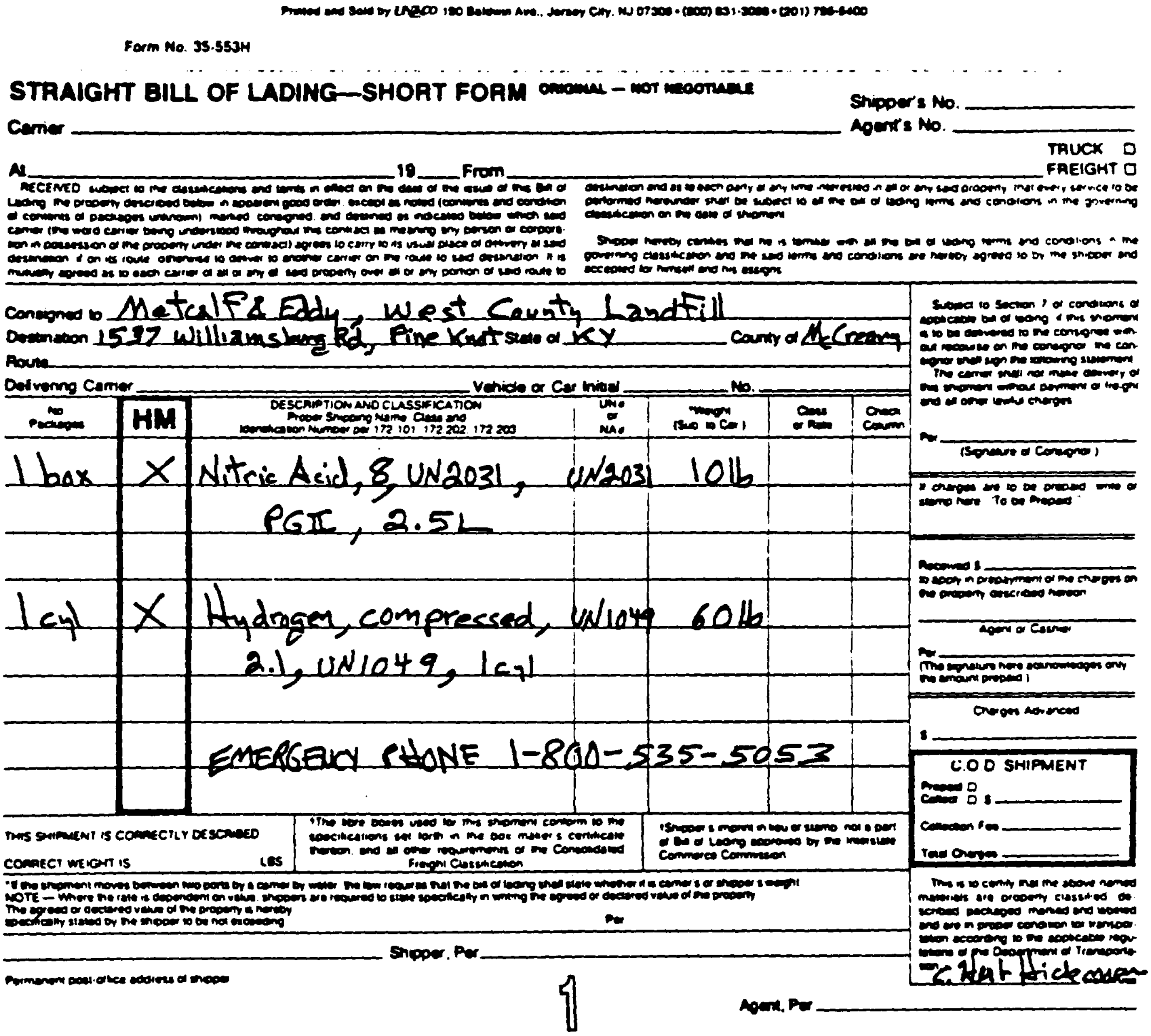
When hazardous materials are shipped by carrier over land or delivered by AWT Shipping Personnel, then the vehicle may have to be placarded. Refer to 49 CFR 172.500 to 172.560 to determine the requirements.

Most shipments of hazardous environmental samples weigh less than 1,001 pounds and thus do not require placarding. See 40 CFR 172.504(c). (Note, however, that this exception does not apply in the case of poison-inhalation hazards. See 49 CFR 172.505(a).) Proper packaging, marking, labeling, and shipping papers are still required.

6.9 Incidents and Emergencies

INFOTRAC will be notified by the carrier if an emergency or spill incident during transit of an M&E shipment. INFOTRAC will also notify the M&E Shipping Personnel who shipped the package.

As soon as field sampling personnel know of any incident or emergency involving the shipment of hazardous materials, they must immediately report the incident or emergency to (a) the next level of management, (b) the AWT



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Form No. 35-553H

STRAIGHT BILL OF LADING—SHORT FORM ORIGINAL — NOT NEGOTIABLE

Shipper's No. ______
Agent's No. ______
Carrier ______
TRUCK ☐
FREIGHT ☐
At ______ 19____ From ______

RECEIVED subject to the classifications and tariffs in effect on the date of the issue of this Bill of Lading, the property described below in apparent good order, except as noted (contents and condition of contents of packages unknown), marked, consigned, and destined as indicated below which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination, if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed as to each carrier of all or any of said property over all or any portion of said route to destination and as to each party at any time interested in all or any said property, that every service to be performed hereunder shall be subject to all the bill of lading terms and conditions in the governing classification on the date of shipment.

Shipper hereby certifies that he is familiar with all the bill of lading terms and conditions in the governing classification and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

Consigned to Metcalf & Eddy, West County Landfill
Destination 1537 Williamsburg Rd, Pine Knot State of KY County of McCreary
Route ______
Delivering Carrier ______ Vehicle or Car Initial ______ No. ______

No Packages	HM	DESCRIPTION AND CLASSIFICATION Proper Shipping Name, Class and Identification Number per 172.101, 172.202, 172.203	UN# or NA#	*Weight (Sub. to Cor.)	Class or Rate	Check Column
1 box	X	Nitric Acid, 8, UN2031, PGII, 2.5L	UN2031	10lb		
1 cyl	X	Hydrogen, compressed, 2.1, UN1049, 1 cyl	UN1049	60lb		
		EMERGENCY PHONE 1-800-535-5053				

Subject to Section 7 of conditions of applicable bill of lading, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement:
The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.

Per ______
(Signature of Consignor.)

If charges are to be prepaid, write or stamp here, "To be Prepaid."

Received $ ______
to apply in prepayment of the charges on the property described hereon.

______
Agent or Cashier

Per ______
(The signature here acknowledges only the amount prepaid.)

Charges Advanced
$ ______

C.O.D. SHIPMENT
Prepaid ☐
Collect ☐ $ ______
Collection Fee ______
Total Charges ______

THIS SHIPMENT IS CORRECTLY DESCRIBED
CORRECT WEIGHT IS ______ LBS

†The fibre boxes used for this shipment conform to the specifications set forth in the box maker's certificate thereon, and all other requirements of the Consolidated Freight Classification.

†Shipper's imprint in lieu of stamp; not a part of Bill of Lading approved by the Interstate Commerce Commission.

*If the shipment moves between two ports by a carrier by water, the law requires that the bill of lading shall state whether it is carrier's or shipper's weight.
NOTE — Where the rate is dependent on value, shippers are required to state specifically in writing the agreed or declared value of the property.
The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding ______ Per ______

This is to certify that the above named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.
C. Kat Hickman

______ Shipper, Per ______
Permanent post-office address of shipper

1

Agent, Per ______

FIGURE 3. BILL OF LADING

NOTE: Shipping Orders (Shipping Memos) are specific to the company or organization that creates them. These may be internal documents within a shipper organization or may be forms used by a trucking company or other carrier organization.

All share a general resemblance to the Bill of Lading and Dangerous Goods Airbill shown in figures above, and incorporate the same required information.

FIGURE 4. SHIPPING ORDER

Corporate Health and Safety Officer, (c) the AWT Corporate Legal Department, (d) the AWT Corporate Insurance Officer, and (e) the AWT Corporate Communications Office. Notifications to the DOT (40 CFR 171.15 and 49 CFR 171.16), the EPA (40 CFR Parts 302 and 355), and other agencies may be necessary. The relevant telephone numbers are set forth in Appendix A.

The reportable quantities (RQ) for certain hazardous substances are set forth in the 49 CFR 172.101 Appendix A Tables.

6.10 Chain of Custody

An integral part of the environmental sampling episode is the documentation of the sample. The sample must be identified by affixing a label, tag, or some type of container etching. The sample must be recorded in a field logbook. The sample must also be recorded on a chain-of-custody form, cross referencing the sample to a specific location and sampling time. The chain-of-custody form is a record of all transfers of the custody of a sample. A sample is considered to be in a person's custody if it is:

- In a person's physical possession.
- In view after being in physical possession.
- Locked so that no one can tamper with it after having been placed in physical custody.
- In a secured area, restricted to authorized personnel.

The chain-of-custody form must be completed in such a manner to ensure concise and accurate sample transfer. An example of a standard chain-of-custody (COC) form is included in Figure 5. As described above, the COC form(s) is placed in a zip-lock plastic bag and taped to the inside of the shipping container lid.

In the case of sample shipment by an overnight airborne carrier or land-based carrier, a properly prepared air bill, bill of lading, or shipping paper will serve as an extension of the chain-of-custody form while the supplies are in transit.

M&E Metcalf & Eddy

CHAIN OF CUSTODY FORM

Job/Project Name: West County
Job/Project Location: West County Landfill Site
Job/Project Number: 004609-0100-001
Samplers: (Signatures) John Doe George Roe
Recorder: (Signature) Jane Irwin
Date: 2/29/93
Lab (Samples Sent To):

Sampling Date	Sampling Time	Sample Number	Sample Location	Matrix: Water	Matrix: Soil	Composite/Grab	Preservative (Y/N)	VOA	BNA	Pesticide/PCB	Metals	Cyanide	Total #	Comments
2/29/93	10:42	AZW-210	MW-283-6		X	C	N	X	X	X				
2/29/93	10:49	AZW-211	MW-286-9		X	C	N	X	X	X				
2/29/93	11:32	AZW-212	MW3W-2	X		G	Y	X	X	X	X	X		
2/29/93	11:48	AZW-213	MW4W-5	X		G	Y	X	X	X	X	X		
2/29/93	13:45	AZW-214	EB-3	X		G	Y	X	X	X	X	X		

NOTHING FOLLOWS

Relinquished By: (Signature) Jane Irwin	Date: 2/29/93	Time: 18:39	Received By: (Signature)	Relinquished By: (Signature)	Date: Time:	Received By: (Signature)
Relinquished By: (Signature)	Date:	Time:	Received By: (Signature)	Relinquished By: (Signature)	Date: Time:	Received By: (Signature)
Relinquished By: (Signature)	Date:	Time:	Received for Lab By: (Signature)	Date: Time:	Comments:	
Method of Shipment:						

Distribution: Original to Lab Copy 1 to Field Files, Copy 2 to Project Manager

Form 274 (Rev 5/89)

U.S. Army Environmental Center (USAEC)
Environmental Services Contract
July 1993

7. RECORD RETENTION

All chain-of-custody forms, airbills, bills of lading, and shipping papers must be retained in the project file and must be available for inspection at any time.

8. INFORMATION RESOURCES WITHIN AWT

For questions regarding proper handling, packaging, and shipping procedures, please contact one of the following persons before shipping any environmental samples:

Herb Hickman	614-890-5501 ext. 220 (Columbus)
Andy Beliveau	617-246-5200 ext. (Wakefiled)
Dan Watton	617-246-5200 ext. 4043 (Wakefield)
Mark Gaddis	617-246-5200 ext. 4195 (Wakefield)
Alan Ford	508-393-2537 ext. 241 (Northboro)
Thomas Brower	508-393-2537 ext. 211 (Northboro)
Richard Renzi	617-246-5200 ext. 4450 (Wakefield)

APPENDIX A

EMERGENCY RESPONSE TELEPHONE NUMBERS

INFOTRAC	800-535-5053
DOT Information (Not emergency response)	202-366-4488
EPA Emergency Hotline (National Response Center)	800-424-8802
Federal Express - Dangerous Goods Hotline	800-238-5355 (will transfer)
Airborne Express Emergency Hotline	800-736-3973 ext 2335 fax ext 2541

AWT Corporate Health and Safety Officer (Richard A. Renzi)
- (617) 246-5200 Ext. 4450
- (617) 245-2689 (Fax)

AWT Corporate Legal Department in Branchburg (Kevin P. Duffy)
- (908) 685-4448
- (908) 685-4212 (Fax)

AWT Corporate Insurance Officer (Douglas Cullum)
- (908) 685-4567
- (908) 685-4055 (Fax)

AWT Corporate Communications Office (Ruthanne Neely)
- (908) 686-4600

APPENDIX M. SHALLOW PIEZOMETER INSTALLATION TECHNICAL MEMORANDUM

DEPARTMENT OF THE AIR FORCE
AIR FORCE BASE CONVERSION AGENCY, DIVISION B, LORING
LORING AIR FORCE BASE, MAINE

OCT 2 7 1997

MEMORANDUM FOR Michael Nalipinski
US Environmental Protection Agency
JFK Federal Building
Mail Code HBT
Boston MA 02203-2211

Naji Akladiss
Maine Department of
Environmental Protection
State House Station 17
Augusta ME 04333-0017

FROM: AFBCA/DB Loring
RR 1 Box 1719
Limestone ME 04750-9743

SUBJECT: Shallow Piezometer Installation Technical Memorandum

1. Attached is the subject document for your review and comment. Upon finalization this memo will be incorporated into the Preliminary Mitigation Plan for Operable Unit 13 impacts.

2. Upon approval we will proceed to plan to get the piezometers installed early in the 1998 field season.

3. We look forward to discussing this plan with you. If you have any questions or require additional information, please feel free to call me at (207) 328-7109.

DAVID S. HOPKINS, JR., P.E.
Wetland Program Administrator

Distribution:
Naji Akladiss (MEDEP) 1 copy
Peter Baker (ABB-ES) 1 copy
Darrell Cullins (USACE) 1 copy
John Lortie (Woodlot Alternatives, Inc.) 1 copy
Steve Mierzykowski (USFWS) 1 copy
Michael Nalipinski (USEPA) 1 copy
Claudia Sait (MEDEP) 1 copy
Susan Svirsky (USEPA) 1 copy
Robert Sypitkowski (MEDEP) 1 copy
Ed Trujillo (BEI) 3 copies

S:\ENV\HOPKINS\SHALLOW.DOC

TECHNICAL MEMORANDUM

SHALLOW PIEZOMETER INSTALLATION
WETLAND MANAGEMENT PROGRAM
LORING AIR FORCE BASE

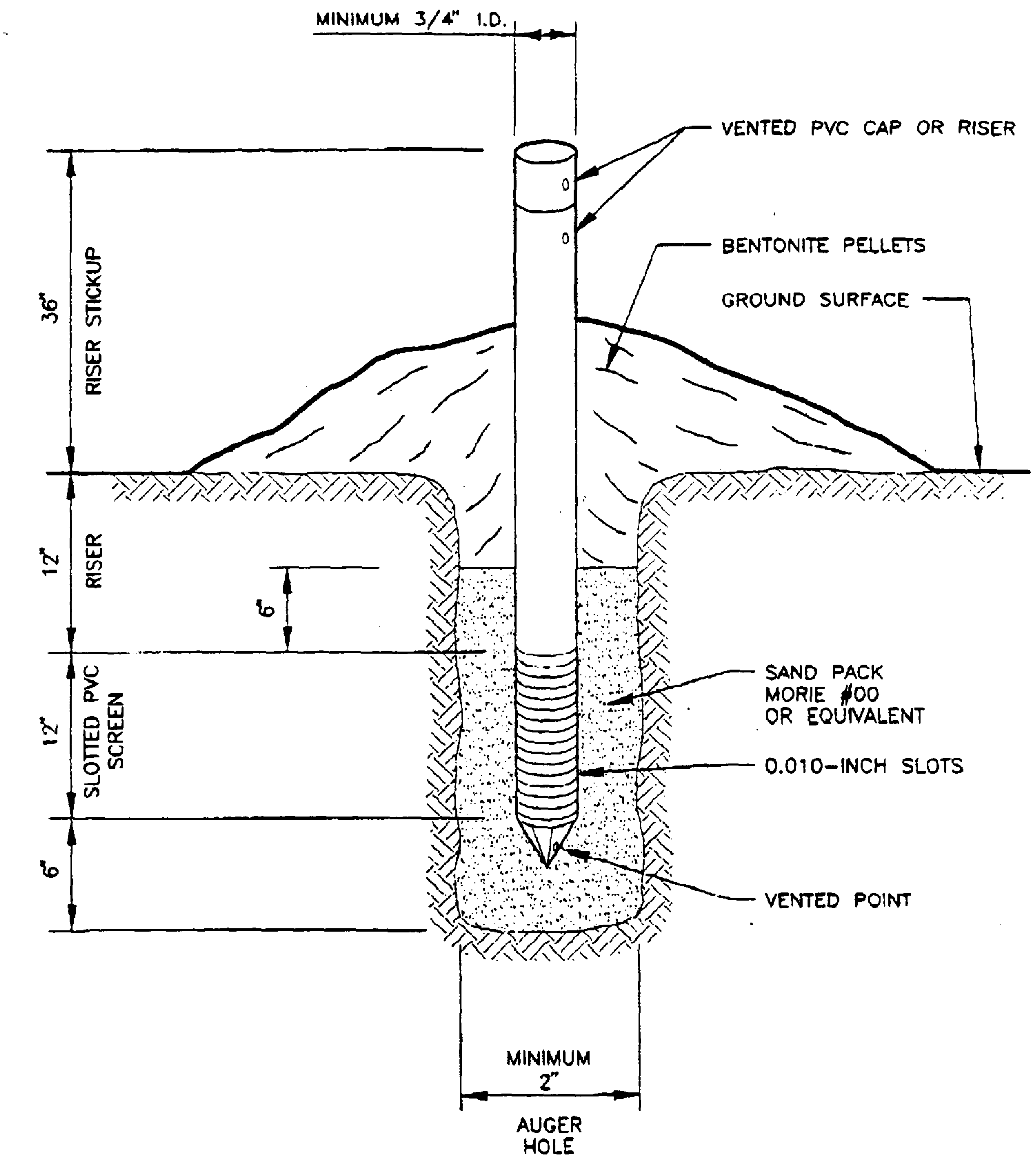
Purpose: The purpose of the piezometers is to obtain water table information in wetland restoration areas. Shallow piezometers will be installed in the remediated floodplain areas associated with the Flightline Drainage Ditch (FLDD) Wetland and the East Branch of Greenlaw Brook, as addressed in Backfill Plans 1 through 4. Water level data in these areas will assist in future evaluations of wetland success.

Materials: The piezometers will be constructed of minimum 3/4-inch inside diameter (ID) slotted PVC. Slot sizes will be .010-inch. Slotted screens will be 1 foot in length. The sand pack around the slotted screens will be Morie #00 or equivalent. The tip of the slotted screen will be vented (free draining) so as not to give false readings with trapped water. Solid PVC risers will be approximately 4 feet in length providing a stickup of 3 feet above ground surface. The riser will have a PVC cap, and the riser or cap will be vented with a 1/8-inch hole. Bentonite pellet seals will be installed above the sandpacks.

Installation Methods: The 2-foot deep piezometers will be installed as follows:

1) auger a 2.5-foot deep hole in the floodplain with a minimum 2-inch auger
2) place 6 inches of the specified well sand at the bottom of the hole
3) insert the assembled piezometer screen and riser into the hole with the vented point into but not through the sand
4) install well sand into the annular space around the slotted screen and riser, to within 6 inches of ground surface and at least 6 inches above the top of the slotted screen
5) complete backfilling the annular space with bentonite pellets
6) mound bentonite pellets around the riser to induce surface water to flow away from the completed installation

See Figure 1 for illustration of a typical completed installation. See Figures 2 and 2A for proposed piezometer installation locations.



NOT TO SCALE

FIGURE 1

SHALLOW PIEZOMETER
INSTALLATION DIAGRAM
WETLAND MANAGEMENT PROGRAM
TECHNICAL MEMORANDUM

LORING AIR FORCE BASE
LIMESTONE, MAINE

APPENDIX N. ENCORE SAMPLER APPARATUS

En Novative Technologies, Inc.

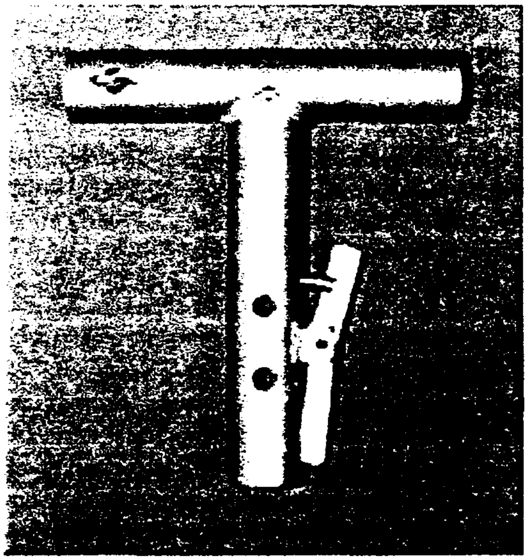
1241 Bellevue Street
Green Bay, WI 54302
PHONE (920) 465-3960 • FAX (920) 465-3963
TOLLFREE (888) 411-0757

Developer of the En Core™ Sampler

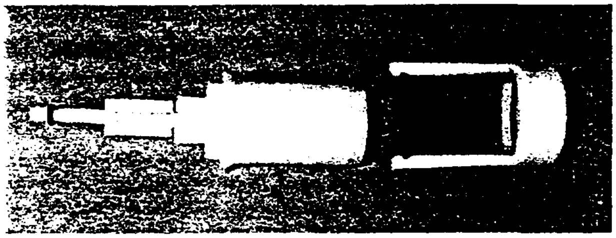
Pictorial Description of The En Core™ Sampler and Accessories.

See Instruction Sheet for Directions for Use.

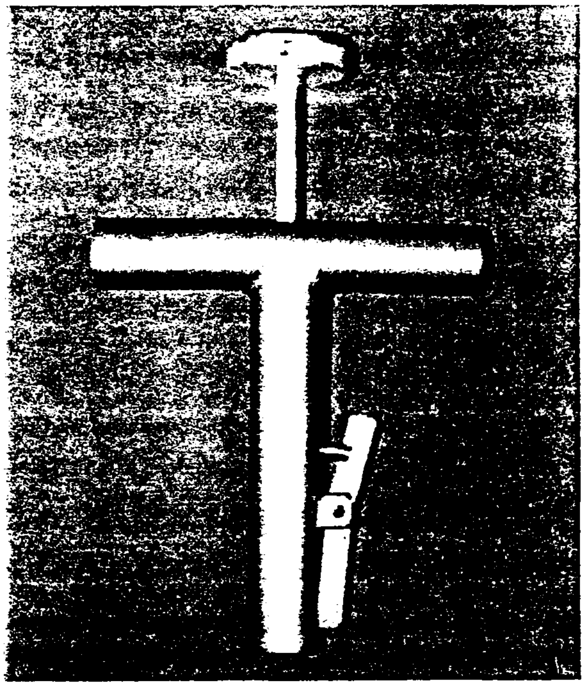
5 Gram Disposable En Core™ Sampler: Delivers approximately 5 grams of soil. Except for smaller size, construction and appearance are identical to 25 gram En Core Sampler. En Core Sampler is used in accordance with SW 846 Method 5035. Consult your regulatory agency for detection limit requirements to help determine which size En Core Sampler to use. Works with Standard T-Handle or En Core Extrusion Tool.



Standard En Core™ T-Handle: Attach either a 5 gram or 25 gram En Core disposable sampler to this Standard T-Handle and push the sampler into the soil for a measured soil sample. T-handle measures ~4.5" long. Longer, custom T-Handles can be made. Call for details.



25 Gram Disposable En Core™ Sampler: Delivers approximately 25 grams of soil. Except for larger size, construction and appearance are identical to 5 gram En Core Sampler. En Core Sampler is used in accordance with SW 846 Method 5035. Consult your regulatory agency for detection limit requirements to help determine which size En Core Sampler to use. Works with Standard T-Handle or En Core Extrusion Tool.



En Core™ Extrusion Tool: When either a 5 gram or 25 gram disposable En Core Sampler arrives at the laboratory, attach it to this Extrusion Tool, engage the plunger, and push the sample into an appropriate vial.

■ Research and Approval of the En Core™ Sampler

Research performed on the original stainless steel **En Core Sampler** by the Wisconsin DNR and EPA Region V demonstrated that the Sampler is effective for storage of soil for up to 48 hours. Recoveries during this time period were statistically the same as with immediate methanol preservation, indicating little volatilization or biodegradation over the same length of time using the **En Core** method.

Later research was performed by Alan Hewitt at the Army Corps of Engineers Cold Regions Research Engineering Laboratory. Results on the current disposable **En Core Sampler** demonstrated that the **En Core** is effective for up to seven days. Recoveries were statistically the same as with immediate methanol preservation. This information is published in American Environmental Laboratory[1]

Based on these results, many state agencies as well as the Environmental Protection Agency have approved use of the **En Core Sampler** as an alternative sampling technique for short term sample storage, followed by field, office or laboratory methanol preservation or other appropriate sample preparation.

For additional technical information, contact Chris Reitmeyer at En Novative Technologies, Inc., 1-888-411-0757.

---

[1] Hewitt, Alan D., American Environmental Laboratory, 11-97-12-97, Volume 9, Number 10 "A tool for the collection and storage of soil samples for volatile organic compound analysis"

En Core is covered by one or more of the following U.S. Patents: 5,343,771; 5,505,098; 5,517,868; 5,522,271; 5,706,904. Other U.S. and foreign patents pending.

Summary and Comparison of Current Soil Collection Practices

Collection and storage of soils for VOC analysis using current US EPA methodology has changed since the promulgation of SW846 Method 5035. The collection options are:

En Core Sampler Preservation. Collect three **En Core** and a dry weight for each sample point. Ship to lab within 40 hours of collection.

Methanol Preservation. Requires coring and weighing 5 gram samples and placing in 40 mL vials preserved with methanol. VOC losses are prevented by both retarding volatilization and preventing biodegradation. However, this method involves the use of a hazardous substance and weighing samples in the field. VOC detection limits are elevated 25 to 50 fold. Unused methanol and samples must be disposed of as hazardous waste with the accompanying transportation restrictions.

Acid Preservation. Requires coring and weighing 5 gram samples and placing in 40 mL vials preserved with an acid solution (formed from sodium bisulfate). While this method overcomes the methanol objections and eliminates subsampling in the lab, different limitations are presented: Acid may be insufficient for preservation in soils with high buffering capacity; Alkaline soils may react vigorously with the acid and the vials may explode; Acid may salt in or salt out the contaminants, depending on organic carbon content; A high level analysis may be needed in addition to the low level analysis.

™ En Novative Technologies, Inc.
1241 Bellevue Street
Green Bay, WI 54302
1-888-411-0757

THE En Core™ SOIL SAMPLER

A new approach to sampling procedures ™

En Novative Technologies, Inc.
Green Bay, Wisconsin

■ The En Core™ Sampler . . . meets the high demands of today's environmental market for effective soil sampling.

The **En Core Sampler**, a disposable volumetric sampling device, was developed to assist field personnel in taking soil samples with ***minimal handling and maximum accuracy***.

The Sampler collects, stores and delivers soil samples...all within one easy-to-use device. It has three components: the coring body, the plunger and the cap. An attachable and reusable T-handle is used to assist in pushing the sampler into the soil. The airtight sealing cap prevents the transfer of volatiles as the Sampler becomes its own self-contained package. No chemicals are involved in the field.

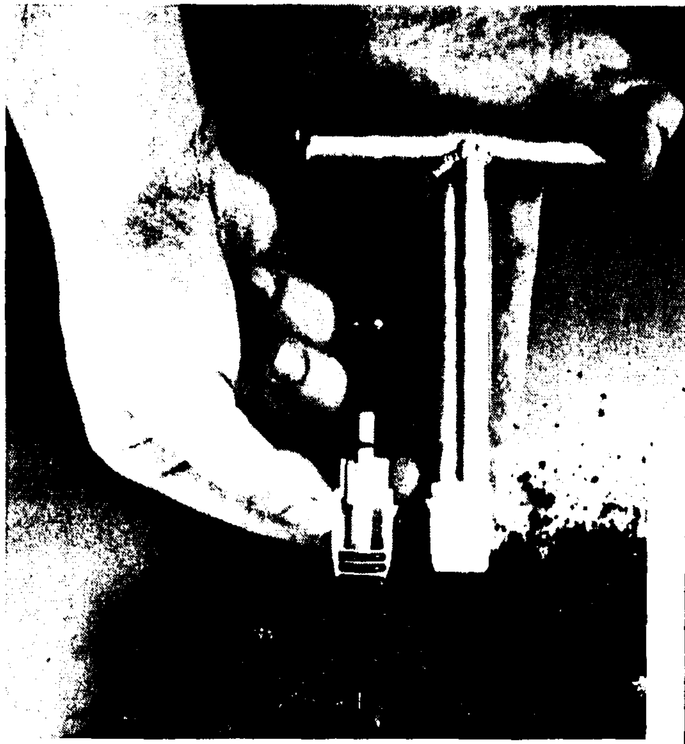
Besides its simplicity of use, **En Core Sampler** avoids many of the problems of current VOC soil collection techniques: *

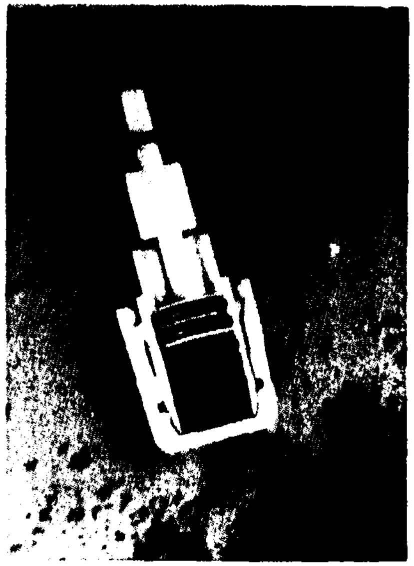
- Use of the Sampler eliminates the need for methanol preservation
- Use of the Sampler also eliminates the need for preservation with sodium bisulfate, an alternate method.
- Most importantly, the Sampler avoids many sources for lab discrepancies, thus assuring more consistent and accurate analyses.

Note: The **En Core Sampler** is designed for one-time-use only.

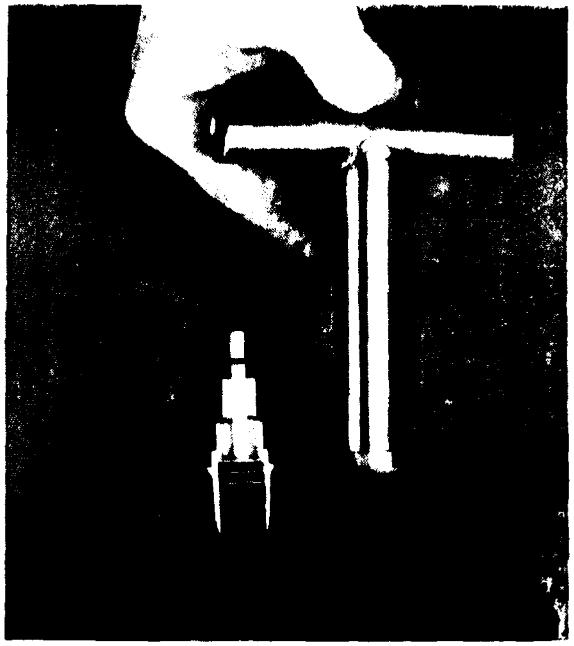
* See back page for a more complete explanation of current collection techniques, problems.

THE MOST EFFECTIVE METHOD OF SOIL SAMPLING





ABOVE: Cut-away showing soil sample within the capped and locked **En Core Sampler**, ready for shipment to a lab.



Two cut-away views showing the Sampler in action. TOP LEFT: Empty sampler attached to T-handle with plunger in down position, ready for use. LOWER RIGHT: **En Core** as it is pushed into soil by the T-handle. Plunger is pressed up during sample collection.

The **En Core Sampler**, made of high-tech inert composite polymer, has been designed to collect, store and deliver soil in a sealed, headspace free state. Seals are provided by three Viton® o-rings. The Sampler is available in 5 and 25 gram versions.

The **En Core Sampler** has been validated in a joint research effort with the Wisconsin Department of Natural Resources under a grant from the US EPA Region V.

Complete sampling instructions are included in each **En Core Sampler** packet.

Viton® is a registered trademark of DuPont Dow Elastomers.

APPENDIX O. FIELD ANALYTICAL METHODS REPORTING LIMITS

APPENDIX O.
FIELD ANALYTICAL METHODS REPORTING LIMITS

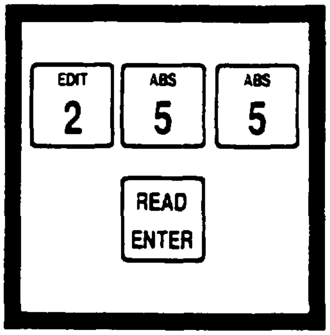
TEST KIT	**REPORTING LIMITS**
ENSYS PCB test kit for soils	2 ppm as Aroclor 1254
HACH Ferrous Iron Test Kit for groundwater (1,10 Phenanthroline)	0-3.00 mg/L
HACH Sulfide Test Kit (Methylene Blue)	0-0.600 mg/L

APPENDIX P. TEST KIT PROCEDURES

IRON, FERROUS (0 to 3.00 mg/L) For water, wastewater and seawater

1,10 Phenanthroline Method* (Powder Pillows or AccuVac Ampuls)

USING POWDER PILLOWS



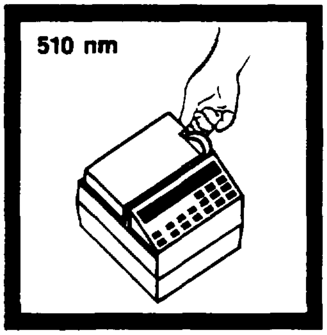
1. Enter the stored program number for ferrous iron, (Fe^{2+})-powder pillows.

Press: **2 5 5 READ/ENTER**

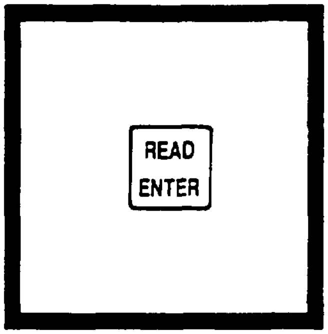
The display will show:
DIAL nm TO 510

Note: Or, use the up and down arrows to scroll the display to:
255 mg/l Fe^{2+}
and press: READ/ENTER

Note: Analyze samples as soon as possible to prevent air oxidation of ferrous iron to ferric, which is not determined.



2. Rotate the wavelength dial until the small display shows:
510 nm

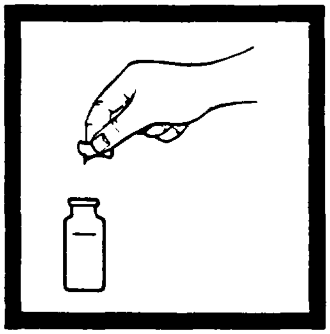


3. Press: **READ/ENTER**

The display will show:
mg/l Fe^{2+}

4. Fill a sample cell with 25 mL of sample.

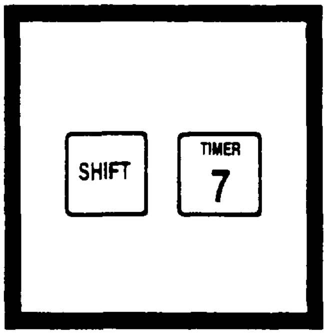
Note: For proof of accuracy, use a 1.0 mg/L ferrous iron standard solution (preparation given in the Accuracy Check) in place of the sample.



5. Add the contents of one Ferrous Iron Reagent Powder Pillow to the sample cell (the prepared sample). Swirl to mix.

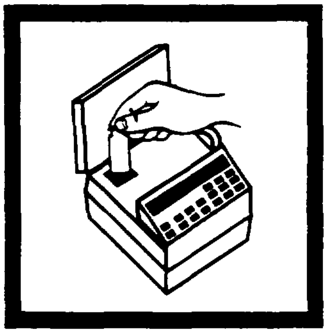
Note: An orange color will form if ferrous iron is present.

Note: Undissolved powder does not affect accuracy.



6. Press: **SHIFT TIMER**

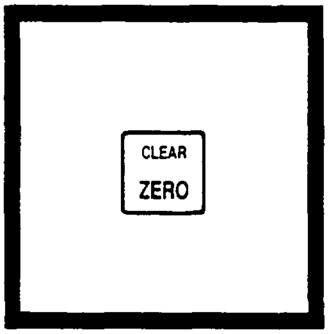
A three-minute reaction period will begin.



7. When the timer beeps, the display will show:
mg/l Fe^{2+}

Fill a second sample cell (the blank) with 25 mL of sample. Place it into the cell holder.

Note: The Pour-Thru Cell can be used with this procedure.

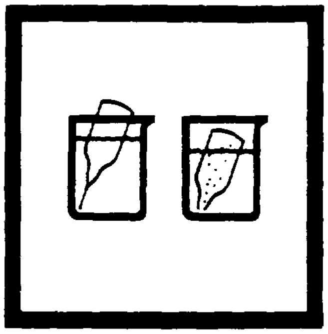


8. Press: **ZERO**

The display will show:
WAIT
then:
0.00 mg/l Fe^{2+}

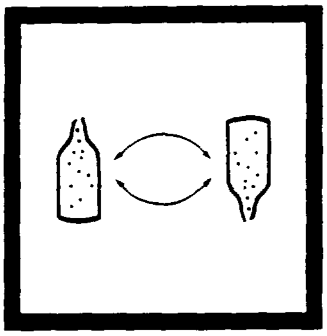
---

*Adapted from *Standard Methods for the Examination of Water and Wastewater*



5. Fill a Ferrous Iron AccuVac Ampul with sample.

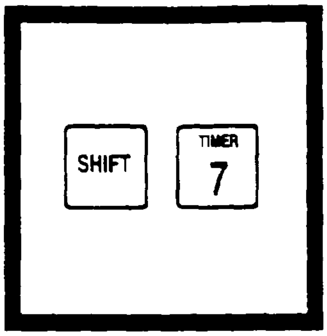
Note: Keep the tip immersed while the ampul fills completely.



6. Quickly invert the ampul several times to mix. Wipe off any liquid or fingerprints.

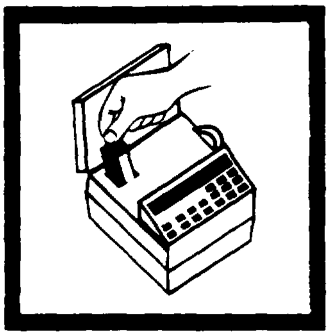
Note: An orange color will form if ferrous iron is present.

Note: Undissolved powder does not affect accuracy.



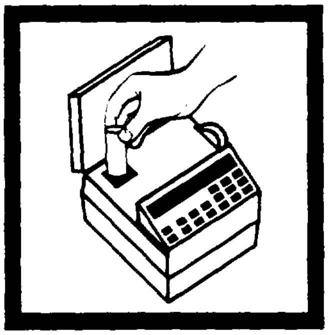
7. Press: **SHIFT TIMER**

A three-minute reaction period will begin.



8. Place the AccuVac Vial Adapter into the cell holder.

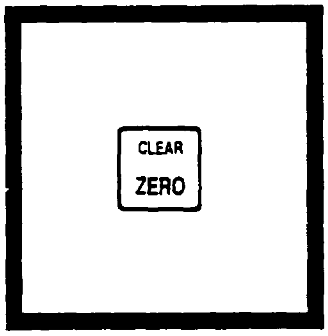
Note: Place the grip tab at the rear of the cell holder.



9. When the timer beeps, the display will show:

mg/l Fe^{2+} AV

Place the blank into the cell holder. Close the light shield.



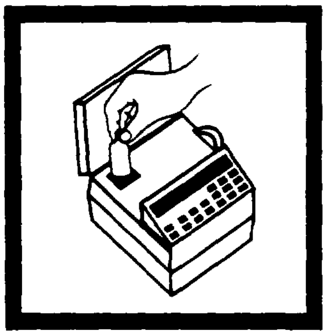
10. Press: **ZERO**

The display will show:

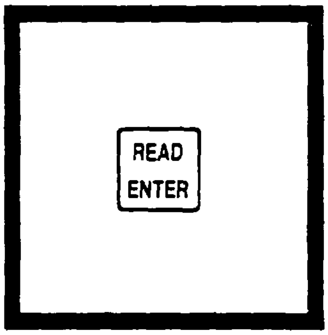
WAIT

then:

0.00 mg/l Fe^{2+} AV



11. Place the AccuVac ampul into the cell holder. Close the light shield.



12. Press: **READ/ENTER**

The display will show:

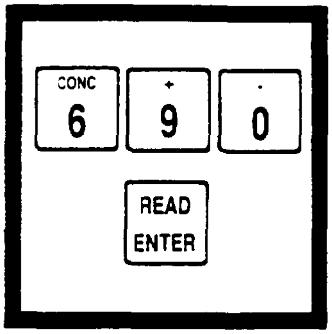
WAIT

then the result in mg/L Fe^{2+} will be displayed.

Note: *In the constant-on mode, pressing READ/ENTER is not required. WAIT will not appear. When the display stabilizes, read the result.*

SULFIDE (0 to 0.600 mg/L S^{2-}) For water, wastewater and seawater

Methylene Blue Method*; EPA Approved



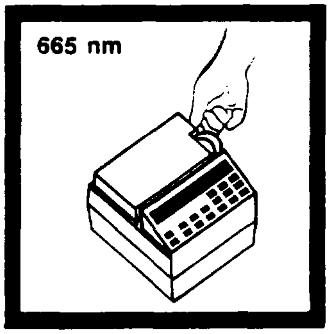
1. Enter the stored program number for sulfide (S^{2-}).

Press: **6 9 0 READ/ENTER**

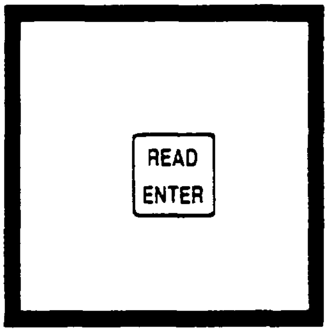
The display will show:
DIAL nm TO 665

Note: Or, use the up and down arrows to scroll the display to:
690 mg/l S^{2-}
and press: READ/ENTER

Note: Samples must be analyzed immediately and cannot be preserved for later analysis. Avoid excessive agitation.



2. Rotate the wavelength dial until the small display shows:
665 nm



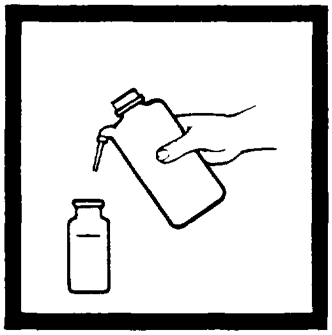
3. Press: **READ/ENTER**

The display will show:
mg/l S^{2-}

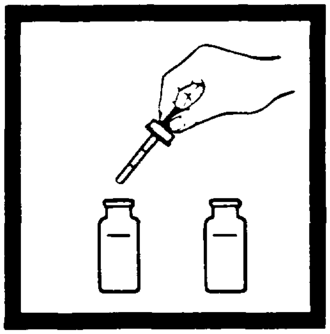
4. Fill a sample cell (the prepared sample) with 25 mL of sample.

Note: For turbid samples, see Interferences below for pretreatment instructions.

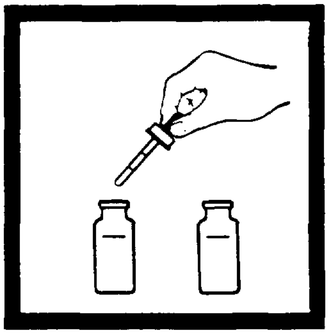
Note: Excessive agitation will cause loss of sulfide. Use a pipet to minimize sulfide loss.



5. Fill another sample cell (the blank) with 25 mL of deionized water.

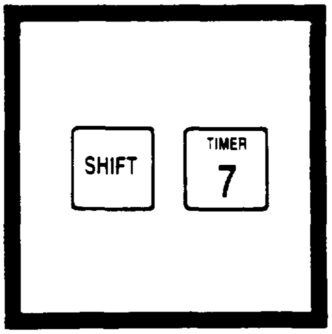


6. Add 1.0 mL of Sulfide 1 Reagent to each cell. Swirl to mix.



7. Add 1.0 mL of Sulfide 2 Reagent to each cell. Immediately swirl to mix.

Note: A pink color will develop. The solution will turn blue if sulfide is present.



8. Press: **SHIFT TIMER**

A five-minute reaction time will begin.

---

*Adapted from *Standard Methods for the Examination of Water and Wastewater*

REQUIRED REAGENTS

	Cat. No.
Sulfide Reagent Set (100 Tests) Includes: (2) 1816-14, (2) 1817-14	22445-00

Description	Quantity Required Per Test	Unit	Cat. No.
Sulfide 1 Reagent	2 mL	118 mL MDB	1816-37
Sulfide 2 Reagent	2 mL	118 mL MDB	1817-37
Water, deionized	25 mL	3.78 L	272-17

REQUIRED APPARATUS

Cylinder, graduated, 25 mL	1	each	508-40
Pipet, volumetric, 25 mL	1	each	515-40
Pipet filler, safety bulb	1	each	14651-00

OPTIONAL REAGENTS

Bromine Water, 30 g/L	29 mL	2211-20
Phenol Solution, 30 g/L	29 mL	2112-20
Sodium sulfide, hydrate	114 g	785-14

OPTIONAL APPARATUS

Dropper, for 1 oz bottle	each	2258-00
Flask, erlenmeyer, 50 mL	each	505-41
Pour-Thru Cell Assembly Kit	each	45215-00
Standard Methods for the Examination of Water and Wastewater	each	2278-00

For additional ordering information, see final section.
In the U.S.A. call 800-227-4224 to place an order.

APPENDIX Q. ENSYS TEST KIT PROCEDURE

Strategic Diagnostics Inc.

Sample Extraction Kit User's Guide

Intended Use

For use in conjunction with the appropriate immunoassay test kit. Each Sample Extraction Kit Contains materials to process twelve (12) soil or wipe samples.

Principle

The reagents contained in the Sample Extraction Kit have been optimized for fast, efficient removal of compounds from soil or surfaces and convenient preparation of the sample for immunoassay testing at levels of interest to the investigator. The system allows for reliable, convenient and cost effective determinations at the field testing or remediation site.

Customer Support

If there are any questions regarding this procedure, please call the SDI Technical Services Department at 1-800-544-8881 or (302)-456-6789, before running samples to avoid costly mistakes.

Extraction Solvents

Extraction Solution - 100% Methanol

per kit: 12 ampules containing 20 mL each for use with:

- EnSys™ PCB Soil and Wipe Test Systems (Item # 7020301, 7020601, 7021301 or 7021201)
- EnSys Petro Soil Test Systems (Item # 7042301 and 7043001)
- EnSys PAH Soil Test Systems (Item # 7061301 and 7060501)
- EnSys Penta Soil Test Systems (Item # 7000301)
- PCB RaPID Assay® (Item # A00133 and A00134)
- PAH RaPID Assay (Item # A00156 and A00157)
- Carcinogenic PAHs RaPID Assay (Item # A00200 and A00201)
- TNT RaPID Assay (Item # A00186)

Extraction Solution - 100% Methanol

per kit: 12 ampules containing 10 mL each for use with:

- EnviroGard® PCB in Soil and Wipe Test Kits (Item # 7020800, 7021600, 7021500 and 7021600)
- EnviroGard PAH in Soil Test Kit (Item # 7060600)
- EnviroGard Petroleum Hydrocarbons (BTEX) in Soil Test Kits (Item # 7004000)
- EnviroGard Petroleum Hydrocarbons (TPH) in Soil Test Kits (Item # 7042000)
- EnviroGard DDT in Soil Test Kits (Item # 7310000)

Extraction Solution - 90% Methanol

per kit: 12 ampules containing 20 mL each for use with:

- EnviroGard Chlordane in Soil test Kit (Item # T311000)
- EnviroGard Toxaphene in Soil test Kit (Item # T420000)
- EnviroGard Lindane in Soil Test Kit (Item # T630000)

Extraction Solution - 75% Methanol

per kit: 12 ampules containing 10 mL each for use with:

- BTEX RaPID Assay (Item # A00161 and A00162)

Extraction Solution - 75% Methanol with Sodium Hydroxide

per kit: 12 ampules containing 20 mL each for use with:

- Pentachlorophenol RaPID Assay (Item # A00110 and A00111)

Extraction Solution - 100% Methanol with Surfactant

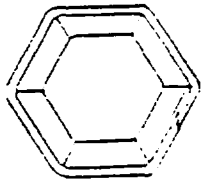
per kit: 12 ampules containing 10 mL each for use with:

- Cyclodienes RaPID Assay (Item # A00216)

Description of Contents

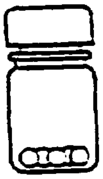
Filtration barrel

Filtration plunger

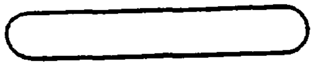


Weigh Boat

Bulb pipette

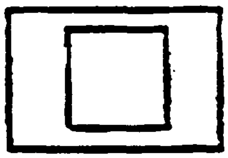


Extraction jar



Wooden spatula

Ampule Cracker



Template

Filter Modules

per kit: 12 filter plungers and barrels

Wooden Spatulas

per kit: 12 each

Weigh Canoes

per kit: 12 each

Disposable Transfer Pipettes

per kit : 12 each

Extraction Jars

per kit: 12 each with 3 bearings per jar

Ampule Crackers

per kit: 3 each

Wipe Template

per kit: 12 each 10 cm by 10 cm plastic templates (PCB Wipe Kit only)

Gauze Wipes

per kit: 12 each (PCB Wipe Kit only)

Protective Gloves

per kit: 24 each (PCB Wipe Kit Only)

Sample Dilution

RaPID Assay Test Systems

- BTEX Extract Diluent: 12 vials containing 4.5 mL each (Item #00664).
- PCB Extract Diluent: 12 vials containing 25 mL each. One (1) 25 µL disposable pipet with 12 tips (Item #00533).
- Pentachlorophenol Extract Diluent: 12 vials containing 25 mL each. One (1) 50 µL disposable pipet with 12 tips (Item #00479).
- PAH Extract Diluent: 12 vials containing 12.25 mL each (Item #00623).
- Carcinogenic PAHs Extract Diluent: 12 vials containing 9.3 mL each (Item #00738)
- TNT Extract Diluent: 12 vials containing 25 mL each. One (1) 50 µL disposable pipet with 12 tips (Item #00745).
- Cyclodienes Extract Diluent: 12 vials containing 12.25 mL each (Item #01024)

EnSys Soil Test Systems

- Dilution ampules provided dependent upon detection levels of interest.

EnviroGard Soil Test Systems

- No additional dilution materials required.

Reagent Storage and Stability

Store all reagents and components in a dry well ventilated area at 2-30°C.

Reagents may be used until the expiration date shown on the vials.

Consult local, state and federal regulations for proper disposal of all reagents.

Materials Not Provided

In addition to the materials provided, the following items will be necessary for the procedure:

- stopwatch or clock with second hand
- permanent marking pen
- protective gloves
- digital balance (available from SDI, Item # A00131)

Sample Information

This kit was validated for use with soil samples. Other types of sample matrices and solid wastes may require different procedures to efficiently extract compounc of interest. Contact SDI's Technical Services Department for application guidance.

Procedural Notes and Precautions

Do not use any reagent beyond its stated shelf life.

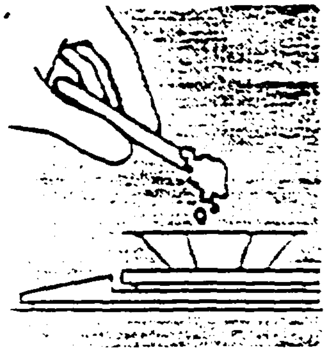
Continuous agitation of the soil sample in the presence of the extraction solution for the prescribed time is important for good extraction efficiency. Use of a timer or stopwatch to assure adequate shaking time is recommended.

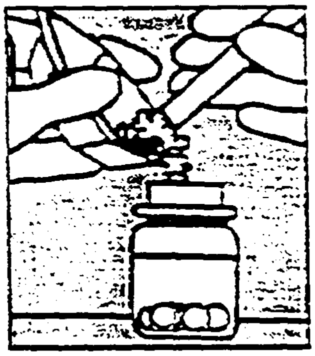
Avoid contact of extraction solution (methanol) with skin and mucous membrane If this reagent comes in contact with skin wash with water.

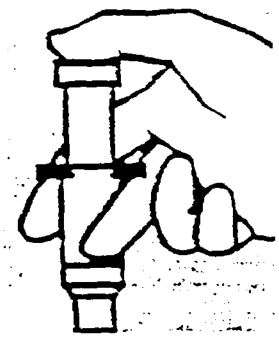
Limitations

The Sample Extraction Kit, when used in conjunction with the appropriate test k will provide screening results. Results may need to be confirmed by a non-immunological method.

Soil Extraction Procedure







WEIGH SAMPLE

1. Place unused weigh boat on pan balance.
2. Press ON/MEMORY button on pan balance. Balance will beep and display 0.0.
3. Weigh out 10 ± 0.1 grams of sample using the wooden spatula.
4. If balance turns off prior to completing weighing, use empty weigh boat to re-tare then continue.
5. Repeat steps 1-4 for each sample to be tested.

EXTRACTION

1. Uncap extraction jar and place on flat surface. Using a wooden spatula, transfer 10 grams of sample from the weigh boat into the extraction jar.
2. Open solvent ampule and pour the entire contents into the extraction jar
3. Recap the extraction jar and shake vigorously for one (1) minute.
4. Allow to settle for one (1) minute or until a clear solvent layer is observed above the sample.
5. Repeat steps 1-4 for each sample to be tested.

FILTRATION

1. Insert bulb pipet into top (liquid) layer in extraction jar and draw up sample. Transfer at least ½ bulb capacity into the filtration barrel. *Do not use more than one full bulb.*
2. Press plunger firmly into barrel until adequate filtered sample is available or unit snaps together. Place on flat surface.
3. Repeat steps 1-3 for each sample to be tested.

DILUTION

EnviroGard - Use the filtered extract as "SAMPLE" in the User's Guide Procedure.

EnSys - If the instructions start with Phase 1 *Extraction and Preparation of the Sample* in the User's Guide, skip to Phase 2 *Sample and Standard Preparation* and follow the remainder of the assay procedure and data interpretation. If the instructions start at Phase 1 *Sample & Standard Preparation*, continue with the instructions, as written.

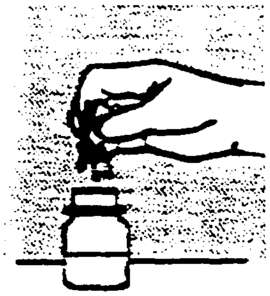
Note: Kit may contain additional ampules in order to achieve your test levels. Always transfer filtered sample to the dilution ampule labeled with the lowest PPM level and then transfer from this ampule to the next higher level dilution ampule.

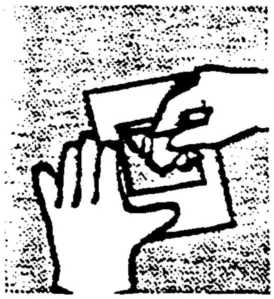
RaPID Assay - Dilute the filtered extract into the appropriate Extract Diluent as described below or follow customized dilution procedure provided by the SDI Technical Services Department.

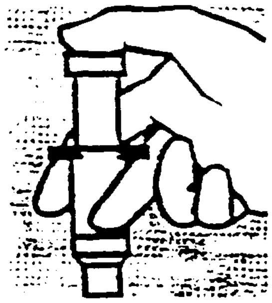
RaPID Assay Dilution

Contaminant	Extract Volume (µL)	Extract Diluent (mL)	Test Range (ppm)
PCB	25	25	0.5 to 10.0 (Aroclor 1254)
PAH	250	12.25	0.2 to 5.0 (Phenanthrene)
cPAH	200	9.8	0.01 to 0.5 (Benzo(a)pyrene
BTEX/TPH	500	4.5	0.9 to 30 (Total BTEX)
Pentachlorophenol	50	25	0.1 to 10.0 (PCP)
TNT	50	25	0.25 to 5.0 (TNT)
Cyclodienes	250	12.5	0.1 to 2.0 (Dieldrin)

Wipe Extraction Procedure







WIPE SAMPLE

1. Wearing the protective gloves provided, uncap the extraction jar.
2. Using an ampule cracker, open solvent ampule and pour the entire contents into the extraction jar.
3. Soak gauze pad in extraction jar containing solvent.
4. Remove gauze wipe from solvent and squeeze excess from pad back into extraction jar.
5. Hold clean template on surface to be wiped.
6. Wipe entire exposed area for 15-20 seconds. Wipe should be damp when finished.
7. Place wipe back into same extraction jar and cap tightly.
8. Remove and discard protective gloves.
9. Repeat steps 1-8 for each sample to be tested.

EXTRACTION

1. Shake each jar vigorously for one (1) minute.
2. Repeat step 1 for each sample to be tested.

FILTRATION

1. Disassemble filtration plunger from filtration barrel.
2. Insert bulb pipet into top (liquid) layer in extraction jar and draw up sample. Transfer at least ½ bulb capacity into the filtration barrel. *Do not use more than one full bulb.*
3. Press plunger firmly into barrel until adequate filtered sample is availal or unit snaps together. Place on flat surface.
4. Repeat steps 1-3 for each sample to be tested.

DILUTION

EnviroGard - Use the filtered extract as "SAMPLE" in the User's Guide Procedure.

EnSys - If the instructions start with Phase 1 *Extraction and Preparation of the Sample* in the User's Guide, skip to Phase 2 *Sample and Standard Preparation* and follow the remainder of the assay procedure and data interpretation. If the instructions start at Phase 1 *Sample & Standard Preparation*, continue with the instructions, as written.

Note: Kit may contain additional ampules in order to achieve your test levels. Always transfer filtered sample to the dilution ampule labeled with the lowest PPM level and then transfer from this ampule to the next higher level dilution ampule.

RaPID Assay - Dilute the filtered extract into the appropriate Extract Diluent as described below or follow customized dilution procedure provided by the SDI Technical Services Department.

RaPID Assay Dilution

Contaminant	Extract Volume (µL)	Extract Diluent (mL)	Test Range (µg/100cm²)
PCB	25	25	5 to 100 (Aroclor 1254)

Assistance

For ordering or technical assistance contact:
Strategic Diagnostics Inc.
111 Pencader Drive
Newark, Delaware 19702-3322

(800)544-8881
(302)456-6789
Fax(302)456-6782
www.sdix.com
techservice@sdix.com

ENSYS INC.
ENVIRONMENTAL PRODUCTS

PCB RISc® SOIL TEST SYSTEM

RAPID IMMUNOASSAY SCREEN

User's Guide

IMPORTANT NOTICE

This method correctly identifies 95% of samples that are PCB-free and those containing 1 ppm or greater of PCBs. A sample that develops less color than the standard is interpreted as positive. It contains PCBs. A sample that develops more color than the standard is interpreted as negative. It contains less than 1 ppm PCBs.

This test system should be used only under the supervision of a technically qualified individual who is capable of understanding any potential health and environmental risks of this product as identified in the product literature. The components must only be used for the analysis of soil samples for the presence of polychlorinated biphenyls. After use, the kits must be disposed of in accordance with applicable federal and local regulations.

TROUBLESHOOTER GUIDE

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

WASH STEP

Lack of vigorous washing may result in false positives or negatives depending on whether the **wash** error was committed on standard or sample tubes. Solution: Make sure to wash four times vigorously, **washing** the whole set of 12 tubes at once.

PIPET CALIBRATION

An out-of-calibration pipet may result in false positives or negatives depending on whether the amount is greater or less than the specified transfer volume. *Solution:* Check the calibration at least daily and after any extreme mechanical shock (such as dropping). An indication that the pipet is out of calibration is if the gold barrell is loose and will turn. (When set on 30 µl there should be about a 1/4 of an inch between the white plunger and the end of the clear pipet tip.)

AIR BUBBLES IN THE PIPET

The presence of air bubbles in the pipet tip when transferring extracts may result in false positives or negatives depending on whether the error was committed on standard or sample tubes. *Solution:* Quickly examine the pipet tip each time an aliquot is withdrawn and go back to the source and take another aliquot to displace the bubble if necessary.

MIXING

Lack of thorough mixing, when instructed, can cause inconsistent results. *Solution:* Observe the times in the instructions and mix with sufficient force to ensure that the liquid is homogenous.

TIMING

It is important to follow the timing steps in the instructions carefully. The incubation step in the antibody tubes can vary a bit without harm to the tests. The color development step timing is critical and should be no less than 2 minutes and no greater than 3 minutes.

WIPING THE TUBES

Wiping of the tubes should be done before they are read in the spectrophotometer because smudges and fingerprints on the tubes can give potentially false negative readings.

MIXING LOT #'S

Never mix lots! Each kit's components are matched for optimal performance and may give inaccurate results with the components from other kits with different lot #'s. Also, NEVER mix components from different types of kits (ex: Petro kit buffer can not be used with a PAH kit).

STORAGE AND OPERATING TEMPERATURES

Temperature requirements are very important and should be strictly adhered to. This test kit should be stored at less than 80°F/27°C and operated between 40°F/4°C and 90°F/32°C.

SHELF-LIFE

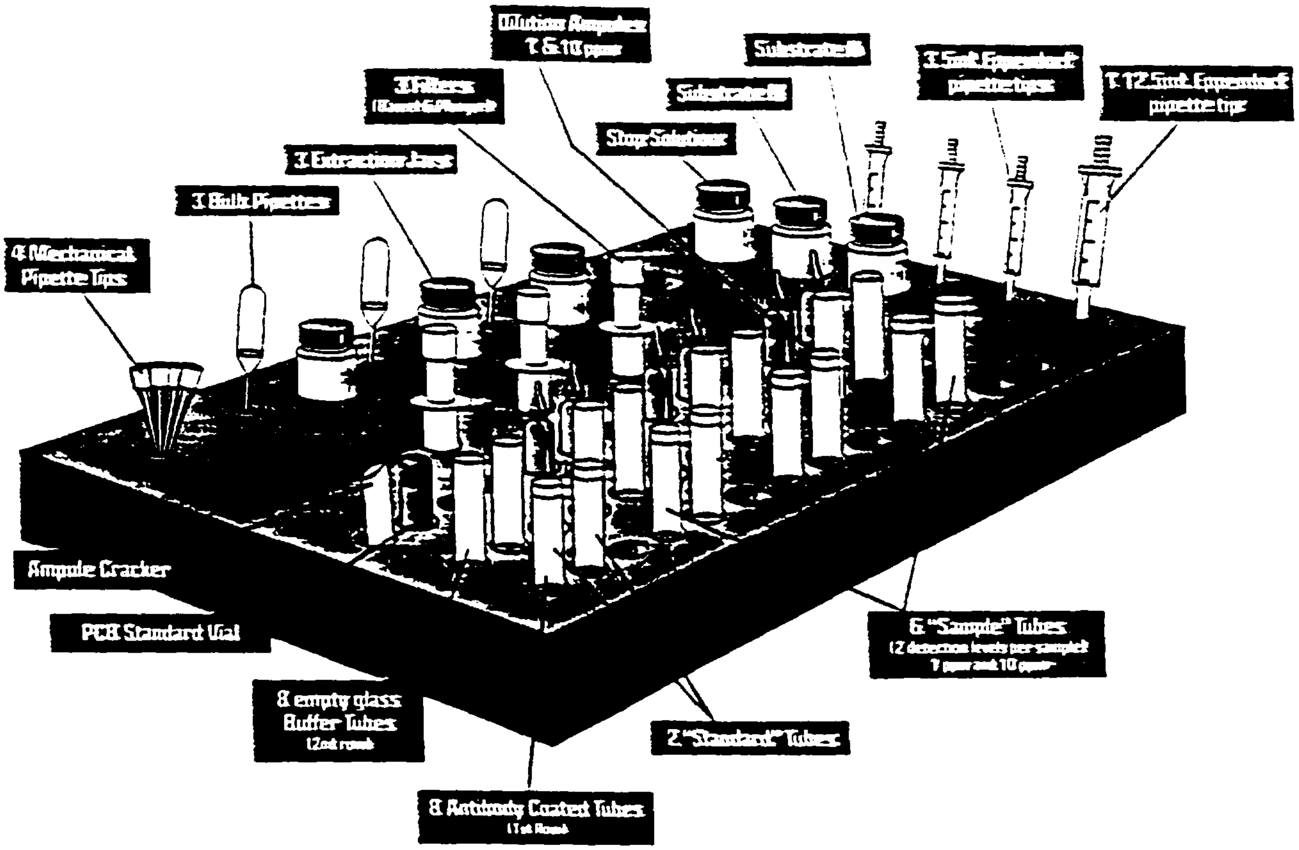
Each kit label contains the kit expiration date. To achieve accurate results, kits must be used prior to expiration.

WORKSTATION SET-UP

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

WORKSTATION SET-UP

- Mechanical pipet tips
- Filter barrels & plungers
- Ampule cracker
- Glass PCB buffer tubes
- Substrate A
- Eppendorf pipet tips
- Bulb pipets
- PCB standard
- Antibody coated tubes
- Substrate B
- Extraction jars
- 1 & 10 ppm dilution ampules
- Stop Solution



Workstation shows components for 3 samples tested at 2 levels

TEST PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING

- Do not attempt to run more than 12 tubes, two of which must be standards.
- Items that you will need that are not provided in the test kit include: a permanent marking pen, laboratory tissue (or paper towels), a liquid waste container, and disposable gloves.
- This User's Guide was written for analyzing soil samples for PCBs at 1 and 10 ppm. See table on page 10 for sensitivity to various aroclors.

TEST PREPARATION

- Label all Eppendorf repeater tips. Tips can be reused for future analyses. Label the first 5mL tip "A", the second 5mL tip "B" and the third 5mL tip "Stop".
- Label the 12.5 mL tip "Buffer".


Eppendorf Tip

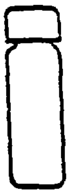
STANDARD PREPARATION

- Open PCB Standard ampule by slipping ampule cracker over top, and then breaking tip at scored neck. Transfer solution to empty vial with Bulb Pipets.
- Label vial with current date. Standard is usable for 2 weeks. Always cap tightly when finished using standard.
- A new PCB Standard should be opened for every 4 samples.


PCB Standard


Ampule cracker


Bulb pipet


Amber vial

PHASE 1

EXTRACTION & PREPARATION OF THE SAMPLE

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

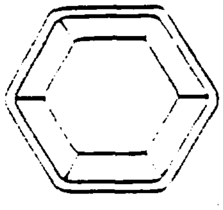
WEIGH SAMPLE

1a. Place unused weigh boat on pan balance.

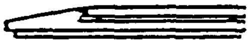
1b. Press ON / MEMORY button on pan balance. Balance will beep and display 0.0.

1c. Weigh out 10 ± 0.1 grams of soil.

1d. If balance turns off prior to completing weighing, use empty weigh boat to retare, then continue.



Weigh Boat



Pan balance

Wooden spatula

EXTRACT PCBS

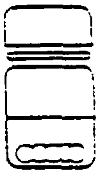
2a. Uncap extraction jar and place on a flat surface. Without contacting solvent puncture foil seal with ampule cracker or sharp object. Peel the remainder of the seal off extraction jar.

2b. Using wooden spatula, transfer 10 grams of soil from weigh boat into extraction jar.

2c. Recap extraction jar tightly and shake **vigorously** for one minute.

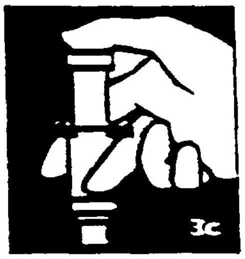
2d. Allow to settle for one minute.

Repeat steps **1a - 2c** for each sample to be tested.



Extraction jar

FILTER SAMPLE



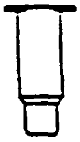
3a. Disassemble filtration plunger from filtration barrel.

3b. Insert bulb pipet into top (liquid) layer in extraction jar and draw up sample. Transfer **at least ½ bulb capacity** into filtration barrel. **Do not use more than one full bulb.**

3c. Press plunger firmly into barrel until adequate filtered sample is available (place on table and press if necessary).

Repeat steps **3a - 3c** for each sample to be tested.

Filtration plunger



Filtration barrel

Bulb pipet

READ TO AVOID COSTLY MISTAKES

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

SAMPLE DILUTION PROGRAM

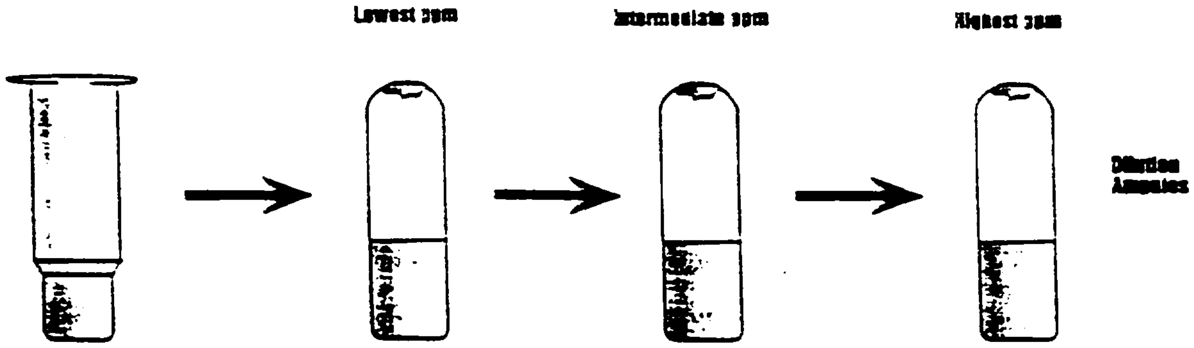
1. The sample dilution procedure on the next page is for standard detection levels. The following diagram represents the sample dilution procedure for all other detection levels.

2. Your kit may include extra dilution ampules to reach high detection levels.

3. EVERY AMPULE PROVIDED MUST BE USED!

If there are any questions concerning the dilution procedure please call Technical Services before running the samples to help avoid costly mistakes.
1-800-242-7472 or 919-941-5509.

EXAMPLE:



NOTE: Your Kit may include additional ampules in order to achieve your test levels. Always transfer filtered sample to the dilution ampule labeled with the lowest PPM level and then transfer from this ampule to the next higher level dilution tube.

PHASE 2

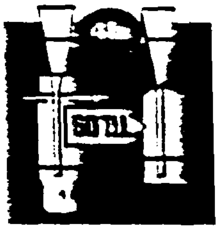
SAMPLE & STANDARD PREPARATION

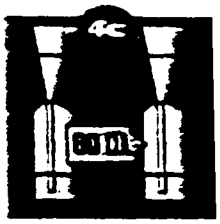
READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

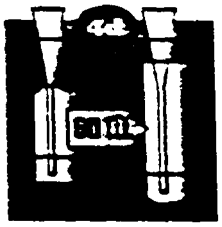
READ BEFORE PROCEEDING

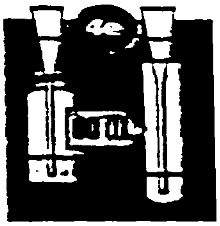
- Label the plastic antibody coated tubes with a permanent marking pen.
- When using the mechanical pipet always withdraw and dispense below the liquid level.
- "Shake tubes" means to thoroughly mix the contents with special care not to spill or splash.

DILUTE SAMPLES AND STANDARDS









4a. Set the Eppendorf Repeater on 4, assemble the "Buffer" tip and fill with Buffer.

4b. Dispense 1 mL of Buffer into each glass buffer tube.

4c. Open 1 and 10 ppm dilution ampules by slipping ampule cracker over top, and then breaking top at scored neck.

4d. Withdraw 60 µL of filtered sample using mechanical pipet and dispense below the liquid level in "1 ppm" dilution ampule. Gently shake ampule from side to side for 5 seconds to mix thoroughly.

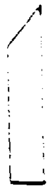
4e. Withdraw 60 µL from the "1 ppm" dilution ampule using mechanical pipet and dispense below the liquid level in "10 ppm" dilution ampule. Gently shake ampule from side to side for 5 seconds to mix thoroughly.

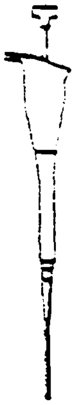
4f. Transfer 60 µL from each dilution ampule into glass buffer tubes. Always wipe tip after dispensing into buffer tube.

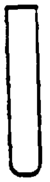
4g. Change pipet tip and repeat **4d** - **4f** for each sample.

4h. Assemble new pipet tip on mechanical pipet and transfer 60 µL from Standard vial into two glass buffer tubes. Immediately replace cap on PCB Standard vial.

4i. Shake all glass buffer tubes for 5 seconds.





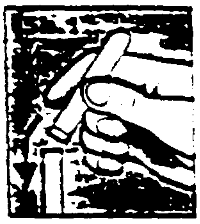


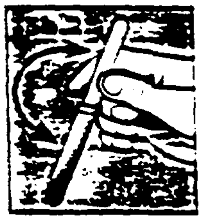
PHASE 3

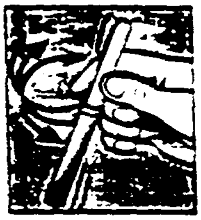
THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

TRANSFER FROM DILUTION TUBE TO ANTIBODY COATED TUBE







5a. Set timer for 10 minutes.

5b. Working left to right in the workstation:

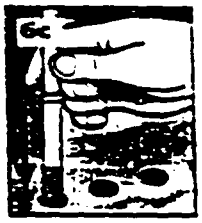
1. Fit all antibody coated tubes firmly on top of all corresponding glass buffer tubes.
2. Start timer and immediately invert all connected tube pairs so that the liquid is poured into the antibody coated tubes. Return the tube pairs to the appropriate workstation row making sure the larger (antibody coated) tube is on the bottom.

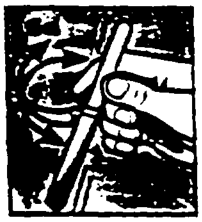
5c. Invert all tube pairs several more times making sure the pair is returned to the workstation with the larger (antibody coated) tube on the bottom.

5d. Disconnect and discard the smaller (dilution) tubes. It is not important to worry about drops of liquid adhering to lips of tubes.

5e. Place conjugate tubes behind antibody tubes in workstation. Remove grey caps and discard.

TRANSFER OF CONJUGATE TO ANTIBODY COATED TUBES





AFTER 10 MINUTES, IMMEDIATELY:

6a. Set timer for 5 minutes.

6b. Working left to right in the workstation:

Start timer and immediately:

Dissolve the conjugate pellets by horizontally connecting the antibody coated tubes and conjugate tubes and **tilt the liquid up to pour it onto the conjugate.**

6c. Return the connected tubes to the appropriate workstation row making sure **the larger (antibody coated) tube is on the bottom. It is important that this step is completed within one minute for all tubes.**

6d. In order to adequately mix solution, **invert** all connected tube pairs **several more times** making sure that the pair is returned to the workstation with the larger (antibody coated) tube on the bottom.

6e. Disconnect and discard the conjugate tubes. It is not important to worry about the loss of liquid adhering to lip of tubes.

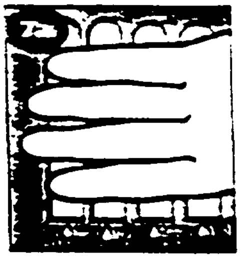
PHASE 4
INTERPRETATION

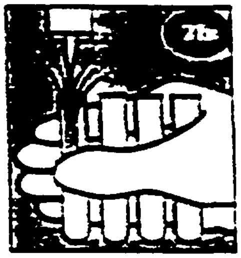
READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING
WASH PROCEDURE

- An accurate test requires a virgorous wash accomplished by directing a strong stream into the antibody coated tubes.
- The wash solution is a harmless, dilute solution of detergent.

WASH



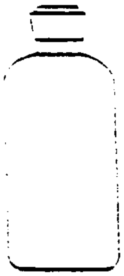


7a. After the 5 minute incubation (a total of 15 minutes), empty antibody coated tubes into liquid waste container.

7b. Wash antibody coated tubes by vigorously filling and emptying a total of 4 times.

7c. Tap antibody coated tubes upside down on paper towels to remove excess liquid. Residual foam in the tubes will not interfere with test results.

Note: When running up to 12 antibody coated tubes, tubes can be washed in two groups - one group immediately following the other group.



Wash bottle

PHASE 3

THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

COLOR DEVELOPMENT

8a. Set the Eppendorf Repeater on 2, assemble the "A" tip and fill with Substrate A (TMB, yellow label).

8b. Dispense once (200 µL) into each antibody coated tube.

8c. Set timer for exactly 2 1/2 minutes.

8d. Assemble "B" tip, fill with Substrate B, start timer, and dispense once (200 µL H_2O_2, green label) into each antibody coated tube.

8e. Shake all tubes for 5 seconds. Solution will turn blue in some or all antibody coated tubes.

8f. Assemble "Stop" tip, fill with Stop Solution (red label), and stop reaction at end of 2 1/2 minutes by dispensing once (200 µL) into each antibody coated tube.

AROCLOR SENSITIVITY

Aroclor	Lowest Detection Level
1248	1.0 ppm
1254	0.5 ppm
1260	0.5 ppm
1242	2.0 ppm
1232	4.0 ppm
1016	4.0 ppm

PHASE 4

ANALYSIS OF RESULTS

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

SELECT STANDARD

9a. Wipe outside of all antibody coated tubes.

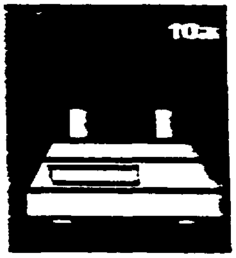
9b. Place both Standard tubes in photometer.

9c. Switch tubes until the photometer reading is negative or zero. Record reading.

If reading is greater than - 0.3 in magnitude, results are outside QC limits. Retest the sample(s).

9d. Remove and discard tube in right well. The tube in the left well is the conservative standard.

MEASURE SAMPLE



10a. Place 1 ppm tube in right well of photometer and record reading.

If photometer reading is negative or zero, PCBs are present.

If photometer reading is positive, concentration of PCBs is less than 1 ppm.

10b. Place 10 ppm tube in right well of photometer and record reading.

If photometer reading is negative or zero, PCBs are present.

If photometer reading is positive, concentration of PCBs is less than 10 ppm.

QUALITY CONTROL

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

System Description

Each PCB RISc Soil 12 Test Case contains enough material to perform 12 test samples, each at two detection levels.

The PCB RISc Soil Test is divided into four phases. The instructions and notes should be reviewed before proceeding with each phase.

Hotline Assistance

If you need assistance or are missing necessary Test System materials, call toll free: 1-800-242-RISC (7472).

Validation and Warranty Information

Product claims are based on validation studies carried out under controlled conditions. Data has been collected in accordance with valid statistical methods and the product has undergone quality control tests of each manufactured lot.

PCB-free soil and soil containing 1 ppm or greater of PCBs were tested with the EnSys PCB RISc analytical method. The method correctly identified 95% of these samples. A sample that has developed less color than the standard is interpreted as positive. It contains PCBs. A sample that has developed more color than the standard is interpreted as negative. It contains less than 1 ppm PCBs.

The company does not guarantee that the results with the PCB RISc Soil 24 Test Case will always agree with instrument-based analytical laboratory methods. All analytical methods, both field and laboratory, need to be subject to the appropriate quality control procedures.

EnSys, Inc. warrants that this product conforms to the descriptions contained herein. No other warranties, whether expressed or implied, including warranties of merchantability and of fitness for a particular purpose shall apply to this product.

EnSys, Inc. neither assumes nor authorizes any representative or other person to assume for it any obligation or liability other than such as is expressly set forth herein.

Under no circumstances shall EnSys, Inc. be liable for incidental or consequential damages resulting from the use or handling of this product.

How It Works

Standards, **Samples**, and color-change reagents are added to test tubes, coated with a chemical specific to PCBs. The concentration of PCBs in an unknown **Sample** is determined by comparing its color intensity with that of a **Standard**.

Note: PCB concentration is inversely **proportional** to color intensity: the lighter the color development of the sample, the higher the concentration of PCBs.

Quality Control

Standard precautions for maintaining quality control:

- Do not use reagents or test tubes from one Test System with reagents or test tubes from another Test System.
- Do not use the Test System after any portion has passed its expiration date.
- Do not attempt the test using more than 12 antibody coated tubes (two of which are **Standards**) at the same time.
- Do not exceed incubation periods prescribed by the specific steps.
- Always follow the procedure in this user's guide.
- Use EPA Method 8080 or Code of Federal Regulations Title 40, Part 136, Appendix A, Method 680 to confirm results.

Storage and Handling Precautions

- Wear protective gloves and eyewear.
- Store kit at room temperature and out of direct sunlight (less than 80°F).
- Keep aluminized pouch (containing unused antibody coated tubes) sealed when not in use.
- If Stop Solution or liquid from the extraction jar comes into contact with eyes, wash thoroughly with cold water and seek immediate medical attention.
- Standard Solution contains PCBs. Test samples may contain PCBs. Handle with care.

REPEATER PIPET & MECHANICAL PIPET

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

HOW TO OPERATE THE REPEATER PIPET

To Set Or Adjust Volume

To determine the pipetting volume, the dial setting (1-5) is multiplied by the minimum pipetting volume of the tip.

To Assemble Pipet Tip

Slide filling lever down until it stops. Then raise the locking clamp and insert the tip until it clicks into position. Be sure the tip plunger is fully inserted into the barrel before lowering the locking clamp to affix the tip in place.

To Fill Tip

With tip mounted in position on pipet, immerse end of tip into solution. Slide filling lever upward slowly.

To Dispense Sample

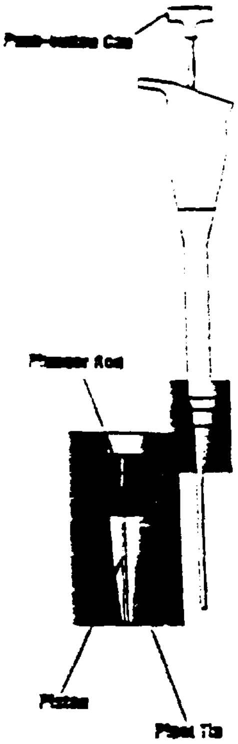
Check the volume selection dial to ensure pipetting volume. Place tip inside test tube so that tip touches the inner wall of tube. Completely depress the pipetting lever.

To Eject Tip

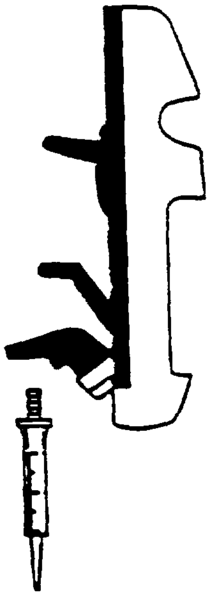
Empty tip of any remaining solution into appropriate container. Raise locking clamp upward, and remove the tip.

For additional information regarding operation and use of repeater, please refer to your Repeater pipet manual.

Mechanical Pipet



Repeater Pipet



HOW TO OPERATE THE MECHANICAL PIPET

To Set Or Adjust Volume

Remove push-button cap and use it to loosen volume lock screw. Turn lower part of push-button to adjust volume up or down. Meter should read "060". Tighten volume lock screw and replace push-button cap.

To Assemble Pipet Tip

Slide larger mounting end of pipet tip onto end of pipet. Holding tip in place, press push-button until plunger rod enters pipet tip. Ensure no gap exists between piston and plunger rod.

To Withdraw Sample

With tip mounted in position on pipet, press push-button to first stop and hold it.

Place tip at bottom of liquid sample and slowly release push-button to withdraw measured sample. Ensure that no bubbles exist in liquid portion of sample. If bubbles exist, dispense sample and re-withdraw sample.

To Dispense Sample

Place tip into dispensing vessel (immersing end of the tip if vessel contains liquid) and slowly press push-button to first stop. (Do not push to second stop or tip will eject).

Remove tip from vessel and release push-button.

To Eject Tip

Press push-button to second stop. Tip is ejected.

For additional information regarding operation and use of pipet, please refer to your pipet manual.

ON-SITE QUALITY CONTROL/QUALITY ASSURANCE RECOMMENDATIONS
EnSys RISc® TEST SYSTEM

Please read the following before proceeding with field testing.

SAMPLING

The result of your screening test is only as valid as the sample that was analyzed. Samples should be homogenized thoroughly to ensure that the 10 grams you remove for field testing is representative of the sample as a whole. All other applicable sample handling procedures should be followed as well.

PRIOR TO TESTING SAMPLES

Carefully follow the instructions in the User's Guide included with every test kit. This is the key element in obtaining accurate results. In addition, store your unused test kits at room temperature and do not use them past their expiration date (see label on each test kit).

INTERNAL TEST QC

Two standards are analyzed with each sample to provide internal test system quality control. With both standards inserted in the photometer, a valid test is indicated when the magnitude of the displayed number (irrespective of the sign, + or -) is less than the value given in the User's Guide. Test runs resulting in a greater number should be repeated to ensure valid conclusions.

QA/QC

The validity of field test results can be substantially enhanced by employing a modest, but effective QA/QC plan. EnSys recommends that you structure your QA/QC plan with the elements detailed below. These have been developed based on the data quality principles established by the U.S. Environmental Protection Agency.

A. **Sample Documentation**
   1. Location, depth
   2. Time and date of collection and field analysis

B. **Field analysis documentation** - provide raw data, calibration, any calculations, and final results of field analysis for all samples screened (including QC samples)

C. **Method calibration** - this is an integral part of EnSys RISc® immunoassay tests; a duplicate calibration is performed for each set of samples tested (see the instructions in the User's Guide)

D. **Method blank** - analyze methanol from the extraction jar.

E. **Site-specific matrix background field analysis** - collect and field analyze uncontaminated sample from site matrix to document matrix effect

F. **Duplicate sample field analysis** - field analyze duplicate sample to document method repeatability; at least one of every 20 samples should be analyzed in duplicate

G. **Confirmation of field analysis** - provide confirmation of the quantitation of the analyte via an EPA-approved method different from the field method on at least 10% of the samples; choose at least two representative samples testing above the action level; provide chain of custody and documentation such as gas chromatograms, mass spectra, etc.

H. **Performance evaluation sample field analysis (optional, but strongly recommended)** - field analyze performance evaluation sample daily to document method/operator performance

I. **Matrix spike field analysis** (optional) - field analyze matrix spike to document matrix effect on analyte measurement

FURTHER QUESTIONS?

EnSys technical support personnel are always prepared to discuss your quality needs to help you meet your data quality objectives.

Data for PCB RISC® Soil Test

Operator: .... Date: .... Location: ....

Sample ID	ΔOD Standards	OD sample _____ ppm	Interpretation	OD sample _____ ppm	Interpretation	Comments

APPENDIX R. TARGET ANALYTE LIST AND QUANTITATION LIMITS FOR RAS ANALYSES

APPENDIX R. TARGET ANALYTE LIST AND QUANTITATION LIMITS FOR RAS ANALYSES

Parameter[1]	Analyte	Quantitation Limit (ug/L)
Volatile Organic Analysis (OLC02.1)		
	Chloromethane	1
	Bromomethane	1
	Vinyl chloride	1
	Chloroethane	1
	Methylene chloride	2
	Acetone	5
	Carbon disulfide	1
	1,1-Dichloroethene	1
	1,1-Dichloroethane	1
	cis-1,2-Dichloroethene	1
	trans-1,2-Dichloroethene	1
	Chloroform	1
	1,2-Dichloroethane	1
	2-Butanone	5
	Bromochloromethane	1
	1,1,1-Trichloroethane	1
	Carbon tetrachloride	1
	Bromodichloromethane	1
	1,2-Dichloropropane	1
	cis-1,3-Dichloropropene	1
	Trichloroethene	1
	Dibromochloromethane	1
	1,1,2-Trichloroethane	1
	Benzene	1
	trans-1,3-Dichloropropene	1
	Bromoform	1
	4-Methyl-2-pentanone	5
	2-Hexanone	5
	Tetrachloroethene	1
	1,1,2,2-Tetrachlorethane	1
	1,2-Dibromoethane	1
	Toluene	1
	Chlorobenzene	1
	Ethylbenzene	1
	Styrene	1
	Xylene (total)	1
	1,3-Dichlorobenzene	1
	1,4-Dichlorobenzene	1

APPENDIX R. TARGET ANALYTE LIST AND QUANTITATION LIMITS FOR RAS ANALYSES

Parameter[1]	Analyte	Quantitation Limit (ug/L)
Volatile Organic Analysis (OLC02.1) (Cont'd)		
	1,2-Dichlorobenzene	1
	1,2-Dibromo-3-chloropropene	1
	1,2,4-Trichlorobenzene	1
Pesticide / PCB Analysis (OLM03.2)		
	alpha-BHC	0.050
	beta-BHC	0.050
	delta-BHC	0.050
	gamma-BHC (Lindane)	0.050
	Heptachlor	0.050
	Aldrin	0.050
	Heptachlor epoxide	0.050
	Endosulfan I	0.050
	Dieldrin	0.10
	4,4'-DDE	0.10
	Endrin	0.10
	Endosulfan II	0.10
	4,4'-DDD	0.10
	Endosulfan sulfate	0.10
	4,4'-DDT	0.10
	Methoxychlor	0.50
	Endrin ketone	0.10
	Endrin aldehyde	0.10
	alpha-Chlordane	0.050
	gamma-Chlordane	0.050
	Toxaphene	5.0
	Aroclor-1016	1.0
	Aroclor-1221	2.0
	Aroclor-1232	1.0
	Aroclor-1242	1.0
	Aroclor-1248	1.0
	Aroclor-1254	1.0
	Aroclor-1260	1.0

(1) - RAS Method numbers indicate the most recent revision. Previous versions may be used by the laboratory.

OLC02.1 - (U.S. EPA, 1996a)

OLM03.2 - (U.S. EPA, 1994b)

APPENDIX S. EPA REGION I DRAFT CALIBRATION OF FIELD INSTRUMENTS

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION I

LOW STRESS (low flow) PURGING AND SAMPLING PROCEDURE FOR THE COLLECTION OF GROUND WATER SAMPLES FROM MONITORING WELLS

OPTIONAL FORM 99 (7-90)
FAX TRANSMITTAL
# of pages ▶ 13
To John Verban
From Dick Willey
Dept./Agency M+E
Phone # 573-9639
Fax # 245-6293
Fax #
NSN 7540-01-317-7368 5099-101 GENERAL SERVICES ADMINISTRATION

July 30, 1996
Revision 2

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
J.F.K. FEDERAL BUILDING
BOSTON, MASSACHUSETTS 02203

MEMORANDUM

DATE: September 23, 1996

SUBJ: New Procedure for Collecting Ground Water Samples for the Determination of Organic and Inorganic Analytes

FROM: Linda M. Murphy, Director
Office of Site Remediation and Restoration

Edward J. Conley, Director
Office of Environmental Measurement and Evaluation

TO: OSRR, OEME
David Fierra, Director
Office of Ecosystem Protection

The purpose of this memorandum is to issue the new EPA-New England guidelines for the collection of ground-water samples from monitoring wells. The attached standard operating procedure (SOP) is one of several products being developed jointly by OSRR and OEME as part of the Superfund Reforms and Innovative Technology Initiative.
This SOP has been peer reviewed by individuals from the Superfund and RCRA Ground Water Forum, Superfund and RCRA Headquarters staff, R.S. Kerr Environmental Research Center, and private contractors.

The impetus for low stress (low flow) sampling was initially related to the need to collect unfiltered metals samples for determination of potential risks to human health. Conventional sampling methods often overestimate metals concentrations due to artificially elevated turbidity levels. However, filtering the water sample may cause the total contaminant loads, and therefore potential risks, to be underestimated. More recent technical literature and regional sampling experience indicate that the benefits of utilizing the low stress technique extends to sampling all inorganic and organic analyses. The major benefit is that the water quality data will be more reproducible and representative of actual ground-water conditions. Reasons for this include:

o purging and sampling operations are more controlled,

o pumping stresses are minimized,

o objective criteria are used to determine when sampling should begin,

- o operational variability between sampling events can be minimized.

This standard operating procedure should be integrated into ground-water sampling programs at Superfund, Federal Facility, and RCRA sites. It is also strongly recommended for all EPA New England programs that collect or use water quality data from monitoring wells.

Richard Willey, OSRR (617-573-9639) and Charles Porfert, OEME (617-860-4313) took the lead in developing these procedures. Please contact them should you need assistance in implementation of the procedures or information on the selection of field equipment.

SOP #: GW 0001
Region I Low Stress
(Low Flow) SOP
Revision Number: 2
Date: July 30, 1996
Page 1 of 13

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION I

LOW STRESS (low flow) PURGING AND SAMPLING PROCEDURE FOR THE COLLECTION OF GROUND WATER SAMPLES FROM MONITORING WELLS

I. SCOPE & APPLICATION

This standard operating procedure (SOP) provides a general framework for collecting ground water samples that are indicative of mobile organic and inorganic loads at ambient flow conditions (both the dissolved fraction and the fraction associated with mobile particulates). The SOP emphasizes the need to minimize stress by low water-level drawdowns, and low pumping rates (usually less than 1 liter/min) in order to collect samples with minimal alterations to water chemistry. This SOP is aimed primarily at sampling monitoring wells that can accept a submersible pump and have a screen, or open interval length of 10 feet or less (this is the most common situation). However, this procedure is flexible and can be used in a variety of well construction and ground-water yield situations. Samples thus obtained are suitable for analyses of ground water contaminants (volatile and semi-volatile organic analytes, pesticides, PCBs, metals and other inorganics), or other naturally occurring analytes.

This procedure does not address the collection of samples from wells containing light or dense non-aqueous phase liquids (LNAPLs and DNAPLs). For this the reader may wish to check: Cohen, R.M. and J.W. Mercer, 1993, DNAPL Site Evaluation; C.K. Smoley (CRC Press), Boca Raton, Florida and U.S. Environmental Protection Agency, 1992, RCRA Ground-Water Monitoring: Draft Technical Guidance; Washington, DC (EPA/530-R-93-001).

The screen, or open interval of the monitoring well should be optimally located (both laterally and vertically) to intercept existing contaminant plume(s) or along flowpaths of potential contaminant releases. It is presumed that the analytes of interest move (or potentially move) primarily through the more permeable zones within the screen, or open interval.

Proper well construction and development cannot be overemphasized, since the use of installation techniques that are appropriate to the hydrogeologic setting often prevents "problem well" situations from occurring. It is also recommended that as part of development or redevelopment the well should be tested to determine the appropriate pumping rate to obtain stabilization of field indicator parameters with minimal drawdown in shortest amount of time. With this information field crews can then conduct purging and sampling in a more expeditious manner.

The mid-point of the saturated screen length (which should not exceed 10 feet) is used by convention as the location of the pump intake. However, significant chemical or permeability contrast(s) within the screen may require additional field work to determine the optimum vertical location(s) for the intake, and appropriate pumping rate(s) for purging and sampling more localized target zone(s). Primary flow zones (high(er) permealability and/or high(er) chemical concentrations) should be identified in wells with screen lengths longer than 10 feet, or in wells with open boreholes in bedrock. Targeting these zones for water sampling will help insure that the low stress procedure will not underestimate contaminant concentrations. The Sampling and Analysis Plan must provide clear instructions on how the pump intake depth(s) will be selected, and reason(s) for the depth(s) selected.

Stabilization of indicator field parameters is used to indicate that conditions are suitable for sampling to begin. Achievement of turbidity levels of less than 5 NTU and stable drawdowns of less than 0.3 feet, while desirable, are not mandatory. Sample collection may still take place provided the remaining criteria in this procedure are met. If after 4 hours of purging indicator field parameters have not stabilized, one of 3 optional courses of action may be taken: a) continue purging until stabilization is achieved, b) discontinue purging, do not collect any samples, and record in log book that stabilization could not be achieved (documentation must describe attempts to achieve stabilization) c) discontinue purging, collect samples and provide full explanation of attempts to achieve stabilization (note: there is a risk that the analytical data obtained, especially metals and strongly hydrophobic organic analytes, may not meet the sampling objectives).

Changes to this SOP should be proposed and discussed when the site Sampling and Analysis Plan is submitted for approval. Subsequent requests for modifications of an approved plan must include adequate technical justification for proposed changes. All changes and modifications must be approved before implementation in field.

II. EQUIPMENT

A. Extraction device

Adjustable rate, submersible pumps are preferred (for example, centrifugal or bladder pump constructed of stainless steel or Teflon).

Adjustable rate, peristaltic pumps (suction) may be used with caution. Note that EPA guidance states: "Suction pumps are not recommended because they may cause degassing, pH modification, and loss of volatile compounds" (EPA/540/P-87/001, 1987, page 8.5-11).

The use of inertial pumps is discouraged. These devices frequently cause greater disturbance during purging and sampling and are less easily controlled than the pumps listed above. This can lead to sampling results that are adversely affected by purging and sampling operations, and a higher degree of data variability.

B. Tubing

Teflon or Teflon lined polyethylene tubing are preferred when sampling is to include VOCs, SVOCs, pesticides, PCBs and inorganics.

PVC, polypropylene or polyethylene tubing may be used when collecting samples for inorganics analyses. However, these materials should be used with caution when sampling for organics. If these materials are used, the equipment blank (which includes the tubing) data must show that these materials do not add contaminants to the sample.

Stainless steel tubing may be used when sampling for VOCs, SVOCs, pesticides, and PCBs. However, it should be used with caution when sampling for metals.

The use of 1/4 inch or 3/8 inch (inner diameter) tubing is preferred. This will help ensure the tubing remains liquid filled when operating at very low pumping rates.

Pharmaceutical grade (Pharmed) tubing should be used for the section around the rotor head of a peristaltic pump, to minimize gaseous diffusion.

C. Water level measuring device(s), capable of measuring to 0.01 foot accuracy (electronic "tape", pressure transducer). Recording pressure transducers, mounted above the pump, are especially helpful in tracking water levels during pumping operations, but their use must include check measurements with a water level "tape" at the start and end of each record.

D. Flow measurement supplies (e.g., graduated cylinder and stop watch).

E. Interface probe, if needed.

F. Power source (generator, nitrogen tank, etc.). If a gasoline generator is used, it must be located downwind and at least 30 feet from the well so that the exhaust fumes do not contaminate the samples.

G. Indicator field parameter monitoring instruments - pH, Eh, dissolved oxygen (DO), turbidity, specific conductance, and temperature. Use of a flow-through-cell is required when measuring all listed parameters, except turbidity. Standards to perform field calibration of instruments. Analytical methods are listed in 40 CFR 136, 40 CFR 141, and SW-846. For Eh measurements, follow manufacturer's instructions.

H. Decontamination supplies (for example, non-phosphate detergent, distilled/deionized water, isopropyl alcohol, etc.).

I. Logbook(s), and other forms (for example, well purging forms).

J. Sample Bottles.

K. Sample preservation supplies (as required by the analytical methods).

L. Sample tags or labels.

M. Well construction data, location map, field data from last sampling event.

N. Well keys.

O. Site specific Sample and Analysis Plan/Quality Assurance Project Plan.

P. PID or FID instrument (if appropriate) to detect VOCs for health and safety purposes, and provide qualitative field evaluations.

III.PRELIMINARY SITE ACTIVITIES

Check well for security damage or evidence of tampering, record pertinent observations.

Lay out sheet of clean polyethylene for monitoring and sampling equipment.

Remove well cap and immediately measure VOCs at the rim of the well with a PID or FID instrument and record the reading in the field logbook.

If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one. Describe its location and record the date of the mark in the logbook.

A synoptic water level measurement round should be performed (in the shortest possible time) before any purging and sampling activities begin. It is recommended that water level depth (to 0.01 ft.) and total well depth (to 0.1 ft.) be measured the day before, in order to allow for re-settlement of any particulates in the water column. If measurement of total well depth is not made the day before, it should not be measured until after sampling of the well is complete. All measurements must be taken from the established referenced point. Care should be taken to minimize water column disturbance.

Check newly constructed wells for the presence of LNAPLs or DNAPLs before the initial sampling round. If none are encountered, subsequent check measurements with an interface probe are usually not needed unless analytical data or field head space information signal a worsening situation. Note: procedures for collection of LNAPL and DNAPL samples are not addressed in this SOP.

IV.PURGING AND SAMPLING PROCEDURE

Sampling wells in order of increasing chemical concentrations (known or anticipated) is preferred.

1. Install Pump

Lower pump, safety cable, tubing and electrical lines slowly (to minimize disturbance) into the well to the midpoint of the zone to be sampled. The Sampling and Analysis Plan should specify the sampling depth, or provide criteria for selection of intake depth for each well (see Section I). If possible keep the pump intake at least two feet above the bottom of the well, to minimize mobilization of particulates present in the bottom of the well. Collection of turbid free water samples may be especially difficult if there is two feet or less of standing water in the well.

2. Measure Water Level

Before starting pump, measure water level. If recording pressure transducer is used-initialize starting condition.

3. Purge Well

3a. Initial Low Stress Sampling Event

Start the pump at its lowest speed setting and slowly increase the speed until discharge occurs. Check water level. Adjust pump speed until there is little or no water level drawdown (less than 0.3 feet). If the minimal drawdown that can be achieved exceeds 0.3 feet but remains stable, continue purging until indicator field parameters stabilize.

Monitor and record water level and pumping rate every three to five minutes (or as appropriate) during purging. Record any pumping rate adjustments (both time and flow rate). Pumping rates should, as needed, be reduced to the minimum capabilities of the pump (for example, 0.1 - 0.4 l/min) to ensure stabilization of indicator parameters. Adjustments are best made in the first fifteen minutes of pumping in order to help minimize purging time. During pump start-up, drawdown may exceed the 0.3 feet target and then "recover" as pump flow adjustments are made. Purge volume calculations should utilize stabilized drawdown value, not the initial drawdown. Do not allow the water level to fall to the intake level (if the static water level is above the well screen, avoid lowering the water level into the screen). The final purge volume must be greater than the stabilized drawdown volume plus the extraction tubing volume.

Wells with low recharge rates may require the use of special pumps capable of attaining very low pumping rates (bladder, peristaltic), and/or the use of dedicated equipment. If the recharge rate of the well is lower than extraction rate capabilities of currently manufactured pumps and the well is essentially dewatered during purging, then the well should be sampled as soon as the water level has recovered sufficiently to collect the appropriate volume needed for all anticipated samples (ideally the intake should not be moved during this recovery period). Samples may then be collected even though the indicator field parameters have not stabilized.

3b. Subsequent Low Stress Sampling Events

After synoptic water level measurement round, check intake depth and drawdown information from previous sampling event(s) for each well. Duplicate, to the extent practicable, the intake depth and extraction rate (use final pump dial setting information) from previous event(s). Perform purging operations as above.

4. Monitor Indicator Field Parameters

During well purging, monitor indicator field parameters (turbidity, temperature, specific conductance, pH, Eh, DO) every three to five minutes (or less frequently, if appropriate). Note: during the early phase of purging emphasis should be put on minimizing and stabilizing pumping stress, and recording those adjustments. Purging is considered complete and sampling may begin when all the above indicator field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings, taken at three (3) to five (5) minute intervals, are within the following limits:

turbidity (10% for values greater than 1 NTU),
DO (10%),
specific conductance (3%),
temperature (3%),
pH (± 0.1 unit),
ORP/Eh (± 10 millivolts).

All measurements, except turbidity, must be obtained using a flow-through-cell. Transparent flow-through-cells are preferred, because they allow field personnel to watch for particulate build-up within the cell. This build-up may affect indicator field parameter values measured within the cell and may also cause an underestimation of turbidity values measured after the cell. If the cell needs to be cleaned during purging operations, continue pumping and disconnect cell for cleaning, then reconnect after cleaning and continue monitoring activities.

The flow-through-cell must be designed in a way that prevents air bubble entrapment in the cell. When the pump is turned off or cycling on/off (when using a bladder pump), water in the cell must not drain out. Monitoring probes must be submerged in water at all times. If two flow-through-cells are used in series, the one containing the dissolved oxygen probe should come first (this parameter is most susceptible to error if air leaks into the system).

5. Collect Water Samples

Water samples for laboratory analyses must be collected before water has passed through the flow-through-cell (use a by-pass assembly or disconnect cell to obtain sample).

VOC samples should be collected first and directly into pre-preserved sample containers. Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

During purging and sampling, the tubing should remain filled with water so as to minimize possible changes in water chemistry upon contact with the atmosphere. It is recommended that 1/4 inch or 3/8 inch (inside diameter) tubing be used to help insure that the sample tubing remains water filled. If the pump tubing is not completely filled to the sampling point, use one of the following procedures to collect samples: (1) add clamp, connector (Teflon or stainless steel) or valve to constrict sampling end of tubing; (2) insert small diameter Teflon tubing into water filled portion of pump tubing allowing the end to protrude beyond the end of the pump tubing, collect sample from small diameter tubing; (3) collect non-VOC samples first, then increase flow rate slightly until the water completely fills the tubing, collect sample and record new drawdown, flow rate and new indicator field parameter values.

Add preservative, as required by analytical methods, to samples immediately after they are collected if the sample containers are not pre-preserved. Check analytical methods (e.g. EPA SW-846, water supply, etc.) for additional information on preservation. Check pH for all samples requiring pH adjustment to assure proper pH value. For VOC samples, this will require that a test sample be collected during purging to determine the amount of preservative that needs to be added to the sample containers prior to sampling.

If determination of filtered metal concentrations is a sampling objective, collect filtered water samples using the same low flow procedures. The use of an in-line filter is required, and the filter size (0.45 um is commonly used) should be based on the sampling objective. Pre-rinse the filter with approximately 25 - 50 ml of ground water prior to sample collection. Preserve filtered water sample immediately. Note: filtered water samples are not an acceptable substitute for unfiltered samples when the monitoring objective is to obtain chemical concentrations of total mobile contaminants in ground water for human health risk calculations.

Label each sample as collected. Samples requiring cooling (volatile organics, cyanide, etc.) will be placed into a cooler with ice or refrigerant for delivery to the laboratory. Metal samples after acidification to a pH less than 2 do not need to be cooled.

6. Post Sampling Activities

If recording pressure transducer is used, remeasure water level with tape.

After collection of the samples, the pump tubing may either be dedicated to the well for resampling (by hanging the tubing inside the well), decontaminated, or properly discarded.

Before securing the well, measure and record the well depth (to 0.1 ft.), if not measured the day before purging began. Note: measurement of total well depth is optional after the initial low stress sampling event. However, it is recommended if the well has a "silting" problem or if confirmation of well identity is needed.

Secure the well.

V. DECONTAMINATION

Decontaminate sampling equipment prior to use in the first well and following sampling of each subsequent well. Pumps will not be removed between purging and sampling operations. The pump and tubing (including support cable and electrical wires which are in contact with the well) will be decontaminated by one of the procedures listed below.

Procedure 1

The decontaminating solutions can be pumped from either buckets or short PVC casing sections through the pump or the pump can be disassembled and flushed with the decontaminating solutions. It is recommended that detergent and isopropyl alcohol be used sparingly in the decontamination process and water flushing steps be extended to ensure that any sediment trapped in the pump is removed. The pump exterior and electrical wires must be rinsed with the decontaminating solutions, as well. The procedure is as follows:

Flush the equipment/pump with potable water.

Flush with non-phosphate detergent solution. If the solution is recycled, the solution must be changed periodically.

Flush with potable or distilled/deionized water to remove all of the detergent solution. If the water is recycled, the water must be changed periodically.

Flush with isopropyl alcohol (pesticide grade). If equipment blank data from the previous sampling event show that the level of contaminants is insignificant, then this step may be skipped.

Flush with distilled/deionized water. The final water rinse must not be recycled.

Procedure 2

Steam clean the outside of the submersible pump.

Pump hot potable water from the steam cleaner through the inside of the pump. This can be accomplished by placing the pump inside a three or four inch diameter PVC pipe with end cap. Hot water from the steam cleaner jet will be directed inside the PVC pipe and the pump exterior will be cleaned. The hot water from the steam cleaner will then be pumped from the PVC pipe through the pump and collected into another container. Note: additives or solutions should not be added to the steam cleaner.

Pump non-phosphate detergent solution through the inside of the pump. If the solution is recycled, the solution must be changed periodically.

Pump potable water through the inside of the pump to remove all of the detergent solution. If the solution is recycled, the solution must be changed periodically.

Pump distilled/deionized water through the pump. The final water rinse must not be recycled.

VI. FIELD QUALITY CONTROL

Quality control samples are required to verify that the sample collection and handling process has not compromised the quality of the ground water samples. All field quality control samples must be prepared the same as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples shall be collected for each batch of samples (a batch may not exceed 20 samples). Trip blanks are required for the VOC samples at a frequency of one set per VOC sample cooler.

Field duplicate.

Matrix spike.

Matrix spike duplicate.

Equipment blank.

Trip blank (VOCs).

Temperature blank (one per sample cooler).

Equipment blank shall include the pump and the pump's tubing. If tubing is dedicated to the well, the equipment blank will only include the pump in subsequent sampling rounds.

Collect samples in order from wells with lowest contaminant concentration to highest concentration. Collect equipment blanks after sampling from contaminated wells and not after background wells.

Field duplicates are collected to determine precision of sampling procedure. For this procedure, collect duplicate for each analyte group in consecutive order (VOC original, VOC duplicate, SVOC original, SVOC duplicate, etc.).

If split samples are to be collected, collect split for each analyte group in consecutive order (VOC original, VOC split, etc.). Split sample should be as identical as possible to original sample.

All monitoring instrumentation shall be operated in accordance with EPA analytical methods and manufacturer's operating instructions. EPA analytical methods are listed in 40 CFR 136, 40 CFR 141, and SW-846 with exception of Eh, for which the manufacturer's instructions are to be followed. Instruments shall be calibrated at the beginning of each day. If a measurement falls outside the calibration range, the instrument should be re-calibrated so that all measurements fall within the calibration range. At the end of each day, check calibration to verify that instruments remained in calibration. Temperature measuring equipment, thermometers and thermistors, need not be calibrated to the above frequency. They should be checked for accuracy prior to field use according to EPA Methods and the manufacturer's instructions.

VII.FIELD LOGBOOK

A field log shall be kept to document all ground water field monitoring activities (see attached example matrix), and record all of the following:

Well identification.

Well depth, and measurement technique.

Static water level depth, date, time and measurement technique.

Presence and thickness of immiscible liquid (NAPL) layers and detection method.

Pumping rate, drawdown, indicator parameters values, and clock time, at the appropriate time intervals; calculated or measured total volume pumped.

Well sampling sequence and time of each sample collection.

Types of sample bottles used and sample identification numbers.

Preservatives used.

Parameters requested for analysis.

Field observations during sampling event.

Name of sample collector(s).

Weather conditions.

QA/QC data for field instruments.

Any problems encountered should be highlighted.

Description of all sampling equipment used, including trade names, model number, diameters, material composition, etc.

VIII. DATA REPORT

Data reports are to include laboratory analytical results, QA/QC information, and whatever field logbook information is needed to allow for a full evaluation of data useability.

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EXAMPLE (Minimum Requirements)
Well PURGING-FIELD WATER QUALITY MEASUREMENTS FORM

Page____of____

Location (Site/Facility Name)____________________
Well Number______________Date____________________
Field Personnel____________________
Sampling Organization____________________
Identify MP____________________

Depth to (below MP) ________ top / ________ bottom of screen
Pump Intake at (ft. below MP)____________________
Purging Device; (pump type)____________________

Clock Time 24 HR	Water Depth below MP ft	Pump Dial[1]	Purge Rate ml/min	Cum. Volume Purged liters	Temp. °C	Spec. Cond.[2] µS/cm	pH	ORP/ Eh[3] mv	DO mg/L	Turb-idity NTU	Comments

1. Pump dial setting (for example: hertz, cycles/min, etc).
2. µSiemens per cm(same as µmhos/cm)at 25°C.
3. Oxidation reduction potential (stand in for Eh).

APPENDIX T. EPA REGION I LOW STRESS (LOW FLOW) PURGING AND SAMPLING PROCEDURE FOR THE COLLECTION OF GROUNDWATER SAMPLES FROM MONITORING WELLS

SOP #:
Region 1 Calibration of
Field Instruments
Revision Number: DRAFT
Date: June 3, 1998
Page 1 of 10

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 1

DRAFT CALIBRATION OF FIELD INSTRUMENTS
(temperature, pH, dissolved oxygen, conductivity/specific conductance, oxidation/reduction potential [ORP], and turbidity)

I. SCOPE & APPLICATION

The purpose of this standard operating procedure (SOP) is to provide a framework for calibrating field instruments used to measure water quality parameters for ground water and surface water. Water quality parameters include temperature, pH, dissolved oxygen, conductivity/specific conductance, oxidation/reduction potential [ORP], and turbidity. This SOP supplements, but does not replace, EPA analytical methods listed in 40 CFR 136 and 40 CFR 141 for temperature, dissolved oxygen, conductivity/specific conductance, pH and turbidity.

This SOP is written for instruments that utilize multiple probes (temperature, pH, dissolved oxygen, conductivity/specific conductance, and/or oxidation/reduction potential [ORP]) and the probe readings for pH, dissolved oxygen, and specific conductance are automatically corrected for temperature. Communications to the instrument (programming and displaying the measurement values) are performed using a display/logger or a computer. Information sent to the instrument is entered through the keypad on the display/logger or computer. It is desirable that the display/logger or computer have data storage capabilities. If the instrument does not have a keypad, follow the manufacturer's instructions for entering information into the instrument.

For ground water monitoring the instrument must be equipped with a flow-through-cell, and the display/logger or computer display screen needs to be large enough to simultaneously contain the readouts of each probe in the instrument. Turbidity is measured using a separate instrument because turbidity cannot be measured in a flow-through-cell. This procedure is applicable for use with the EPA Region 1 Low Stress (low flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells.

II. GENERAL

All monitoring instruments must be calibrated before they are used to measure environmental samples. Part of the calibration is performed prior to the field event. For instrument probes that rely on the temperature sensor (pH, dissolved oxygen, conductivity/specific conductance, and oxidation/reduction potential [ORP]), each temperature sensor needs to be checked for accuracy against a thermometer that is traceable to the National Institute of Standards and Technology (NIST). Before any instrument is calibrated or used to perform environmental measurements, the instrument must stabilize (warm-up) according to manufacturer's instructions.

Most instruments will require at least two standards to bracket the expected measurement range, that is, one standard less than the expected value and one higher. Calibration must be performed at the beginning of each sampling day prior to sample collection. To determine if the instruments have remained in calibration during transport to each sampling location, use one of the previously used standards as a check standard at the sampling site. If the check measurement does not agree with the initial calibration or to within the specifications of the instrument, then the instrument must be re-calibrated. When an environmental sample measurement falls outside the calibration range, the instrument must be recalibrated to bracket the new range before continuing measurements.

This SOP requires that the manufacturer's instruction manual (including the instrument specifications) accompany the instrument into the field.

III. CALIBRATION PROCEDURES

Prior to calibration, all instrument probes must be cleaned according to the manufacturer's instructions. Failure to perform this step (proper maintenance) can lead to erratic measurements.

Program the multi-probe instrument so that the following parameters to be measured will be displayed: temperature, percent dissolved oxygen, mg/l dissolved oxygen, conductivity, specific conductance, and ORP.

The volume of the calibration solutions must be sufficient to cover both the probe and temperature sensor (see manufacturer's instructions for additional information).

While calibrating or measuring, make sure there are no air bubbles lodged between the probe and the probe guard.

TEMPERATURE

Most instrument manuals state there is no calibration of the temperature sensor, but the temperature sensor must be checked to determine its accuracy. This accuracy check is performed at least once per year and the accuracy check date/information is kept with the instrument. If the accuracy check date/information is not included with the instrument or if the last check was over a year, the temperature sensor accuracy needs to be checked at the beginning of the sampling event. If the instrument contains multiple temperature sensors, each sensor must be checked.

Verification Procedure

1. Allow a container filled with water to come to room temperature.

2. Place a thermometer that is traceable to the National Institute of Standards and Technology (NIST), and the instrument's temperature sensor in the water and wait for both temperature readings to stabilize.

3. Compare the two measurements. The instrument's temperature sensor must agree with the reference thermometer measurement within the accuracy of the sensor (usually ±0.15°C). If the measurements do not agree, the instrument may not be working properly and the manufacturer needs to be consulted.

pH (electrometric)

The pH of a sample is determined electrometrically using a glass electrode.

Choose the appropriate buffered standards that will bracket the expected values at the sampling locations. For groundwater the pH will usually be close to seven. Three standards are needed for the calibration: one close to seven, one at least two pH units below seven and the other at least two pH units above seven. For those instruments that will not accept three standards, the instrument will need to be re-calibrated if the water sample's pH is outside the initial calibration range described by the two standards.

Calibration Procedure

1. Allow the buffered standards to equilibrate to the ambient temperature.

2. Fill calibration containers with the buffered standards so each standard will cover the pH probe and temperature sensor.

3. Remove probe from its storage container, rinse with distilled water, blot dry with soft tissue.

4. Select monitoring/run mode. Immerse probe into the initial standard (e.g., pH 7).

5. Stir the standard until the readings stabilize. If the reading does not change within 30 seconds, select calibration mode and then select [illegible]. Enter the buffered standard value into instrument. Select monitoring/run mode. The readings should remain within manufacturer's specifications; if they change, re-calibrate. If readings continue to change after re-calibration, consult manufacturer.

6. Remove probe from the initial standard, rinse with distilled water, and blot dry.

7. Immerse probe into the second standard (e.g., [illegible]). Repeat step 5.

8. Remove probe from the second standard, rinse with distilled water, and blot dry. If instrument only accepts two standards, the calibration is complete. Go to step 11. Otherwise continue.

9. Immerse probe in third buffered standard (e.g., pH 9) and repeat step 5.

10. Remove probe from the third standard, rinse with distilled water, and blot dry.

11. Select monitoring/run mode, if not already selected. To ensure that the initial calibration standard (e.g., pH 7) has not changed, immerse the probe into the initial standard. Wait for the readings to stabilize. The reading should read the initial standard value within the manufacturer's specifications. If not, re-calibrate the instrument. If re-calibration does not help, the calibration range may be too great. Reduce calibration range by using standards that are closer together.

12. The calibration is complete. Place pH probe in its storage container.

DISSOLVED OXYGEN

Dissolved oxygen (DO) content in water is measured using a membrane electrode. The DO probe's membrane and electrolyte solution should be replaced prior to the sampling period. Failure to perform this step may lead to erratic measurements.

Calibration Procedure

1. Gently dry the temperature sensor according to manufacturer's instructions.

2. Place a wet sponge or a wet paper towel on the bottom of the DO calibration container.

3. Place the DO probe into the container without the probe coming in contact with the wet sponge or paper towel. The probe must fit tightly into the container to prevent the escape of moisture evaporating from the sponge or towel.

4. Allow the confined air to become saturated with water vapor (saturation occurs in approximately 10 to 15 minutes). During this time, turn-on the instrument to allow the DO probe to warm-up. Select monitoring/run mode. Check temperature readings. Readings must stabilize before continuing to the next step.

5. Select calibration mode; then select "DO %".

6. Enter the local barometric pressure (usually in mm of mercury) for the sampling location into the instrument. This measurement must be determined from an on-site barometer. Do not use barometric pressure obtained from the local weather services unless the pressure is corrected for the elevation of the sampling location. [Note: inches of mercury times 25.4 mm/inch equals mm of mercury or consult Oxygen Solubility at Indicated Pressure chart attached to the SOP for conversion at selected pressures].

7. The instrument should indicate that the calibration is in progress. The instrument will take approximately one minute to calibrate. After calibration, the instrument should display percent saturated DO.

8. Select monitoring/run mode. Compare the DO mg/l reading to the Oxygen Solubility at Indicated Pressure chart attached to the SOP. The numbers should agree. If they do not agree to the accuracy of the instrument (usually ± 0.2 mg/L), repeat calibration. If this does not work, change the membrane and electrolyte solution.

9. Remove the probe from the container and place it into a 0.0 mg/L DO standard (see note). The standard must be filled to the top of its container and the DO probe must fit tightly into the standard's container (no head space). Check temperature readings. They must stabilize before continuing.

Oxygen Solubility at Indicated Pressure (continued)

Temp	Pressure (Hg)								
	725	720	715	710	705	700	695	690	mm
°C	28.54	28.35	28.15	27.95	27.76	27.56	27.36	27.17	in
0	13.89	13.80	13.70	13.61	13.51	13.41	13.32	13.22	mg/l
1	13.51	13.42	13.33	13.23	13.14	13.04	12.95	12.86	
2	13.15	13.06	12.07	12.88	12.79	12.69	12.60	12.51	
3	12.81	12.72	12.63	12.54	12.45	12.36	12.27	12.18	
4	12.47	12.39	12.30	12.21	12.13	12.04	11.95	11.87	
5	12.15	12.06	11.98	11.89	11.81	11.73	11.64	11.56	
6	11.84	11.73	11.68	11.60	11.51	11.43	11.35	[illegible]	
7	11.55	11.47	11.39	11.31	11.22	11.14	11.06	[illegible]	
8	11.26	11.18	11.10	11.02	10.95	10.87	10.79	[illegible]	
9	10.99	10.92	10.84	10.76	10.69	10.61	10.53	[illegible]	
10	10.74	10.66	10.59	10.51	10.44	[illegible]	10.29	10.21	
11	10.48	10.40	10.33	10.28	10.18	[illegible]	10.04	9.96	
12	10.24	10.17	10.10	10.02	9.95	[illegible]	9.81	9.46	
13	10.01	9.94	9.87	9.80	9.73	9.66	[illegible]	9.52	
14	9.79	9.72	9.65	9.68	9.51	9.45	[illegible]	9.31	
15	9.58	9.51	9.44	9.58	9.31	9.24	[illegible]	[illegible]	
16	9.37	9.30	9.24	9.17	9.11	9.04	8.97	[illegible]	
17	9.18	9.11	9.05	8.98	8.92	8.85	8.79	[illegible]	
18	8.99	8.92	8.86	8.80	[illegible]	[illegible]	8.61	[illegible]	
19	8.81	8.74	8.68	8.62	[illegible]	[illegible]	8.43	[illegible]	
20	8.63	8.57	8.51	8.45	8.39	[illegible]	[illegible]	8.21	
21	8.46	8.40	8.34	8.28	8.22	8.16	[illegible]	8.04	
22	8.30	8.24	8.18	[illegible]	8.06	8.00	[illegible]	7.89	
23	8.15	8.09	8.03	7.97	[illegible]	7.86	7.80	7.74	
24	7.99	7.94	7.88	7.82	[illegible]	7.71	7.65	7.59	
25	7.85	7.79	[illegible]	7.68	7.60	[illegible]	7.51	7.46	
26	7.70	7.65	[illegible]	7.54	[illegible]	[illegible]	7.37	7.32	
27	7.57	7.52	[illegible]	7.41	[illegible]	7.30	7.25	7.19	
28	7.44	[illegible]	[illegible]	7.28	[illegible]	7.17	7.12	7.06	
29	[illegible]	7.26	[illegible]	7.15	7.10	7.05	7.00	6.94	
30	[illegible]	7.14	[illegible]	7.03	6.98	6.93	6.88	6.82	
31	[illegible]	7.01	[illegible]	[illegible]	6.86	6.81	6.76	6.70	
32	[illegible]	[illegible]	6.85	6.80	6.70	6.70	6.64	6.59	
33	6.83	[illegible]	6.73	6.68	6.83	6.58	6.53	6.48	
34	6.73	[illegible]	[illegible]	6.58	6.53	6.48	6.43	6.38	
35	6.61	[illegible]	[illegible]	6.47	6.42	6.37	6.36	6.27	
36	6.51	[illegible]	6.41	6.36	6.31	6.27	6.22	6.17	
37	6.40	[illegible]	6.31	6.26	6.21	6.16	6.12	6.07	
38	6.30	6.26	6.21	6.16	6.12	6.07	6.02	5.98	
39	6.26	6.15	6.11	6.06	6.01	5.97	5.92	5.87	
40	6.10	6.06	6.01	5.96	5.92	5.86	5.83	5.78	
[illegible]	[illegible]	5.96	5.91	5.87	5.82	5.78	5.73	5.69	
[illegible]	5.91	5.86	5.82	5.77	5.73	5.69	5.64	5.60	
43	5.82	5.78	5.73	5.69	5.65	5.60	5.56	5.51	
44	5.72	5.68	5.64	5.59	5.55	5.51	5.46	5.42	
45	5.64	5.59	5.55	5.51	5.47	5.42	5.38	5.34	

Source: Draft EPA Handbook of Methods for Acid Deposition Studies, Field Operations for Surface Water Chemistry, EPA/600/4-89/020, August 1989.

10. Wait until the "mg/l DO" readings have stabilized. The instrument should read 0.0 mg/L or to the accuracy of the instrument (usually ± 0.2 mg/L). If the instrument cannot reach these values, it will be necessary to clean the probe, and change the membrane and electrolyte solution. If this does not work, prepare a new 0.0 mg/L DO standard. If these measures do not work, contact manufacturer.

Note: To prepare a zero mg/L DO standard follow the procedure stated in Standard Methods (Method 4500-O G). The method basically states to add excess sodium sulfite (until no more dissolves) and a trace amount of cobalt chloride to water. The standard container must be completely filled (no head space). This solution is prepared prior to the sampling event. If some of the solution is lost during instrument calibration, add more water to the container so that the standard is stored with no head space.

SPECIFIC CONDUCTANCE

Conductivity is used to measure the ability of an aqueous solution to carry an electrical current. Specific conductance is the conductivity value corrected to 25°C.

Most instruments are calibrated against a single standard which is near, but below the specific conductance of the environmental samples. A second standard which is above the environmental sample specific conductance is used to check the linearity of the instrument in the range of measurements.

Calibration Procedure:

1. Allow the calibration standard to equilibrate to the ambient temperature.

2. Remove probe from its storage container, rinse the probe with a small amount of the conductivity/specific conductance standard (discard the rinsate), and place the probe into the conductivity/specific conductance standard.

3. Select monitoring/run mode. Wait until the probe temperature has stabilized.

4. Look up the conductivity value at this temperature from the conductivity versus temperature correction table usually found on the standard bottle or the standard instruction sheet. You may need to interpolate the conductivity value between temperatures. Select calibration mode, then conductivity. Enter the temperature corrected conductivity value into the instrument.

5. Select monitoring/run mode. The reading should remain within manufacturer's specifications. If it does not, re-calibrate. If readings continue to change after re-calibration, consult manufacturer.

6. Read the specific conductance on the instrument and compare the value to the specific conductance value on the standard. The instrument value should agree with the standard within the manufacturer's specifications. If not, re-calibrate. If the re-calibration does not correct the problem, the probe may need to be cleaned or serviced by the instrument manufacturer.

7. Remove probe from the standard, rinse the probe with a small amount of the second conductivity/specific conductance standard (discard the rinsate), and place the probe into the second conductivity/specific conductance standard. The second standard will serve to verify the linearity of the instrument. Read the specific conductance value from the instrument and compare the value to the specific conductance on the standard. The two values should agree within the specifications of the instrument. If they do not agree, re-calibrate. If readings do not compare, then the second standard may be outside the linear range of the instrument. Use a standard that is closer, but above the first standard and repeat the verification. If values still do not compare, try cleaning the probe or consult the manufacturer.

8. When monitoring ground water or surface water, use the specific conductance readings.

OXIDATION/REDUCTION POTENTIAL (ORP)

The oxidation/reduction potential is the electrometric difference measured in a solution between an inert indicator electrode and a suitable reference electrode. The electrometric difference is measured in millivolts and is temperature dependent.

Calibration or Verification Procedure

1. Allow the calibration standard (a Zobell solution) to equilibrate to ambient temperature.

2. Remove the probe from its storage container, and place it into the standard.

3. Select monitoring/run mode.

4. While stirring the standard, wait for the probe temperature to stabilize, then read the temperature.

5. Look up the millivolt (mv) value at this temperature from the millivolt versus temperature correction table usually found on the standard bottle or on the standard instruction sheet. You may need to interpolate millivolt value between temperatures. Select "calibration mode", then "ORP". Enter the temperature-corrected ORP value into the instrument.

6. Select monitoring/run mode. The readings should remain unchanged within manufacturer's specifications. If they change, re-calibrate. If readings continue to change after re-calibration, consult manufacturer.

7. If the instrument instruction manual states that the instrument is factory calibrated, then verify the factory calibration against the standard. If they do not agree within the specifications of the instrument, the instrument will need to be re-calibrated by the manufacturer.

TURBIDITY

The turbidity method is based upon a comparison of intensity of light scattered by a sample under defined conditions with the intensity of light scattered by a standard reference suspension. A turbidimeter is a nephelometer with a visible light source for illuminating the sample and one or more photo-electric detectors placed ninety degrees to the path of the light source.

Some instruments will only accept one standard. For these instruments, the standards will serve as check points.

Calibration Procedures

1. Allow the calibration standards to equilibrate at the ambient temperature. The use of commercially available polymer primary standards (AMCO-AEPA-1) is preferred, however, the standards can be prepared using Formazin according to the EPA analytical Method 180.1.

2. If the standard cuvette is not sealed, rinse a cuvette with deionized water. Shake the cuvette to remove as much water as possible. Do not wipe dry the inside of the cuvette because lint from the wipe may remain in the cuvette. Add the standard to the cuvette.

3. Before performing the calibration procedure, make sure the cuvettes are not scratched and the outside surfaces are dry, free from fingerprints and dust. If the cuvette is scratched or dirty, discard or clean the cuvette respectively.

4. Zero the instrument by using either a zero or 0.02 NTU standard. A zero standard (approximately 0 NTU) can be prepared by passing distilled water through a 0.45 micron pore size membrane filter.

5. Using a standard in the range of [illegible] 20 NTUs, calibrate according to manufacturer's instructions or verify calibration if instrument will not accept a second standard. If verifying, the instrument should read standard value to within the specifications of the instrument. If the instrument has range of scales, check each range that will be used during the sampling event with a standard that falls within that range.

7. Using a standard between 20 and 100 NTUs, calibrate according to manufacturer's instructions or verify calibration if instrument does not accept a third standard. If verifying, the instrument should read standard value to within the specifications of the instrument. If the instrument has range of scales, check each range that will be used with the proper standard for that scale.

IV. DATA MANAGEMENT AND RECORDS MANAGEMENT

All calibration records must be documented in the project's log book. At a minimum, include the instrument manufacturer, model number, instrument identification number, standards used to calibrate the instruments (including source), calibration date, and the instrument readings.

<u>References</u>

Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995.

Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020, Revised March 1983.

Turbidity - Methods for the Determination of Inorganic Substances in Environmental Samples, EPA/600/R-93/100, August 1993.

Oxygen Solubility at Indicated Pressure

Temp.	Pressure (Hg)							
	760	755	750	745	740	735	730	mm
°C	29.92	29.72	29.53	29.33	29.13	28.94	28.74	in
0	14.57	14.47	14.38	14.28	14.18	14.09	13.99	mg/l
1	14.17	14.08	13.98	13.89	13.79	13.70	13.61	
2	13.79	13.70	13.61	13.52	13.42	13.33	13.24	
3	13.43	13.34	13.25	13.16	13.07	12-98	12.90	
4	13.08	12.99	12.91	12.82	12.73	12.65	12.56	
5	12.74	12.66	12.57	12.49	12.40	12.32	12.23	
6	12.42	12.34	12.26	12.17	12.09	12.01	11.93	
7	12.11	12.03	11.95	11.87	11.79	11.71	11.63	
8	11.81	11.73	11.65	11.57	11.50	11.42	11.34	
9	11.53	11.45	11.38	11.30	11.22	11.15	11.07	
10	11.28	11.19	11.11	11.04	10.96	10.89	10.81	
11	10.99	10.92	10.84	10.77	10.70	[illegible]	[illegible]	
12	10.74	10.67	10.60	10.53	10.45	[illegible]	[illegible]	
13	10.50	10.43	10.36	10.29	10.22	10.15	[illegible]	
14	10.27	10.20	10.13	10.06	10.00	9.93	[illegible]	
15	10.05	9.98	9.92	9.85	9.78	9.71	9.65	
16	9.83	9.76	9.70	9.63	9.57	9.50	9.43	
17	9.63	9.57	9.50	9.44	9.37	[illegible]	9.24	
18	9.43	9.37	9.30	9.24	9.18	[illegible]	9.05	
19	9.24	9.18	9.12	9.05	8.99	8.93	[illegible]	
20	9.06	9.00	8.94	8.88	8.82	8.75	[illegible]	
21	8.88	8.82	8.76	8.70	8.64	8.58	[illegible]	
22	8.71	8.65	8.59	8.53	8.47	8.42	8.36	
23	8.55	8.49	8.43	8.38	8.32	8.26	8.20	
24	8.39	8.33	8.28	8.22	8.16	8.11	8.05	
25	8.24	8.18	[illegible]	8.07	[illegible]	7.96	7.90	
26	8.09	8.03	7.98	7.92	[illegible]	7.81	7.76	
27	7.95	7.90	[illegible]	7.79	[illegible]	7.68	7.62	
28	[illegible]	7.76	[illegible]	7.65	7.60	7.54	7.49	
29	[illegible]	7.63	[illegible]	7.52	7.47	7.42	7.36	
30	[illegible]	[illegible]	7.45	7.39	7.34	7.29	7.24	
31	7.45	[illegible]	7.32	7.27	7.22	7.16	7.11	
32	7.30	[illegible]	7.20	7.15	7.10	7.05	7.00	
33	7.08	[illegible]	7.08	7.03	6.98	6.93	6.88	
34	7.07	7.02	6.97	6.92	6.87	6.82	6.78	
35	6.95	6.90	6.85	6.80	6.76	6.71	6.66	
36	6.84	[illegible]	6.76	6.70	6.65	6.60	6.55	
37	6.73	6.68	6.64	6.59	6.54	6.49	6.45	
38	6.63	6.58	6.54	6.49	6.44	6.40	6.35	
39	6.52	6.47	6.43	6.38	6.35	6.29	6.24	
40	[illegible]	6.37	6.33	6.28	6.24	6.19	6.15	
41	6.32	6.27	6.23	6.18	6.14	6.09	6.05	
42	6.22	6.18	6.13	6.09	6.04	6.00	5.95	
43	6.13	6.09	6.04	6.00	5.95	5.91	5.87	
44	6.03	5.99	5.94	5.90	5.86	5.81	5.77	
45	5.94	5.90	5.85	5.81	5.77	5.72	5.68	

(Continued)

Source: Draft EPA Handbook of Methods for Acid Deposition Studies, Field Operations for Surface Water Chemistry, EPA/600/4-89/020, August 1989.

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Oxygen Solubility at Indicated Pressure (continued)

Temp.	Pressure (Hg)								
	725	720	715	710	705	700	695	690	mm
°C	28.54	28.35	28.15	27.95	27.76	27.56	27.36	27.17	in
0	13.89	13.80	13.70	13.61	13.51	13.41	13.32	13.22	mg/l
1	13.51	13.42	13.33	13.23	13.14	13.04	12.95	12.86	
2	13.15	13.06	12.07	12.88	12.79	12.69	12.60	12.51	
3	12.81	12.72	12.63	12.54	12.45	12.36	12.27	12.18	
4	12.47	12.39	12.30	12.21	12.13	12.04	11.95	11.87	
5	12.15	12.06	11.98	11.89	11.81	11.73	11.64	11.56	
6	11.84	11.73	11.68	11.60	11.51	11.43	11.35	[illegible]	
7	11.55	11.47	11.39	11.31	11.22	11.14	11.06	[illegible]	
8	11.26	11.18	11.10	11.02	10.95	10.87	10.79	[illegible]	
9	10.99	10.92	10.84	10.76	10.69	10.61	10.53	[illegible]	
10	10.74	10.66	10.59	10.51	10.44	[illegible]	10.29	10.21	
11	10.48	10.40	10.33	10.28	10.18	[illegible]	10.04	9.96	
12	10.24	10.17	10.10	10.02	9.95	9.88	9.81	9.46	
13	10.01	9.94	9.87	9.80	9.73	9.66	[illegible]	9.52	
14	9.79	9.72	9.65	9.68	9.51	9.45	[illegible]	9.31	
15	9.58	9.51	9.44	9.58	9.31	9.24	[illegible]	[illegible]	
16	9.37	9.30	9.24	9.17	9.11	9.04	8.97	[illegible]	
17	9.18	9.11	9.05	8.98	8.92	8.85	8.79	[illegible]	
18	8.99	8.92	8.86	8.80	[illegible]	[illegible]	8.61	[illegible]	
19	8.81	8.74	8.68	8.62	[illegible]	[illegible]	8.43	[illegible]	
20	8.63	8.57	8.51	8.45	8.39	[illegible]	[illegible]	8.21	
21	8.46	8.40	8.34	8.28	8.22	8.16	[illegible]	8.04	
22	8.30	8.24	8.18	[illegible]	8.06	8.00	[illegible]	7.89	
23	8.15	8.09	8.03	7.97	[illegible]	7.86	7.80	7.74	
24	7.99	7.94	7.88	7.82	[illegible]	7.71	7.65	7.59	
25	7.85	7.79	7.74	7.68	[illegible]	[illegible]	7.51	7.46	
26	7.70	7.65	[illegible]	7.54	[illegible]	[illegible]	7.37	7.32	
27	7.57	7.52	[illegible]	7.41	[illegible]	7.30	7.25	7.19	
28	7.44	[illegible]	[illegible]	7.28	[illegible]	7.17	7.12	7.06	
29	[illegible]	7.26	[illegible]	7.15	7.10	7.05	7.00	6.94	
30	[illegible]	7.14	[illegible]	[illegible]	6.98	6.93	6.88	6.82	
31	[illegible]	7.01	6.96	6.91	6.86	6.81	6.76	6.70	
32	[illegible]	[illegible]	6.85	6.80	6.70	6.70	6.64	6.59	
33	6.83	[illegible]	6.73	6.68	6.83	6.58	6.53	6.48	
34	6.73	[illegible]	[illegible]	6.58	6.53	6.48	6.43	6.38	
35	6.61	[illegible]	6.51	6.47	6.42	6.37	6.36	6.27	
36	6.51	[illegible]	6.41	6.36	6.31	6.27	6.22	6.17	
37	6.40	[illegible]	6.31	6.26	6.21	6.16	6.12	6.07	
38	6.30	6.26	6.21	6.16	6.12	6.07	6.02	5.98	
39	6.26	6.15	6.11	6.06	6.01	5.97	5.92	5.87	
40	6.10	6.06	6.01	5.96	5.92	5.86	5.83	5.78	
41	6.00	5.96	5.91	5.87	5.82	5.78	5.73	5.69	
42	5.91	5.86	5.82	5.77	5.73	5.69	5.64	5.60	
43	5.82	5.78	5.73	5.69	5.65	5.60	5.56	5.51	
44	5.72	5.68	5.64	5.59	5.55	5.51	5.46	5.42	
45	5.64	5.59	5.55	5.51	5.47	5.42	5.38	5.34	

Source: Draft EPA Handbook of Methods for Acid Deposition Studies, Field Operations for Surface Water Chemistry, EPA/600/4-89/020, August 1989.

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APPENDIX O. FIELD ANALYTICAL METHODS REPORTING LIMITS

APPENDIX O.
FIELD ANALYTICAL METHODS REPORTING LIMITS

TEST KIT	REPORTING LIMITS
ENSYS PCB test kit for soils	2 ppm as Aroclor 1254
HACH Ferrous Iron Test Kit for groundwater (1,10 Phenanthroline)	0-3.00 mg/L
HACH Sulfide Test Kit (Methylene Blue)	0-0.600 mg/L