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Environmental Restoration Program

REMEDIAL INVESTIGATION/FEASIBILITY STUDY OPERABLE UNIT 9, SITE-WIDE QUALITY ASSURANCE PROJECT PLAN

REVISION 3
Final

MOUND PLANT
MIAMISBURG, OHIO

June 1993

Department of Energy
Albuquerque Operations Office

Environmental and Health Division
EG&G Mound Applied Technologies

[redacted]

9406140032

CURRENT SUMMARY OF NEEDED MODIFICATIONS TO OU 9 QAPP

AUGUST 1993

1) We are aware of the following problems with Table IV.1 and will make these changes in the next revision.

   a. Standard Operating Procedure 1.4 is at Revision 4 with the same date, we will update the table to reflect this change. Revision 4 was submitted in QAPP, Revision 2.

   b. Standard Operating Procedure 6.3 is currently at revision 2, dated June 1993.

   c. Standard Operating Procedure 6.4 is currently at revision 1 which was submitted in QAPP, revision 0 and we will update the table.

   d. Standard Operating Procedure 6.7 is currently at revision 0 which was submitted in QAPP, revision 0 and we will update the table.

2) We are aware of the following problems with Contents, page vii and will make corrections in the next revision.

   Distribution list changes need to be made for both Martha Hatcher and Kathy Koehler.

3) We are aware of the following problems with Section 6, page 6-20 and will make the corrections in the next revision.

   In footnote 5, the chemical hexachloro cyclopentadiene needs to be made one word.

4) Section 7, page 7-11

   No longer a page 7-11 because there was a repeated sentence.

5) Finalization of SOP 1.15, revision 3 is pending completion of discussions between DOE DAO and OEPA.

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bc w/o Table IV.2,
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ENVIRONMENTAL RESTORATION PROGRAM

REMEDIAL INVESTIGATION/FEASIBILITY STUDY OPERABLE UNIT 9, SITE-WIDE, QUALITY ASSURANCE PROJECT PLAN

REVISION 3 FINAL

MOUND PLANT

MIAMISBURG, OHIO

June 1993

DEPARTMENT OF ENERGY

ALBUQUERQUE FIELD OFFICE

ENVIRONMENT AND HEALTH DIVISION

EG&G MOUND APPLIED TECHNOLOGIES

OPERABLE UNIT 9

SITE-WIDE REMEDIAL INVESTIGATION

QUALITY ASSURANCE PROJECT PLAN

REVISION 3, FINAL

DEPARTMENT OF ENERGY, MOUND PLANT

MIAMISBURG, OHIO

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***Laboratories will not receive Table IV.2, Appendix D, and Appendix F.**

ACRONYMS

AA	atomic absorption
AEA	Atomic Energy Act
AL	Albuquerque Operations Office
ASTM	American Society for Testing and Materials
BFB	bromofluorobenzene
BOD	biological oxygen demand
CAR	Corrective Action Report
CCC	calibration check compound
CCV	continuing calibration verification
CEARP	Comprehensive Environmental Assessment and Response Program
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CGI	combustible gas indicator
CLP	Contract Laboratory Program
COD	chemical oxygen demand
CRDL	contract-required detection limit
CRQL	contract-required quantitation limit
DAO	Dayton Area Office
DFTPP	decafluorotriphenylphosphine
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DQO	data quality objective
EDD	electronic data deliverable
EG&G	EG&G Mound Applied Technology
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
FFA	Federal Facilities Agreement
FIDLER	field instrument for the detection of low-energy radiation
FS	feasibility study
FSP	field sampling plan
GC	gas chromatography
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HPLC	high-performance liquid chromatography
HSP	Health and Safety Plan
IATA	International Air Transport Association
ICP	inductively coupled plasma
ICS	interference check sample
ICV	initial calibration verification
IDL	instrument detection limit
IT	International Technology
ITAS	International Technology Analytical Services
LANL	Los Alamos National Laboratory
LCS	laboratory control sample
LLD	lower limit of detection
LRA	linear range analysis
MCL	maximum contaminant level
MDA	minimum detectable activity

ACRONYMS (cont.)

MCLG	maximum contaminant level goal
MS	mass spectrometry
MSA	method of standard addition
MSD	matrix spike duplicate
NA	not applicable
NB	nitrobenzene
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
OVA	organic vapor analyzer
PCB	polychlorinated biphenyl
PE	performance evaluation
PID	photoionization detector
PM-10	particulates less than 10 microns
PQL	practical quantitation limit
QA	quality assurance
QAM	quality assurance manager
QAO	Quality Assurance Officer
QAP	Quality Assurance Program
QAPP	Quality Assurance Project Plan
QC	quality control
QCC	Quality Control Coordinator
RAS	routine analytical services
RCRA	Resource Conservation and Recovery Act
RD/RA	remedial design/remedial action
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RF	radio-frequency
RI	remedial investigation
ROD	Record of Decision
RPD	relative percent difference
RRF	relative response factor
RSD	relative standard deviation
SARA	Superfund Amendments and Reauthorization Act
SD	standard deviation
SOP	Standard Operating Procedure
SOW	statement of work
SPCC	system performance check compounds
SWMU	Solid Waste Management Unit
SW846	"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (U.S. Environmental Protection Agency)
TAL	Target Analyte List
TCL	Target Compound List
TDS	total dissolved solids
TNT	2,4,6-trinitrotoluene
TOC	total organic carbon
TSO	Technical Support Office
TSP	total suspended particulates
TSS	total suspended solids

ACRONYMS (cont.)

VOC	volatile organic compounds
WD	waste disposal

1. INTRODUCTION

1.1. OVERVIEW

Quality assurance is a system of measures taken to ensure that a desired product meets a defined level of quality. This Quality Assurance Project Plant (QAPP) presents the system of quality assurance to be implemented for the Operable Unit 9 remedial investigation (RI) at the Mound Plant. The plan provides specific procedures that delineate how field and laboratory data of known and accepted quality will be generated.

A system of quality assurance consists of two elements: quality control and quality assessment. Quality control is a system of procedures performed to control the quality of the product, usually with defined standards of performance for those procedures. Quality assessment is a program of activities to evaluate the performance of implemented quality control procedures and the quality of the product.

This QAPP describes the quality control procedures for sampling activities (sampling procedures in section 4 and sample custody in section 5), for field screening and field measurements (section 6), and for laboratory analyses (section 6). Specific quality control steps, defined as quality control checks, for these activities are discussed in section 8. The standards of performance, defined as acceptance criteria, for these checks are presented in section 3. Quality control procedures for calibration of field and laboratory instrumentation are outlined in section 7. The procedures for data reduction, validation, and reporting are included in section 9. As part of the quality control program, preventive maintenance procedures for equipment and instrumentation are summarized in section 11. Corrective actions for the planned field and laboratory activities are necessary for a quality control program in order to keep the quality of generated data under control. The corrective actions for these activities are provided in Section 13.

Quality assessment activities for this RI include evaluation of field and laboratory quality control data, performance and system audits, and issuing of quality assurance reports to management. Procedures for these activities are described in sections 12, 10, and 14, respectively.

In fulfilling its role of ensuring that the goals of the project are met, the quality assurance program relies on the structure of the project organization and on the effectiveness of key individuals in carrying out their

responsibilities. This report describes the project organization and identifies the individuals who are responsible for assessing the collection and generation of data and for ensuring that this data is of defined quality (Section 2).

1.2. ENVIRONMENTAL RESTORATION PROGRAM DESCRIPTION

The Environmental Restoration (ER) Program, formerly known as the Comprehensive Environmental Restoration Program and, before that, the Comprehensive Environmental Assessment and Response Program (CEARP), was initiated by the U.S. Department of Energy (DOE) Albuquerque Operations Office (AL) in 1984 to fulfill its obligations under the following environmental laws:

- the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 300);
- the Resource Conservation and Recovery Act (RCRA) (40 CFR 260-270);
- the National Environmental Policy Act of 1969 (NEPA) (volume 83, page 852 of the U.S. Statutes and chapter 42, section 4321 of the U.S. Code); and
- the Atomic Energy Act of 1954 (AEA) (volume 68, page 1919 of the U.S. Statutes and chapter 42, section 2011 of the U.S. Code).

The authority to implement the ER Program is derived primarily from the following DOE and DOE AL orders:

- CERCLA requirements (DOE Order 5400.4);
- Hazardous, Toxic, and Radioactive Mixed Waste Management (DOE Order 5480.2);
- Prevention, Control, and Abatement of Environmental Pollution (DOE Order 5480.1, Chapter XII);
- Environmental Protection, Safety, and Health Protection Information Reporting Requirements (DOE Order 5484.1); and
- Proposed DOE NEPA implementing procedures (10 CFR 1021).

The ER Program consists of three phases patterned after the U.S. Environmental Protection Agency (EPA) CERCLA program. Phase I, preliminary assessment/site inspection, was completed at Mound Plant in 1986 and reported in the installation assessment (DOE 1986). Phase II, the remedial investigation/feasibility study (RI/FS), is currently under way at Mound Plant. Phase III, remedial design/remedial action (RD/RA), will

implement the remedial alternative chosen in the FS of Phase II. The RD/RA phase includes selection of a remedy; the production of a record of decision (ROD), which describes the chosen remedial action; the design of the remedial action; and the actual performance of the remedial action.

1.3. MOUND PLANT ER PROGRAM

Mound Plant was placed on the CERCLA (Superfund) National Priorities List (NPL) in November, 1989. Pursuant to that status, a CERCLA Section 120 Federal Facility Agreement (FFA) was signed between DOE and EPA (Administrative Docket Number V-W-90-C-075), and became effective October 12, 1990. Because of this, the RI/FS process at Mound Plant, as outlined in this Work Plan, follows the methodology that the Superfund program has established for characterizing the nature and extent of risks posed by uncontrolled hazardous waste sites and for evaluating potential remedial options. This approach is a flexible process that is tailored to specific circumstances of individual sites and can be adjusted as additional information becomes available.

The goal of the ER Program at Mound Plant is to reduce adverse impacts on public health and the environment by

- reducing releases of hazardous or radioactive materials, and
- bringing all inactive wastes sites requiring remediation into compliance with existing state and federal regulations and requirements.

These goals will be accomplished, in part, by activities stemming from the RI/FS process:

- investigating the nature and extent of contamination,
- performing risk assessment(s) to identify and evaluate potential threats to human health and the environment,
- developing and evaluating remedial action alternatives to reduce these threats to acceptable levels, and
- implementing the selected remedial actions.

The FFA between the DOE and the EPA contains both the procedural and substantive requirements for RI/FS work (Administrative Docket Number V-W-90-C-075). As of January, 1991, a similar agreement was being negotiated between the DOE and the Ohio EPA.

The FFA defines the Mound Plant Site as follows:

> "'Site' shall mean any area where hazardous substances, pollutants or contaminants have come to be located, due to the activities at the Mound Plant (hereafter referred to as the Site). The U.S. EPA, after consulting with Ohio EPA and U.S. DOE, may change the Site designation on the basis of additional investigations to more accurately reflect the areas contaminated by hazardous substances, pollutants or contaminants, related in whole or in part to the Mound Plant. The work to be performed in this Agreement will conform to the definition of the Site as established by U.S. EPA."

Consistent with this definition, the DOE is proposing RI/FS activities for a broad geographic area, including the area within the Mound Plant as well as areas beyond the Mound Plant boundaries.

1.4. PROJECT DESCRIPTION

The Operable Unit 9 (Site Wide) RI/FS has two main objectives. First, the Work Plan will provide a summary of the RI/FS at Mound Plant in order to ensure that a comprehensive investigation will be performed. This objective is accomplished by summarizing the conceptual models, the migration pathways, and the potential impacts to the public and the environment for all nine operable units. Specific work to be conducted will be detailed in individual operable unit work plans. Once the individual operable unit remedial investigations are complete, the Operable Unit 9 investigation will utilize data from all the investigations in order to present a comprehensive report.

Second, specific field investigations will be conducted in Operable Unit 9 to address potential contamination and contaminant transport outside the Mound Plant boundary. These will include regional studies to ascertain the background setting of the plant. Results of these studies will be reported in a series of interim reports or technical memoranda so that the data will be available during the other operable unit investigations.

The Operable Unit 9 field investigations will include the following specific activities.

- hydrogeologic investigations of the natural plant groundwater flow system and offsite groundwater contamination to assess the effects of the plant on local water supply;
- a residential well investigation to identify and sample residential supply wells within a 2-mile radius of the plant in order to support the risk assessment;
- soil investigations that include investigations of potential releases from local leakage

of the NPDES 001 outfall pipeline and fence line and regional effects of airborne contaminant deposition;

- surface water and sediment investigations that include investigations of all watersheds originating in or passing through Mound Plant to assess surface transport of contaminants;

- meteorological and air quality investigations will be phased and will eventually include point source sampling of air emissions from potential release sites and additional monitoring in subsequent phases (an addendum to this quality assurance project plan will be required);

- an ecological assessment of the plant and its environs; and

- background measurements that will address groundwater quality in the bedrock and Buried Valley aquifer, the natural chemical character of the plant soils in the Miamisburg area, and the chemical character of surface water and sediments from small watersheds of similar geomorphic setting.

Additional investigations addressing surface features, geology and land use will not require field work, but will require the compilation of information from either existing reports or data from the field investigations above.

The current understanding of existing data, data needs, site setting, and work plan rationale, including the design of the sample network for each of these investigations, is described in the Operable Unit 9 Work Plan, sections 5, 6, 7, 8, 9, and 10, supplied as a companion document to this QAPP.

These investigations are intended to establish the current level of contamination in the groundwater, soils, sediments, and surface water that surround the plant. The investigations will also determine any air emissions as well as identify contaminants in biota. The specified parameters to be analyzed are designed to determine the presence of contaminants in representative samples, including the presence of unexpected contaminants. Parameters to be analyzed in the field and laboratory for each task of the investigation are listed in Table I.1. The selected laboratory methods of analysis for these parameters will be performed under EPA's Contract Laboratory Program (CLP) requirements where appropriate and using approved and known methodologies where available.

Objectives for data quality are discussed in the following sections of this QAPP. However, analytical levels, as defined by the EPA's "Data Quality Objectives for Remedial Response Activities" (EPA 1987), may be assigned to the planned analyses. These analytical levels were designed by the EPA to serve as guidance

for obtaining data of appropriate quality for its intended use. A general description of the typical types of analyses performed, the types of data uses, the limitations, and a generic description of data quality are provided for each analytical level (I, II, III, IV, and V) in the EPA guidance. The details of intended data usage for each task are presented in the respective sections of the Operable Unit 9 Work Plan. These analytical levels have been applied to each set of parameters to be analyzed and are presented in Table I.1 for each task of the investigation. The purpose for data collection and the media to be investigated for each task are also included in this table.

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Table I.1. Summary DQO Analytical Levels for Site-Wide Operable Unit 9 Investigations

Task	Purpose	Media	Field Parameters	Laboratory Parameters	Analytical Level[a]
Hydrogeology Characterization of the natural hydrogeologic system	Understand the hydrology in order to define potential transport pathways and to provide sufficient engineering data for development and screening of remedial action alternatives and the baseline risk assessment.	Subsurface soils and bedrock	- Lithologic logs		I
			- New well completion data		I
				- VOCs	IV
				- Semivolatile organic compounds	IV
				- TCL pesticides/PCBs	IV
				- TAL inorganics	IV
				- Bismuth	IV
				- Fluoride	IV
				- USATHAMA explosives	V
				- Nitrate/nitrite	IV
				- Chloride	IV
				- Sulfate	IV
				- Isotopic plutonium (238, 239/240)	V
				- Isotopic thorium (228, 230, 232)	V
				- Isotopic uranium (234/235, 238)	V
				- Strontium-90	V
				- Gamma spectrometry	V
				- Tritium	V
				- Total organic carbon	III
				- pH	III
				- Particle size distribution	III
				- Clay mineralogy	III
				- Cation exchange capacity	III
				- Permeability test	III
				- Relative density	III
				- Maximum density	III
				- Moisture content	III
				- Organic content	III
				- Specific gravity	III
		Groundwater	- Temperature		II
			- pH		II
			- Specific conductivity		II
			- Dissolved oxygen		II
			- Redox potential		II
			- Water level		I
			- Aquifer tests		I
			- Pumping data		I
			- Precipitation data		I

Table I.1. (page 2 of 10)

Task	Purpose	Media	Field Parameters	Laboratory Parameters	Analytical Level*
Characterization of on-plant and off-plant contamination including background wells	Determine the nature and extent of contamination and the concentration of potential contaminants.	Groundwater		- VOCs	IV
				- Semivolatile organic compounds	IV
				- TCL pesticides/PCBs	IV
				- TAL inorganics	IV
				- Bismuth	IV
				- Fluoride	IV
				- USATHAMA explosives	V
				- Nitrate/nitrite	IV
				- Nitrite	III
				- Chloride	IV
				- Sulfate	IV
				- Isotopic plutonium (238, 239/240)	V
				- Isotopic thorium (228, 230, 232)	V
				- Isotopic uranium (234/235, 238)	V
				- Radium-226	V
				- Strontium-90	V
				- Americium-241	V
				- Gamma spectrometry	V
				- Tritium	V
				- Total suspended solids	III
				- Total dissolved solids	III
				- Total organic carbon	III
				- Nutrients (TKN, TP)	III
				- Alkalinity	III
Residential Characterization of residential wells	Identify potential for contamination of groundwater in public sector for risk assessment	Subsurface soils and bedrock	- Lithologic logs (if available)		I
			- Stratigraphy data (if available)		I
			- Well completion data (if available)		I
		Groundwater	- Temperature		II
			- pH		II
			- Specific conductivity		II
			- Dissolved oxygen		II
			- Redox potential		II
			- Water level		I
			- Aquifer tests (if available)		I
			- Pumping data (if available)		I
			- Precipitation data (if available)		I

Table I.1. (page 3 of 10)

Task	Purpose	Media	Field Parameters	Laboratory Parameters	Analytical Level*
		Groundwater		- VOCs	V
				- Semivolatile organic compounds	V
				- TCL pesticides/PCBs	V
				- TAL inorganics	V
				- Fluoride	V
				- Nitrate/nitrite	V
				- Nitrite	III
				- Chloride	V
				- Sulfate	V
				- Isotopic plutonium (238, 239/240)	V
				- Isotopic thorium (228, 230, 232)	V
				- Isotopic uranium (234/235, 238)	V
				- Radium-226	V
				- Americium-241	V
				- Gamma spectrometry	V
				- Tritium	V
				- Strontium-90	V
				- Total suspended solids	III
				- Total dissolved solids	III
				- Alkalinity	III
		Sediments (cistern)		- VOCs	IV
				- Semivolatile organic compounds	IV
				- TCL pesticides/PCBs	IV
				- TAL inorganics	IV
				- Bismuth	IV
				- Fluoride	IV
				- Nitrate/nitrate	IV
				- Isotopic plutonium (238, 239/240)	V
				- Isotopic thorium (228, 230, 232)	V
				- Isotopic uranium (234/235, 238)	V
				- Tritium	V
				- Gamma spectrometry	V
				- Strontium-90	V

Table I.1. (page 4 of 10)

Task	Purpose	Media	Field Parameters	Laboratory Parameters	Analytical Level[a]
Soil Characterization of regional soils	Phase I: Collection of basic chemical data for soil types that occur on the Site to support selection of background locations	Soil	- Location - Soil type - Stratigraphic data		I I I
				- TAL inorganics - TCL pesticides/PCBs - Fluoride - Nitrate/nitrite - Chloride - Sulfate - Isotopic plutonium (238, 239/240) - Isotopic thorium (228, 230, 232) - Isotopic uranium (234/235, 238) - Tritium - Strontium-90 - Gamma spectrometry - pH - Total organic carbon	IV IV IV IV IV IV V V V V V V III III
	Phase II: Establish background chemical characteristics of Site soils	Soil	- Location - Soil type - Stratigraphic data		I I I
				- TAL inorganics - Fluoride - TCL pesticides/PCBs - Nitrate/nitrite - Chloride - Sulfate - Isotopic plutonium (238, 239/240) - Isotopic thorium (228, 230, 232) - Isotopic uranium (234/235, 238) - Strontium-90 - Tritium - Gamma spectrometry - pH - Total organic carbon	IV IV IV IV IV IV V V V V V V III III

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Task	Purpose	Media	Field Parameters	Laboratory Parameters	Analytical Level*
Sample soils in downwind directions, in major quadrants, and in areas of suspected contamination	Characterize nature and extent of airborne deposited contamination, and identify presence or absence of contamination.	Soil	- Location		I
			- Soil series		I
			- Stratigraphic data		I
				- VOCs	IV
				- TAL inorganics	IV
				- TCL pesticides/PCBs	IV
				- Bismuth	IV
				- Fluoride	IV
				- Semivolatile organic compounds	IV
				- USATHAMA explosives	V
				- Chloride	IV
				- Nitrate/nitrite	IV
				- Sulfate	IV
				- Isotopic plutonium (238, 239/240)	V
				- Isotopic thorium (228, 230, 232)	V
				- Isotopic uranium (234/235, 238)	V
				- Tritium	V
				- Strontium-90	V
				- Gamma spectrometry	V
				- Cation exchange capacity	III
				- Permeability test	III
				- Clay mineralogy	III
				- Specific gravity	III
				- Particle size distribution	III
				- Moisture content	II
				- Organic content	II
				- Relative density	III
				- Maximum density	III
				- pH	III
				- Total organic carbon	III

Table I.1. (page 6 of 10)

Task	Purpose	Media	Field Parameters	Laboratory Parameters	Analytical Level*
Sample groundwater at seeps in conjunction with soil sampling at seeps		Groundwater (seeps)	- Temperature		II
			- pH		II
			- Specific conductivity		II
			- Dissolved oxygen		II
			- Redox potential		II
			- Flow rate		II
				- VOCs	IV
				- TAL inorganics	IV
				- Bismuth	IV
				- Fluoride	IV
				- Semivolatile organic compounds	IV
				- TCL pesticides/PCBs	IV
				- USATHAMA explosives	IV
				- Chloride	IV
				- Nitrate/nitrite	IV
				- Sulfate	IV
				- Isotopic plutonium (238, 239/240)	V
				- Isotopic thorium (228, 230, 232)	V
				- Isotopic uranium (234/235, 238)	V
				- Radium-226	V
				- Tritium	V
				- Americium-241	V
				- Strontium-90	V
				- Gamma spectrometry	V
				- Total dissolved solids	III
				- Total suspended solids	III
				- Ammonia	III
				- Nutrients (TKN, TP)	III
				- Total organic carbon	III
				- Alkalinity	III

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Table I.1. (page 7 of 10)

Task	Purpose	Media	Field Parameters	Laboratory Parameters	Analytical Level*
Surface Water and Sediment Characterization of on-plant and off-plant surface water and sediments	Establish surface transport of contamination to support risk assessment and selection of remedial action alternatives.	Sediments	- Volume (depth, area)		I
			- Stratigraphic data		I
				- VOCs	IV
				- TCL pesticides/PCBs	IV
				- Semivolatile organic compounds	IV
				- TAL inorganics	IV
				- Bismuth	IV
				- Fluoride	IV
				- Lithium	IV
				- Molybdenum	IV
				- Isotopic plutonium (238, 239/240)	V
				- Isotopic thorium (228, 230, 232)	V
				- Isotopic uranium (234/235, 238)	V
				- Strontium-90	V
				- Gamma spectrometry	V
				- Tritium	V
				- USATHAMA explosives	V
				- Nitrate/nitrite	IV
				- Chloride	IV
				- Sulfate	IV
				- Particle size distribution	III
				- Specific gravity	III
				- Cation exchange capacity	III
				- pH	III
				- Total organic carbon	III
				- Moisture content	III
				- Organic content	III
				- Permeability	III
				- Relative density	III
				- Maximum density	III

Table I.1. (page 8 of 10)

Task	Purpose	Media	Field Parameters	Laboratory Parameters	Analytical Level[a]
Characterization of on-plant and off-plant surface water and sediments (continued)	Establish surface transport of contamination to support risk assessment and selection of remedial action alternatives (continued).	Surface water (high and low flow)	- Temperature		II
			- pH		II
			- Specific conductivity		II
			- Dissolved oxygen		II
			- Redox potential		II
			- Flow rate		II
				- VOCs	IV
				- TCL pesticides/PCBs	IV
				- Semivolatile organic compounds	IV
				- TAL inorganics	IV
				- Lithium	IV
				- Molybdenum	IV
				- Bismuth	IV
				- Fluoride	IV
				- Isotopic plutonium (238, 239/240)	V
				- Isotopic thorium (228, 230, 232)	V
				- Isotopic uranium (234/235, 238)	V
				- Radium-226	V
				- Strontium-90	V
				- Americium-241	V
				- Gamma spectrometry	V
				- Tritium	V
				- Nutrients (TKN, TP)	IV
				- Nitrate/nitrite	IV
				- Chloride	IV
				- Sulfate	IV
				- Total suspended solids	III
				- Total dissolved solids	III
				- USATHAMA explosives	IV
				- Ammonia	III
				- Total organic carbon	III
				- Alkalinity	III
		Water (impounded)	- Temperature		II
			- pH		II
			- Specific conductivity		II
			- Dissolved oxygen		II
			- Redox potential		II

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Table I.1. (page 9 of 10)

Task	Purpose	Media	Field Parameters	Laboratory Parameters	Analytical Level*
Characterization of on-plant and off-plant surface water and sediments (continued)	Establish surface transport of contamination to support risk assessment and selection of remedial action alternatives (continued).	Water (impounded) (continued)		- VOCs	IV
				- TCL pesticides/PCBs	IV
				- Semivolatile organic compounds	IV
				- TAL inorganics	IV
				- Lithium	IV
				- Molybdenum	IV
				- Bismuth	IV
				- Fluoride	IV
				- Isotopic plutonium (238, 239/240)	V
				- Isotopic thorium (228, 230, 232)	V
				- Isotopic uranium (234/235, 238)	V
				- Radium-226	V
				- Americium-241	V
				- Gamma spectrometry	V
				- Strontium-90	V
				- Tritium	V
				- Nutrients (TKN, TP)	IV
				- USATHAMA explosives	V
				- Nitrate/nitrite	IV
				- Chloride	IV
				- Sulfate	IV
				- Total suspended solids	III
				- Total dissolved solids	III
				- Total organic carbon	III
				- Ammonia	III
				- Alkalinity	III
Ecological	Provide a detailed inventory of flora and fauna; identify sensitive environments, endangered species, and related food chains; define and delineate habitat types across the Site as wells as the types of communities typical of contaminated and noncontaminated areas.	Terrestrial fauna (reptiles, amphibians, mammals, and birds)	- Field biotic inventory (4 times/year)		I
Ecological field assessments			- Collect vouchers		I
		Terrestrial flora (grass, forbs, shrubs, and trees)	- Field biotic inventory (4 times/year)		I
			- Collect vouchers		I
			- Map vegetation types		I
		Aquatic fauna (fish, macrobenthos)	- Field biotic inventory for abundance/diversity (2 times/year)		I
			- Collect vouchers		I
		Aquatic flora (plants)	- Field biotic inventory for abundance/diversity (2 times/year)		I
			- Collect vouchers		I

Table I.1. (page 10 of 10)

Task	Purpose	Media	Field Parameters	Laboratory Parameters	Analytical Level*
Air Air Quality	To characterize emissions from contaminated sites	Air	Phase I: None Phase II: To be determined		

*As defined in "Data Quality Objectives for Remedial Response Activities," EPA-540/G-87/003, discussed in Section 15.
Notes:
Explosives include the 11 USATHAMA explosives: HMX; RDX; 1,3,5-TNB; 1,3-DNB; NB; Tetryl; 2A,4,6-DNT; 2,4,6-TNT; 2,6-DNT; 2,4-DNT; and PETN.
Onsite screening for plutonium-238 and thorium-232 is performed using a FIDLER detection system calibrated to detect these isotopes.
PCBs - polychlorinated biphenyls
TAL - Target Analyte List, includes dissolved and/or total metals and cyanide
TCL - Target Compound List
VOC - volatile organic compound

2. PROJECT ORGANIZATION AND RESPONSIBILITY

Project organization and responsibility are divided among the DOE ER Program Group, which includes the following: the DOE Albuquerque Field Office; the DOE Dayton Area Office and its operating contractor, EG&G Mound Applied Technologies, Inc. (EG&G); and the ER Program EG&G subcontractors. The currently identified EG&G subcontractor for Operable Unit 9 is Roy F. Weston, Inc. (WESTON). If additional EG&G subcontractors are identified at a later date, this section of the QAPP will be revised.

DOE AL has primary responsibility for overall ER Program implementation activities; the Dayton Area Office has program direction and review responsibility. Roy F. Weston, Inc., will carry out the Operable Unit 9 field investigation at Mound Plant and will be responsible for reviewing data.

Figure 2.1 illustrates the specific lines of authority and communication for Operable Unit 9. EPA Region V is responsible for review and approval of this QAPP. The EPA Region V Central Regional Laboratory and/or Central District Office Regional Laboratory are responsible for performing external audits of the Operable Unit 9 field activities. The Central Regional Laboratory is also responsible for performing external audits of all laboratories. Additional review and approval is provided by the Ohio EPA.

2.1. OPERATIONAL RESPONSIBILITIES

The DOE is organized into divisions that have tiered elements at DOE Headquarters, DOE AL, and the Dayton Area Office. One of these divisions is the Environment, Safety, and Health Division, which includes the Environment and Health Group. The DOE AL has an ER Program Group that is responsible for ER Program implementation at all seven installations within the DOE AL. Descriptions of the operational responsibilities of each entity are as follows:

- DOE Dayton Area Office. The DOE Dayton Area Office (DAO) is the signatory to the FFA with EPA, and has the Remedial Project Manager (RPM), Mr. Arthur William Kleinrath. As the agreement signatory, the DAO is directly accountable for all substantive procedural requirements of the agreement, including quality assurance.

- EG&G Mound Applied Technologies, Inc. EG&G is the operations and maintenance (O&M) contractor at Mound Plant and has an environmental compliance structure.

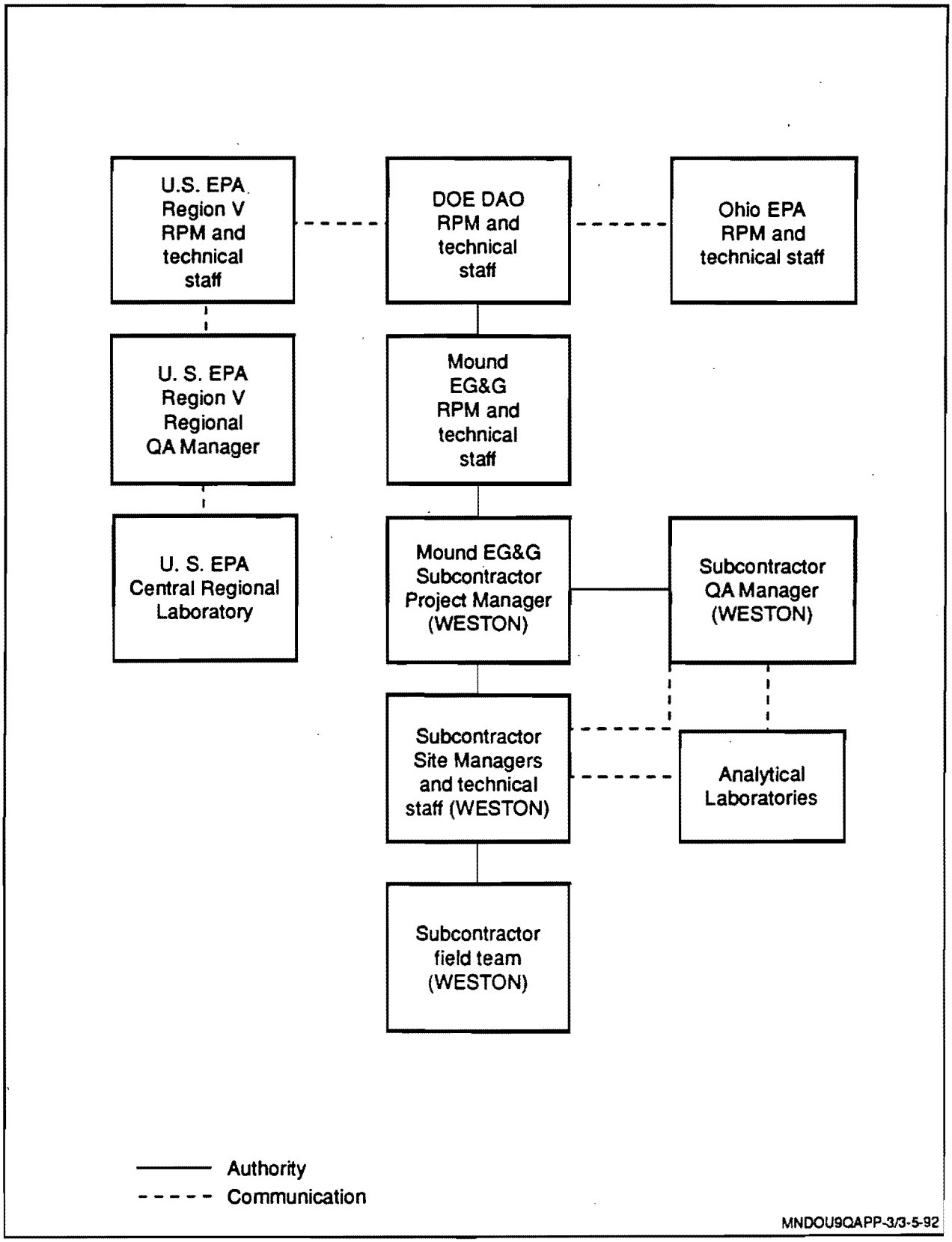

Figure 2.1. Operable Unit 9 organizational chart.

paralleling that of the DOE. EG&G has a manager responsible for environment, safety, and health (Warren Smith) and a subsidiary manager responsible for environment (Charles Friedman). The Mound Plant environmental assessment and planning group has functions that include environmental compliance and waste management. Katherine Koehler is responsible for the project management of Operable Unit 9. The EG&G employs a technical support subcontractor, WESTON, based in Albuquerque, New Mexico. WESTON will perform the assessment of the Operable Unit 9 data.

The WESTON project manager, John W. Thorsen, P.E., is responsible for implementing contracted ER Program activities. His primary responsibilities are to provide access to the resources of the subcontractor organization and to ensure project quality, timeliness, and cost-effectiveness. The project manager also is the primary point of contact between EG&G and WESTON.

The WESTON alternate project manager, John Price, is responsible for the daily management of the project and support staff. In addition to being responsible for the work plan and schedules, the installation manager coordinates the work and serves as the liaison to the EG&G manager. Based upon reports from the quality assurance manager (QAM), the installation manager will ensure that sampling and analyses are conducted in full compliance with the QAPP and will initiate corrective actions, if necessary, that are suggested by the QAM.

WESTON site managers are responsible for day-to-day implementation of the work plans and quality assurance plans. The site managers are responsible for coordinating daily activities and providing the installation manager with current accomplishments and problems.

The WESTON Quality Assurance Manager (QAM), Cemantha Davisson, is responsible for the development and implementation of the project QAPP. The QAM also conducts internal performance and system audits of laboratory, field, and project activities and ensures corrective action(s) are performed.

The WESTON Quality Assurance Officer (QAO), Martha Mitchell, is responsible for implementing QA procedures and conducts systems and performance audits at field and office locations to verify that published QA procedures are properly followed.

The WESTON Data Administrator, Tina Sanchez, is responsible for receiving field and laboratory data, ensuring that the data is filed and distributed, and verifying data entry into the database.

DOE AL. DOE AL has line authority over DAO. It is responsible for program management and has a designated project manager, Mr. David Flynn.

2.2. FIELD TEAM RESPONSIBILITIES

The subcontractor field team responsibilities for the Operable Unit 9 limited field investigation will consist of performing the field activities specified in the Operable Unit 9 Work Plan. The field team will have four identified positions: the field team leader, site health and safety coordinator (SHSC), field technicians, and sample document control administrator. The field team leader is responsible for directing the field activities specified in the Work Plan and communicates progress and any issues to the subcontractor site manager. The SHSC is responsible for ensuring that the health and safety guidelines specified in the Health and Safety Plan are followed. He or she will be trained in first aid and CPR. It is the responsibility of the SHSC to make sure safe work practices are implemented and to report all incidents that occur during the field activities.

The field technicians are responsible for conducting the field activities, as specified in the Work Plan, under the supervision of the field team leader.

A member of the field team will be designated the sample document control administrator. He or she will be responsible for tracking the locations sampled and for ensuring that samples are properly labeled and documented prior to shipment to the laboratory. The administrator ensures that the sample control procedures specified in this QAPP are followed.

2.3. LABORATORY RESPONSIBILITIES

Laboratory responsibilities for this investigation will consist of performing analytical services according to guidelines presented in this QAPP, reporting all laboratory nonconformances should they occur, and transmitting quality-assured data packages. The currently designated project analytical laboratories are noted in the laboratory specifications attachments. Laboratory specifications attachments will include those topics discussed in the QAPP, including laboratory responsibilities, which are specific to a given laboratory. Those topics are 1) analyses to be performed, 2) laboratory responsibilities, 3) laboratory sample custody procedures, 4) laboratory quantitation limits (outside the project required limits), 5) laboratory data reduction procedures, 6) laboratory data validation procedures, 7) preventive maintenance, and 8) specific procedures to assess precision, accuracy, and completeness (if different from the QAPP).

Other laboratories may be used to perform selected analyses depending upon whether the required laboratory services and scheduling requirements can be met. When an additional laboratory is included for services, an additional laboratory specifications attachment will be prepared and submitted to US EPA for approval. At this time, a laboratory has not been identified for the analysis of groundwater and residential well samples. An attachment for the laboratory performing the analyses will be prepared and submitted when the laboratory is identified. These laboratories must also meet the quality assurance requirements presented in this QAPP.

This section identifies the various general responsibilities within the analytical laboratories. Specific laboratory responsibilities and position titles vary with each laboratory, and therefore, will be discussed in the laboratory specifications attachments. The quality assurance program defined in this QAPP takes precedence over equivalent sections in the laboratory quality assurance manuals, unless otherwise referenced. Sections of the laboratory quality assurance manuals may be referenced in the laboratory specifications attachment where they directly apply and when more information is available in the manuals.

The laboratories identified for this program must assume the following general quality assurance responsibilities:

- laboratory management will:
    - approve the quality assurance manual, project specific requirements, and standard operating procedures;
    - approve laboratory reports;
    - implement the quality assurance program (QAP) for the laboratory;
    - oversee the training program;
    - evaluate analytical techniques, instrumentation, and quality control procedures;
    - assure that project QAPPs are implemented in the laboratory;
    - develop and approve corrective actions to out of control situations;

- supervisors for a given analytical group will:
    - supervise analysts;
    - schedule analyses;
    - review analytical data; and
    - report out of control and nonconforming situations to management.
- the quality assurance group will:
    - monitor the implementation of the QAPP;
    - prepare quality control samples to be inserted into the sample stream;
    - notify management of out of control situations;
    - perform quality assurance audits;
    - perform quality assurance training program; and
    - perform statistical analyses on the quality control results.
- analysts/technicians will:
    - report out-of-control situations;
    - perform their assigned tasks in accordance with the established and requested protocols; and procedures; and
    - perform data processing.

2.4. QUALITY ASSURANCE RESPONSIBILITIES

Quality assurance for the environmental investigation is the responsibility of all ER Program personnel. Responsibilities include detailed monitoring and review of all procedures used to perform every aspect of the remedial investigation. All personnel involved with the ER Program activities will strictly adhere to the implementation of the QAPP, Mound Plant ER Program SOPs, analytical laboratory procedures, data acceptance criteria, and data reporting schedules.

Primary responsibility for project quality rests with the ER Program EG&G subcontractor project manager. Specific responsibilities include the management of quality assurance issues as they relate to the ER Program, ensuring that nonconformances are corrected, and ensuring the overall quality, timeliness, and cost-effectiveness of the activities performed by ER Program EG&G subcontractors. The project manager is also responsible for coordinating and maintaining consistency between this QAPP and those of the various subcontractors at the Mound Plant and across the ER Program as a whole.

The Quality/Assurance project officer (QAO) is independent of project line management to ensure no conflict of interest in implementing and monitoring the Quality Assurance/Control Program. The direct tie to the subcontractor's Corporate QA also ensures consistent interpretation and application of various QA guidance documents and programs (e.g., EPA, DOE, ASTM, USATHAMA, TQM, etc.).

The responsibilities of the QAO for the project are:

- Prepares and implements project QA procedures to provide controls consistent with the requisite quality of project deliverables. Identifies appropriate QA/QC source documents (such as EPA QAMS-005, DOE ER Program SOPs, ASME NQA-1) and applicable elements.

- Ensures, through document review, that the project execution documents, such as work plans, adequately reflect the guidance from the source documents.

- Verifies, through systems and performance audits at field and office locations, that published and approved QA/QC procedures are properly and completely followed and appropriate for the technical activities performed. All audits result in documentation of the findings, recommendations for improvement, and/or corrective measures for any deficiencies. Reports of surveillance, audits, and corrective actions are given to the Project Manager, his staff, and the Corporate Director of Quality Assurance.

The QAM has responsibility for quality assurance/quality control within the project. This person will document compliance with this QAPP and Mound Plant SOPs. The project QAM's responsibilities include the following:

- performing internal system and performance, laboratory, audits;

- development and implementation of the QAPP;

- ongoing review of individual quality assurance procedures;

- overall quality assurance for project activities;
- ensuring that laboratory activities are consistent with the objectives and requirements of this QAPP;
- coordination of quality assurance training;
- quality assurance for field activities;
- serve as field/laboratory liaison to resolve custody and sample problems;
- overall coordination of the quality assurance/quality control plan;
- project quality assurance/quality control; and
- periodic reports to management, including suggestions for performing and verifying corrective actions.

Although it is the QAM's responsibility to ensure compliance with this QAPP, it is the responsibility of the installation and site managers to implement the quality assurance program and to maintain a strong line of communication with the QAM.

The QAO, QAM, and the designated auditor will have the following qualifications at minimum:

- Bachelors degree in an appropriate scientific discipline and five years of work experience in RI/FSs with a focus on quality assurance, and
- Two years of experience in performing field activities (for field auditors), or
- Two years of experience in an environmental analytical laboratory (for laboratory auditors).

The QAM is also responsible for validating and assessing analytical data. Either the QAM or his or her designee will perform data validation. The following minimum qualifications are required to perform data validation:

- Bachelors degree in chemistry,
- Two years of work experience in an environmental analytical laboratory, and
- Two years of experience in performing data validation activities.

If a validator having all three qualifications cannot be obtained with all reasonable attempts, a validator having at least one of the qualifications will be obtained and the work product will be reviewed by an individual with all the minimum qualifications.

Subcontractors generating data for the RI are responsible for ensuring that the precision, accuracy, completeness, and representativeness of their data are known and documented. To ensure that responsibilities are uniformly met, each subcontractor will be required to adhere to this QAPP and to Mound Plant ER Program SOPs.

An ER Program EG&G subcontractor internal kickoff meeting will be held before field work begins to review the operable unit-specific project work and quality assurance plan(s) and procedures. The kickoff meeting will be attended by, at a minimum, the following ER Program EG&G subcontractor personnel: the project manager or deputy project manager, the installation manager, the site manager, the field manager, the project QAM, and all personnel assigned to the field effort. Attendance at this meeting will be documented to provide evidence of quality assurance indoctrination for the field activities to be conducted during the RI at Mound Plant. Such documents are to be maintained by the QAM and filed in the Mound Plant project file.

3. QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, COMPLETENESS, REPRESENTATIVENESS, AND COMPARABILITY

The overall quality assurance objectives for field sampling, field measurements, and laboratory analysis are to produce data of known and sufficient quality to support the site evaluation and the selection of remedial alternatives. Appropriate procedures and quality control checks will be used so that known and acceptable levels of accuracy and precision are maintained for each data set. This section defines the objectives (goals) for accuracy, precision, completeness, representativeness, and comparability for measurement data. These goals are primarily expressed in terms of acceptance criteria for the quality control checks performed. The field and laboratory quality control checks planned for this investigation are presented in Tables III.1 through III.3 and are defined in Section 8 of this QAPP. Quality assurance goals for field measurements and field screening are also discussed.

3.1. ACCURACY

3.1.1. Definition

Accuracy of measurement data is defined as the degree of a measurement, X, with an accepted reference or true value, T. It is usually expressed as the difference between the two values, X - T, the difference as a percentage of the reference of true value, 100(X - T)/T, and sometimes expressed as a ratio, X/T. These expressions give a measure of the bias in a system.

3.1.2. Accuracy Goals for Field Screening and Field Measurements

Field measurements will include pH, specific conductance, dissolved oxygen, alkalinity, oxidation-reduction potential, water level, and temperature of surface water and groundwater samples. Field screening will include organic vapor and combustible gas levels, low energy gamma radiation, and alpha surface contamination. Accuracy is measured with a calibration check (source check for radiation measurements) for all of these parameters except water level and temperature. Table III.1 summarizes the quality control checks, acceptance criteria, and corrective actions taken for accuracy.

3.1.3 Accuracy Goals for Laboratory Measurements

Accuracy of laboratory analyses will be assessed using the following quality control checks: calibration

Table III.1. Summary of Quality Control Procedures for Field Screening and Field Measurements

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
SOP 2.2	pH	Calibration with two buffer solutions (pH 4 and 7 or 7 and 10) (for accuracy)	Before and after a well purge	± 0.1 units of true value	Recalibrate; check pH meter; replace probe and meter if necessary.
		Calibration check with one buffer solution (for accuracy)	Once per well, after alkalinity analysis	± 0.1 units of true value	Recalibrate.
SOP 2.2	Electrical conductivity	Calibration (3 standards) (for accuracy)	Before and after sample shift	± 10% of true value	Recalibrate; check meter; replace probe or meter if necessary.
		Calibration check (1 standard) (for accuracy)	One per ten or fewer field samples collected	± 20% of true value	Recalibrate.
SOP 2.2	Temperature	Duplicate sample (for precision)	One per ten or fewer field samples collected	± 1°C	Evaluate data usability.
		Calibration (for accuracy)	NA	± 2°C (manufacturer's specification)	NA

NA - Not Applicable

Table III.1. (page 2 of 4)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
SOP 2.2	Dissolved O_2	Duplicate sample (for precision)	One per ten or fewer field samples collected.	$\leq$ 20% RPD	Evaluate data for usability.
		Calibration (for accuracy)	One per day	$\pm$ 10% of expected value	Recalibrate; check probe and meter; replace if necessary.
SOP 6.1	Combustible gas level	Calibration (1 standard) (for accuracy)	Once per day	$\pm$ 10% of true value	Recalibrate.
		Duplicate standard (for precision)	Once per day	$\pm$ 20% of initial calibration	Remeasure.
SOP 6.2	Organic vapor level (PID)	Initial calibration (for accuracy)	Once per day	$\pm$ 10% of true value	Recalibrate.
		Duplicate standard (for precision)	Once per day	$\pm$ 20% of initial calibration	Remeasure.
SOP 3.1	Water level	Duplicate measurement (for precision)	Once per well sampled	$\pm$ 0.02 feet of first reading	Remeasure.
SOP 3.3	Water level (transducer)	Depth response (for accuracy)	Once per test	$\leq$ 2-5% difference, measured vs. recorded	Return transducer to the manufacturer for calibration.

NA - Not Applicable

Table III.1. (page 3 of 4)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
SOP 6.7	Low-energy gamma radiation	Source check (for accuracy)	Once per day	± 3xSD	Check instrument settings (voltage, gain, etc.); remeasure source.
		Background check (for accuracy)	Once per day	± 3xSD	Clean detector and nearby surfaces; ventilate room; recheck.
		Voltage plateau (for accuracy)	Once per week	Voltage should be 1100 to 1300V	Check voltage setting and re-plateau beginning at 900V. If still outside range, replace probe and check again. Do not exceed 1400V.
		Replicate measurement (for precision)	Once every 10 measurements	± 4xSD	Identify and correct problem; remeasure.
SOP 6.4	Alpha surface contamination	Source check (for accuracy)	Once per day or after instrument adjustments or repairs	± 10% of expected value	Check instrument settings (gain, voltage, etc.) recheck; replace if still out.
		Background count (10 minutes) (for accuracy)	Once per day	≤ 2 cpm	Clean detector and nearby surfaces; check for light leaks; replace probe if necessary.
		Replicate measurement (for precision)	once every 10 measurements	± 4xSD	Identify and correct problem, remeasure.
SOP 6.3	Organic Vapor Level (FID)	Calibration (for accuracy)	Once per day	± 10% of true value	Recalibrate
		Duplicate Standard (for precision)	Once per day	± 20% of initial calibration	Identify and correct problem; remeasure

NA - Not Applicable

Table III.1. (page 4 of 4)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
SOP 2.2	Oxidation-Reduction Potential	Calibration (for accuracy)	Once per day	± 10% of true value	Recalibrate; check meter; replace electrode and meter if necessary.
		Duplicate sample (for precision)	One per ten or fewer field samples collected	≤ 20% RPD	Evaluate data for useability.
SOP 6.16	Gamma-Ray Fields	Source check (for accuracy)	Once per day	± 10% of known value	Check instrument settings, recheck; replace if still outside criteria.
		Background check (for accuracy)	Once per day	± 10% of previous value	Check instrument settings, recheck; replace if still outside criteria.

NA - Not Applicable

Table III.2. Summary of Quality Control Procedures For Field Activities and Laboratory Measurements: Surface Water/Groundwater and Soil/Sediment Samples

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
NAS 1962[a] NAS 1965[a] NAS 1960[a] ASTM D2460-70[c] EML Am-01[4]	Isotopic uranium Isotopic plutonium Isotopic thorium Radium-226 Americium-241	Field quality control			
		Duplicate	1 every 10 or fewer field samples (water)	+ 4 x SD[a,b]	Evaluate data for useability.
			1 every 10 or fewer field samples (soil)	Not Applicable	Evaluate variability.
		Equipment (rinsate) blank[a]	1 every 10 or fewer field samples (water)	≤ 10 x level in associated samples[1]	Evaluate potential sources; Evaluate associated data for useability.
		Laboratory quality control			
		Background (1000 minutes)	Once per week	For background subtraction; minimum detectable activity	Identify and correct problem; recount
		Pulse check	Once per day	Peak counts at 6 meV ± 3 x SD	Identify and correct problem; recheck.
		Method blank	1 per 20 samples of a similar matrix	≤ 2 x MDA	Identify and correct problem. Reanalyze blank.

Table III.2. (page 2 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
NAS, 1962[a] NAS, 1965[a] NAS, 1960[b] ASTM D2460-70[c] EML Am-01[d] (continued)	Isotopic uranium Isotopic plutonium Isotopic thorium Radium-226 Americium-241	Method spike	1 per 20 samples of a given matrix or 1 whenever a batch of samples is prepared in a day, whichever is more frequent	± 3 x SD[e] normalized deviations	Identify and correct problem; evaluate associated sample results for useability.
		Matrix spike	1 per 20 samples of a similar matrix	± 3 x SD[e] normalized deviations	Evaluate data for useability.
		Replicate sample	1 per 20 samples of a similar matrix	+ 4 x SD[e,f] normalized range	Evaluate data for useability.
E906.0[g]	Tritium	Field quality control			
		Duplicate	1 every 10 or fewer field samples (water)	+ 4 x SD[e,f,i]	Evaluate data for useability.
			1 every 10 or fewer field samples (soil)	Not applicable	Evaluate variability.
		Equipment (rinsate) blank[4]	1 every 10 or fewer field samples (water)	≤ 10 x level in associated samples[i]	Evaluate potential sources; Evaluate associated data for useability.
		Laboratory quality control			
		Background	Once per day	+ 3 x SD, limit-gross contamination; background subtracts	Identify and correct problem.
		Source check	Once per day	± 3 x SD	Identify and correct problem.

Table III.2. (page 3 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
E906.0[a] (continued)	Tritium	Method blank	1 per 20 samples of a given matrix or 1 whenever a batch of samples is prepared in a day, whichever is more frequent	$\leq$ 2 x MDA	Identify and correct problem; reanalyze blank.
		Method spike	1 every 20 or fewer field samples of a similar matrix	$\pm$ 3 x SD[e] normalized deviations	Identify and correct problem; associated sample results for useability.
		Matrix spike	1 every 20 or fewer field samples of a similar matrix	$\pm$ 3 x SD[e] normalized deviation	Identify and correct problem; evaluate associated sample results for useability.
		Replicate sample	1 every 20 or fewer field samples of a similar matrix	+ 4 x SD[e,i] normalized range	Identify and correct problem; associated sample results for useability.
Nuclear Data, Inc., 1986[h]	Gamma radiation	Field quality control			
		Duplicate	1 every 10 or fewer field samples (water) 1 every 10 or fewer field samples (soil)	+ 4 x SD[e,i] Not applicable	Evaluate data for useability. Evaluate variability.
		Equipment (rinsate) blank[a]	1 every 10 or fewer field samples (water)	$\leq$ 10 x level in associated samples[i]	Evaluate potential sources; Evaluate associated data for useability.
		Laboratory quality control			
		Background (10 minutes)	Once per day	No identifiable peaks; $\pm$ 20% error	Identify and correct problem; recount.

Table III.2. (page 4 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
Nuclear Data, Inc., 1986[4] (continued)	Gamma radiation	Background (1000 minutes)	Once per month	Not Applicable; Stored for background subtraction	Not Applicable
		Source check	Once per day	± 3 x SD	Identify and correct problem; recount.
		Mixed standard	Initial setup and as necessary	Full range energy, linearity and efficiency calibration ± 5% of known standard	Not Applicable
		Replicate sample[1]	1 every 20 or fewer samples of a similar matrix	+ 4 x SD[a,f] normalized range	Identify and correct problem; evaluate associated sample results for useability.
NAS 1960[1] Martin 1979[2] PHS 1985[3]	Strontium-90	Field Quality Control			
		Duplicate	1 every 10 or fewer field samples (water)	+ 4 x SD [a,f]	Evaluate data for useability.
			1 every 10 or fewer field samples (soil)	Not applicable	Evaluate variability.
		Equipment (rinsate) blank[d]	1 every 10 or fewer field samples (water)	≤ 10 x level in associated samples[1]	Evaluate potential sources; Evaluate associated data for useability.
		Laboratory Quality Control			
		Method blank	Once per day	≤ 2 x MDA	Identify and correct problem; reanalyze.
		Background check	Once per week	+ 3 x SD, limit-gross contamination	Identify and correct problem; recheck.
		Instrument reliability	Once per day	+ 3 x SD	Identify and correct problem; recheck.

Table III.2. (page 5 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
NAS 1960[1] Martin 1979[2] PHS 1965[3] (continued)	Strontium-90	Method spike	1 per 20 samples of a similar matrix	± 3 x SD Normalized deviations	Identify and correct problem; evaluate associated sample results for useability.
		Matrix spike	1 per 20 samples of a similar matrix	± 3 x SD Normalized deviations	Evaluate data for useability.
		Replicate sample	1 per 20 samples of a similar matrix	+ 4 x SD Normalized range	Evaluate data for useability.
		Plateau	Once per year	Not Applicable	Not Applicable
		Efficiency determination	Once per year	Not Applicable	Not Applicable
CLP SOW[1]	Organochlorine pesticides/PCBs (TCL)[5]	Field quality control			
		Duplicate	1 every 10 or fewer field samples (water) 1 every 10 or fewer field samples (soil)	≤ 35% RPD[1] N/A	Evaluate data for useability. Evaluate variability.
		Equipment (rinsate) blank[4]	1 every 10 or fewer field samples (water)	≤ 10 x level in associated samples[1]	Evaluate potential sources; evaluate associated data for useability.
		Laboratory quality control			
		Method blank	1 per 20 samples of a given matrix or 1 whenever a batch of samples is prepared in a day, whichever is more frequent; see CLP SOW	≤ CRQL; surrogate retention times per CLP SOW	Investigate source; Reextract and reanalyze associated samples. See CLP SOW.
		Sulfur cleanup blank	When portion of samples require sulfur clean up	≤ CRQL; surrogate retention times per CLP SOW	Investigate source; reextract and reanalyze associated samples. See CLP SOW.

Table III.2. (page 6 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
CLP SOW[1] (continued)	Organochlorine pesticides/PCBs (TCL)[4]	Instrument blank	CLP SOW	CLP SOW	See CLP SOW.
		Matrix spike	1 per 20 samples of a given matrix in a case or fewer; see CLP SOW	See Table III.3; surrogate retention times per CLP SOW	Evaluate data for useability.
		Matrix spike duplicate	1 per 20 samples of a given matrix in a case or fewer; see CLP SOW	See Table III.3; surrogate retention times per CLP SOW	Evaluate data for useability.
		Laboratory Control Sample	1 per 20 samples of given matrix or 1 whenever a batch of samples is prepared in a day, whichever is more frequent	See Table III.3	Evaluate associated data for useability.
		Surrogate spike	All lab and field samples	See Table III.3	Evaluate data for useability.
		Calibration (initial and continuing)	CLP SOW	CLP SOW	Recalibrate, see CLP SOW.
		GC/MS confirmation	Any sample with a detection from the TCL list for pesticides/PCBs	CLP SOW	See CLP SOW.
		Retention times and Retention time window	CLP SOW	CLP SOW	See CLP SOW.

Table III.2. (page 7 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
CLP SOW[1] Modification D	Volatile organic compounds	Field quality control			
		Trip blank	1 per shipping container to Lab	≤ 10 x level in associated samples[1]	Evaluate potential sources; Evaluate associated data for useability.
		Ouplicate	1 every 10 or fewer field samples (water) 1 every 10 or fewer field samples (soil)	≤ 35% RPD[1] N/A	Evaluate data for useability. Evaluate variability.
		Equipment (rinsate) blank[4]	1 every 10 or fewer field samples (water)	≤ 10 x level in associated samples[1]	Evaluate potential sources; Evaluate associated data for useability.
		Sample bank blank[5]	1 every 20 or fewer field samples	≤ 10 x level in associated samples[1]	Evaluate potential sources; Evaluate associated data for useability.
		Ambient blank	1 every 20 or fewer field samples	≤ 10 x level in associated samples[1]	Evaluate potential sources; Evaluate associated data for useability.
		Laboratory quality control			
		Method blank	Once per 12-hour period	≤ 5 x CRQL of [1] ≤ CRQL others	Investigate source; reanalyze associated samples.
		Matrix spike	1 per 20 samples of a given matrix in a case or fewer; see CLP SOW	See Table III.3	Evaluate data for useability.
		Matrix spike duplicate	1 per 20 samples of a given matrix in a case or fewer; see CLP SOW	See Table III.3	Evaluate data for useability.
		Laboratory Control Sample	Once per 12-hour period	See Table III.3	Evaluate associated data for useability.

Table III.2. (page 8 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
CLP SOW[1] Modification D (continued)	Volatile organic compounds	System monitoring compounds	All lab and field samples	See Table III.3	See CLP SOW.
		Instrument performance check	Daily or each 12-hour period, whichever is more frequent	CLP SOW	Retune; Reanalyze associated samples.
		Calibration	CLP SOW	CLP SOW	Recalibrate before sample analysis.
		Retention time window	CLP SOW	± 0.06 relative retention time units (sample and standard)	See CLP SOW.
		Qualitative verification	When a detection occurs in a sample	CLP SOW	See CLP SOW.
		Calibration check	With every calibration	CLP SOW	Recalibrate.
		Internal standard	Every standard and sample	CLP SOW	See CLP SOW.
		Continuing calibration check	Once each 12-hour period	CLP SOW	Identify source and correct. Recalibrate if source not found and corrected.

Table III.2. (page 9 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
8021	Volatile organic compounds	Field quality control			
		Trip blank	1 per shipping container to lab	≤ 10 x level in associated samples[1]	Evaluate potential sources; Evaluate associated data for useability.
SW8030[m]	Acrylonitrile, Acetonitrile				
		Duplicate	1 every 10 or fewer field samples (water)	≤ 35% RPD[1]	Evaluate data for useability.
		Equipment (rinsate) blank[e]	1 every 10 or fewer field samples (water)	≤ 10 x level in associated samples[1]	Evaluate potential sources; Evaluate associated data for useability.
		Sample bank blank[e]	1 every 20 or fewer field samples	≤ 10 x level in associated samples[1]	Evaluate potential sources; Evaluate associated data for useability.
		Ambient blank	1 every 20 or fewer field samples	≤ 10 x level in associated samples[1]	Evaluate potential sources; Evaluate associated data for useability.
		Laboratory quality control			
		Method blank	1 per 20 samples of a given matrix or 1 whenever a batch of samples is prepared in a day, whichever is more frequent	<PQL	Identify and correct source. Reanalyze blank and associated samples.
		Calibration	5 points; when calibration check criteria exceeded	≤ 20% RSD for calibration factors	Recalibrate.
		Calibration check	Once per 10 samples analyzed	± 15% from initial response factor	Recalibrate.

Table III.2. (page 10 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
SW8021[m] SW8030[m] (continued)	Volatile organic compounds Acrylonitrile, Acetonitrile	Matrix spike	1 per 20 samples of a given matrix	See Table III.3	Evaluate data for useability.
		Matrix spike duplicate	1 per 20 samples of a given matrix	See Table III.3	Evaluate data for useability.
		Surrogate spikes	All field and lab samples	See Table III.3	Check calculations, surrogate and standard solutions, and instrument. If problem not identified then reanalyze sample.
		Retention time window	When new column installed and as needed	± 3 x SD of three retention times for each analyte as per SW846	Identify source, correct problem.
		Laboratory control sample (LCS)	1 per 20 samples of a given matrix or 1 whenever a batch of samples is prepared in a day, whichever is more frequent	See Table III.3	Identify and correct problem prior to further sample analyses, reanalyze.
CLP SOW[l] Modification D	Semivolatile organic compounds	Field quality control			
		Duplicate	1 every 10 or fewer field samples (water) 1 every 10 or fewer field samples (soil)	≤ 55% RPD[l] Not Applicable	Evaluate data for useability. Evaluate variability.
		Equipment (rinsate) blank[a]	1 every 10 or fewer field samples (water)	≤ 10 x level in associated samples[l]	Evaluate potential sources; Evaluate associated data for useability.

Table III.2. (page 11 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
CLP SOW[1] Modification D (continued)	Semivolatile organic compounds	Laboratory quality control			
		Method blank	1 per 20 samples of a given matrix or whenever a batch of samples is prepared in a day, whichever is more frequent; see CLP SOW	≤ 5 x CRQL phthalate esters ≤ CRQL others	Investigate source; reextract and reanalyze associated samples.
		Matrix spike	1 per 20 sample of a given matrix or fewer; see CLP SOW	See Table III.3	Evaluate data for useability.
		Matrix spike duplicate	1 per 20 samples of a given matrix or fewer; see CLP SOW	See Table III.3	Evaluate data for useability.
		Laboratory Control Sample (LCS)	1 per 20 samples of a given matrix or 1 whenever a batch of samples is prepared in day, whichever is more frequent	See Table III.3	Evaluate data for useability.
		Surrogate spike	All lab and field samples	See Table III.3	See CLP SOW.
		Instrument performance check	Daily or each 12-hour period, whichever is more frequent	CLP SOW	Retune; reanalyze associated samples.
		Calibration	CLP SOW	CLP SOW	Recalibrate before sample analysis.
		Calibration check	With every calibration	CLP SOW	Recalibrate.
		Internal standard	Every standard and sample	CLP SOW	See CLP SOW.

Table III.2. (page 12 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
CLP SOW[1] Modification D (continued)	Semivolatile organic compounds	Continuing calibration check	Once each 12-hour period	CLP SOW	Identify source and correct. Recalibrate if source not found and corrected.
		Retention time window	CLP SOW	± 0.06 relative retention time units (sample and standard)	See CLP SOW.
		Qualification verification	When a detection occurs in a sample	CLP SOW	See CLP SOW.
CLP SOW[2] Modification A	Metals and cyanide or calcium, potassium, sodium, magnesium, iron, and manganese	Field quality control			
		Duplicate	1 every 10 or fewer field samples (water)	≤ 25% RPD[3]	Evaluate data for useability.
			1 every 10 or fewer field samples (soil)	Not Applicable	Evaluate variability.
		Equipment (rinsate) blank[4]	1 every 10 or fewer field samples (water)	≤ 10 x level in associated samples[5]	Evaluate potential sources; Evaluate associated data for useability.
		Laboratory quality control			
		Initial and continuing calibration blanks (ICB, CCB)	After every ICV and CCV or 10% or every 2 hours, whichever is more frequent	≤ CRDL	Correct problem; recalibrate; reanalyze preceding 10 samples or all since last good blank.

Table III.2. (page 13 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
CLP SOW* Modification A (continued)	Metals and cyanide or calcium, potassium, sodium, magnesium, iron, and manganese	Preparation blank (PB)	1 per 20 samples of a given matrix or 1 whenever a batch of samples is prepared in a day, whichever is more frequent; see CLP SOW	≤ CRDL	If sample results < 10 x CRDL, but > CRDL, redigest and reanalyze.
		Laboratory control sample (LCS)	1 per group of samples in a delivery group or batch, whichever is more frequent	80-120% Recovery	Correct problem; redigest and reanalyze associated samples.
		Initial calibration verification std. (ICV)	CLP SOW	CLP SOW	See CLP SOW.
		Continuing calibration verification std. (CCV)	CLP SOW	CLP SOW	See CLP SOW.
		Linear range check standard (CRI, CRA) (ICP and AA only)	CLP SOW	Not established	None.
		Interference check sample (ICS) (ICP only)	Sample twice per 8-hour shift, or at beginning and end of analysis run, whichever is more frequent	± 20% of true value	Correct problem; recalibrate reanalyze samples since last good ICS.

Table III.2. (page 14 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
CLP SOW* Modification A (continued)	Metals and cyanide or calcium, potassium, sodium, magnesium, iron, and manganese	ICP Serial dilution (L) (ICP only)	1 per group of samples of a given matrix, concentration, or each delivery group, whichever is more frequent	If result > 50 x IDL: ± 10% difference	Evaluate data for useability.
		Spike sample (S)	1 per group of samples of a given matrix, concentration, or sample delivery group, whichever is more frequent.	75-125% Recovery	Evaluate data for useability.
		Sample dup. (D) (sample replicate)	1 per group of samples of a given matrix, concentration, or sample delivery group, whichever is more frequent.	If result ≥ 5 x CRDL: ± 20% RPD If result ≤ 5 x CRDL: ± CRDL	Evaluate data for useability.
		Method std. addition GFAA* only (MSA)	CLP SOW	CLP SOW	See CLP SOW.
		Linear range analysis (LRA) (for ICP only)	CLP SOW	CLP SOW	Reanalyze.

Table III.2. (page 15 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
CLP SOW[7] Modification A (continued)	Metals and cyanide or calcium, potassium, sodium, magnesium, iron, and manganese	Interelement corrections (for ICP only)	Once per year or or when instrument adjusted	CLP SOW	CLP SOW.
E325.1[4]/SW9250[m]	Chloride, (Cl)	Field quality control			
E325.2[4]/SW9251[m]					
E353.2[4]	Nitrate-Nitrite (NO_3-NO_2)				
E375.2[4]	Sulfate (SO_4)				
E351.3[4]	Total nitrogen, (N)	Duplicate	1 every 10 or fewer field samples (water)	$\leq$ 25% RPD[1]	Evaluate data for useability.
E365.1[4]	Total phosphorus (P)				
E354.1[4]	Nitrite		1 every 10 or fewer field samples (soil)	Not Applicable	Evaluate variability.
E340.2[4]	Fluoride				
E350.1/350.3[4]	Ammonia				
		Equipment (rinsate) blank[6]	1 every 10 or fewer field samples (water)	$\leq$ 10 x level in associated samples[1]	Evaluate potential sources; Evaluate associated data for useability.
		Laboratory quality control			
		Method blank	1 per 20 samples of a given matrix or 1 whenever a batch of samples is prepared in a day, whichever is more frequent	<PQL	Correct problem; reanalyze.
		Calibration (3 points) and Reagent Blank	When instrument conditions change or when calibration check criteria exceeded	Correlation coefficient $\geq$ 0.995 or plot curve for nonlinear analytes	Recalibrate

Table III.2. (page 16 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
E325.1[a]/SW9250[m]	Chloride, (Cl)	Calibration check	Prior to sample analysis and one per 20 samples analyzed	± 15% of initial calibration response	Identify and correct problem; recalibrate.
E325.2[a]/SW9251[m]					
E353.2[a]	Nitrate-Nitrite (NO_3-NO_2)				
E375.2[a]	Sulfate (SO_4)				
E351.3[a]	Total nitrogen, (N)				
E365.1[a]	Total phosphorus (P)				
E354.1[a]	Nitrite				
E340.2[a]	Fluoride	Matrix spike	1 per 20 samples of a given matrix	75-125% Recovery	Evaluate data for useability.
E350.1/350.3[a] (continued)	Ammonia				
		Matrix spike duplicate	1 per 20 samples of a given matrix	≤ 20% RPD	Evaluate data for useability.
		Laboratory Control Sample (chloride, nitrate)	1 for each calibration	Vendor specification	Evaluate data for useability.
E160.1[a]	Total dissolved solids (TDS)	Field quality control			
E160.2[a]	Total suspended solids (TSS)	Duplicate	1 every 10 or fewer field samples (water)	≤ 25% RPD[l]	Evaluate data for useability.
		Equipment (rinsate) blank[e]	1 every 10 or fewer field samples (water)	≤ 10 x level in associated samples[l]	Evaluate associated data for useability.
		Laboratory quality control			
		Method blank	1 per 20 samples of a given matrix or 1 whenever a batch of samples is prepared in a day, whichever is more frequent	<PQL	Identify and correct problem. Reanalyze blank.

Table III.2. (page 17 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
E160.1[a] E160.2[a] (continued)	Total dissolved solids (TDS) Total suspended solids (TSS)	Replicate sample	1 per 20 samples analyzed	≤ 20% RPD	Reanalyze a replicate sample; report both results.
		Laboratory control sample (LCS)	1 per 20 samples analyzed	80 - 120%	Identify and correct problem.
E415.1[a]/E415.2[a]	Total organic carbon (TOC)	Field quality control			
		Duplicate	1 every 10 or fewer field samples (water)	≤ 35% RPD[f]	Evaluate data for useability.
			1 every 10 or fewer field samples (soil)	Not Applicable	Evaluate variability.
		Equipment (rinsate) blank[d]	1 every 10 or fewer field samples (water)	≤ 10 x level in associated samples[f]	Evaluate associated data for useability.
		Laboratory quality control			
		Method blank	1 per 20 samples of a given matrix or 1 whenever a batch of samples is prepared in a day, whichever is more frequent	<PQL	Correct problem; reanalyze blank.
		Calibration	When instrument conditions change or when calibration check criteria exceeded	Second reading must be within 25% of initial	Recalibrate.
		Calibration check	1 per 20 samples analyzed	± 15% of initial calibration response	Recalibrate.
		Matrix spike (MS)	1 per 20 samples of a given matrix	75-125% Recovery	Evaluate data for useability.

Table III.2. (page 18 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
E415.1[a]/E415.2[a] (continued)	Total organic carbon (TOC)	Matrix spike duplicate (MSD)	1 per 20 samples of a given matrix	≤ 20% RPD	Evaluate data for useability.
		Replicate sample	4 analyses for every sample	≤ 25% RSD	Reanalyze aqueous samples once. Evaluate soil samples considering inhomogeneity. Reanalyze aqueous samples if no matrix effects.
SW8330[m]	Explosives	Field quality control			
		Duplicate	1 every 10 or fewer field samples (water)	≤ 35% RPD[i]	Evaluate data for useability.
			1 every 10 or fewer field samples (soil)	Not Applicable	Evaluate variability.
		Equipment (rinsate) blank[d]	1 every 10 or fewer field samples (water)	≤ 10 x level in associated samples[i]	Evaluate potential sources; Evaluate associated data for useability.
		Laboratory quality control			
		Method blank	1 per 20 samples of a given matrix or 1 whenever a batch of samples is prepared in a day, whichever is more frequent	<PQL	Reanalyze blank.
		Calibration	(5 pt.) when calibration check limit criteria exceeded	≤ 20% RSD	Recalibrate.
		Surrogate Spike[5]	All lab and field samples	See Table III.3	Reanalyze

Table III.2. (page 19 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
SW8330[a] (continued)	Explosives	Matrix spike (MS)	1 per 20 samples of a given matrix	See Table III.3	Evaluate data for useability.
		Matrix spike duplicate (MSD)	1 per 20 samples of a given matrix	See Table III.3	Evaluate data for useability.
		Laboratory Control Sample (LCS)	1 per 20 samples of a given matrix or 1 whenever a batch of samples is prepared in a day, whichever is more frequent	See Table III.3	Evaluate data for useability.
		Retention time window	With every calibration check	Column and Compound Specific	Identify source, correct problem; reanalyze samples since last good calibration check.
		Calibration check	Prior to sample analysis and 1 per 10 samples analyzed	± 15% of peak height of initial calibration	Recalibrate.
		Secondary column confirmation	Every positive detection ≥ PQL	Not Applicable	Evaluate positive identification of analyte.
E310.1	Alkalinity	Field quality control			
		Duplicate	1 every 10 field samples	≤ 35% RPD[1]	Evaluate data for useability.
		Laboratory quality control			
		Method blank	1 per 20 samples of a given matrix or 1 whenever a batch of samples is prepared in a day, whichever is more frequent	≤ PQL	Identify and correct source; Reanalyze blank prior to sample analysis.
		Calibration	pH 4 and 7 standards; once every 10 samples	± 0.1 units of true value	Recalibrate; check pH meter, replace probe and meter if necessary.
		Calibration check	After initial calibration with pH 4 standard	± 0.1 units of true value	Recalibrate.

Table III.2. (page 20 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
SW9081[m]	Cation exchange capacity (CEC)	Field quality control			
ASTM D422-63[l] ASTM D854-83[l] ASTM D-2974[l]	Particle size analysis Specific gravity Organic content and moisture content	Duplicate (for soil pH, alkalinity only)	1 every 10 field samples (soil)	Not applicable	Evaluate variability.
ASTM D-2434[l] ASTM D-4253[l], D-4254	Hydraulic conductivity Relative density	Laboratory quality control			
SW9045[m] E310.1[n] ASTM D-4253[l]	Soil pH Alkalinity Maximum density	Method blank (CEC) analyzed	1 per 20 samples	as per SW846	Identify source; correct problem, reanalyze blank.
502.2[v]	Volatile organic compounds[v]	Field Quality Control			
		Duplicate	1 every 10 or fewer field samples (water)	≤ 25% RPD[l]	Evaluate data for useability.
		Trip blank	1 per shipping container to laboratory	≤ 10 x level in associated samples[l]	Evaluate potential sources; evaluate associated data for useability.
		Equipment (rinsate) blank	1 every 10 or fewer field samples collected.	≤ 10 x level in associated samples[l]	Evaluate potential sources; evaluate associated data for useability.
		Sample bank blank	1 every 10 or fewer field samples collected.	≤ 10 x level in associated samples[l]	Evaluate potential sources; evaluate associated data for useability.
		Ambient blank	1 every 10 or fewer field samples collected.	≤ 10 x level in associated samples[l]	Evaluate potential sources; evaluate associated data for useability.

Table III.2. (page 21 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
602.2[v] (continued)	Volatile organic compounds[v]	Laboratory Quality Control			
		Laboratory reagent blank (method blank)	1 per 10 samples of a given matrix or 1 whenever a batch of samples is prepared in a day, whichever is more frequent	≤ PQL	Identify and correct problem; reanalyze blank and associated samples.
		Laboratory fortified blank (blank spike)	1 every 20 samples analyzed of a given matrix	80-120%; 20% RSD	Identify and correct problem prior to further sample analysis.
		Calibration	5 points; when calibration check criteria exceeded	≤ 10 % RSD for calibration factors	Recalibrate.
		Calibration check	Once every day or every 10 samples, whichever is more frequent.	± 20% RPD from initial response factor	Recalibrate.
		Matrix spike	1 every 10 samples of a given matrix	See Table III.3	Evaluate data for useability.
		Matrix spike duplicate	1 every 10 samples of a given matrix	See Table III.3	Evaluate data for useability.
		Surrogate spike	Every field and laboratory sample	See Table III.3; method 602.2	Evaluate data for useability.
		Check standard	Once every 10 or fewer samples analyzed	60-140% recovery	Reanalyze failed analyte.

Table III.2. (page 22 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
602.2[v] (continued)	Volatile Organic Compounds[v]	Low level check	Once per week	60-140% recovery	Identify and correct problem; reanalyze check for the failed analytes.
		Laboratory control sample	Once every 20 or fewer sample analyzed.	80-120%; SD ≤ 30% of result.	Reanalyze LCS for failed analytes.
		Retention time windows	When new column installed and as needed	± 0.1 minutes	Identify source, correct problem.
		Secondary column confirmation	Every positive detection ≥ PQL	Not Applicable	Evaluate positive identification of analyte.
CLP SOW [v,x] Modification B	Metals, CN[v]	Field quality control			
		Duplicate	1 every 10 or fewer field samples (water)	≤ 25% RPD[1]	Evaluate data for useability.
		Equipment (rinsate) blank	1 every 10 or fewer field samples (water)	≤ 10 x level in associated samples[1]	Evaluate potential sources, evaluate associated data for useability.
		Laboratory quality control			
		Initial and continuing calibration blanks (ICB, CCB)			
		- ICP, mercury, cyanide	After every ICV and CCV or 10% or every 2 hours, whichever is more frequent	≤ IDL	Correct problem; recalibrate; reanalyze preceding 10 samples or all since last good blank.

Table III.2. (page 23 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
CLP SOW [illegible]* Modification B (continued)	Metals, CN*	- graphite AA	One every 5 samples	≥ IDL	Correct problem; recalibrate; reanalyze preceding 5 samples or all since last good blank.
		Preparation blank (PB)	One every sample delivery group or batch of 10 samples, whichever is more frequent.	≤ CRDL	If sample results < 10 x CRDL, but > CRDL, redigest and reanalyze.
		Laboratory control sample (LCS)	One every sample delivery group or batch of 10 samples, whichever is more frequent.	85-115% recovery	Correct problem; redigest and reanalyze associated samples.
		Initial calibration verification std. (ICV) and continuing calibration verification std. (CCV)			
		- ICP, mercury, cyanide	Per CLP SOW	Per CLP SOW	See CLP SOW.
		- Graphite AA	Initially ICV, and CCV every 5 samples	90-110% recovery	See CLP SOW.
		Linear range check standard (CRI, CRA) (for ICP and AA only)	Per CLP SOW	Not established	None.

Table III.2. (page 24 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
CLP SOW [illegible] Modification B (continued)	Metals, CN[illegible]	Interference check sample (ICS) (for ICP only)	Per CLP SOW	Per CLP SOW	See CLP SOW.
		ICP Serial dilution (L) (for ICP only)	Per CLP SOW	Per CLP SOW	See CLP SOW.
		Spike sample (S)	One every group of samples of similar matrix, concentration, sample delivery group or batch of 10 samples, whichever is more frequent	85-115% recovery 80-120% recovery Hg, Cn	Evaluate data for useability.
		Sample duplicate (D) (sample replicate)	One every group of samples of similar matrix, concentration, sample delivery group, or batch of 10 samples, whichever is more frequent	10% RPD or < IDL difference 15% RPD Hg, Cn	Evaluate data for useability.
		Method std. addition (MSA), GFAA only	Per CLP SOW	Per CLP SOW	See CLP SOW.
		Linear range analysis (LRA) (for ICP only)	Per CLP SOW	Per CLP SOW	See CLP SOW.
		Interelement corrections (for ICP only)	Once per year or when instrument is adjusted	CLP SOW	See CLP SOW

Table III.2. (page 25 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
CLP SOW[a] Modification C	Lanthanides	Field quality control			
		Duplicate	1 every 10 or fewer field samples (water)	≤ 25% RPD[i]	Evaluate data for useability.
			1 every 10 or fewer field samples (soil)	Not Applicable	Evaluate variability.
		Equipment (rinsate) blank[e]	1 every 10 or fewer field samples (water)	≤ 10 x level in associated samples[i]	Evaluate potential sources; evaluate associated data for useability.
		Laboratory quality control			
		Initial and continuing calibration blanks (ICB, CCB)	After every ICV and CCV or 10% or every 2 hours, whichever is more frequent	≤ CRDL	Correct problem; recalibrate; reanalyze preceding 10 samples or all since last good blank.
		Preparation blank (PB)	1 per 10 samples of a given matrix or 1 whenever a batch of samples is prepared in a day, whichever is more frequent	≤ CRDL	If sample results < 10 x CRDL, but > CRDL, redigest and reanalyze.
		Laboratory control sample(LCS)	1 per group of samples in a delivery group or batch, whichever is more frequent	80-120% recovery	Correct problem; redigest and reanalyze associated samples.
		Initial calibration verification aid (ICV)	CLP SOW	CLP SOW	See CLP SOW.
		Continuing calibration verification aid (CCV)	CLP SOW	CLP SOW	See CLP SOW.
		Linear range check standard (CRI, CRA)	CLP SOW	Not established	None.
		Interference check sample (ICS)	Sample twice per 8-hour shift, or at beginning and end of analysis run, whichever is more frequent	± 20% of true value	Correct problem; recalibrate reanalyze samples since last good ICS.

Table III.2. (page 26a of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
SW8290[m]	PCDD[d]	Field Quality Control			
	PCDF[d] 2,3,7,8.TCDD 2,3,7,8,TCDF	Duplicate	1 every 10 or fewer field samples	Not applicable	Evaluate variability.
		Equipment (rinsate) blank	1 every 20 or fewer field samples	≤ 10 x level in associated samples	Evaluate potential sources. Evaluate associated data for usability.
		Laboratory Quality Control			
		Method blank	1 per 20 samples or fewer of given matrix	≤ quantitation limit for all isomers except OCDD/OCDF and HpCDD/HpCDF. OCDD/OCDF and HpCDD/HpCDF must be ≤ 3 or quantitation limit	Investigate source and correct.
		Matrix spike	1 per 20 samples or fewer of a given matrix	See Table 111.3	Evaluate data for usability.
		Matrix spike duplicate	1 per 20 samples or fewer of given matrix	See Table 111.3	Evaluate data for usability.
		Tuning criteria	Beginning and end of each 12 hr period or shift whichever is more frequent	Per SW8290	Correct problem; reanalyze required standards; recalibrate if necessary
		Calibration	Initial 5 point	Per SW8290	Recalibrate before sample analysis.
		Internal standard	Every sample	40% - 135% recovery of initial standard	Perform carbon column cleanup; if still not within criteria, evaluate instrument and correct.
		Column performance check solution	Beginning of each 12-hour period and every calibration	Per SW8290	Identify source and correct.
		Continuing calibration check	Beginning and end of each 12-hour period	Per SW8290	Identify source and correct. Recalibrate if source not found and corrected.

2,3,7,8-TCOD - tetrachlorodibenzo-p-dioxin
2,3,7,8-TCDF - tetrachlorodibenzofuran
PCDD - polychlorinated dibenzo-p-dioxin
PCDF - polychlorinated dibenzofuran
RPD - relative percent difference

Table III.2. (page 26 of 27)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
CLP SOW* Modification C	Lanthanides (continued)	ICP Serial dilution (L)	1 per group of samples of a given matrix, concentration, or each delivery group, whichever is more frequent	If results > 50 x IDL ± 10% difference	Evaluate data for useability.
		Spike sample (S)	1 per group of samples of a given matrix, concentration, or sample delivery group, whichever is more frequent	75-125% Recovery	Evaluate data for useability.
		Sample dup. (D) (sample replicate)	1 per group of samples of a given matrix, concentration, or sample delivery group, whichever is more frequent	If results ≥ 5 x CRDL; ± 20% RPD If results ≤ 5 x CRDL; ± CRDL	Evaluate data for useability.
		Linear range analysis (LRA) for ICP	CLP SOW	CLP SOW	Reanalyze.
		Interelement corrections for ICP	Once per year or when instrument adjusted	CLP SOW	CLP SOW.

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[a]A sample bank blank monitors for VOCs potentially present in the surrounding environment where samples are commonly handled before shipment. The blank is prepared with organic-free deionized water in sample vials, capped with no bubbles, and placed in the desired location during sample handling.
[b]"The Radiochemistry of Plutonium," G.H. Coleman, NAS-NS-3058, National Academy of Sciences, September 1965, and "The Radiochemistry of Uranium," NAS-NS-3050, National Academy of Sciences, March 1962.
[c]"The Radiochemistry of Thorium," E.K. Hyde, NAS-NS-3004, National Academy of Sciences, January 1960.
[d]"Standard Test Methods for Radium in Water," ASTM, latest version.
[e]To be prepared for sampling locations without dedicated sampling equipment.
[f]Procedures according to "Environmental Radioactivity Laboratory Intercomparison Studies Program," U.S. EPA, EPA-600/4-81-004.
[g]"Improved Evaluation of Environmental Radiochemical Inorganic Solid Matrix Replicate Precision: Normalized Range Analysis Revisited," J.W. Dillard and R.E. Gladd, 36th Annual Conference on Bioassay, Analytical, and Environmental Radiochemistry, Oakridge, TN., 1990.
[h]"Prescribed Procedures for Measurement of Radioactivity in Drinking Water," U.S. EPA, EPA-600/4-80-032, latest version.
[i]ND 9900 VAX/VMS Spectroscopy Application Package User's Manual (09-0196), Nuclear Data, Inc., Schauumberg, IL. August 1988.
[j]Counted twice on different detectors.
[k]USEPA Contract Laboratory Program Statement of Work for Organic Analysis, Document No. OLM01.8, August 1991.
[l]Target Compound List.
[m]For methylene chloride, acetone, toluene, or 2-butanone.
[n]"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, U.S.EPA, December 1987 or most recent version.
[o]USEPA Contract Laboratory Program Statement of Work for Inorganic Analysis, Document No. ILM03.0, March 1990.
[p]Target Analyte List.
[q]Graphite furnace atomic absorption.
[r]"Methods for Chemical Analysis of Water and Wastes," U.S. EPA, EPA-600/4-79-020, revised March 1983.
[s]Soil and Rock; Dimension Stone, Geosynthetics Vol. 4.08. 1991 Annual Book of ASTM Standards Section 4 "Construction."
[t]USATHAMA Methods for Ion Nitroexplosives in Water by HPLC, and Nitroexplosives in Soils by HPLC.
[u]All field quality control samples associated with a batch of samples will be evaluated as a unit. This criterion is designed for evaluating an isolated quality control sample and does not take into account the interdependencies of quality control results. Corrective actions will be taken at all levels of detection in the blank samples associated with field sampling. The criterion applies only if there is a positive detection of the same compound in associated samples. All data will be evaluated on a case-by-case basis; therefore, this criterion may not be applicable at times (e.g., reported levels near detection limit).
[v]"Manual for the Certification of Laboratories Analyzing Drinking Water," EPA/570/9-90/008. Revision 2.0 to Method 502.2. U.S. EPA.
[w]For analysis of residential well samples.
[x]Arsenic, selenium, cadmium, lead, antimony, and thallium will be analyzed by graphite furnace atomic absorption. Zeeman background correction will be used. Deuterium background correction may be used for lead and antimony instead of Zeeman background correction.
[1]"The Radiochemistry of Barium, Calcium, and Strontium," D.N. Sunderman and D.W. Townley, NAS-NS-3010. National Academy of Sciences, January 1960.
[2]"Determination of Strontium-89 and -90 in Soil with Total Sample Decomposition," D.B. Martin, Analytical Chemistry, October 1979.
[3]"Procedures for Determination of Stable Elements and Radionuclides in Environmental Samples," Public Health Service Publication 999-RH-10. January 1965.
[4]"EML Procedures Manual," HASL-300, Environmental Measurements Laboratory, U.S. Department of Energy, 27th Edition.
[5]4-nitrotoluene and 4-netrobutene will be used for the surrogate.
[6] PCDD's and PCDF's shall include each 2378-COD/CDF cougeners, as well as total homolog concentrations for tetra through octa-CDD/CDF.

Table III.3. Laboratory Control Limits for Matrix Spikes, Matrix Spike Duplicates, and Surrogate Spikes: Surface Water/Groundwater and Soil/Sediment Samples

ANALYTICAL METHOD	SPIKING COMPOUNDS	SPIKE CONCENTRATION		ADVISORY LIMITS			
		Water	Soil	Percent Recovery (%)[a]		Relative Percent Difference (%)	
		(µg/L)	(µg/kg)[a]	Water	Soil	Water	Soil
8021	Matrix Spike[a]/LCS						
	Bromodichloromethane	•	•	42-172	60-140	≤15	≤30
Volatile	Bromoform	•	•	13-159	60-140	≤15	≤30
Organic	Carbon tetrachloride	•	•	43-143	60-140	≤15	≤30
Compounds	Chloroform	•	•	49-133	60-140	≤15	≤30
	Dibromochloromethane	•	•	24-191	60-140	≤15	≤30
	1,4-Dichlorobenzene	•	•	42-143	60-140	≤15	≤30
	1,2-Dichloroethane	•	•	51-147	60-140	≤15	≤30
	1,1-Dichloroethene	•	•	28-167	60-140	≤15	≤30
	1,1,1-Trichloroethane	•	•	41-138	60-140	≤15	≤30
	Trichloroethene	•	•	35-146	60-140	≤15	≤30
	Vinyl chloride	•	•	28-163	60-140	≤15	≤30
	Benzene	•	•	39-150	60-140	≤15	≤30
	Surrogates						
	Bromochloromethane	30	30	59-117	70-130	≤ 15	≤30
	Fluorobenzene	30	30	48-120	70-130	≤ 15	≤30
	1,4-dichlorobutane	30	30	80-140	60-140	≤ 15	≤15
	2-bromo-1 chloropropane	30	30	60-140	60-140	≤ 15	≤15
SW8030	Matrix Spike[a]/LCS						
	Acrylonitrite	•	NA	70-136	NA	≤ 15	NA
	Acetonitrite	•	NA	70-135	NA	≤ 15	NA

NA - Not Applicable

Table III.3. (page 2 of 5)

ANALYTICAL METHOD	SPIKING COMPOUNDS	SPIKE CONCENTRATION		ADVISORY LIMITS			
		Water	Soil	Percent Recovery (%)[a]		Relative Percent Difference (%)	
		(µg/L)	(µg/kg)[c]	Water	Soil	Water	Soil
CLP SOW Pesticides/ PCBs	Matrix Spike/LCS						
	Lindane	*	*	56-123	46-127	≤15	≤50
	Heptachlor	*	*	40-131	35-130	≤20	≤31
	Aldrin	*	*	40-120	34-132	≤22	≤43
	Dieldrin	*	*	52-126	31-134	≤18	≤38
	Endrin	*	*	56-121	42-139	≤21	≤45
	4,4'-DDT	*	*	38-127	23-134	≤27	≤50
	Surrogate						
	Tetrachloro-m-xylene	per CLP SOW	per CLP SOW	60-150	60-150	NA	NA
	Decachlorobiphenyl	per CLP SOW	per CLP SOW	60-150	60-150	NA	NA
CLP SOW Volatile Organic Compounds	Matrix Spike/LCS						
	1,1-DCE	*	*	61-145	59-172	≤14	≤22
	Trichloroethene	*	*	71-120	62-137	≤14	≤24
	Benzene	*	*	76-127	66-142	≤11	≤21
	Toluene	*	*	76-125	59-139	≤13	≤21
	Chlorobenzene	*	*	75-130	60-133	≤13	≤21
	Surrogates						
	Toluene-d8	per CLP SOW	per CLP SOW	88-110	84-138	NA	NA
	4-Bromo-fluorobenzene	per CLP SOW	per CLP SOW	86-115	59-113	NA	NA
	1,2-Dichloroethane-d4	per CLP SOW	per CLP SOW	76-114	70-121	NA	NA

NA - Not Applicable

Table III.3. (page 3 of 5)

ANALYTICAL METHOD	SPIKING COMPOUNDS	SPIKE CONCENTRATION		ADVISORY LIMITS			
		Water	Soil	Percent Recovery (%)[a]		Relative Percent Difference (%)	
		(µg/L)	(µg/kg)[c]	Water	Soil	Water	Soil
CLP SOW Semivolatile Organic Compounds	Matrix Spike/LCS						
	Phenol	*	*	12-110	26-90	≤42	≤35
	2-Chlorophenol	*	*	27-123	25-102	≤40	≤50
	1,4-Dichlorobenzene	*	*	36-97	28-104	≤28	≤27
	N-nitroso-di-n-propyl-amine	*	*	41-116	41-126	≤38	≤38
	1,2,4-Trichlorobenzene	*	*	39-98	38-107	≤28	≤23
	4-Chloro-3-methylphenol	*	*	23-97	26-103	≤42	≤33
	Acenaphthene	*	*	46-118	31-137	≤31	≤19
	4-Nitrophenol	*	*	10-80	11-114	≤50	≤50
	2,4-Dinitrotoluene	*	*	24-96	28-89	≤38	≤47
	Pentachlorophenol	*	*	9-103	17-109	≤50	≤47
	Pyrene	*	*	26-127	35-142	≤31	≤36
	Surrogates						
	Nitrobenzene-d5	per CLP SOW	per CLP SOW	35-114	23-120	NA	NA
	2-Fluorobiphenyl	per CLP SOW	per CLP SOW	43-116	30-115	NA	NA
	p-Terphenyl-d14	per CLP SOW	per CLP SOW	33-141	18-137	NA	NA
	Phenol-d6	per CLP SOW	per CLP SOW	10-110	24-113	NA	NA
	2-Fluorophenol	per CLP SOW	per CLP SOW	21-110	25-121	NA	NA
	2,4,6-Tribromophenol	per CLP SOW	per CLP SOW	10-123	19-122	NA	NA
	2-Chlorophenol-d4	per CLP SOW	per CLP SOW	33-110	20-130	NA	NA
	1,2-Dicholorobenzene-d4	per CLP SOW	per CLP SOW	16-110	20-130	NA	NA

NA - Not Applicable

Table III.3. (page 4 of 5)

ANALYTICAL METHOD	SPIKING COMPOUNDS	SPIKE CONCENTRATION		ADVISORY LIMITS			
		Water	Soil	Percent Recovery (%)[a]		Relative Percent Difference (%)	
		(µg/L)	(µg/kg)[c]	Water	Soil	Water	Soil
502.2 Volatile Organic Compounds	Matrix Spike/LCS						
	1,1,1-Trichloroethane	0.1-5	NA	80-120	NA	20%	NA
	1,1,2,2-Tectrachloroethane	0.1-5	NA	80-120	NA	20%	NA
	1,1-Dichloroethene	0.1-5	NA	80-120	NA	20%	NA
	1,2-Dichloroethane	0.1-5	NA	80-120	NA	20%	NA
	Benzene	0.1-5	NA	80-120	NA	20%	NA
	Bromodichloromethane	0.1-5	NA	80-120	NA	20%	NA
	Bromoform	0.1-5	NA	80-120	NA	20%	NA
	Chlorobenzene	0.1-5	NA	80-120	NA	20%	NA
	Cis-1,3-Dichloropropene	0.1-5	NA	80-120	NA	20%	NA
	Ethylbenzene	0.1-5	NA	80-120	NA	20%	NA
	Tetrachloroethene	0.1-5	NA	80-120	NA	20%	NA
	Toluene	0.1-5	NA	80-120	NA	20%	NA
	Trans-1,2-Dichloroethene	0.1-5	NA	80-120	NA	20%	NA
	Trans-1,3-Dichloropropene	0.1-5	NA	80-120	NA	20%	NA
	Trichloroethene	0.1-5	NA	80-120	NA	20%	NA
	Xylenes (total)	0.1-5	NA	80-120	NA	20%	NA
	Surrogates						
	Fluorobenzene	10	NA	80-120[e]	NA	20%	NA
	1-Chloro-2-Bromopropane	10	NA	80-120[e]	NA	20%	NA

NA - Not Applicable

Table III.3. (page 5 of 5)

ANALYTICAL METHOD	SPIKING COMPOUNDS	SPIKE CONCENTRATION		ADVISORY LIMITS			
		Water	Soil	Percent Recovery (%)[a]		Relative Percent Difference (%)	
		(µg/L)	(mg/kg)	Water	Soil	Water	Soil
SW8330 Explosives	Matrix Spike/LCS[d] (low concentration)						
	RDX	11.6	N/A	62-87	N/A	32	N/A
	1,3,5-TNB	28	N/A	85-100'	N/A	19	N/A
	2,4,6-TNT	5.8	N/A	78-102	N/A	29	N/A
	2,6-DNT	1.0	N/A	66-102	N/A	45	N/A
	2,4-DNT	0.8	N/A	74-99	N/A	31	N/A
	Matrix Spike/LCS[d] (high concentration)						
	RDX	58	22	49-71	40-160	19	30
	1,3,5-TNB	140	13	85-108	40-160	20	30
	2,4,6-TNT	29	13	83-104	40-160	19	30
	2,6-DNT	5.0	13	74-96	40-160	19	30
	2,4-DNT	4.0	3.0	77-100	40-160	20	30
	Surrogate						
	4-Nitrotoluene[h]	4.0	25	50-150	50-150	NA	NA
	4-Nitrobutene[h]	4.0	25	50-150	50-150	NA	NA
		pg/L	ng/kg				
SW8290	2,3,7,8-TCDD	200	20	60-140	60-140	±50	±50
	2,3,7,8-TCDF	200	20	60-140	60-140	±50	±50
	1,2,3,7,8-PeCDD	1000	100	60-140	60-140	±50	±50
	1,2,3,7,8-PeCDF	1000	100	60-140	60-140	±50	±50
	1,2,3,6,7,8-HxCDD	1000	100	60-140	60-140	±50	±50
	1,2,3,4,7,8-HxCDF	1000	100	60-140	60-140	±50	±50
	1,2,3,4,6,7,8-HpCDD	1000	100	60-140	60-140	±50	±50
	1,2,3,4,6,7,8-HpCDF	1000	100	60-140	60-140	±50	±50
	1,2,3,4,5,6,7,8-OCDD	2000	200	60-140	60-140	±50	±50
	1,2,3,4,5,6,7,8-OCDF	2000	200	60-140	60-140	±50	±50

2,3,7,8-TCDD - tetrachlorodibenzo-p-dioxin
2,3,7,8-TCDF - tetrachloroibenzofuran
1,2,3,7,8-PeCDD - pentachlorodibenzo-p-dioxin
1,2,3,7,8-PeCDF - pentachlorodibenzofuran
1,2,3,6,7,8-HxCDD - hexachlorodibenzo-p-dioxin
1,2,3,4,7,8-HxCDF - hexachlorodibenzofuran
1,2,3,4,6,7,8-HpCDD - heptachlorodibenzo-p-dioxin
1,2,3,4,6,7,8-HpCDF - heptachlorodibenzofuran
1,2,3,4,5,6,7,8-OCDD - octachlorodibenzo-p-dioxin
1,2,3,4,5,6,7,8-OCDF - octachlorodibenzofuran

Table III.3. (page 5a of 5)

[a]Percent recovery limits for water are those established in SW846. The control limits for soil matrix spikes and surrogates and for precision are project-established advisory limits until enough data points are generated to develop control charts.
[b]Spike amount is for low concentration soils.
[c]Control limits for sample matrix spikes have not been determined. These recoveries are based on blank spikes. Actual recoveries may vary.
[d]Control limits have not been established for solid matrices. These limits are project-established advisory limits for data evaluation purposes and not for validation and will be used until control charts have been developed.
[e]Matrix spike recoveries are advisory limits only.
[f]Actual spiking concentration may change due to performance of method validation. 4-nitrobutene is a proposed surrogate and may be changed to a different compound depending on performance data.
[g]Sample will be spiked at a concentration at least 25% above the sample concentration, unless the concentration is less than the detection limit, where the spike concentration will be 2 to 5 times the method detection limit.

NA - Not Applicable
Note: Recoveries may vary depending upon sample matrix. These recoveries are based on using reagent water.

standards, surrogate spikes of all samples, laboratory control samples, and matrix spikes of selected samples collected in the field. Surrogate spike and matrix spike results will be expressed as a recovery of an analyte added to the sample at a known concentration:

$$\% \text{ Recovery} = \frac{(SSR-SR)}{SA} \times 100\%$$

where

SSR = spiked sample result
SR = sample results (not applicable for surrogate recovery)
SA = amount of spike added.

Calibration check standards are expressed as a percent difference from the true value, i.e., 100 (X-T)/T.

Tables III.2 and III.3 summarize the frequency and acceptance criteria for the accuracy quality control checks for soil/sediment and groundwater/surface water analyses. For those analyses performed according to the procedures in the CLP, goals for accuracy are established in the CLP Statement of Work. Accuracy goals for other analyses are based on established laboratory control limits and guidance in the analytical methods.

Additional quality control checks to be performed that monitor accuracy of results are trip blanks, laboratory method blanks, sample bank blanks, ambient blanks, and equipment (rinsate) blanks. Trip blanks are analyzed for volatile organic compounds to check for cross-contamination or contamination from ambient conditions that might occur during sample shipping and storage. Method blanks are performed as part of the applicable analytical methods to monitor for contamination due to laboratory procedures. Sample bank blanks and ambient blanks monitor for potential volatile organic contaminants in common areas in the field where samples are handled. Equipment blanks are performed in order to monitor potential sources of contamination due to the sampling procedure. The frequency of these blanks for each analysis are presented in Table III.2.

3.2. PRECISION

3.2.1. Definition

Precision is a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is expressed as a standard deviation among a group of measurements or as a relative percent difference between two measurements.

3.2.2. Precision Goals for Field Measurements

Where applicable, precision of field measurements will be assessed for a selected set of parameters. Precision for alkalinity, dissolved oxygen, oxidation-reduction potential, and temperature will be measured with duplicate sample analysis for every 10 or fewer samples collected. During purging of monitor wells, specific conductance and pH measurements are performed on a continual basis, until the purge is complete and the measurements remain stable (within 10%); therefore, duplicate sample readings are not necessary to determine precision during purging of monitor wells. For measurements of combustible gas and organic vapor, precision will be assessed by analyzing the calibration standard a second time. A duplicate measurement of the water level for each well will also be performed. A replicate measurement will be made for every 10 measurements for low-energy gamma radiation and alpha surface contamination. Table III.1 summarizes the acceptance criteria for duplicate measurements, usually in terms of relative percent difference (RPD). RPD is defined as

$$RPD = \frac{C1-C2}{(C1+C2)/2} \times 100\%$$

where

C1 = Concentration of analyte in the primary sample
C2 = Concentration of analyte in the duplicate sample

3.2.3. Precision Goals for Laboratory Measurements

Precision of laboratory analyses will be assessed by analyzing duplicate samples (matrix spike duplicates), and/or by analyzing aliquots (sample replicates) of one sample. Analysis of duplicate samples measures the precision of both the sampling and analysis, whereas a sample replicate generally measures only the

analytical precision (depending upon the nature of the sample matrix). Precision of the duplicate and replicate analyses will be expressed as an RPD. Table III.2 summarizes for each laboratory analysis the frequency and acceptance criteria for duplicate and replicate samples. Precision criteria are based on CLP guidance, where available, and best technical judgement.

3.3. COMPLETENESS

Completeness is a measure of the amount of data obtained from a measurement system that achieves the project goals, compared to the amount expected under normal conditions. Completeness is affected by unexpected conditions that may occur during the data collection process. Occurrences that reduce the amount of data collected include events such as a dry well, an instrument breakdown, or a loss of sample extract. All reasonable attempts will be made to minimize loss of data (e.g., through regular maintenance of field instruments, and replacing/repairing instruments that have broken down) and to recover lost data. Completeness for this project will be calculated for a number of the criteria established in this QAPP, including accuracy and precision acceptance criteria, detection limits (expressed as quantitation limits in Tables VI.1 and VI.2), sample holding times, the number of sample points sampled, and the other analytical requirements listed on Tables III.1 through III.3 (e.g., calibration and tune criteria, and blank contamination). Completeness will be assessed for each field measurement and laboratory analysis. The following are parameters used to measure completeness of laboratory analyses:

- The number of sample holding times met.
- The number of sample analyses that meet precision criteria (on Tables III.2 through III.3).
- The number of sample analyses that meet accuracy criteria (on Tables III.2 through III.3).
- The number of sample analyses that meet calibration and tuning criteria (on Table III.2).
- The number of sample analyses with reported quantitation limits at or below the required limits (Tables VI.1 and VI.2).
- The number of sample analyses with laboratory method blanks below established criteria (on Table III.2).

It should be noted that reported quantitation limits are heavily dependent upon the nature of the sample matrix, the amount of sample used in the analysis, percent moisture (solid matrices), and the dilution factor,

if any. Therefore, samples with unusual matrices (e.g., a very high petroleum hydrocarbon content) will not be included in the completeness calculation, since the acceptance criteria developed are not based upon these matrices. However, the quality control results for these samples will be noted.

Completeness goals for this program have been established for three aspects of the scope of work: field measurements, sample collection, and laboratory analyses. The completeness goal for sample collection and field measurements is 90%. If the 90% completeness goal is not met, the necessity for resampling will be determined on a case-by-case basis due to the many factors that could impact data completeness. The completeness goal for each individual laboratory analyses is 95%. For critical data points, consisting of background samples and residential well samples, the completeness goal for sample collection and analysis is 100%. If access to a residential well is denied, or if a well is found to be dry or has been destroyed, the completeness of critical data points will be affected. If data collection for the critical data points cannot be accomplished after all reasonable attempts have been made, then the scope of work for the particular focus of investigation will be reevaluated.

Table III.4 summarizes the equations used for calculating completeness of sample collection, field measurements, and laboratory analyses. Completeness will be calculated on a routine basis (e.g., monthly) during sample collection and analysis by the Quality Assurance Manager or her designee.

3.4. REPRESENTATIVENESS

Representativeness expresses the degree to which data accurately and precisely represent characteristics of a population, parameter, variation at a sampling point, process condition, or environmental condition. Data representativeness for this project is accomplished through implementing approved sampling procedures and analytical methods that will generate data representative of site conditions. Sampling procedures to be used (Mound Plant ER Program SOP 2.2, Field Measurements on Ground and Surface Water Samples (included in Appendix A) are designed to minimally impact the sample generated so that conditions representative of the sampling location are obtained. An example of a sampling technique that achieves this is collection of a groundwater sample after a specified volume of groundwater is purged from the well so that a sample representative of the groundwater conditions is obtained. Field sampling locations (i.e., background samples, spatial distributions, sample population statistics, etc.) have been identified by evaluating all available site information. The rationale for the sample locations are described in the Operable Unit 9 Work Plan.

Analytical methods are selected that will most accurately and precisely represent the true concentration of the parameter of interest to the best of technical knowledge and to the level that suits the program's needs. The quality control procedures implemented and instrumentation used for a given analysis, for example, affect the representativeness of the data generated.

3.5. COMPARABILITY

Comparability expresses the confidence with which one data set can be compared to another. Comparability of data sets generated for this investigation will be obtained through implementation of specific protocols for sampling and analysis of samples, by the use of traceable reference materials for laboratory standards, by expressing results in comparable concentration units and by participation of the laboratories in external performance evaluation programs. The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods. The procedures to be used in obtaining the planned analytical data, as documented in the following sections, are expected to provide comparable data. These new analytical data, however, may not be directly comparable to existing data because of differences in procedures and quality assurance objectives.

Table III.4. Calculations for Completeness of Measurement Data

Sample Collection:

$$\text{Completeness} = \frac{\text{Number of sample points sampled}}{\text{Number of sample points planned}} \times 100\%$$

Field Measurements (Calculated for each type of field measurement):

$$\text{Completeness} = \frac{\text{Number of sample points sampled}}{\text{Number of sample points planned}} \times 100\%$$

Laboratory Analyses (Calculated for each analysis)[a, b]:

$$\text{Total Completeness (\%) (for a given laboratory analysis)} = \frac{\text{Number of "valid"}^{c}\text{ data points}}{\text{Number of data points collected}} \times 100\%$$

[a]Please note that completeness will be impacted by unusual sample matrices; therefore, these sample results will not be included in the calculations for completeness, but will be noted separately.
[b]Calculated for individual parameters. Completeness will be reported for each parameter for a given analysis.
[c]"Valid" data is data which has been determined usable from data validation and evaluation of qualified results.

4. SAMPLING PROCEDURES

The Operable Unit 9 investigation will follow standard operating procedures (SOPs) in performing environmental sampling and other specific field activities. Activities that will be performed as part of the investigation include the sampling of surface water and groundwater; surface and subsurface soils; and sediments. Additional activities to be performed include water level measurements, drilling and logging, and health and safety screening. These activities are discussed in detail in the Operable Unit 9 Field Sampling Plan (FSP) and the Operable Unit 9 Work Plan. However, the procedures for these activities will be summarized in this section as part of the quality assurance plan for the investigations. The SOPs developed for the Mound Plant ER Program that will be followed are listed in Table IV.1 and are provided in Appendix A of this QAPP. It should be noted that the Mound Plant ER Program SOPs have been revised in response to comments from both EPA Region V and Ohio EPA.

4.1. GENERAL PROCEDURES FOR SAMPLING

General procedures for all sampling activities address instructions to field personnel; sample control and documentation; sample containers; handling, packaging, and shipping of samples; and equipment decontamination.

4.1.1. Instructions to Field Personnel

Prior to the beginning of each type of sampling event, the field manager will meet with the assigned sampling personnel and review the purpose and objectives of the event. This meeting will provide final clarification of the sampling event details. Topics of review and discussion will include items such as sampling locations, types of samples to be collected, number of samples collected, sample numbering, preservation requirements, parameter(s) to be analyzed, sampling procedures, equipment decontamination procedures, and chain-of-custody requirements. Mound Plant ER Program SOP 1.1, General Instructions for Field Personnel (included in Appendix A), provides the procedures for instructions to field personnel.

4.1.2. Sample Control and Documentation

The steps required for sample control, sample identification, data recording, and chain-of-custody documentation are defined in Mound Plant ER Program SOP 1.3, Sample Control and Documentation (included in Appendix A). Examples of completed documentation and labels for environmental samples are presented in this SOP.

Table IV.1. Mound Plant ER Program SOPs Applicable to Operable Unit 9

Section 1 - General	Effective Date	Revision Number	Purpose
1.1 General Instructions for Field Personnel	March 1992	2	To provide field personnel with instructions regarding activities to be performed before, during, and after field investigations.
1.3 Sample Control and Documentation	March 1992	1	To define the steps necessary for sample control and identification, data recording, and chain-of-custody documentation.
1.4 Sample Containers and Preservation	March 1993	3	To provide guidance in the selection and preservation of suitable containers for samples, container cleaning, required sample volumes, sample collection, times, and the recommended holding preservation techniques for water, wastes,sediments, sludges, and soil samples.
1.5 Guide to the Handling, Packaging, and Shipping of Samples	January 1993	2	To provide a general guide for packaging and shipping samples of environmental and hazardous materials to the laboratory. In addition, instructions are provided to select the correct category for packaging and shipping samples of unknown contents.
1.6 General Equipment Decontamination	March 1992	2	To describe methods for the decontamination of field equipment potentially contaminated during sample collection.
1.8 Personnel Decontamination --Level D Protection	March 1992	1	To describe the equipment and procedures required for the decontamination of persons who have performed field activities in Level D protective clothing.
1.9 Personnel Decontamination --Level C Protection	March 1992	1	To describe the equipment and procedures required for the decontamination of persons who have performed field activities in Level C protective clothing.
1.10 Personnel Decontamination --Level B Protection	January 1991	0	To describe the equipment and procedures required for decontamination of persons who have performed field activities in Level B protective clothing.
1.15 Guide to Waste Management	February 1993	2	To provide a general guide for the management of investigation-derived materials at the Mound Plant.

Table IV.1. (page 2 of 5)

Section 2 - Water Sampling	Effective Date	Revision Number	Purpose
2.1 Presample Purging of Wells	March 1992	1	To identify well-purging procedures for evacuation of stagnant water from the well bore and its replacement by groundwater in sufficient quantities so that a water sample representative of the formation of completion can be collected.
2.2 Field Measurements on Ground and Surface Water Samnples	March 1992	2	To obtain reliable and accurate measurements of the field chemistry of water quality samples.
2.3 Sampling Monitoring Wells with a Bladder Pump	March 1992	3	To use a bladder pump to obtain representative groundwater samples at shallow depths that are beyond the capabilities of a peristaltic pump.
2.4 Sampling Monitoring Wells with a Bucket-Type Bailer	June 1991	1	To obtain a representative groundwater sample at depths beyond the range (or capability) of suction lift pumps when bailer volatile air stripping is of concern, well-casing diameters are too narrow to accept submersible pumps, or other difficult conditions are present.
2.5 Sampling Monitoring Wells with a Submersible Pump	January 1991	0	To obtain a representative sample of the groundwater at depths beyond the capabilities of peristaltic pumps when bailing and bladder pumps are ineffective.
2.6 Sampling Monitoring Wells with a Peristaltic Pump	June 1991	1	To obtain a representative groundwater sample from a shallow well (less than 26 ft deep).
2.7 Sampling Commercial/ Municipal/Domestic Wells	June 1991	1	To define guidelines for field personnel to follow in sampling commercial, municipal, and domestic wells.
2.8 Sampling for Volatile Organics	January 1991	0	To outline procedures for collecting a representative groundwater sample and transporting it from its original environment to the laboratory for analysis of trace volatile organics.

Table IV.1. (page 3 of 5)

Section 2 - Water Sampling	Effective Date	Revision Number	Purpose
2.9 Surface Water Sampling	June 1991	1	To define guidelines followed by field personnel in sampling surface water bodies and documenting all aspects of surface water sample collection.
2.10 Stream Flow Measurements Using Flumes, Velocity - Cross Sectional Area Direct Volume	March 1992	0	To define guidelines that will be followed by field personnel for measuring surface, and water flow rates in ditches, creeks, and springs using flumes, velocity cross sectional area method, and the bucket and stopwatch method.
2.11 Stream Flow Measurements Using Weirs	March 1992	0	To define guidelines that will be followed by field personnel for measuring surface water flow rates in rivers, creeks, springs, and ditches using weirs.
Section 3 - Hydraulic Testing			
3.1 Water Level Measurement	March 1992	1	To determine the depth-to-water in an open borehole, cased borehole, monitoring well, or potentiometer.
3.3 Operational Check of Pressure Transducers Used In Measuring Water Levels in Wells	September 1992	1	To describe procedures for conducting office and field checks of pressure transducers.
Section 4 - Drilling and Logging			
4.1 Soil Boring	March 1992	2	To ensure acceptable, consistent soil-boring procedures for all pertinent aspects of hazardous waste investigations.
4.1.1 Methods to Control Communications of Subsurface Contaminants Groundwater	December 1992	2	To insure that acceptable, consistent with soil-boring procedures are used to prevent communication of subsurface contaminants in vadose zone soils or landfill materials with underlying groundwater.
4.2 Rock Boring	March 1992	1	To ensure acceptable, consistent rock boring procedures for all pertinent aspects of hazardous waste investigations.

Table IV.1. (page 4 of 5)

Section 4 - Drilling and Logging	Effective Date	Revision Number	Purpose
4.3 Monitoring Well Installation	March 1992	1	To ensure acceptable, consistent monitoring well installation.
4.4 Monitoring Well Development	March 1992	1	To remove foreign materials that may have been introduced into the groundwater, well annulus, or well screen during well installation and to facilitate hydraulic communication between the screened formation and the monitoring well.
4.7 Piezometer Installation	December 1992	2	To ensure acceptable, consistent piezometer installation.
4.8 Piezometer Development	December 1992	2	To remove foreign materials that may have been introduced into the groundwater, well annulus, or well screen during well installation and to facilitate hydraulic communication between the screened formation and the piezometer.
Section 5 - Soil Sampling			
5.1 Soil and Rock Borehole Logging and Sampling	March 1992	1	To describe the physical nature of consolidated or unconsolidated subsurface earthen materials encountered during auger, rotary, or other drilling or trenching activities and collect samples of the earthen materials for further evaluation.
5.2 Soil Sampling with a Spade and Scoop	March 1992	3	To describe a method for collecting a soil sample less than 4 ft below the land surface.
5.3 Subsurface Solid Sampling with Hand Auger and Thin-Wall Sampler	March 1992	2	To define a method of collecting subsurface solid samples with a hand auger and thin-wall tube sampler.
5.4 General Soil Gas Sampling and Field Chemical Analysis	January 1991	0	To define a method that ensures acceptable, consistent soil gas sampling and on-plant analysis with a gas chromatograph for volatile organic contaminants.
5.8 Soil Sampling with a Stainless Steel Surface Soil Sampler	October 1991	1	To define procedures for collecting surface soil samples to determine the chemical and physical soil properties.

Table IV.1. (page 5 of 5)

Section 5 - Soil Sampling	Effective Date	Revision Number	Purpose
5.9 Sediment Sampling Procedures for Streams, Rivers, and Ponds	March 1992	0	To describe the methods for collecting deposited sediment samples in streams, rivers, and ponds.
Section 6 - Health and Safety			
6.1. Health and Safety Monitoring of Combustible Gas Levels	March 1992	1	To describe the equipment and proper method for monitoring combustible gas levels in order to determine when an explosion hazard exists in the work environment.
6.2. Health and Safety Monitoring of Organic with a Photoionization Detector	March 1992	1	To describe the equipment and proper method for environmental monitoring of toxic gases and vapors using a portable photoionization detector (PID).
6.3. Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector	March 1993	2	To describe the equipment and proper method for environmental monitoring of toxic gases and vapors using a portable flame ionization detector (FID).
6.4 Total Alpha Surface Contamination Measurements	January 1991	0	To provide guidance for determining levels of total surface alpha contamination on equipment, vehicles, and personnel that have been in contact with material that was potentially contaminated with alpha-emitting radionuclides.
6.7 Near Surface and Soil Sample Screening for Low-Energy Gamma Radiation Using the FIDLER	January 1991	0	To describe the procedure in which a field instrument for the detection of low-energy radiation (FIDLER) is used to monitor surfaces and soil samples for the presence of low-energy gamma radiations that accompany some alpha emissions.
6.15. Measurement of Gamma-Ray Fields Using a Sodium Iodide (NaI) Detector	January 1991	0	To describe the procedure for making count-rate measurements of a gamma-ray field with a sodium iodide (NaI) detector.

The Operable Unit 9 FSP provides the general sample identification system that will be used for samples collected as part of the RI. This system is summarized in Table IV.2.

4.1.3. Sample Containers, Preservation, and Holding Times

Mound Plant ER Program SOP 1.4, Sample Containers and Preservation (included in Appendix A), provides guidance in the selection of suitable containers for samples, requirements for container cleaning, required sample volumes, sample collection, holding times, and the recommended preservation techniques. Tables IV.3, and IV.4 summarize the required sample containers, sample volumes, preservation techniques, and holding times for each set of parameters and media to be analyzed for this investigation. The laboratory must perform all analyses and any required re-analyses within required holding times.

Sample containers will be certified clean by the manufacturer and will be cleaned by the manufacturer according to EPA standards (EPA, 1990). The manufacturer's statement of certification and analytical results will accompany each bottle lot. At least one bottle per lot number for each non-CLP analysis will be retained and enclosed in the shipping boxes. These bottles will be held until analytical results are received from the laboratory. If there is an indication that a bottle lot is contaminated with a non-CLP analyte, then a bottle lot blank will be prepared for analysis of the analyte of concern (Subsection 8.2).

4.1.4. Sample Shipment

Samples will be shipped by common overnight carrier or hand-delivered to the laboratory and are to be prepared for shipment according to Mound Plant, ER Program SOP 1.5, Guide to the Handling, Packaging, and Shipping of Samples (included in Appendix A). This SOP was developed from U.S. Department of Transportation (DOT) hazardous materials regulations (49 CFR 100-199) and regulations from the International Air Transport Association (IATA). The current DOT or applicable IATA procedures for the transportation of samples will be determined prior to sample shipment. In general, samples are to be shipped on the same day as collected, if possible, and, at the latest, the very next day. Samples collected on-site will not be shipped until Mound Plant screening results of the samples have been received. Figure 4.1 summarizes the sampling procedures.

All sample bottles will be sealed in Ziploc®, plastic bags and packed with sealed bags of ice to attempt to reach a sample temperature of 4°C. A 40 mL VOC glass vial filled with deionized water will be prepared as a "temperature blank" and packaged near the surface of the cooler contents. Immediately upon receipt by the laboratory, the temperature of the "temperature blank" will be measured. If the temperature is not between 1°C and 12°C, then the EG&G subcontractor site manager will be contacted immediately. The site manager will determine if resampling is necessary.

Table IV.2. Operable Unit 9 Site-Wide Field Sample Identification Plan

FIELD SAMPLES:

Sample Matrix	Identification Scheme
Groundwater	MND20-YYYY-ZZZZ
Surface Water	MND21-YYYY-ZZZZ
Sediment	MND22-YYYY-ZZZZ
Soil	MND23-YYYY-ZZZZ
Residential Water	MND24-YYYY-ZZZZ
Cistern Sediment	MND25-YYYY-ZZZZ
Air Samples	MND26-YYYY-ZZZZ
Ecological Samples	MND27-YYYY-ZZZZ

FIELD QUALITY CONTROL SAMPLES:

Sample	Identification Scheme
Trip Blank	MNDXX-YYYY-2ZZZ
Sample Bank Blank/Ambient Blank	MNDXX-YYYY-3ZZZ
Duplicate	MNDXX-YYYY-1ZZZ
Equipment Blank	MNDXX-YYYY-4ZZZ
Field Blank (Air)	MNDXX-YYYY-5ZZZ
Bottle Lot Blanks	MNDXX-YYYY-6ZZZ

Notes:

MND = Mound Plant
XX = sample matrix identifier
YYYY = sample location number
ZZZZ = sample round or sample depth

Field quality control samples will be assigned a sample location number and sample round of the last sample of the associated sample batch.

Table IV.3. Sample Containers, Volumes, Preservation, and Holding Times: Groundwater/Surface Water Samples

Parameters	Analytical Method	Container[a]	Minimum Volume[d]	Preservation	Holding Time[b]
Volatile Organic Compounds	SW5030/SW8021	Glass vial with Teflon-lined septum (No headspace)	Two 40 mL vials	HCl to pH <2 Cool 4°C	14 days
Acrylonitrile, Acetonitrile	SW5030/SW8030	Glass vial with Teflon-lined septum (no headspace)	Two 40-mL vials	Cool 4°C	14 days
Volatile Organic Compounds	CLP SOW and 502.2	Glass vial with Teflon-lined septum (No headspace)	Two 40 mL vials	HCl to pH <2 Cool 4°C	14 days
Semivolatile Organic Compounds	CLP SOW	Amber glass bottle with Teflon-lined lid	Two 1000 mL bottles	Cool 4°C	7 days extraction/40 days analysis[c]
Pesticides/PCBs	CLP SOW	Amber glass bottle with Teflon-lined lid	Two 1000 mL bottles	Cool 4°C	7 days extraction/40 days analysis[c]
Metals or Lanthanides	CLP SOW Modifications A, B, or C	Polyethylene bottle	1000 mL	HNO_3 to pH <2, Cool 4°C	6 months, 28 days (Mercury)

Table IV.3. (page 2 of 3)

Parameters	Analytical Method	Container[a]	Minimum Volume[d]	Preservation	Holding Time[b]
Cyanide	CLP SOW	Polyethylene bottle	1500 mL	NaOH to pH >12 Cool 4°C	14 days
Nitrate-Nitrite	E353.2	Polyethylene bottle	500 mL	H_2SO_4 to pH <2 Cool 4°C	28 days
Fluoride	E340.2	Polyethylene bottle	500 mL	Cool 4°C	28 days
Ammonia	E350.1/350.3	Polyethylene bottle	500 mL	Cool 4°C H_2SO_4 to pH <2	28 days
Nitrite	E354.1	Polyethylene bottle	150 mL	Cool 4°C	48 hours
Sulfate Chloride	E375.2 E325.1/325.2/ SW9250/9251	Polyethylene bottle	500 mL	Cool 4°C	28 days
Total Nitrogen Total Phosphorus	E351.3 E365.1	Polyethylene bottle	1000 mL	H_2SO_4 to pH < 2, Cool 4°C	28 days
Total Organic Carbon	E415.1/E415.2	Amber glass bottle with Teflon-lined lid (No headspace)	250 mL	H_2SO_4 to pH < 2, Cool 4°C	28 days
Total Dissolved Solids	E160.1	Polyethylene bottle	1000 mL	Cool 4°C	7 days

Table IV.3. (page 3 of 3)

Parameters	Analytical Method	Container[a]	Minimum Volume[d]	Preservation	Holding Time[b]
Total Suspended Solids	E160.2	Polyethylene bottle	1000 mL	Cool 4°C	7 days
Alkalinity	E310.1	Polyethylene bottle	200 mL	Cool 4°C	14 days
Explosives	SW8330	Amber glass bottle with Teflon-lined lid	1 liter	Cool 4°C	7 days extraction/ 40 days analysis[c]
Radionuclides	Nuclear Data, Inc.	Plastic cubetainer	2x4 liter	HNO_3 to pH < 2 (15 mL 1 N HNO_3 per liter)	NA
Gamma Spectrometry	1986				
Plutonium Isotopes	NAS 1965				
Thorium Isotopes	NAS 1960				
Radium-226	ASTM D2460-70				
Americium-241	EML Am-01				
Uranium Isotopes	NAS 1962				
Strontium-90	NAS 1960				
Tritium	E906.0	Glass bottle	250 mL	None	None
Dioxin/furan	SW8290	Amber glass bottle with Teflon-lined lid	Two 1000 mL bottles	Cool 4°C	30 days extraction/ 45 days analysis[b]

NOTE: Holding times for CLP analyses are based on "Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses," EPA, February 1, 1988 and "Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses," EPA, July 1,1988. The laboratory must perform all analyses and any required re-analyses within the required holding times.

[a] Sample containers will be certified cleaned by the manufacturer according to EPA standards.
[b] From date of collection.
[c] From date of extraction.
[d] For samples identified for "MS/MSD" pair or "MS", fill one additional set of containers except for VOC analysis, fill 2 additional sets of containers. Add "MS/MSD" or "MS", depending upon the analysis, on the end of the sample ID for the additional containers.

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Table IV.4. Sample Containers, Volumes, Preservation, and Holding Times: Soil/Sediment Samples

Parameters[d]	Analytical Method	Container[a]	Minimum[a] Volume/Weight	Preservation	Holding Time[b]
Volatile Organic Compounds	CLP SOW	Glass vial with Teflon-lined septum	120 mL (no headspace)	Cool 4°C	14 days
Semivolatile Organic Compounds	CLP SOW	Amber glass jar with Teflon-lined lid	100 grams	Cool 4°C	14 days extraction/ 40 days analysis[c]
Pesticides/PCBs	CLP SOW	Amber glass jar with Teflon-lined lid	100 grams	Cool 4°C	14 days extraction/ 40 days analysis[b]
Total Organic Carbon	E415.1/E415.2	Amber glass jar with Teflon-lined lid	50 grams	Cool 4°C	28 days
Soil pH	SW9045	Wide-mouth polyethylene bottle	50 grams	NA	48 hours
Metals	CLP SOW	Wide-mouth poly-ethylene bottle	100 grams	Cool 4°C	6 months, 28 days (Mercury)
Cyanide	CLP SOW	Wide-mouth poly-ethylene bottle	100 grams	Cool 4°C	14 days
Fluoride	E340.2	Wide-mouth polyethylene bottle	50 grams	Cool 4°C	28 days
Nitrate-Nitrite Chloride Sulfate	E353.2 SW9250/9251/ 325.1/325.2 E375.2	Wide-mouth poly-ethylene bottle	100 grams	Cool 4°C	28 days

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Table IV.4. (continued)

Parameters[d]	Analytical Method	Container[a]	Minimum[e] Volume/Weight	Preservation	Holding Time[b]
Cation Exchange Capacity	SW9081	Wide-mouth polyethylene bottle	100 grams	Cool 4°C	NA
Grain Size Distribution	ASTM D422-63	5-gallon wide-mouth plastic bucket	50 lbs.	NA	NA
Specific Gravity	ASTM D854-83			NA	NA
Hydraulic Conductivity	ASTM D2434-68			NA	NA
Relative Density	ASTM D4254-83			NA	NA
Maximum Density	ASTM D4253-83			NA	NA
Moisture Content	ASTM D2974-87	Wide-mouth polyethylene bottle	500 grams	Airtight	
Organic Content				Cool 4°C	7 days
Clay Mineralogy	X-ray Diffraction	Wide-mouth polyethylene bottle	100 grams	NA	NA
Explosives	SW8330	125-mL wide-mouth amber glass jar with Teflon-lined lid	100 grams	Cool 4°C	14 days extraction/ 40 days analysis[c]
Radionuclides					
Gamma Spectrometry	Nuclear Data, Inc. 1986	Wide-mouth nalgene bottle	750 grams	None	NA
Tritium	E906.0				
Plutonium Isotopes	NAS 1965				
Thorium Isotopes	NAS 1960				
Uranium Isotopes	NAS 9162				
Strontium-90	NAS 1960				
Dioxin/furan	SW8290	Amber glass jar with Teflon-lined lid	50 grams	Cool 4°C	30 days extraction/ 45 days analysis[b]

NOTE: Holding times for CLP analyses are based on "Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses," EPA, February 1, 1988 and "Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses," EPA, July 1, 1988. The laboratory must perform all analyses and any required re-analyses within the required holding times.

[a]Sample containers will be certified cleaned by the manufacturer according to EPA standards.
[b]From date of collection.
[c]From date of extraction.
[d]A 40 mL glass vial will be filled with soil for each sample requiring chemical analyses. This vial will be labelled "% moisture" and will be used to determine % moisture for reporting purposes.
[e]For samples identified for MS/MSD pair or an MS, fill one additional set of containers and add "MS/MSD" or "MS" on the end of the sample ID for the additional containers.

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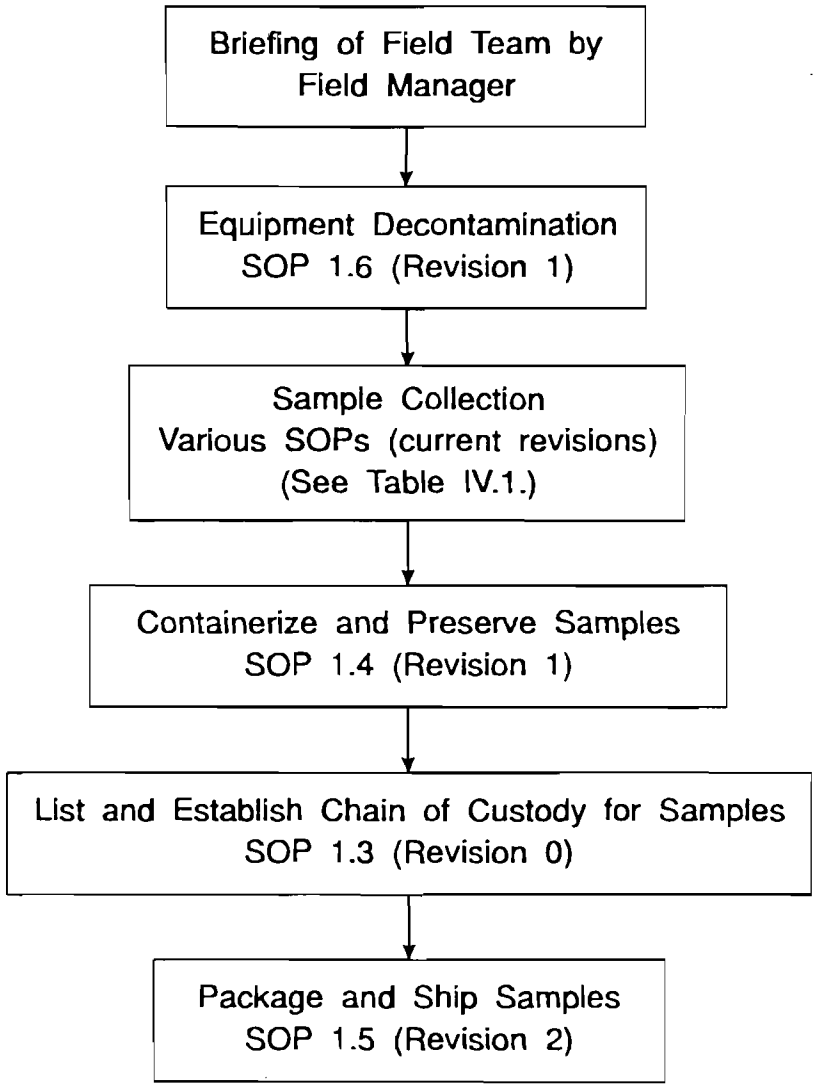

Figure 4.1. Sampling procedures flow chart.

4.1.5. Equipment Decontamination

Equipment decontamination is an integral part of the data collection and quality assurance process. The implementation of proper decontamination practices and procedures will begin in the field prior to the use of sample collection equipment. The field manager is responsible for ensuring that samples are collected with properly decontaminated equipment. All field sampling equipment will be decontaminated before use and after activities are completed at each sample location, in accordance with Mound Plant ER Program SOP 1.6, General Equipment Decontamination (included in Appendix A). Wash water and other fluids created during decontamination will be considered hazardous until determined otherwise.

4.2. WATER SAMPLING

SOPs specific to groundwater sampling and surface water sampling have been developed for the Mound Plant ER Program. A protocol for purging wells prior to sampling is presented as Mound Plant ER Program SOP 2.1, Presample Purging of Wells (included in Appendix A). Techniques for sampling monitor wells and commercial/municipal/domestic wells are established in Mound Plant ER Program SOPs 2.3 (included in Appendix A), 2.4, 2.6 and 2.7 (included in Appendix A), and SOP 2.5 (included in Appendix A). These procedures cover the sampling of monitor wells with a bucket-type bailer; a submersible pump, and a peristaltic pump. Guidelines for surface water sampling are provided in Mound Plant ER Program SOP 2.9, Surface Water Sampling (included in Appendix A).

Also included in the Mound Plant ER Program SOPs is a specific groundwater sampling protocol for volatile organic compounds, Mound Plant ER Program SOP 2.8, Sampling for Volatile Organics (included in Appendix A). This protocol ensures that a representative sample is collected and transported for volatile organic analysis.

4.3. SOIL/SEDIMENT SAMPLING

Surface and subsurface soil sampling procedures to be followed for this investigation are provided in Mound Plant ER Program SOPs 5.2, 5.3, and 5.8 (included in Appendix A). These procedures consist of protocols for sampling with a spade and scoop (surface and subsurface), subsurface soil sampling with a hand auger and thin wall sampler, and surface soil sampling with a stainless steel surface soil sampler. Soil and rock borehole logging and sampling procedures to be followed are also presented as Mound Plant ER Program SOP 5.1, Soil and Rock Borehole Logging and Sampling (included in Appendix A).

Sediment sampling will be accomplished with a spade or scoop, as outlined in Mound Plant ER Program SOP 5.2 (included in Appendix A). Specific procedures for sampling sediment in streams, rivers, and ponds are outlined in Mound Plant ER Program SOP 5.9 (included in Appendix A).

4.4. OTHER FIELD ACTIVITIES

Additional Operable Unit 9 field activities to be Included as part of the quality assurance plan are water level measurements, drilling and logging, and specific analytical field measurements. Water level measurements of depth-to-water in boreholes, monitor wells, or potentiometers will be performed according to Mound Plant ER Program SOP 3.1, Water Level Measurement (included in Appendix A). Drilling and logging procedures for soil and rock borings, monitor wells and piezometers are specified in Mound Plant ER Program SOPs 4.1, 4.1.1, 4.2, 4.3, 4.4, 5.1, 4.7, and 4.8 (included in Appendix A). Procedures for analytical field measurements are discussed in Section 6 of this QAPP.

4.5. SUMMARY OF SAMPLING ACTIVITIES

Table IV.5 summarizes the sampling and analysis program for phase I of the investigation. Included are the number of samples and their frequency. The dioxin/furan analysis has been included in Sections 3, 4, 6, 8, and 9 for other OU investigations.

Table IV.5. Summary of Sampling and Analysis Program

Sample Matrix	Field Parameters	Laboratory Parameters	Investigative Samples			Field Quality Control Samples[a]									MATRIX TOTAL[c]
						Duplicate			MS/MSD[b]			Equip. Rinsate Blank			
			No.	Freq.	Total	No.	Freq.	Total	No.	Freq.	Total	No.	Freq.	Total	
Surface soil	Soil gas screening using PID/FID, screening for radioactive constituents, soil classification	TAL Inorganics (Total)	104	1	104	11	1	11	6	1	6	11	1	11	126
		Bismuth	104	1	104	11	1	11	6	1	6	11	1	11	126
		Fluoride	104	1	104	11	1	11	6	1	6	11	1	11	126
		TCL pesticides/PCBs	104	1	104	11	1	11	6	1	6	11	1	11	126
		Isotopic plutonium (238, 239/240)	334	1	334	34	1	34	17	1	17	34	1	34	402
		Isotopic thorium (228, 230, 232)	149	1	149	15	1	15	8	1	8	15	1	15	179
		Isotopic uranium (234/235, 238)	149	1	149	15	1	15	8	1	8	15	1	15	179
		Strontium-90	104	1	104	11	1	11	6	1	6	11	1	11	126
		Tritium	283	1	283	29	1	29	15	1	15	29	1	29	341
		Gamma spectrometry	104	1	104	11	1	11	6	1	6	11	1	11	126
		Nitrate/nitrite	104	1	104	11	1	11	6	1	6	11	1	11	126
		Chloride	104	1	104	11	1	11	6	1	6	11	1	11	126
		Sulfate	104	1	104	11	1	11	6	1	6	11	1	11	126
		TOC	48	1	48	5	1	5	3	1	3	5	1	5	58
		VOCs	56	1	56	6	1	6	3	1	3	6	1	6	68
		Semivolatile organic compounds	56	1	56	6	1	6	3	1	3	6	1	6	68
		USATHAMA explosives	12	1	12	2	1	2	1	1	1	2	1	2	16

Table IV.5. (page 2 of 5)

Sample Matrix	Field Parameters	Laboratory Parameters	Investigative Samples			Field Quality Control Samples[a]									MATRIX TOTAL[c]
						Duplicate			MS/MSD[b]			Equip. Rinsate Blank			
			No.	Freq.	Total	No.	Freq.	Total	No.	Freq.	Total	No.	Freq.	Total	
Subsurface soil	Soil gas screening using PID/FID, screening for radioactive constituents, soil classification	TAL Inorganics (Total)	285	1	285	29	1	29	15	1	15	29	1	29	343
		Bismuth	285	1	285	29	1	29	15	1	15	29	1	29	343
		Fluoride	285	1	285	29	1	29	15	1	15	29	1	29	343
		Lithium	25	1	25	3	1	3	2	1	2	3	1	3	31
		Molybdenum	25	1	25	3	1	3	2	1	2	3	1	3	31
		TCL pesticides/PCBs	217	1	217	22	1	22	11	1	11	22	1	22	261
		Isotopic plutonium (238, 239/240)	515	1	515	52	1	52	26	1	26	52	1	52	619
		Isotopic thorium (228, 230, 232)	253	1	253	26	1	26	13	1	13	26	1	26	305
		Isotopic uranium (234/235, 238)	253	1	253	26	1	26	13	1	13	26	1	26	305
		Strontium-90	285	1	285	29	1	29	15	1	15	29	1	29	343
		Tritium	464	1	464	47	1	47	24	1	24	47	1	47	558
		Gamma spectrometry	285	1	285	29	1	29	15	1	15	29	1	29	343
		Nitrate/nitrite	285	1	285	29	1	29	15	1	15	29	1	29	343
		Chloride	285	1	285	29	1	29	15	1	15	29	1	29	343
		Sulfate	285	1	285	29	1	29	15	1	15	29	1	29	343
		TOC	147	1	147	15	1	15	8	1	8	15	1	15	177
		pH	61	1	61	7	1	7	4	1	4	7	1	7	75
		VOCs	169	1	169	17	1	17	9	1	9	17	1	17	203
		Semivolatile organic compounds	141	1	141	15	1	15	8	1	8	15	1	15	177
		USATHAMA explosives	71	1	71	8	1	8	4	1	4	8	1	8	87
		Particle size analysis	68	1	68	–	–	–	–	–	–	–	–	–	–
		Specific gravity	68	1	68	–	–	–	–	–	–	–	–	–	–
		Cation exchange capacity	68	1	68	–	–	–	–	–	–	–	–	–	–
		Moisture content	46	1	46	–	–	–	–	–	–	–	–	–	–
		Organic content	46	1	46	–	–	–	–	–	–	–	–	–	–
		Permeability	68	1	68	–	–	–	–	–	–	–	–	–	–
		Relative density	46	1	46	–	–	–	–	–	–	–	–	–	–
		Maximum density	46	1	46	–	–	–	–	–	–	–	–	–	–
		Clay Mineralogy	28	1	28	–	–	–	–	–	–	–	–	–	–

Table IV.5. (page 3 of 5)

Sample Matrix	Field Parameters	Laboratory Parameters	Investigative Samples			Field Quality Control Samples[a]									MATRIX TOTAL[c]
						Duplicate			MS/MSD[b]			Equip. Rinsate Blank			
			No.	Freq.	Total	No.	Freq.	Total	No.	Freq.	Total	No.	Freq.	Total	
Sediment	Soil gas screening using PID/FID, screening for radioactive constituents, soil classification	TAL Inorganics (Total)	160	2	320	16	2	32	8	2	16	16	2	32	384
		Bismuth	160	2	320	16	2	32	8	2	16	16	2	32	384
		Fluoride	160	2	320	16	2	32	8	2	16	16	2	32	384
		Lithium	52	2	104	6	2	12	3	2	6	6	2	12	128
		Molybdenum	52	2	104	6	2	12	3	2	6	6	2	12	128
		TCL pesticides/PCBs	160	2	320	16	2	32	8	2	16	16	2	32	384
		Isotopic plutonium (238, 239/240)	160	2	320	16	2	32	8	2	16	16	2	32	384
		Isotopic thorium (228, 230, 232)	160	2	320	16	2	32	8	2	16	16	2	32	384
		Isotopic uranium (234/235, 238)	160	2	320	16	2	32	8	2	16	16	2	32	384
		Strontium-90	160	2	320	16	2	32	8	2	16	16	2	32	384
		Tritium	160	2	320	16	2	32	8	2	16	16	2	32	384
		Gamma spectrometry	160	2	320	16	2	32	8	2	16	16	2	32	384
		Nitrate/nitrite	160	2	320	16	2	32	8	2	16	16	2	32	384
		Chloride	160	2	320	16	2	32	8	2	16	16	2	32	384
		Sulfate	160	2	320	16	2	32	8	2	16	16	2	32	384
		TOC	160	2	320	16	2	32	8	2	16	16	2	32	384
		pH	160	2	320	16	2	32	8	2	16	16	2	32	384
		VOCs	146	2	292	15	2	30	8	2	16	15	2	30	352
		Semivolatile organic compounds	72	2	144	8	2	16	4	2	8	8	2	16	176
		USATHAMA explosives	55	2	110	6	2	12	3	2	6	6	2	12	134
		Rare earth elements (lanthanides)	3	2	6	1	2	2	1	2	2	1	2	2	10
		Particle size analysis	145	2	290	–	–	–	–	–	–	–	–	–	–
		Specific gravity	24	2	48	–	–	–	–	–	–	–	–	–	–
		Cation exchange capacity	24	2	48	–	–	–	–	–	–	–	–	–	–

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Table IV.5. (page 4 of 5)

Sample Matrix	Field Parameters	Laboratory Parameters	Investigative Samples			Field Quality Control Samples[a]									MATRIX TOTAL[a]
						Duplicate			MS/MSD[b]			Equip. Rinsate Blank			
			No.	Freq.	Total	No.	Freq.	Total	No.	Freq.	Total	No.	Freq.	Total	
Surface water	pH Temperature Dissolved oxygen Redox potential Specific conductivity Flow rate	TAL Inorganics (Total)	92	2	184	10	2	20	5	2	10	10	2	20	224
		TAL Inorganics (Dissolved)	92	2	184	10	2	20	5	2	10	10	2	20	224
		Bismuth	92	2	184	10	2	20	5	2	10	10	2	20	224
		Fluoride	92	2	184	10	2	20	5	2	10	10	2	20	224
		Lithium	38	2	76	4	2	8	2	2	4	4	2	8	92
		Molybdenum	38	2	76	4	2	8	2	2	4	4	2	8	92
		TCL pesticides/PCBs	92	2	184	10	2	20	5	2	10	10	2	20	224
		Isotopic plutonium (238, 239/240)	92	2	184	10	2	20	5	2	10	10	2	20	224
		Isotopic thorium (228, 230, 232)	92	2	184	10	2	20	5	2	10	10	2	20	224
		Isotopic uranium (234/235, 238)	92	2	184	10	2	20	5	2	10	10	2	20	224
		Strontium-90	92	2	184	10	2	20	5	2	10	10	2	20	224
		Tritium	92	2	184	10	2	20	5	2	10	10	2	20	224
		Radium-226	92	2	184	10	2	20	5	2	10	10	2	20	224
		Americium-241	92	2	184	10	2	20	5	2	10	10	2	20	224
		Gamma spectrometry	92	2	184	10	2	20	5	2	10	10	2	20	224
		Nitrate/nitrite	92	2	184	10	2	20	5	2	10	10	2	20	224
		Chloride	92	2	184	10	2	20	5	2	10	10	2	20	224
		Sulfate	92	2	184	10	2	20	5	2	10	10	2	20	224
		TOC	92	2	184	10	2	20	5	2	10	10	2	20	224
		pH	92	2	184	10	2	20	5	2	10	10	2	20	224
		Ammonia	92	2	184	10	2	20	5	2	10	10	2	20	224
		Nutrients (TKN, TP)	92	2	184	10	2	20	5	2	10	10	2	20	224
		Total dissolved solids	92	2	184	10	2	20	5	2	10	10	2	20	224
		Total suspended solids	92	2	184	10	2	20	5	2	10	10	2	20	224
		Alkalinity	92	2	184	10	2	20	5	2	10	10	2	20	224
		VOCs	78	2	156	8	2	16	4	2	8	8	2	16	188
		Semivolatile organic compounds	41	2	82	5	2	10	3	2	6	5	2	10	102
		USATHAMA explosives	33	2	66	4	2	8	2	2	4	4	2	8	82

Table IV.5. (page 5 of 5)

Sample Matrix	Field Parameters	Laboratory Parameters	Investigative Samples			Field Quality Control Samples[a]									MATRIX TOTAL[c]
						Duplicate			MS/MSD[b]			Equip. Rinsate Blank			
			No.	Freq.	Total	No.	Freq.	Total	No.	Freq.	Total	No.	Freq.	Total	
Ground-water[d]	pH Temperature Dissolved oxygen Redox potential Specific conductivity	TAL Inorganics (Total)	163	2	326	17	2	34	9	2	18	17	2	34	394
		TAL Inorganics (Dissolved)	163	2	326	17	2	34	9	2	18	17	2	34	394
		Bismuth	163	2	326	17	2	34	9	2	18	17	2	34	394
		Fluoride	163	2	326	17	2	34	9	2	18	17	2	34	394
		TCL pesticides/PCBs	163	2	326	17	2	34	9	2	18	17	2	34	394
		Isotopic plutonium (238, 239/240)	163	2	326	17	2	34	9	2	18	17	2	34	394
		Isotopic thorium (228, 230, 232)	163	2	326	17	2	34	9	2	18	17	2	34	394
		Isotopic uranium (234/235, 238)	163	2	326	17	2	34	9	2	18	17	2	34	394
		Strontium-90	163	2	326	17	2	34	9	2	18	17	2	34	394
		Tritium	163	2	326	17	2	34	9	2	18	17	2	34	394
		Radium-226	163	2	326	17	2	34	9	2	18	17	2	34	394
		Americium-241	163	2	326	17	2	34	9	2	18	17	2	34	394
		Gamma spectrometry	163	2	326	17	2	34	9	2	18	17	2	34	394
		Nitrate/nitrite	163	2	326	17	2	34	9	2	18	17	2	34	394
		Chloride	163	2	326	17	2	34	9	2	18	17	2	34	394
		Sulfate	163	2	326	17	2	34	9	2	18	17	2	34	394
		TOC	155	2	310	16	2	32	8	2	16	16	2	32	374
		Ammonia	8	2	16	4	2	8	2	2	4	4	2	8	32
		Nutrients (TKN, TP)	163	2	326	17	2	34	9	2	18	17	2	34	394
		Total dissolved solids	163	2	326	17	2	34	9	2	18	17	2	34	394
		Total suspended solids	163	2	326	17	2	34	9	2	18	17	2	34	394
		Alkalinity	163	2	326	17	2	34	9	2	18	17	2	34	394
		VOCs	163	2	326	17	2	34	9	2	18	17	2	34	394
		Semivolatile organic compounds	163	2	326	17	2	34	9	2	18	17	2	34	394
		USATHAMA explosives	54	2	108	6	2	12	3	2	6	6	2	12	132

[a]The field quality control samples include: duplicate (1 per 10 investigative samples); matrix spike/matrix spike duplicate (MS/MSD, 1 per 20 investigative samples); equipment rinsate blank (1 per 10 investigative samples); trip blank (1 per shipping container to lab with VOC samples); sample bank blank (1 per 20 investigative samples; VOC analysis only); ambient blank (1 per 20 investigative samples; VOC analysis only).

[b]Numbers given are for pairs of samples (triple volume is needed); only an MS (no MSD) is collected for TAL Inorganics (total and dissolved), isotopic plutonium, isotopic thorium, isotopic uranium, strontium-90, tritium, radium-226, and gamma spectrometry (double volume is needed).

[c]The number of samples to be collected for MS/MSD, trip blanks, sample bank blank, and ambient blank are not included in the matrix total.

[d]The number of groundwater samples for the Residential Well investigation has not been determined. However, the number and type of field quality control samples is the same as that described in footnote (a), except sample bank blank (1 per 10 investigative samples; VOC analysis only) and ambient blank (1 per 10 investigative samples; VOC analysis only).

5. SAMPLE CUSTODY

Sample custody procedures to be followed during the Operable Unit 9 activities require that the possession and handling of each sample from the moment of its collection through analysis be documented by written record. A sample is in someone's custody when one of the criteria listed below has been satisfied:

1. The sample is in one's actual possession.
2. The sample is in one's view after being in one's physical possession.
3. The sample is in one's physical possession and is then locked up so that no one can tamper with it.
4. The sample is kept in a secured area that is restricted to authorized personnel only.

Samples will consist of material collected in the field, such as water, soil, or sediments, and any reagents added for the purposes of sample preservation.

5.1. CHAIN OF CUSTODY

5.1.1. Field Custody Procedures

Sample Labels

All samples will be identified with a label attached directly to the container. Examples of sample labels are presented in Mound Plant ER Program SOP 1.3, Sample Control and Documentation (included in Appendix A). Sample label information will be completed using waterproof black ink. The labels will contain the following information:

- sample number,
- time and date of collection,
- installation name,
- parameters to be analyzed,
- preservative (if any),

- sample source/location, and
- sampler's initials.

Chain of Custody Record

To maintain a record of sample collection, transfer between personnel, shipment, and receipt by the laboratory, a chain-of-custody record (Figure 5.1) will be filled out for each Operable Unit 9 sample as it is collected by the field sampler. Each time the samples are transferred, the signatures of the persons relinquishing and receiving the samples, as well as the date and time of transfer, will be documented.

Chain-of-custody seals are used to determine if any tampering has occurred during shipment of samples. These signed and dated seals will be placed at the junction between the lid and the jar or cooler on all Operable Unit 9 sample containers and shipment containers (coolers) by the person responsible for packaging. If the coolers or jars are opened before receipt at the laboratory, the seals will not be intact. If the chain-of-custody seals are not intact, the laboratory project manager for the Mound Plant ER Program will notify the Operable Unit 9 WESTON field manager within 24 hours of container receipt. The WESTON field manager will then complete a nonconformance report (discussed in Section 13 of this QAPP).

Transfer of Custody and Shipment

Prior to shipment of samples, the chain-of-custody record will be signed and dated by a member of the field team who has verified that those samples indicated on the record are indeed being shipped. Mound Plant ER Program SOP 1.3, Sample Control and Documentation (included in Appendix A) describes the completion of this form and the steps necessary for sample control, sample identification, and data recording. A copy of each chain-of-custody form will be retained in the project file at the site, and the original will be sent with the samples (sealed inside the sample cooler). After packaging has been completed, custody seals, signed and dated by a member of the field team, will be placed on the cooler.

M9QAD112.W05

WESTON Analytics Use Only

Custody Transfer Record/Lab Work Request

WESTON

Client _____
Work Order _____
Date Rec'd. _____ Date Due _____
RFW Contact _____
Client Contact/Phone _____

Refrigerator#											
#/Type Container											
Containers/Volume											
Preservative											
ANALYSES REQUESTED ➡											

WA Use Only Lab ID	Client ID/Description	Matrix	Date Collected										

Matrix:
S - Soil
SE - Sediment
SO - Solid
W - Water
O - Oil
A - Air
DS - Drum Solids
DL - Drum Liquids
F - Fish
X - Other

Special Instructions:

Item/Reason	Relinquished by	Received by	Date	Time	Item/Reason	Relinquished by	Received by	Date	Time

WESTON Analytics Use Only

Samples Were:
1 Shipped or Hand-Delivered
NOTES:

2 Ambient or Chilled
NOTES:

3 Received Broken/Leaking (Improperly Sealed)
Y N
NOTES:

4 Properly Preserved
Y N
NOTES:

5 Received Within Holding Times
Y N
NOTES:

COC Tape Was:
1 Present on Outer Package Y N
2 Unbroken on Outer Package Y N
3 Present on Sample Y N
4 Unbroken on Sample Y N
NOTES:

COC Record Was:
1 Present Upon Receipt of Samples Y N

Discrepancies Between Sample Labels and COC Record? Y N
NOTES:

RFW 21-21-001/A-5/88

After samples are collected and screened by Mound Plant, they will be transported by field personnel as soon as possible to the courier location for subsequent shipment to the laboratory or hand-delivered to the laboratory. (It should be noted that Federal Express does not claim responsibility for samples and does not sign off on the chain of custody. However, the laboratory retains the shipping ticket, indicating acceptance and delivery of shipment.) Rental vehicles used by the field personnel may be used for transporting nonhazardous and nonradioactive samples from Mound Plant to the Federal Express® office only if the samples are properly packaged and labeled. Upon receipt of the samples at the laboratory, the receiver will complete the transfer by dating and signing the chain-of-custody record (Figure 5.1). This chain-of-custody record will remain with the sample at the laboratory.

5.1.2. Laboratory Custody Procedures

Sample custody procedures in the laboratory include the procedures for general security, sample receipt, storage, preparation, and analysis. The laboratory specifications attachments describe these procedures unique for the given laboratory. The following subsections describe the minimum general requirements for the laboratory.

5.1.2.1. Sample Receipt

- Samples will be checked for integrity and the temperature inside the coolers, measured in the temperature blank, will be noted on the Chain of Custody. Sample containers for VOCs will be checked for bubbles. The QAM and field manager will be notified immediately of any discrepancies or broken bottles.
- The appropriate section managers and analysts will be notified of any short holding times.
- The laboratory will have a sample custodian who will assume custody of the samples by signing the chain of custody.
- The samples will be checked against the chain of custody and discrepancies will be resolved with the field manager and QAM.
- The completed chain of custody, with all relinquished signatures, will be returned to the subcontractor with the data package as described in Section 9.2.3 of this QAPP.

5.1.2.2 Sample Storage

Samples (except those samples designated for radiological or geotechnical analyses which do not have preservation requirements) will be stored in locked refrigerators which are maintained at 4° ± 2°C. When samples, extracts, or digestates are retrieved from or returned to the refrigerator, a chain of custody record is signed by the analyst.

Unused samples, sample containers, sample extracts, and sample digests are stored for a minimum of 60 days after analysis and are not disposed of without written authorization from the EG&G subcontractor.

Laboratories will have controlled access to sample storage areas.

5.1.2.3. Sample Tracking

For samples requiring preparation, a sample preparation record is completed by the analyst/technician during the time of preparation. Sample extracts are maintained in secured refrigerator storage. Sample digests for metals and extracts for radiochemical analysis are stored at room temperature in a secured area. Chemical and radiological sample preparation records are stored in a bound notebook.

5.1.2.4. Record Keeping

Sample preparation and analysis information are recorded in bound laboratory notebooks. Sample tracking information includes the following:

- project identification number;
- sample numbers;
- sample type;
- date received;
- date put into storage after analysis;
- date of extraction or digestion;
- date of analysis; and
- date of disposal.

Corrections to entries in laboratory notebooks are made by drawing a single line through the erroneous entry and entering the correct entry. Corrections are dated and initialed by the individual making the entry.

The laboratory archives all GC/MS magnetic tapes related to the program.

5.2. DOCUMENTATION

5.2.1. Field Logs

All data collection activities performed at a site will be documented, using waterproof, nonerasable black ink, either in a field notebook or on ER Program forms. Field notebooks will be bound books and will be assigned to individual field personnel for the duration of their stay in the field. The required contents and procedures for entering into field logs are described in Subsection 9.1.3. In addition, all samples collected will be recorded in the field log with the following information:

- sample location,
- sample identification number,
- date and time of collection,
- sample matrix,
- any unusual appearances of the sample,
- parameters to be analyzed, and
- date and time sample was released or received.

5.2.2. Data Collection Forms

As an added means of ensuring the collection of accurate field and sampling information, standardized data collection forms will be used. These forms will be used to record data in a consistent format that limits individual interpretations or preferences. By explicitly outlining reporting methods, identifying appropriate units of measure, and specifying alternative test procedures, these forms provide a measure of quality control in the data collection process.

The standard data collection forms associated with the Mound Plant ER Program SOPs group data and information according to problem-solving needs. They are a means of preventing the collection of invalid or redundant data and eliminating critical data gaps. Each data collection form precisely defines what data are necessary to accurately characterize a particular property or relationship. This reduces the likelihood of initiating field sampling or laboratory analyses only to discover that key pieces of information have not been collected and that further sampling is required.

Each Mound Plant ER Program SOP for a data collection activity provides examples of all of the forms required for the accurate recording of the procedure. A blank form will be used for each new location or sample, as specified by the SOP. During the field activity, each form will be completed as accurately and completely as possible, as indicated by the example contained in the SOP. All entries on the data collection form will be made using indelible black ink, with incorrect entries crossed out with a single line and initialed. Each form must be signed or initialed and dated by the person completing the form on the day of information entry. Any additional information not recorded on the form will be recorded in the field notebook. After the field activity is completed, all data collection forms will be reviewed by a technical reviewer other than the person recording the data prior to any use of the data and sufficiently soon to take any necessary corrective action. This review will ensure that forms are completed fully and accurately and will verify the integrity of the data. After the review, the reviewer will sign and date each form.

5.2.3. Corrections to Documentation

All measurements made, and samples collected, will be recorded as described above in Subsections 5.2.1 and 5.2.2. If an incorrect entry is made, to the original of the data document, the incorrect data will be crossed out with a single strike mark, the correct information entered, and the correction initialed and dated by the person making the correction. There will be no erasures or deletions from any type of data document record.

5.2.4. Sample Tracking

Samples collected in the field should be tracked by the EG&G subcontractor using a PC-based spreadsheet system or equivalent database. The following information will be recorded:

- Laboratory batch number
- Field batch number
- Sample matrix

- Sample identification
- Sample type (investigative vs. quality control)
- Date of collection
- Date of receipt for laboratory data
- Date of completion for data validation
- Date electronic deliverable loaded
- Requested analysis

Completed chains of custody should be submitted at the end of each week to the data administrator for entry into the sample tracking system. The sample tracking data are then checked for accuracy and completeness by another individual. When hardcopy data packages are received from the laboratory they will be inventoried and the laboratory batch number and analysis/extraction date will be recorded in the tracking system. When the electronic files are received from the laboratory, the date of receipt will be recorded in the tracking system if the data are successfully loaded into the database. When the data validators submit validated results, the date of completion will also be recorded in the sample tracking system.

5.3. SAMPLE HANDLING, PACKAGING, AND SHIPPING

All samples collected and shipped for analysis as part of the investigation of Mound Plant Operable Unit 9 will be considered hazardous samples and will be handled, packaged, and shipped according to this designation. DOT and IATA have established specific regulations governing the packaging of hazardous samples for shipment. Mound Plant ER Program SOP 1.5, Guide to the Handling, Packaging, and Shipping of Samples (included in Appendix A), provides information and references that must be reviewed prior to selection of appropriate packaging materials, shipping containers, and shipping labels. Mound Plant ER Program SOP 1.5 and the current DOT/IATA regulations will be the guidelines for shipment of all samples collected during the investigation of Mound Plant Operable Unit 9.

5.4. FINAL EVIDENCE FILE DOCUMENTATION

Records will be kept by the ER Program EG&G subcontractor to document the quality assurance/quality control activities and to provide support for possible evidentiary proceedings. The following is an outline of project file requirements:

- Communications
  - Internal
  - External
- Quality assurance/quality control
  - Procedures
  - Chain of custody
  - Audit reports
  - Laboratory quality control reports
  - Deviation notification forms
  - Nonconformance/corrective action reports
- Technical information
  - Analytical data
  - Field data
  - Field logbooks
  - Graphic resources
  - Data quality acceptance
  - Calculations/evaluations
  - Data review reports
  - Regulatory compliance

Management

- Schedule
- Budget
- Release site data base

Health and safety

- Plans/procedures
- Audit reports

Documents

- Plans
- Reports

All evidence file documentation will be maintained by the DOE or its subcontractor under the ER Program document control system. Upon termination of the project, all records (e.g., chromatograms, spectra, and calibration records) will be archived indefinitely by the DOE. If at any time the DOE chooses to purge its files, the EPA will be advised and offered possession. The ER Program EG&G subcontractor quality assurance manager will ensure that the quality assurance/quality control records are properly stored and retrievable.

6. ANALYTICAL PROCEDURES

6.1. FIELD MEASUREMENTS AND SCREENING

As part of the remedial investigation at Mound Plant, several parameters will be measured in the field for groundwater and surface water samples. All aqueous samples will be measured for specific conductance, temperature, pH, dissolved oxygen, and oxidation-reduction potential. The water level for wells sampled will be measured. Field screening will include combustible gas, organic vapors, low-energy gamma radiation, and alpha surface contamination. The Mound Plant ER Program SOPs for field determination of these parameters are presented in Appendix A of this QAPP. The following subsections summarize the procedures for measurement of field parameters.

6.1.1. Specific Conductance

The specific conductance of all aqueous samples from surface water and groundwater sampling locations will be taken with a YSI Model 33 meter, or equivalent. The procedures and required solutions for measuring specific conductance are described in detail in Mound Plant ER Program SOP 2.2, Field Measurements on Ground and Surface Water Samples (included in Appendix A).

6.1.2. pH

The pH of all aqueous samples from surface water and groundwater sampling locations will be measured using a Fisher Model No. 107 portable water pH meter, or equivalent. The procedures and solutions required for measuring the pH of aqueous samples are described in detail in Mound Plant ER Program SOP 2.2, Field Measurements on Ground and Surface Water Samples (included in Appendix A).

6.1.3. Dissolved Oxygen

Dissolved oxygen in groundwater and surface water will be measured using a YSI Model 50B dissolved oxygen meter, or equivalent. The procedures for determining dissolved oxygen are described in Mound Plant ER Program SOP 2.2., Measuring Dissolved Oxygen (included in Appendix A).

6.1.4. Temperature

Temperature of groundwater samples will be measured with a Celsius thermometer according to the procedures in Mound Plant ER Program SOP 2.2, Field Measurements on Ground and Surface Water Samples (included in Appendix A).

6.1.5. Combustible Gas

Combustible gas levels will be measured using a combustible gas indicator calibrated with a National Bureau of Standards traceable combustible gas standard. The procedures for measuring combustible gas levels are described in Mound Plant ER Program SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels (included in Appendix A).

6.1.6. Organic Vapor

Organic vapor levels will be measured according to either Mound Plant ER Program SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector and/or SOP 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector (both included in Appendix A). Each detector is calibrated with a specific gas standard such as benzene (for photoionization detector) or methane (for flame ionization detector). Both detectors measure total vapors for a broad range of detectable compounds.

6.1.7. Radionuclide Screening

Soil/sediment samples will be screened for low-energy gamma radiation, primarily for the presence of thorium and plutonium isotopes, using a FIDLER probe. Procedures for screening with a FIDLER are provided in Mound Plant ER Program SOP 6.7, Near Surface and Soil Sample Screening for Low-Energy Gamma Radiation Using the FIDLER (included in Appendix A).

The surfaces of personnel and field equipment will be monitored for total alpha surface contamination before entering and exiting the site. Mound Plant ER Program SOP 6.4, Total Alpha Surface Contamination Measurements (included in Appendix A), describes the procedures for this screening using an alpha scintillation probe.

6.1.8. Water Level

The water levels of wells will be measured with an Enviro-Labs Model PL-120 MCP Datalogger and Pressure Transducer according to procedures described in Mound Plant ER Program SOP 3.3, Operational Check of Pressure Transducers Used in Measuring Water Levels in Wells or a water level measuring device (e.g., steel tape or an electric sounder) as defined in Mound Plant ER Program SOP 3.1 (both included in Appendix A).

6.1.9. Oxidation-Reduction (Redox) Potential

The oxidation-reduction (redox) potential of groundwater and surface water will be measured using a Hach One portable pH meter with a Hach OPR electrode, or equivalent. The procedures for this measurement are described in the Mound Plant ER Program SOP 2.2, Measuring Oxidation Reduction Potential (included in Appendix A).

6.2. LABORATORY ANALYTICAL METHODS

Groundwater, surface water, and soil/sediment, samples collected for Operable Unit 9 RIs will be analyzed either in accordance with the EPA CLP Statement of Work (SOW) for the Target Analyte List (TAL) of inorganics and Target Compound List (TCL) of volatile, semivolatile, and pesticide/PCB organic compounds or in accordance with other standard analytical methods (e.g., American Society for Testing and Materials [ASTM] or EPA) where applicable. Statements of Work have been provided in Appendix C for those analyses or preparation procedures which are not documented in the CLP SOW, ASTM, or EPA methods and require documentation. Laboratory quality control procedures for both CLP and non-CLP analyses are summarized in Table III.2. The versions of the CLP SOW for this program are: organic analyses OLM01.8 and inorganic analyses ILM03.0. Newer versions of the CLP SOW will not invalidate the data collected using the current revision of the SOW.

Laboratory data reports for each analysis will contain sufficient information to perform data validation/review. Reporting requirements are identified in Subsection 9.2.3.

The list of analytes for each analytical method and the program required detection limits are presented in

Table VI.1 for groundwater, surface water, and soil/sediment samples. Additional compounds or elements have been added to the list of semivolatile and volatile organic compounds and metals. They are noted as such on Table VI.1. The limit of detection for each analyte is best expressed as a quantitation limit that is defined as the "lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions" (EPA 1986). This limit may vary significantly depending upon the sample matrix, and, as a final reported limit, will vary with the weight or volume of sample used, percent moisture (where applicable), and the dilution factor, if any. The limits listed in Table VI.1 are the minimum achievable quantitation limits expected from the laboratory with analysis of clean sample matrices of a given sample volume or weight. Actual laboratory established quantitation limits are listed in the laboratory specifications attachments. The quantitation limits for the nonroutine parameters added to existing methods may vary once the method validation study is completed for each additional analyte.
The following subsections summarize the analytical procedures.

6.2.1. Volatile Organic Compounds

Groundwater samples will be analyzed for halogenated and aromatic VOCs using gas chromatography with a Hall electrolytic conductivity detector and a photoionization detector. The methodology to be followed is EPA Method 8021 (EPA 1987). This method was chosen over the CLP SOW for groundwater samples in order to achieve lower detection limits. Because some of the additional VOCs may coelute with other compounds on the specified capillary column, a GC/MS confirmation or second column confirmation will be performed for any detection at the same retention times. If GC/MS confirmation is used, then the data must be reported per the CLP specifications as described in Subsection 9.2.3.

Soil/sediment and surface water samples will be analyzed for VOCs by the CLP SOW using gas chromatography and mass spectrometry as a means for compound identification. Capillary columns as

Table VI.1. Analytical Methods, Parameters, and Quantitation Limits Surface Water/Groundwater and Soil/Sediment Samples

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Quantitation Limits[a] Water (µg/L)	Quantitation Limits[a] Soil/Sediment (µg/kg)
1. Volatile Organic Compounds (VOCs), Groundwater				
	SW5030/ SW8021	NA		
Vinyl chloride			1.0	NA
Trichlorofluoromethane			2.0	NA
1,1-dichloroethene			1.3	NA
Methylene chloride (dichloromethane)			5.0	NA
1,1-dichloroethane			0.7	NA
Trichloromethane (chloroform)			0.5	NA
1,1,1-trichloroethane			0.3	NA
Carbon tetrachloride			1.2	NA
1,2-dichloroethane			0.3	NA
Trans-1,2-dichloroethene			1.0	NA
Trichloroethene			1.2	NA
1,2-dichloropropane			0.4	NA
Bromodichloromethane			1.0	NA
Dibromomethane			2.0	NA
1,1,2-trichloroethane			0.2	NA
Tetrachloroethene			0.3	NA
Dibromochloromethane			0.9	NA
Chlorobenzene			2.5	NA
1,1,1,2-tetrachloroethane			1.0	NA
Bromoform			2.0	NA
1,1,2,2-tetrachloroethane			0.3	NA
1,2,3-trichloropropane			1.0	NA
Phenyl bromide (bromobenzene)			2.0	NA
Chlorotoluene			1.0	NA
1,3-dichlorobenzene			3.2	NA
1,4-dichlorobenzene			2.4	NA
1,2-dichlorobenzene			1.5	NA

NA - Not Applicable

Table VI.1. (page 2 of 16)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Quantitation Limits[a] Water (µg/L)	Quantitation Limits[a] Soil/Sediment (µg/kg)
1. Volatile Organic Compounds, 8021 (continued)				
Benzene			2.0	NA
Chlorobenzene			2.0	NA
1,2-Dichlorobenzene			4.0	NA
1,3-Dichlorobenzene			4.0	NA
1,4-Dichlorobenzene			3.0	NA
Ethylbenzene			2.0	NA
Toluene			2.0	NA
Xylenes			2.0	NA
Additional Compounds:				
Cis-1,2-dichloroethene			1.0	NA
2-chloroethyl vinyl ether			1.3	NA
Cis-1,3-dichloropropene			3.4	NA
Trans-1,3-dichloropropene			3.4	NA
1-chlorohexane			1.0	NA
Bis(2-chloroisopropyl)ether			20	NA
Trichlorotrifluoroethane			2	NA
Diethylbenzene			1	NA
Vinyl acetate			3	NA
Carbon disulfide			5	NA
Acetone			20	NA
Methylethyl ketone (2-butanone)			10	NA
Methylisobutyl ketone (4-methyl-2-pentanone)			5	NA
Acrylonitrile	SW5030/ SW8030	NA	10	100
Acetonitrile	SW5030/ SW8030	NA	10	100
2. Volatile Organic Compounds (VOCs), Soil/Sediment and Surface Water	CLP SOW[c] Modification D	CLP SOW[c] Modification D		Low Soil/ Sediment[d]
Chloromethane			10	10
Bromomethane			10	10
Vinyl Chloride			10	10
Chloroethane			10	10
Methylene chloride			5	5
Acetone			10	10
Carbon disulfide			5	5
1,1-Dichloroethene			5	5
1,1-Dichloroethane			5	5
1,2-Dichloroethene (total)			5	5

NA - Not Applicable

Table VI.1. (page 3 of 16)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Quantitation Limits[a] Water (µg/L)	Quantitation Limits[a] Soil/Sediment (µg/kg)
2. Volatile Organic Compounds (continued)	CLP SOW[c] Modification D	CLP SOW[c] Modification D		Low Soil/ Sediment[d]
Chloroform			5	5
1,2-Dichloroethane			5	5
2-Butanone			10	10
1,1,1-Trichloroethane			5	5
Carbon Tetrachloride			5	5
Bromodichloromethane			5	5
1,2-Dichloropropane			5	5
cis-1,3-dichloropropene			5	5
Trichloroethene			5	5
Dibromochloromethane			5	5
1,1,2-Trichloroethane			5	5
Benzene			5	5
trans-1,3-dichloropropene			5	5
Tribromomethane			5	5
4-Methyl-2-pentanone			10	10
2-Hexanone			10	10
Tetrachloroethene			5	5
Toluene			5	5
1,1,2,2-Tetrachloroethane			5	5
Chlorobenzene			5	5
Ethylbenzene			5	5
Styrene			5	5
Xylenes (total)			5	5
Additional Compounds:				
Acrylonitrile			100	100
Acetonitrile			100	100
Diethylbenzene			5	20
Trichlorotrifluoroethane			5	10
Hexane			10	10
Iodomethane			NA	10
Vinyl Acetate			10	10
3. Semivolatile Organic Compounds	CLP SOW[c] Modification D	CLP SOW[c] Modification D		Low Soil/ Sediment[d]
Phenol			10	330

NA - Not Applicable

Table VI.1. (page 4 of 16)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Quantitation Limits[a] Water (µg/L)	Quantitation Limits[a] Soil/Sediment (µg/kg)
3. Semivolatile Organic Compounds (continued)	CLP SOW[c] Modification D	CLP SOW[c] Modification D		Low Soil/ Sediment[d]
bis(2-chloroethyl) ether			10	330
2-Chlorophenol			10	330
1,3-Dichlorobenzene			10	330
1,4-Dichlorobenzene			10	330
1,2-Dichlorobenzene			10	330
2-Methylphenol			10	330
2,2'-oxybis (1-Chloropropane)*			10	330
4-Methylphenol			10	330
N-nitroso-di-n-dipropylamine			10	330
Hexachloroethane			10	330
Nitrobenzene			10	330
Isophorone			10	330
2-Nitrophenol			10	330
2,4-Dimethylphenol			10	330
bis(2-chloroethoxy) methane			10	330
2,4-Dichlorophenol			10	330
1,2,4-Trichlorobenzene			10	330
Naphthalene			10	330
4-Chloroaniline			10	330
Hexachlorobutadiene			10	330
4-chloro-3-methylphenol (para-chloro-meta-cresol)			10	330
2-Methylnaphthalene			10	330
Hexachlorocyclopentadiene[5]			NA	330
2,4,6-Trichlorophenol			10	330
2,4,5-Trichlorophenol			25	800
2-Chloronaphthalene			10	330
2-Nitroaniline			25	800
Dimethylphthalate			10	330
Acenaphthylene			10	330
2,6-Dinitrotoluene			10	330
3-Nitroaniline			25	800
Acenaphthene			10	330
2,4-Dinitrophenol			25	800
4-Nitrophenol			25	800

NA - Not Applicable
* Previously known by the name bis(2-chloroisopropyl) ether

Table VI.1. (page 5 of 16)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Quantitation Limits[a] Water (µg/L)	Quantitation Limits[a] Soil/Sediment (µg/kg)
3. Semivolatile Organic Compounds (continued)	CLP SOW[c] Modification D	CLP SOW[c] Modification D		
Dibenzofuran			10	330
2,4-Dinitrotoluene			10	330
Diethylphthalate			10	330
4-Chlorophenyl-phenyl ether			10	330
Fluorene			10	330
4-Nitroaniline			25	800
4,6-Dinitro-2-methylphenol			25	800
N-nitrosodiphenylamine			10	330
4-bromophenyl-phenylether			10	330
Hexachlorobenzene			10	330
Pentachlorophenol			25	800
Phenanthrene			10	330
Anthracene			10	330
Carbazole			10	330
Di-n-butylphthalate			10	330
Fluoranthene			10	330
Pyrene			10	330
Butylbenzylphthalate			10	330
3,3'-Dichlorobenzidine			10	330
Benzo(a)anthracene			10	330
Chrysene			10	330
bis(2-Ethylhexyl)phthalate			10	330
Di-n-octylphthalate			10	330
Benzo(b)fluoranthene			10	330
Benzo(k)fluoranthene			10	330
Benzo(a)pyrene			10	330
Indeno(1,2,3-cd)pyrene			10	330
Dibenz(a,h)anthracene			10	330
Benzo(g,h,i)perylene			10	330
Additional Compounds:				
2-benzyl-4-chlorophenol			10	330
Benzyl alcohol			10	330
Benzoic acid			50	1600
4. Pesticides and PCBs	CLP SOW[c]	CLP SOW[c]		
alpha-BHC			0.05	1.7
beta-BHC			0.05	1.7
delta-BHC			0.05	1.7

NA - Not Applicable

Table VI.1. (page 6 of 16)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Quantitation Limits[a] Water (µg/L)	Quantitation Limits[a] Soil/Sediment (µg/kg)
4. Pesticides and PCBs	CLP SOW[c]	CLP SOW[c]		
gamma-BHC (Lindane)			0.05	1.7
Heptachlor			0.05	1.7
Aldrin			0.05	1.7
Heptachlor epoxide			0.05	1.7
Endosulfan I			0.05	1.7
Dieldrin			0.10	3.3
4,4'-DDE			0.10	3.3
Endrin			0.10	3.3
Endosulfan II			0.10	3.3
4,4'-DDD			0.10	3.3
Endosulfan sulfate			0.10	3.3
4,4'-DDT			0.10	3.3
Methoxychlor			0.50	17
Endrin ketone			0.10	3.3
Endrin aldehyde			0.10	3.3
alpha-Chlordane			0.05	1.7
gamma-Chlordane			0.05	1.7
Toxaphene			5.0	170
Aroclor-1016			0.50	33
Aroclor-1221			0.50	67
Aroclor-1232			0.50	33
Aroclor-1242			0.50	33
Aroclor-1248			0.50	33
Aroclor-1254			0.50	33
Aroclor-1260			0.50	33
5. Metals (Target Analyte List)	CLP SOW[e] Modification A	CLP SOW[e] Modification A		(mg/kg)
Aluminum			20	4
Antimony			10	2
Arsenic			10	2
Barium			200	40
Beryllium			1	0.2
Cadmium			5	1
Calcium			5000	1000
Chromium			10	2

NA - Not Applicable

Table VI.1. (page 7 of 16)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Quantitation Limits[a] Water (µg/L)	Quantitation Limits[a] Soil/Sediment (µg/kg)
5. Metals (Target Analyte List) (continued)	CLP SOW[e] Modification A	CLP SOW[e] Modification A		(mg/kg)
Cobalt			50	10
Copper			25	5
Iron			100	20
Lead			3	0.6
Magnesium			5000	1000
Manganese			15	3
Mercury			0.2	0.1
Nickel			40	8
Potassium			5000	1000
Selenium			5	1
Silver			10	2
Sodium			5000	1000
Thallium			10	2
Vanadium			10	2
Zinc			20	4
Additional Elements:				
Molybdenum			20	2
Tin			50	10
Bismuth			150	30
Lithium			100	10
				(mg/kg)
6. Cyanide	CLP SOW[e]	CLP SOW[e]	10	2
7. Common Anions			(mg/L)	(mg/kg)
Nitrate-Nitrite[3]	E353.2[g]	E353.2[g]	0.2	2[f]
Chloride[3]	E325.1[g]/ E325.2	SW9250[b]/ SW9251	1.0	5[f]
Sulfate[3]	E375.2[g]	E375.2[g]	5	50
Nitrite	E354.1[g]	NA	0.01	NA
Ammonia	E350.1[g]	NA	0.1	NA
Fluoride[3]	E340.2[g]	E340.2[g]	0.1	2.5
8. Total Nitrogen	E351.3[g]	NA	0.10	NA
9. Total Phosphorus	E365.1[g]	NA	0.10	NA
10. Total Organic Carbon (TOC)[3]	E415.1/ E415.2[g]	E415.1/ E415.2	1	25

NA - Not Applicable

Table VI.1. (page 8 of 16)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Quantitation Limits[a] Water (mg/L)	Quantitation Limits[a] Soil/Sediment (mg/kg)
11. Total Dissolved Solids (TDS)	E160.1[g]	NA	4	NA
12. Total Suspended Solids (TSS)	E160.2[g]	NA	10	NA
13. Alkalinity	E310.1[g]	NA	5	NA
14. Cation Exchange Capacity	NA	SW9081[b,h]	NA	5 mg/L
15. Particle Size Analysis	NA	ASTM D422-63[i]	NA	NA
16. Specific Gravity	NA	ASTM D854-83[i]	NA	NA
17. Moisture Content	NA	ASTMD 2974[i]	NA	NA
18. Organic Content	NA	ASTMD-2974-87[i]	NA	NA
19. Hydraulic Conductivity	NA	ASTMD-2434-68[i]	NA	NA
20. Relative and Minimum Density	NA	ASTMD-4254-83[i]	NA	NA
Maximum Density		ASTMD-4253-83[i]	NA	NA
21. Clay Mineralogy	NA	X-ray Diffraction	NA	NA
22. Explosives[3]	SW8330[6]	SW8330[6]	(µg/L)	(mg/kg)
HMX			20	3.0
RDX			6.0	2.5
NB			15	1.5
1,3-DNB			15	1.5
1,3,5-TNB			15	1.5
2,4-DNT			0.5	0.5
2,6-DNT			0.5	1.5
TNT			3.0	1.5
2A,4,6-DNT			3.0	1.5
Tetryl			3.0	2.5
PETN			1	1

NA - Not Applicable
TBD - To be determined

Table VI.1. (page 9 of 16)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Quantitation Limits[a] Water (µg/L)	Quantitation Limits[a] Soil/Sediment (µg/kg)
23. Radionuclides			(pCi/L)	(pCi/g dry)
Gamma Spectrometry	Nuclear Data Inc.,	Nuclear		
americium-241 (soils)	1986[n]	1986[n]	NA	1[m]
cobalt-60			20[l]	1[m]
cesium-137			20[l]	1[m]
bismuth-210 metastable			15[l]	1[m]
bismuth-207			15[l]	1[m]
potassium-40			350	10[m]
radium-226 (soils)			NA	0.3[m]
Tritium[3]	R906.0[o]	R906.0[o]	500 pCi/L	50 pCi/g[q]
Plutonium Isotopes	NAS, 1965[r]	NAS, 1965[r]	1[l]	1.0[s]
Thorium Isotopes	NAS, 1960[t]	NAS, 1960[t]	1[l]	1.0[s]
Radium-226	ASTM D2460-70[u]	NA	1[v]	NA
Uranium Isotopes	NAS, 1962[s]	NAS,1962[s]	1	0.6
Strontium-90	NAS 1960[t]	NAS 1960[t]	5	1.0
Americum-241	EML Am-01[2]	NA	1	NA
24. Volatile Organic Compounds (VOCs), residential well samples				
24.1 Purgeable Halocarbons	502.2[w]	NA	µg/L	µg/kg
Vinyl chloride			0.5	NA
Trichlorofluoromethane			1.0	NA
1,1-dichloroethene			1.0	NA
Methylene chloride (dichloromethane)			2.0	NA
trans-1,2-dichloroethene			0.5	NA
cis-1,2-dichloroethene			0.5	NA
1,1-dichloroethane			0.5	NA
Trichloromethane (chloroform)			0.5	NA
1,1,1-trichloroethane			1.0	NA
Carbon tetrachloride			0.5	NA
1,2-dichloroethane			0.5	NA
Trichloroethene			0.5	NA
1,2-dichloropropane			0.5	NA
Bromodichloromethane			0.5	NA
Dibromomethane			0.5	NA
cis-1,3-dichloropropene			0.5	NA
trans-1,3-dichloropropene			0.5	NA

NA - Not Applicable

Table VI.1. (page 10 of 16)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Quantitation Limits[a] Water (µg/L)	Quantitation Limits[a] Soil/Sediment (µg/kg)
24.1 Purgeable Halocarbons (continued)	502.2[w]	NA	(µg/L)	(µg/kg)
1,1,2-trichloroethane			0.5	NA
Tetrachloroethene			1.0	NA
Dibromochloromethane			0.5	NA
Chlorobenzene			0.5	NA
1,1,1,2-tetrachloroethane			0.5	NA
Bromoform			1.0	NA
1,1,2,2-tetrachloroethane			0.5	NA
1,2,3-trichloropropane			0.5	NA
Trichloroethene			0.5	NA
1,2-dichloropropane			0.5	NA
Bromodichloromethane			0.5	NA
Dibromomethane			0.5	NA
cis-1,3-dichloropropene			0.5	NA
trans-1,3-dichloropropene			0.5	NA
1,1,2-trichloroethane			0.5	NA
Tetrachloroethene			1.0	NA
Dibromochloromethane			0.5	NA
Chlorobenzene			0.5	NA
1,1,1,2-tetrachloroethane			0.5	NA
Bromoform			1.0	NA
1,1,2,2-tetrachloroethane			0.5	NA
1,2,3-trichloropropane			0.5	NA
Phenyl bromide (bromobenzene)			0.5	NA
Chlorotoluene			0.5	NA
1,3-dichlorobenzene			0.5	NA
1,4-dichlorobenzene			0.5	NA
1,2-dichlorobenzene			0.5	NA
Carbon disulfide			5	NA
Vinyl acetate			20	NA
Methyl ethyl ketone (2-butanone)			1	NA
Methyl isobutyl ketone (4-methyl-2-pentanone)			2	NA
Additional Compounds:				
Trichlorotrifluoroethane			2	NA
2-Chloroethylvinylether			1.3	NA
Bis (2-chloroisopropyl) ether			2.0	NA
1-Chlorohexane			20	NA

NA - Not Applicable

Table VI.1. (page 11 of 16)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Quantitation Limits[a] Water (µg/L)	Quantitation Limits[a] Soil/Sediment (µg/kg)
24.2. Purgeable Aromatic Compounds, residential well samples	502.2[w]	NA		
Benzene			2.0	NA
Chlorobenzene			2.0	NA
1,2-Dichlorobenzene			1.5	NA
1,3-Dichlorobenzene			3.2	NA
1,4-Dichlorobenzene			2.4	NA
Ethylbenzene			2.0	NA
Toluene			1.0	NA
Xylenes			1.0	NA
Additional Compounds:				
Diethylbenzene			1	NA
Acetone			20	NA
Acetonitrile	SW5030/SW8030		10	NA
Acrylonitrile	SW5030/SW8030		10	NA
25. Semivolatile Organic Compounds (semiVocs), (residential well samples)	CLP SOW[c,x] Modification D	NA		
Phenol			5	NA
bis-(2-Chloroethyl)ether			5	NA
2-Chlorophenol			5	NA
2-Methyphenol			5	NA
2,2'-oxybis(1-Chloropropane)			5	NA
4-Methylphenol			5	NA
N-Nitroso-di-n-propylamine			5	NA
Hexachloroethane			5	NA
Nitrobenzene			5	NA
Isophorone			5	NA
2-Nitrophenol			5	NA
2,4-Dimethylphenol			5	NA
bis-(2-Chloroethoxy)methane			5	NA
2,4-Dichlorophenol			5	NA
1,2,4-Trichlorobenzene			5	NA
Naphthalene			5	NA
4-Chloraniline			5	NA
Hexachlorobutadiene			5	NA
4-Chloro-3-methylphenol			5	NA
2-Methylnaphthalene			5	NA
Hexachlorocyclopentadiene			5	NA
2,4,6-Trichlorophenol			5	NA
2,4,5-Trichlorophenol			5	NA

NA - Not Applicable

Table VI.1. (page 12 of 16)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Quantitation Limits[a] Water (µg/L)	Quantitation Limits[a] Soil/Sediment (µg/kg)
25. Semivolatile Organic (continued)	CLP SOW[c,x] Modification D	NA		
2-Chloronapthalene			5	NA
2-Nitroaniline			20	NA
Dimethylphthalate			5	NA
Acenaphthylene			5	NA
2,6-Dinitrotoluene			5	NA
3-Nitroaniline			20	NA
Acenaphthene			5	NA
2,4-Dinitrophenol			20	NA
4-Nitrophenol			20	NA
Dibenzofuran			5	NA
2,4-Dinitrotoluene			5	NA
Diethylphthalate			5	NA
4-Chlorophenyl-phenylether			5	NA
Fluorene			5	NA
4-Nitroaniline			20	NA
4,6-Dinitro-2-methylphenol			20	NA
N-Nitrosodiphenylamine			5	NA
4-Bromophenyl-phenylether			5	NA
Hexachlorobenzene			5	NA
Pentachlorophenol			20	NA
Phenanthrene			5	NA
Anthracene			5	NA
Di-n-butylphthalate			5	NA
Fluoranthene			5	NA
Pyrene			5	NA
Butylbenzylphalate			5	NA
3,3'-Dichlorobenzidine			5	NA
Benzo(a)anthracene			5	NA
Chrysene			5	NA
bis-(2-Ethylhexyl)phthalate			5	NA
Di-n-octylphthalate			5	NA
Benzo(b)fluoranthene			5	NA
Benzo(k)fluoranthene			5	NA
Benzo(a)pyrene			5	NA
Indeno(1,2,3-cd)pyrene			5	NA
Dibenz(a,h)anthracene			5	NA
Benzo(g,h,i)perylene			5	NA

NA - Not Applicable

Table VI.1. (page 13 of 16)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Quantitation Limits[a] Water (µg/L)	Quantitation Limits[a] Soil/Sediment (µg/kg)
25. Semivolatile Organic (continued)	CLP SOW[c,x] Modification D	NA		
Additional Compounds:				
2-benzyl-4-chlorophenol			10	NA
Benzyl alcohol			10	NA
Benzoic acid			50	NA
26. Pesticides/PCBs (Residential well samples)	CLP SOW[c,x]	NA		
alpha-BHC			0.01	NA
beta-BHC			0.01	NA
delta-BHC			0.01	NA
gamma-BHC (Lindane)			0.01	NA
Heptachlor			0.01	NA
Aldrin			0.01	NA
Heptachlor epoxide			0.01	NA
Endosulfan I			0.01	NA
Dieldrin			0.02	NA
4,4'-DDE			0.02	NA
Endrin			0.01	NA
Endosulfan II			0.02	NA
4,4'-DDD			0.02	NA
Endosulfan sulfate			0.02	NA
4,4'-DDT			0.02	NA
Endrin ketone			0.02	NA
Endrin aldehyde			0.02	NA
alpha-Chlordane			0.01	NA
gamma-Chlordane			0.01	NA
Toxaphene			1.0	NA
Aroclor-1016			0.5	NA
Aroclor-1221			0.5	NA
Aroclor-1232			0.5	NA
Aroclor-1242			0.5	NA
Aroclor-1248			0.5	NA
Aroclor-1254			0.5	NA
Aroclor-1260			0.5	NA

NA - Not Applicable

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Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Quantitation Limits[a] Water (µg/L)	Quantitation Limits[a] Soil/Sediment (mg/kg)
27. TAL metals and Cyanide (residental well samples)	CLP SOW[y] Modification B	NA		
Aluminium			20	NA
Antimony			10	NA
Arsenic			2	NA
Barium			200	NA
Beryllium			1	NA
Cadmium			2	NA
Calcium			5000	NA
Chromium			10	NA
Cobalt			50	NA
Copper			25	NA
Iron			100	NA
Lead			2	NA
Magnesium			5000	NA
Manganese			15	NA
Mercury			0.2	NA
Nickel			40	NA
Potassium			5000	NA
Selenium			2	NA
Silver			10	NA
Sodium			5000	NA
Thallium			2	NA
Vanadium			10	NA
Zinc			20	NA
Cyanide			10	NA
Additional Elements:				
Molybdenum			20	NA
Tin			50	NA
Bismuth			150	NA
Lithium			100	NA
28. Lanthanides	NA	CLP SOW Modification C		
Lanthanum			200	40
Cerium			200	40
Praseodymium			200	40
Neodymium			200	40
Samarium			200	40
Europium			200	40
Gadolinium			200	40
Terbium			200	40
Dysprosium			200	40
Holmium			200	40
Erbium			200	40

NA - Not Applicable

Table VI.1. (page 15 of 16)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Quantitation Limits[a] Water (µg/L)	Quantitation Limits[a] Soil/Sediment (mg/kg)
28. Lanthanides (continued)	NA	CLP SOW Modification C		
Thulium			200	40
Ytterbium			200	40
Lutetium			200	40
29. Dioxin/Furans	SW8290[b]	SW8290[b]	pg/L[v]	pg/g[4]
2,3,7,8-TCDD			10	1.0
Total TCDD			10	1.0
2,3,7,8-PcCDD			50	5.0
Total PcCDD			50	5.0
2,3,7,8-HxCDD			50	5.0
Total HxCDD			50	5.0
2,3,7,8-HpCDD			50	5.0
Total HpCDD			50	5.0
OCDD			100	10
2,3,7,8-TCDF			10	1.0
Total TCDF			10	1.0
2,3,7,8-PeCDF			50	5.0
Total PeCDF			50	5.0
2,3,7,8-HxCDF			50	5.0
Total HxCDF			50	5.0
OCDF			100	10

NA - Not Applicable

[a] For non-CLP analyses, these are expected quantitation limits based on reagent grade water or a purified solid matrix. Actual quantitation limits may be higher depending upon the nature of the sample matrix. The limit reported on final laboratory reports will take into account the actual sample volume or weight, percent moisture (where applicable), and the dilution factor, if any. **The quantitation limits for the additional nonroutine analytes may vary, depending upon the results of the method validation study.**

[b] "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd edition, U.S. EPA, November 1986.

[c] "U.S. EPA Contract Laboratory Program, Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration." Document No. OLM01.8 Quantitation limits are contract-required quantitation limits (CRQLs) with the exception of additional organic compounds. The minimum quantitation limits will be reported by the laboratory.

[d] Medium Soil/Sediment CRQLs are 125 times the low soil/sediment CRQLs for volatile organic compounds and 60 times the low soil/sediment CRQLs for semivolatile organic compounds. Estimated detection limits for metals in soil are based on a 1-gram sample diluted to 200 mL.

[e] "U.S. EPA Contract Laboratory Program, Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration." Document No. ILM03.0. Quantitation limits are CRDLs except for vanadium, beryllium, antimony, aluminum and additional elements. The minimum quantitation limits will be reported by the laboratory.

[f] Based on a 10-gram soil sample and 100 mL volume of extractant and a soil moisture content between 0 and 10 percent (rounded). Actual quantitation limit will vary with the sample and extractant amounts and will depend upon the nature of the soil matrix.

[g] "Methods for Chemical Analysis of Water and Wastes," U.S. EPA, EPA-600/4-79-020 revised March 1983

[h] If soils are acidic, CEC will be analyzed by "Method of Soil Analysis, Part 2 Chemical and Microbiological Properties," by H. D. Chapman, American Society of Agronomists. 1965.

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[l] "1991 Annual Book of American Society of Testing Materials Standards," Section 4, Construction, Volume 04.08, Soil and Rock, Building Stones, Geotextiles," ASTM 1990.
[k] As cesium-137, assumes no interfering lines.
[l] Based on 900-mL sample size.
[m] Based on 650-gram dry sample.
[n] ND 9900 VAX/VMS Spectroscopy Application Package User's Manual (09-0196), Nuclear Data, Inc., Schaumberg, IL. August 1986.
[o] "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," U.S. EPA, EPA-600/4-80-032, latest version.
[p] Based on 100-mL sample size.
[q] Dependent upon percent moisture in sample, based on 10 grams.
[r] "The Radiochemistry of Plutonium," G.H. Coleman, NAS-NS-3058, National Academy of Sciences, September 1965.
[s] Based on 2-gram dry sample.
[t] "The Radiochemistry of Thorium," E.K. Hyde. NAS-NS-3004, National Academy of Sciences, January 1960.
[u] "Standard Test Methods for Radium in Water," ASTM, latest version.
[v] Based on 1,000-mL sample size.
[w] "Manual for the Certification of Laboratories Analyzing Drinking Water," USEPA, EPA/570/9-90/008, April 1990.
[x] These are the maximum quantitation limits that can be reported for residential well samples.
[y] Arsenic, selenium, antimony, cadmium, lead, and thallium will be analyzed by graphite, furnace with Zeeman background correction. Lead and antimony have the option for deuterium background correction.
[z] "The Radiochemistry of Uranium," J.E. Grindler, NAS-NS-3050, National Academy of Sciences, March 1962.
[1] "The Radiochemistry of Barium, Calcium, and Strontium," D.N. Sunderman and D.W. Townley, NAS-NS-3010, National Academy of Sciences, January 1960.
"Determination of Strontium-89 and -90 in Soil With Total Sample Decomposition," D.B. Martin, Analytical Chemistry, October 1979.
"Procedures for Determination of Stable Elements and Radionuclides in Environmental Samples," Public Health Service Publication 999-RH-10, January 1965.
[2] "EML Procedures Manual," HASL-300, Environmental Measurements Laboratory, U.S. Department of Energy 27th Edition.
[3] Procedure includes a statement of work, provided in Appendix C.
[4] Based on a 10.0 gram sample for dioxin analysis.
[5] Spike recoveries in water for hexachloro cyclopentadiene from method validation studies have demonstrated that the compound cannot be adequately detected by this method in water.
[6] "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW. 846, 3rd edition, revision 1, U.S. EPA, December 1987.

specified in the method will be employed. A modification to the CLP SOW (Modification D see Appendix B) has been prepared to account for six additional volatile organic compounds: acrylonitrile, acetonitrile, trichlorotrifluoroethane, iodomethane, hexane, and diethyl benzene.

EPA drinking water Method 502.2 using gas chromatography, capillary column, and a Hall electrolytic conductivity and photoionization detector in series will be implemented for residential well samples. Detection limits for this method are also lower than the CLP methodology. All detections above the quantitation limit will be confirmed on a second column or by GC/MS.

EPA Method 8030 with the purge and trap technique (5030) will be used to identify acrylonitrile and acetonitrile in groundwater samples (including residential well samples). This gas chromatography method uses a flame ionization detector to detect these volatile organic compounds.

6.2.2. Semivolatile Organic Compounds

The EPA CLP SOW Document Number OLOM01.8 (EPA 1990a), using gas chromatography/mass spectrometry, will be the methodology followed for semivolatile organic compound analysis of groundwater, surface water, and soil/sediment samples. Benzoic acid, 2-Benyzl-4-chlorophenol, and benzyl alcohol have been added to this method. A modification to the CLP SOW (Modification D see Appendix B) has been prepared to accommodate these additional compounds.

Residential well samples will also be analyzed by the CLP SOW, however lower maximum quantitation limits are required, as noted on Table VI.1.

6.2.3. Pesticides/PCBs

The CLP SOW Document Number OLM01.8 will be used to analyze groundwater, surface water, and soil/sediment samples. This method uses gas chromatography for separating and identifying the TCL pesticide/PCB compounds. The capillary columns specified in the method will be used.

Residential well samples also will be analyzed by the CLP SOW (Document No. OLM01.8); however, lower maximum quantitation limits have been specified on Table VI.1.

6.2.4. Metals

Groundwater, surface water, and soil/sediment samples will be analyzed for the TAL of metals according to the CLP SOW (EPA 1990b). Inductively coupled plasma (ICP) will be used to detect all the TAL metals with the exception of mercury, arsenic, lead, selenium, thallium, and potassium, which will be detected by atomic absorption (AA) (flame AA for potassium, cold vapor AA for mercury, and graphite AA for the others). Additional elements to be detected by ICP are: bismuth, molybdenum and tin. The additional element lithium will be detected by flame AA. These modifications to the method have been prepared as "Modification A" to the CLP SOW (See Appendix B). ICP metals will also be digested according to EPA Method 200.7 with a fourfold concentration in order to reach lower detection limits for aluminum, antimony, beryllium, and vanadium.

Residential well samples will also be analyzed by the CLP SOW (Document No. ILM03.0) for the TAL metals with modifications in quality control procedures (see Table III.2) and methodologies for specific analytes. Arsenic, selenium, antimony, cadmium, lead, and thallium will be analyzed by graphite furnace atomic absorption according to CLP SOW with Zeeman background correction. Antimony and lead may have a deuterium background correction instead of Zeeman. This modification will accommodate potential interferences that can arise during analysis of these elements. Additional elements to be detected by ICP are: bismuth, molybdenum, and tin. These modifications have been prepared as "Modification B" to the CLP SOW (See Appendix B). The additional element lithium will be detected by flame AA.

6.2.5. Radionuclides

Groundwater, surface water, and soil/sediment samples will be analyzed for isotopic plutonium, isotopic thorium, isotopic uranium, americium-241, strontium-90, and radium-226 according to the laboratory-developed SOPs. These methods are based on established procedures such as U.S. EPA (EPA 1980), U.S. DOE (DOE 1982), National Academy of Sciences, or ASTM (1991). With the exception of strontium-90, alpha spectrometry is used to detect alpha emissions from the isotopes of interest. A surface barrier detector is used for identifying plutonium, uranium, thorium isotopes, and radium-226.

6.2.5.1 Alpha Spectrometry

Specific isotopes from alpha spectrometry include americium-241 (waters), plutonium-238, 239/240; uranium-234, uranium-235, uranium-238; and thorium-227 (for calculation of actinium-227), thorium-228, thorium-230, and thorium-232. Soil samples are prepared using acid digestion procedures to concentrate the isotopes of interest in an aqueous matrix. The alpha emitting isotopes in these acid extracts and in water samples are precipitated from the aqueous solution. The precipitates are redissolved and subjected to a sequential separation of alpha isotopes by elution from anion/cation exchange resins. The separated alpha isotopes are counted using a surface barrier detector.

6.2.5.2 Strontium-90

All strontium present in the sample is assumed to be strontium-90 (Sr-90), due to the short half-life of strontium-89 and the knowledge of process at Mound Plant. Soil samples are subjected to acid digestions to remove interferences and concentrate the strontium as an aqueous matrix. Strontium-90 is precipitated from aqueous samples and extracts. Interferences are reduced by continued precipitations of the strontium carrier. The beta activity of Strontium-90 is determined with a gas flow proportional detector, immediately after removal of yttrium-90.

6.2.5.3 Gamma Spectrometry

Gamma spectrometry measures gamma radiation over a given spectrum and will be used to determine the gamma radiation levels in water and soil/sediment samples. Particular isotopes of interest that will be detected as gamma radiation are radium-226 (soil samples), bismuth-210 metastable, americium-241 (soil samples), cobalt-60, cesium-137, bismuth-207, polonium-210, and potassium-40. Analysis will be performed according to the instrument's spectroscopy application user's manual. Sample preparation and analysis procedures are provided in the laboratory SOPs. The detection limits listed on Table VI.1 are based on cesium-137 and assume no interfering lines. Detection limits of individual isotopes may vary. These methods are based on procedures outlined in HASL-300 (DOE 1982) and in USEPA method 901.1 (EPA 1980)

6.2.5.4 Tritium

Groundwater, surface water and soil/sediment samples will be analyzed for tritium according to EPA Method 906.0 (EPA 1980) Beta emissions are detected using a liquid scintillation method with a fluorescence detector. A statement of work for preparation of soil samples for tritium analysis is provided in Appendix C.

6.2.6. Explosives

Both soils/sediments and water samples will be analyzed for ten SW8330 explosives and PETN using high performance liquid chromatography (HPLC). Analysis will be performed according to laboratory SOPs which are based on USEPA SW846, Method 8330 (EPA 1990). Second column confirmation will be performed if positive results are obtained on the primary column. PETN will be detected at a different wavelength (220 nm) on a separate analytical run. A statement of work for analysis of PETN is provided in Appendix C describing the required variation from method 8330.

6.2.7. Chloride, Nitrate-Nitrite, Sulfate, Ammonia, Fluoride and Total Phosphorus

Soil/sediment or water samples will be analyzed for either chloride, nitrate-nitrite, ammonia, fluoride, sulfate, and total phosphorus. Analysis will be performed using colorimetry, based on EPA Methods 325.1/325.2 or 9250/9251 for chloride, 353.2 for nitrate-nitrite, 350.3 or 350.1 for ammonia, 375.2 for sulfate, and 365.1 for total phosphorus (EPA 1983 and EPA 1986). Fluoride will be detected using an ion-selective electrode using EPA Method 340.2. Soil/sediment samples will be extracted with deionized water for the dissolution of the desired anions prior to analysis, according to the statement of work in Appendix C. Soil detection limits are based on a 10-gram soil sample, 100 mL of extractant, and a soil moisture content between 0 and 10 percent. The actual detection limit will vary depending upon these variables. The laboratory will perform only one of the identified methods for chloride for a given field investigation.

6.2.8. Total Kjeldahl Nitrogen

Groundwater and surface water samples will be analyzed for total Kjeldahl nitrogen using EPA Method 351.3 (EPA 1983). Analysis consists of converting nitrogen to ammonia, then detecting the ammonia by

colorimetry using Nesslerization.

6.2.9. Total Organic Carbon

Soil/sediment samples and groundwater/surface water samples will be analyzed for total organic carbon (TOC), using EPA Methods 415.1 or 415.2. Analysis consists of converting organic carbon to carbon dioxide, which is detected by a nondispersive infrared detector. Soil/sediment samples undergo a pyrolysis to release the carbon dioxide to be detected. This preparation procedure is described in a statement of work in Appendix C.

6.2.10. Nitrite, Soil pH, and Alkalinity

Groundwater samples will be analyzed in a field laboratory for nitrite and alkalinity and soil samples for soil pH in order to meet the required holding times. Nitrite will be analyzed by EPA Method 354.1 using spectrophotometry for detection of the formed diazonuim compound.

Soil pH will be performed according to the SW-846 electrometric procedure, SW-9045.

Alkalinity will be measured using the tritrimetric method in EPA Method 310.1. Carbonate and bicarbonate species will be calculated based on the measurement and the pH of the sample and by making assumptions on alkalinity relationships.

6.2.11. Total Dissolved Solids (TDS) and Total Suspended Solids (TSS)

TSS and TDS for groundwater and surface water samples will be analyzed according to EPA Methods 160.1 and 160.2 (EPA 1984), respectively.

6.2.12. Cation Exchange Capacity (CEC), Specific Gravity, Particle Size Analysis, Hydraulic Conductivity, Organic Content, Soil Moisture, Maximum Density, and Relative Density

Selected soil samples will be analyzed for CEC, specific gravity, particle size analysis, hydraulic conductivity, organic content, soil moisture, and relative density. CEC will be analyzed by EPA Method 9081. The sodium measurement as part of the CEC analysis will be performed by ICP using CLP SOW methodology as stated

in this document for metals. The other physical parameters will be analyzed by the procedures specified in the ASTM Methods noted on Table VI.1.

6.2.13. Cyanide

Cyanide will be analyzed according to the CLP SOW for water and soil samples. This method uses spectrophotometry. The required detection limits for cyanide are 10 μg/L for water and 2 mg/kg for soil.

6.2.14. Lanthanides

Soil/sediment samples will be analyzed for lanthanides using ICP per the CLP SOW. Lanthanides include the elements lanthanum, cerium, praseodymium, neodymium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutetium. A modification to the CLP SOW Document No. ILM03.0 (Modification C) defines the procedures applicable to lanthanides.

6.2.15 Clay Mineralogy

Selected soil samples will be analyzed by X-ray diffraction to determine the geochemical structure of the soil.

6.2.16 Dioxin/Furan

For those operable unit field investigations requiring dioxin/furan analyses, soil/sediment and water samples will be analyzed for all 2,3,7,8-substituted isomers and total isomer homologs (tetra through octa) for polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans, using methodology based on EPA Method 8290 (EPA 1990). Method 8290 uses a high-resolution gas chromatography (HRGC)/high-resolution mass spectrometry (HRMS) method, and isotopically-labeled internal standards for quantitation. Specific criteria, defined in the method, must be met for a gas chromatographic peak to be identified as a PCDD or PCDF. Table VI.1 lists the expected quantitation limits for this method and Table III.2 lists the required quality control procedures for the method.

The required minimum initial cleanup of the extract will consist of a silica gel/alumina column cleanup. A carbon column cleanup must be performed if the internal standard recovery is not within the limits specified

in Table III.2. If GC/MS results are indeterminable by the laboratory, then optional cleanup procedures will be employed, specifically acid/base wash or additional column cleanup using silica gel, alumina, or carbon, as determined by the experienced analyst. In the case of extracts containing known or suspected (i.e. color) interferents, the acid/base wash will precede the column cleanup procedures as determined necessary.

7. CALIBRATION PROCEDURES AND FREQUENCY

Before any instrument is used as a measuring device, the instrument's response to known reference materials (traceable to an appropriate agency standard such as NIST, NBS, or ASTM) must be determined. The manner in which various instruments are calibrated is dependent upon the particular type of instrument and its intended use. All sample measurements are made within the calibrated range of the instrument. For laboratory analyses, appropriate sample dilution is performed if the instrument response is greater than the upper end of the calibration range.

7.1. FIELD EQUIPMENT

Applicable field instruments to be used during the investigation will be calibrated according to the specifications set forth in the respective Mound Plant ER Program SOPs (Appendix A). Instruments will be calibrated at least once per day during field use. Table III.1 in Section 3 summarizes the calibration procedures, frequency of calibration and acceptance criteria necessary for the calibration to be valid for applicable field measurements and field screening.

Records for each field instrument used as part of this program will be maintained to ensure its capability of providing accurate and precise measurements. Records will be maintained on instrument maintenance and calibration. Such records will be reviewed prior to their use in the field. Tracking of instrument records will be accomplished by assigning a unique number to each instrument that will correspond to its records file.

The field measurement and field screening instruments that may be used in the field during the environmental investigation are presented in the following subsections.

7.1.1. Photoionization Detector (PID)

The HNu™ PID is a general survey instrument capable of detecting and measuring many organic and inorganic vapors in air. The instrument can be calibrated to a particular compound; however, it cannot distinguish between detectable compounds in a mixture of gases. The HNu has a sensitivity of approximately 0.1 parts per million (ppm) benzene. However, the instrument's sensitivity depends upon the compounds present and environmental factors such as moisture and temperature. Mound Plant ER

Program SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector (included in Appendix A), provides details on the calibration frequency and procedures for the HNu PID.

7.1.2. Explosimeter/Combustible Gas Indicator (CGI)

Explosimeters, or combustible gas indicators (CGIs), are used to determine the potential for the combustion or explosion of unknown atmospheres. A typical CGI determines the level of organic vapors and other gases present in an atmosphere as a percentage of the lower explosive limit or lower flammability limit by measuring the change in electrical resistance in a Wheatstone bridge circuit. The CGI can reliably detect common combustible vapors such as methane, butane, and pentane. Some CGI models also contain an oxygen detector. The oxygen detector is useful for determining the existence of atmospheres deficient in oxygen. Mound Plant ER Program SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels (included in Appendix A), describes the details of the calibration frequency and procedures of CGIs.

7.1.3. Specific Conductance Meter

The YSI Model 33 specific conductance meter, or equivalent, is a portable, battery-operated, transistorized instrument used to measure salinity, specific conductance, and temperature in surface water, groundwater, and waste water systems. Instrument calibration frequency and procedures for salinity, specific conductance, and temperature measurement instruments are described in detail in Mound Plant ER Program SOP 2.2, Field Measurements on Ground and Surface Water Samples (included in Appendix A).

7.1.4. pH Meter

The Fisher Model No. 107 pH meter, or equivalent, is a portable pH monitoring instrument for determining pH in surface water, groundwater, and waste systems, and for other water quality applications. The calibration frequency and procedures are described in detail in Mound Plant ER Program SOP 2.2, Field Measurements on Ground and Surface Water Samples (included in Appendix A).

7.1.5. Datalogger and Pressure Transducer or Equivalent Water Level Measuring Device

The Enviro-Labs Model DL-120-MCP Datalogger and Pressure Transducer, or other devices defined in Mound Plant ER Program SOP 3.1, will be used to record water level measurements. The calibration frequency and procedures for the datalogger and pressure transducer are described in detail in Mound Plant ER Program SOP 3.3, Operational Check of Pressure Transducers Used in Measuring Water Levels in Wells (included in Appendix A). The calibration of other acceptable water level measuring devices are described in Mound Plant ER Program SOP 3.1.

7.1.6. Zinc Sulfide Alpha Scintillometer

A portable zinc sulfide alpha scintillometer, coupled with a ratemeter/scaler, will be used to screen soil samples that are collected in areas where alpha-emitting radionuclides may exist. This screening must be performed in order to establish proper shipping/packaging procedures for the samples and to establish the average background levels for safe handling of the samples by laboratory personnel. This instrumentation can reliably measure activity levels above 350 disintegrations per minute (dpm) per 100 centimeters squared (cm^2). In addition, this detector may be used for personnel monitoring. This instrumentation can reliably measure activity levels above 350 dpm/100 cm^2, or about 70 counts per minute (cpm)/100 cm^2. Mound Plant ER Program SOP 6.4, Total Alpha Surface Contamination Measurements (included in Appendix A), describes in detail the calibration frequency and procedures for the zinc sulfide alpha scintillometer.

7.1.7. Field Instrument for the Detection of Low-Energy Radiation (FIDLER)

A FIDLER will be used to monitor surfaces and soil samples for the presence of low-energy gamma radiations that accompany some alpha emission, such as the 17-kiloelectron volt (keV) gamma-ray emitted when plutonium-238 low energy decays to uranium-234. The FIDLER, used in combination with the zinc sulfide alpha probe, can provide a determination of the presence or absence of radionuclides. The FIDLER reliably measures gamma levels above 100 picocuries per gram (pCi/g) for plutonium-238 in soil. The calibration frequency and procedures for the FIDLER are described in detail in Mound Plant ER Program SOP 6.7, Near Surface and Soil Sample Screening for Low-Energy Gamma Radiation Using the FIDLER (included in Appendix A).

7.1.8. Dissolved Oxygen Meter

Daily calibration of the dissolved oxygen meter is accomplished with a calibration bottle containing a given moist environment. Mound Plant ER Program SOP 2.2, Measuring Dissolved Oxygen (included in Appendix A), describes the calibration procedures for this meter.

7.1.9. Oxidation-Reduction (Redox) Potential

A prepared calibration solution is used to calibrate once per day the pH meter with a Hach OPR electrode for measuring the redox potential. The solution is prepared according to the operating manual for the Hach OPR electrode. Mound Plant ER Program SOP 2.2, Measuring Oxidation-Reduction Potential (included in Appendix A), describes the calibration procedures for measuring the redox potential.

7.1.10 Flame Ionization Detector (FID)

The FID is a general survey instrument capable of detecting and measuring many organic vapors in air. The FID does not detect inorganic vapors. The instrument cannot distinguish individual compounds, but measures the total concentration of vapors. The FID sensitivity is approximately 0.1 ppm methane. Mound Plant ER Program SOP 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector (included in Appendix A), provides details on the procedures for calibrating the FID.

7.2. LABORATORY EQUIPMENT

Laboratory instrument calibrations typically consist of two types, initial calibration and continuing calibration. Initial calibration procedures establish the calibration range of the instrument and determine instrument response over that range. Typically, three to five analyte concentrations are used to establish instrument response over a concentration range. The instrument response over that range is commonly expressed as a correlation coefficient (e.g., UV-visible/infrared spectrophotometry) or by a response factor, amount/response (e.g., for GC, GC/MS, or high-performance liquid chromatography).

Continuing calibration usually includes measurement of one or more calibration standards. The response is compared to the initial measured instrument response. Continuing calibration is performed at least once per operating shift for laboratory analyses.

Instrument calibration procedures for CLP analyses will be performed according to the CLP SOW for inorganic and organic analyses. For non-CLP analyses, calibration procedures will be performed as described in the approved analytical method and are described in the approved laboratory SOPs. Calibration procedures for all laboratory analyses, along with frequency and acceptance criteria, are summarized in Table III.2 in Section 3. The following subsections discuss the calibration procedures for each type of instrumentation.

7.2.1. Gas Chromatographic (GC) Analyses

Gas chromatography will be used for analysis of volatile organic compounds (Methods SW-8021, SW-8030, and 502.2) and pesticides/PCBs (CLP SOW for organic analysis). Initial calibration is performed when chromatographic conditions are changed (e.g., change in flow rate, detectors, new column) or as required in the CLP SOW for pesticide/PCB analysis. A minimum of five external standards for volatile organic analysis and three external standards for pesticide/PCB analysis of different concentrations are analyzed to determine the linearity of the gas chromatograph. Response factors for each compound are calculated (as specified in the methods) from the results, and a calibration curve generated. Linearity criteria for volatile organic compounds (VOCs) are valid if there is less than or equal to 20% relative standard deviation (15% for Method 502.2) among the calibration factors. A quadratic curve may also be used. Linearity requirements and allowed percentage breakdown of endrin and 4,4'-DDT for pesticide/PCB analysis are presented in the methods.

The CLP SOW for pesticide/PCB analysis requires that the retention times be established and the retention time windows be determined for the target compounds and surrogate compound. The procedures and acceptance criteria are established in the methods.

Performance evaluation mixtures and individual midpoint pesticide/PCB standard mixtures are also analyzed at specified intervals as defined in the CLP SOW. The calibration factor for each standard is established in the methods.

The linearity of the gas chromatograph for volatile organic analysis is checked by analysis of a check standard after every 10 sample analyses. The response for any analyte must be within a 15% difference of the response from the initial calibration. If the percent difference exceeds this criterion, then the instrument is checked and a new calibration curve is performed before samples are analyzed.

Retention time windows for VOCs are established when a column is changed or after other changes are made in instrument conditions that will alter the retention times of the analytes of interest. The windows are established according to procedures defined in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, USEPA (EPA 1987).

7.2.2. Gas Chromatography/Mass Spectrometry (GC/MS) Analyses

GC/MS will be used for analysis of volatile and semivolatile organic compounds. Mass spectral abundance criteria must be met prior to sample analysis. Decafluorotriphenylphosphine (DFTPP) for semivolatile organics and bromofluoro-benzene (BFB) for volatile organics are used to verify instrument performance of the GC/MS system and must meet specific ion abundance criteria established in the CLP SOW. Meeting these criteria is demonstrated daily or every 12-hour time period, whichever is more frequent. The instrument performance is also verified whenever a corrective action to the GC/MS system is taken that affects the tuning (e.g., ion source cleaning or repair).

Initial calibration of the GC/MS system is accomplished with a minimum of five concentrations of target compounds. Only a four-point calibration is required by the CLP SOW for eight of the target semivolatile compounds that have higher CRQLs. Relative response factors (RRFs) must be greater than or equal to 0.05. Relative standard deviations for the RRFs must be less than or equal to 30%. Initial calibration is not valid if this criterion is not met. The relative retention times of each compound in each standard run must agree within 0.06 units.

The initial calibration is verified every 12-hour period with a continuing calibration standard containing all target semivolatile and volatile compounds and surrogate compounds. RRFs are compared to the average RRF from the initial calibration. The minimum RRF for the target compounds must be met. The percent difference between the initial RRFs and the continuing RRF must be less than or equal to 25 percent for the initial calibration to be valid. Prior to sample analysis, the GC/MS system is evaluated and corrective action taken if these criteria are not met.

7.2.3. Inductively Coupled Plasma (ICP) and Atomic Absorption (AA) for Metals and Lanthanides and Spectrophotometry for Cyanide

TAL metals, four additional elements, lanthanides and cyanide will be analyzed according to the procedures presented in the CLP SOW for inorganic analyses. Inductively coupled plasma (ICP), AA instruments, and the spectrophotometer are calibrated daily, or once every 24 hours, and each time the instrument is set up. The AA instrument is calibrated with a blank and at least three concentrations of standards prepared each time for analysis. Minimum linearity for AA analysis is a correlation coefficient of 0.995. The ICP must be calibrated with at least two standards, with one being a blank. The minimum correlation coefficient for cyanide calibration is 0.996.

An initial calibration verification (ICV) is performed to assess the accuracy of the initial calibration using a standard of a certified concentration from an external source. When the measurement exceeds the CLP-established control limits, the problem is corrected, the instrument is recalibrated, and the ICV is run again. The initial calibration is verified by analysis of a continuing calibration verification (CCV) standard every two hours during an analysis run or at a frequency of 10%, whichever is more frequent (once every five samples for residential well samples) for analysis by graphite AA. This standard is also analyzed for at the beginning and end of each sample analysis run. The concentration and source of the CCV and acceptance criteria are specified in the CLP SOW. For ICP and AA CLP analysis, linearity is required near the contract-required detection limit (CRDL). An ICP standard (CRI) at two times the CRDL or two times the instrument detection limit (IDL), whichever is greater, is analyzed for at the beginning and end of each sample analysis run or twice per 8-hour working shift, whichever is more frequent, but not before the ICV. An AA standard (CRA) at the CRDL or IDL, whichever is greater, is analyzed for at the beginning of each sample analysis run, but not before the ICV.

7.2.4. Alpha Spectrometry

Alpha spectrometry will be used for measurement of isotopic plutonium, thorium, uranium, americium-241, and radium-226. A pulse check is performed once every day to determine if the detection system is functioning correctly. The background level is checked for gross contamination at a minimum of once per week with a 1000-minute count.

7.2.5. Gamma Spectrometry

For gamma spectrometry, the counting efficiency is verified once per day with a source check. A mixed standard consisting of selected radionuclides of interest is used with initial instrument setup and when necessary to perform an energy and efficiency calibration of the detection system. The background level is checked for contamination once per day with a 10-minute count. Background is established with a 1000-minute count performed once per month.

7.2.6. Liquid Scintillation

Liquid scintillation is used to measure beta particle activity from tritium. A source check is performed daily to verify calibration and efficiency. The background level is also checked daily.

7.2.7. High-Performance Liquid Chromatography (HPLC)

High-performance liquid chromatography HPLC is used for analysis of explosives. Initial calibration is performed with a minimum of five concentrations of standards whenever there is a change in chromatographic conditions or when the check standard is outside acceptance criteria. The resulting calibration curve must have an average response factor with a relative standard deviation less than or equal to 20%.

The initial calibration is checked prior to sample analysis and once every 10 samples analyzed with a midrange standard for each analyte. The response of the check standard must be within 15% of the predicted response in order for the initial calibration to be valid. If the calibration check is outside this criteria, a new calibration curve will be performed. The retention times and peak heights of the check standard for every 10 samples are compared to those of the check standard run at the beginning of the day. If significant deviation or visible chromatographic abnormalities are observed, then all samples analyzed after the last acceptable standard check will be reanalyzed.

7.2.8. Colorimetry, Ion Selective Electrode, and Total Organic Carbon (TOC) Analysis

Nitrate-nitrite, sulfate, chloride, total nitrogen, nitrite, ammonia, and total phosphorus will be analyzed for by spectrophotometric methods, which use a colorimeter to identify the analyte when the analyte is

complexed with, or creates the formation of, a light-absorbing compound. Total organic carbon (TOC) is analyzed using a spectrophotometer with an infrared detector. Fluoride will be detected using an ion selective electrode. Calibration of the colorimeter and electrode is accomplished with a minimum of three concentrations of standards and is performed when instrument conditions are changed or when the calibration standard exceeds acceptance criteria. The calibration curve is plotted or a minimum correlation coefficient of 0.995 is required for acceptable linearity of the resulting calibration curve. The TOC analyzer is calibrated with a single concentration standard.

The initial calibration is verified with the analysis of a midrange calibration standard prior to sample analysis and for every 20 samples analyzed. The standard result must be less than or equal to a 15% difference from the response of the initial calibration. If this acceptance criterion is exceeded, then the instrument is recalibrated.

7.2.9 pH Meter

Alkalinity is measured titrimetrically using a pH meter to observe change in pH. The pH meter is calibrated every 10 samples with a minimum of two pH standards (pH 4 and 7). Immediately after this initial calibration, the pH 4 standard is checked. If the standard is not within + or - 0.1 units, the instrument is checked and recalibrated.

7.2.10 Cation Exchange Capacity (CEC), Specific Gravity, Particle Size Analysis, Hydraulic Conductivity, Organic Content, Soil Moisture, and Relative Density

Calibration procedures for CEC will be those stated by the method in SW-846 (EPA 1986). Calibration procedures for specific gravity, particle size analysis, hydraulic conductivity, organic content, soil moisture, and relative density will be those specified in the appropriate ASTM method.

7.2.11 Clay Mineralogy

Calibration procedures for X-ray diffraction instruments should include the analysis of an NBS traceable quartz standard to determine alignment and intensity.

7.2.12 Gas Chromatography/Mass Spectrometry for Dioxin/Furan Analyses

High-resolution GC/MS will be used for analysis of PCDDs and PCDFs based on EPA Method 8290 (EPA 1990). Perfluorokerosene (PFK) is used to verify the mass resolving power of the instrument at the beginning and end of each shift or when corrective action is taken to the GC/MS system that affects the resolving power. A GC resolution performance check solution is analyzed at the beginning of each shift to verify the resolution of 2,3,7,8-TCDD and determine the eight homolog retention windows.

Initial calibration of the GC/MS system is accomplished with a minimum of five concentrations of mixture of isotopically-labeled and native target compounds. The following criteria must be met for the initial calibration to be valid:

1) The percent relative standard deviations for the mean relative response factors for unlabeled compounds must not exceed ±20 percent, and those for the labeled compounds must not exceed 30 percent;

2) the signal-to-noise ratio for the GC signals must be greater than or equal to 2.5; and

3) the ion abundance ratios of the homologous series quantitation ions must be within control limits specified in Method 8290.

A continuing calibration check standard is analyzed at the beginning and end of each analytical shift to verify the initial calibration is still valid. The following criteria must be met for acceptable continuing calibration:

1) The continuing Relative Response Factors (RRFs) must be within ±20 percent of the mean values obtained during initial calibration for unlabeled standards;

2) the continuing RRFs must be within ±30 percent of the mean values obtained during initial calibration for labeled standards; and

3) the ion abundance ratios of the homologous series quantitation ions must be within control limits specified in method SW8290.

All criteria for mass resolution, chromatographic resolution, and initial and continuing calibration must be met before samples are analyzed.

8. INTERNAL QUALITY CONTROL CHECKS

Internal quality control checks are performed as part of a field investigation in order to monitor and assess the quality of the data generated. Quality control checks are used to evaluate the accuracy and precision of field screening, field measurements, sampling technique, and laboratory analyses. Acceptance criteria for the quality control checks, and corrective actions to be taken if criteria are not met, have been established for this program so that data of known quality is obtained (Table III.2). The following subsections summarize those internal quality control checks.

8.1. SCREENING AND FIELD MEASUREMENTS

Quality control procedures for screening and field measurements are limited to checking the reproducibility of the measurement by obtaining multiple readings and by calibrating the instruments (when appropriate) with either internal references or external standards. The frequency of these checks and acceptance criteria are presented on Table III.1.

8.2. FIELD SAMPLING

Field conditions and sampling techniques for surface water/groundwater and soil sediment can be assessed by the collection of trip blanks, sample bank blanks, equipment (rinsate) blanks, ambient blanks, and duplicate samples for selected laboratory analyses. Blank samples will not be labeled as such so that laboratory bias is minimized. The laboratory will be kept from using these samples for internal quality control by indicating which samples are to be used for internal quality control on the chain-of-custody record. Trip, sample bank, ambient, and equipment blanks monitor environmental conditions or sampling technique during sampling in order to detect potential sample contamination. Trip blanks monitor volatile organic contamination during sample transport and storage. Trip blanks are prepared in the laboratory by filling vials with organic-free deionized water (ASTM Type II quality), sealing the vials with no air bubbles, and transporting them to the site. These blanks remained unopened while stored with the collected samples (one set per sample cooler). Sample bank blanks monitor VOCs potentially present in the surrounding environment where samples are commonly handled before shipment. Sample bank blanks are prepared, after a given batch of samples are collected, with organic-free deionized water (ASTM Type II quality) in sample vials, capped with no air bubbles, and placed in the desired location during handling. Equipment

blanks are used to evaluate the decontamination technique of sampling equipment that is not dedicated to a given sampling location. Equipment (rinsate) blanks are prepared by filling sample bottles with organic-free, deionized water (ASTM Type II quality) that has been routed through a decontaminated sampling device, including the filtering apparatus (metal samples only). Ambient blanks monitor VOCs potentially present in the surrounding environment where a sample is being collected. These are collected at a selected sampling locations in the same manner as the sample bank blanks at a frequency of one per 20 samples. Trip blanks are collected at such a frequency that one set of sample vials accompanies each cooler that contains samples for volatile organic analysis. Sample bank blanks are collected for every 20 samples for volatile organic analysis collected in the field. Equipment blanks are collected for every 10 or fewer samples collected in the field and will be analyzed for the same parameters as for those applicable samples collected. Those parameters include volatile and semivolatile organic compounds, dioxin/furan, pesticides/ PCBs, explosives, radionuclides, metals, cyanide, lanthanides, chloride, nitrate, total nitrogen, total phosphorus, TOC, and total suspended and dissolved solids.

Collection of duplicate samples can measure the precision of the sampling technique. A duplicate sample is collected for every sample group or every 10 water samples or fewer investigative samples and for every sample group or 10 soil samples or fewer collected in the field. A relative percent difference is calculated for the duplicate sample analysis as defined in Section 3 and is used to evaluate sampling precision. Monitoring analytical precision is discussed in the following section, Laboratory Analyses. Acceptance criteria for precision of duplicate field samples has not been established. A high variation in soil sample results for the primary and duplicate sample is common due to the nonhomogeneous nature of soils; therefore, duplicate soil sample results will be assessed accordingly.

A bottle lot blank will be prepared if there is an indication from the analytical results that a non CLP analyte is a bottle contaminant. At least one bottle for each lot number of non CLP analytes will be stored in the shipping box for this purpose. A bottle blank will be prepared by filling the sample bottle with organic-free, deionized water (ASTM Type II quality), and capping it.

8.3. LABORATORY ANALYSES

Internal quality control checks for CLP analyses are specified in the SOW for organics (EPA 1990a) and the most current SOW for inorganics (ILM03.0). These quality control checks are summarized on Table III.2

along with frequency and acceptance criteria. Corrective actions to be taken, if any acceptance criteria are not met, are specified in Table III.2 and the EPA CLP SOWs for organic and inorganic analyses.

Internal quality control checks for non-CLP analyses are specified in the analytical method and in Table III.2. Additional quality control checks for some analyses will be performed and are also summarized in Table III.2. Frequency of the checks, acceptance criteria, and corrective actions (as presented in Table III.2) are based on guidance in the analytical method and established laboratory control limits.

A definition of the internal quality checks for chemical and radiological laboratory analysis are presented below:

- Method Blank. The method blank is an artificial sample designed to monitor the introduction of artifacts into the analysis which could result from the sample preparation or analytical method. For aqueous sample analysis, reagent water is generally used as the matrix. For solid sample analysis other than for radiological analyses, a purified solid matrix is used. The method blank is carried through the entire analytical scheme (extraction, concentration, and analysis). Method blanks will be performed for all applicable analyses at a frequency stated for the analytical method on Table III.2. For CLP metals analyses, the method blank is referred to as the preparation blank.

- Sulfur Cleanup Blank. When sample extracts for pesticide/PCB analysis require a sulfur cleanup, a sulfur cleanup blank is performed. This method blank monitors for contamination from the sulfur cleanup steps.

- Instrument Blank. For pesticide/PCB analysis, reagent is analyzed to verify the gas chromatograph is free of contaminants.

- Background Check. A background check is performed for liquid scintillation analysis at a given count time and frequency to determine if the instrumentation is contaminated above a maximum acceptable level. For tritium analysis, the background check is performed once per day prior to sample analysis. The maximum acceptance level for system contamination is 3 standard deviations. If this limit has been exceeded, the problem is identified and corrected prior to sample analysis. For alpha and gamma spectrometry, background is established once per month using a longer count time, in addition to a daily background check with a short count time, such as 10 minutes.

- Source Check. A source check is a check of the counting efficiency of the detector. The check determines the reproducibility. The check is performed once per day for liquid scintillation, for tritium analysis, and for gamma spectrometry.

- Method Spike/Blank Spike. A method spike is a method blank sample carried throughout the same process as the samples to be analyzed, with a known amount of standard added. The spike result of the sample provides information on how the method is performing. This quality control check is performed for radiochemical analyses such as tritium and the drinking water method for volatile organic analysis.

- Pulse Check. The pulse check is performed once per day on the alpha spectrometer to check count reproducibility. Peak counts at 5 meV must be within 3 standard deviations.

- Matrix Spike. Predetermined quantities of specific analytes are added to a sample matrix prior to sample extraction or digestion. Percent recoveries are calculated for each analyte to assess the analytical accuracy. Matrix spikes monitor the effects of the sample matrix on the analytical results. One matrix spike for every 20 samples collected will be performed for all applicable analyses (volatile organics, semivolatile organics, pesticides/PCBs, dioxin/furan, explosives, metals, cyanide, chloride, nitrate, total nitrogen, total phosphorus, radionuclides, and TOC). The field sample to spike will be selected by field personnel and will not include a field blank sample (trip blank, equipment blank, or sample bank blank). This will ensure that a Mound sample matrix with possible analyte detections will be spiked to obtain representative results of analytical accuracy.

- Matrix Spike Duplicate. A duplicate matrix spike of the same sample collected in the field will also be performed for every 20 samples collected. The matrix spike duplicate will assess the analytical and sampling precision by calculating a relative percent difference (as defined in Section 3) between the primary and duplicate spike recoveries. This sample will be a duplicate sample of the selected matrix spike.

- Surrogate Spike. Surrogate compounds are organic compounds similar to the analytes of interest in chemical composition and extraction and chromatographic properties, but are not normally found in environmental samples. These compounds are spiked into all field and laboratory samples (blanks, standards, and matrix spikes) for volatile organic, semivolatile organic, and pesticide/PCB analyses. Percent recoveries are calculated for each surrogate compound in each sample. These recoveries give an indication of the performance of the analytical method.

- Replicate Sample. A replicate sample is analyzed for given analyses by taking aliquots from a sample container to assess the precision of the analytical method. An RPD is calculated for the primary and replicate sample results. Replicate samples will be analyzed for radionuclides, metals, and total organic carbon. Field personnel will select the CLP metals sample to be analyzed as a replicate.

- Instrument Performance Check. GC/MS analyses require that the mass spectrometer be tuned prior to calibration and sample analysis. This is accomplished with analysis of a compound with similar properties but not commonly found in the environment. For tunings and mass calibration, BFB, DFTPP, and PFK are used for volatile organic,

semivolatile organic, and dioxin/furan GC/MS analyses, respectively. Specific ion abundance criteria must be met, as defined in the appropriate method, before sample analysis begins.

- Initial Calibration. An instrument is calibrated initially with a series of standards at predetermined concentrations to identify the response factor of the instrument over the given concentration range. This is usually performed for most instruments when there has been a change in instrument conditions or when the calibration check result is outside a defined acceptance criteria.

- Calibration Check. The initial instrument calibration is verified at regular intervals to account for potential instrument drift or other changes in instrument conditions. A standard with a concentration within the calibration range is analyzed for usually after 10 sample analyses or with a frequency defined in the CLP SOW. The standard result is compared to the initial calibration, and a percent difference or RPD is calculated. If the result is not within the established acceptance criteria, then the analytical system is evaluated and recalibrated before continuing sample analysis. For CLP metal analyses, samples analyzed since the last acceptable standard must be reanalyzed.

- Retention Time Window. Retention times of target analytes for GC, GC/MS, and HPLC analyses must be monitored for shifts during samples analysis. The allowed shift of retention time for a given analyte is the retention time window. Retention time windows are established according to the analytical method. Acceptance criteria are expressed as an established range (e.g., ±0.06 units) or for pesticide analysis as plus or minus three times the standard deviation of three retention times of the same compound. Shifts that occur outside the acceptance criteria indicate a change in the chromatographic system or an instrument problem and could lead to misidentifications unless corrective action is taken.

- Internal Standard. Internal standards are performed for volatile, semivolatile, and dioxin/furan GC/MS analyses and are used to ensure the system sensitivity and response are stable for every run. Internal standards consist of compounds that are similar in analytical behavior to the analytes and are added to the calibration standards. Response factors of these standards are used to quantitate sample results. Criteria for internal standard responses and retention times are defined in the method.

- Initial and Continuing Calibration Blanks (ICB, CCB). A blank consisting of reagent water is analyzed immediately after every initial and continuing calibration verification for CLP metal analyses, at a frequency of 10% or every 2 hours, whichever is more frequent.

- Laboratory Control Sample (LCS). An LCS is a standard solution of a certified concentration prepared by a source external to the laboratory performing the analysis and is used to measure the analytical accuracy. This quality control check is performed for metals, volatile organics, chloride, total dissolved and suspended solids, and nitrate-nitrite analyses for every batch of analytical samples. The CLP SOW requires that the recovery of the LCS analysis for metals be within 80 to 120%.

Manufacturer's specifications for acceptance criteria of the LCS are used for the other analyses. An LCS may also be prepared by the EPA Region V Central Regional Laboratory for submittal (blind) to the laboratory for analysis.

- Initial Calibration Verification (ICV). After the ICP, AA, and cyanide systems are calibrated, the accuracy of the initial calibration is verified with the analysis of a calibration verification standard. The CLP SOW has established control limits for each system (ICP and AA: 90 to 110% of the true value; AA--cold vapor for mercury: 80 to 120% of true value, and cyanide: 85 to 115% of true value). If control limits are exceeded, then the problem is identified and corrected, and the instrument is recalibrated.

- Continuing Calibration Verification (CCV). The initial calibration of ICP, AA, and cyanide systems is verified during each set of analyses at a frequency of 10% or every 2 hours, whichever is more frequent. The solution, as required by the CLP SOW, is either an EPA solution, a National Bureau of Standards SRM1643a solution, or a contractor-prepared standard. The control limits for this analysis are the same as for the ICV.

- Linear Range Check Standard (CRI). For ICP analysis, a standard (or CRI) at two times the CRDL or two times the instrument detection limit is analyzed at a frequency defined in the CLP SOW to verify the linearity near the CRDL. For AA analysis, the standard (or CRA) is analyzed at a concentration at the CRDL or IDL.

- Interference Check Sample (ICS). An interference check sample (ICS) is analyzed for the ICP analysis at a frequency defined in the CLP SOW to verify interelement and background correction factors. The ICS consists of one solution containing interferents, and a second containing analytes mixed with the interferents. The second solution must fall within ±20% of the true value. Corrective action, as defined in the CLP SOW, is taken if this criteria is not met.

- ICP Serial Dilution (L). A serial dilution is a series of different dilutions of a given sample and a comparison of sample results. An ICP serial dilution is performed on one sample from each group of samples of a similar matrix and concentration or for each sample delivery group, whichever is more frequent, as defined in the CLP SOW. Results of the analysis must agree within 10%. The analysis of serial dilutions gives an indication of potential chemical or physical interferences.

- Method of Standard Addition (MSA). The method of standard addition (MSA) is a method for quantitating furnace AA sample results to eliminate the effects of the sample matrix. A sample whose matrix is interfering with quantitation is spiked at three concentrations, and the results are used as a calibration curve to quantitate the sample results. The conditions under which standard addition is performed and how the sample results are qualified are defined in the CLP SOW.

- Linear Range Analysis (LRA). The linear range for ICP analyses is checked with a standard quarterly. The standard is analyzed with a routine analytical run. The results must be within ±5% of the true value. The concentration of the standard is the upper limit of the ICP linear range.

- Interelement Corrections. ICP interelement correction factors are determined prior to the start of CLP contract analyses and at least annually. The interelement corrections are for spectral interference due to aluminum, calcium, iron, and magnesium and are checked for all wavelengths used for each analyte.

- Low Level Check Sample. For a low concentration analysis, a low level standard is analyzed routinely to demonstrate that low levels can be accurately identified and quantified.

- Secondary Column Confirmation. For gas chromatographic analysis, a GC column with different coating or packing is used as a second analysis on samples with detections on the primary column. This second analysis confirms the presence or absence of the detected analyte.

- Performance Evaluation Sample. This check is a sample prepared externally to the laboratory to assess the ability of the laboratory to accurately perform the analysis. The sample is prepared with known concentrations of analytes of interest.

- Qualitive Verification. The CLP SOW for organic analysis has requirements for verifying the identification of target compounds. This includes a comparison of the sample mass spectrum to the mass spectrum of a standard of the suspected compound. The criteria to be met for proper identification are discussed in the CLP SOW.

9. DATA REDUCTION, VALIDATION, AND REPORTING

9.1. FIELD AND TECHNICAL DATA

The field and technical (non-laboratory) data that will be collected during the RI effort at Mound Plant can generally be characterized as either objective or subjective data. Objective data include all direct measurements such as field screening/analytical parameters and water level measurements. Subjective data include descriptions and observations. Test boring and well logs include both types of data, in that the data recorded in the field are descriptive but can be reduced using the standardized lithologic coding system.

9.1.1. Field and Technical Data Reduction

For field measurement data which require calculations to obtain final concentrations/values (e.g., alkalinity), equations used and the calculations performed will be recorded in the appropriate field log. The equations used for measurement data are provided in the respective Mound Plant ER Program SOPs in Appendix A. All calculations will be checked at least once by the field team member performing the field measurement.

Occasionally a field measurement will result in an outlier with a value significantly outside the expected range for most field conditions (e.g., a zero reading for specific conductance). Attempts will be made by the experience of the field team to identify outliers during the field measurement. All health and safety screening measurements will be considered. When identified at this time, the outlier will be recorded as would any other field measurement, and at least two additional measurements will be made and recorded to verify or invalidate the suspected outlier. When appropriate, field instrumentation and calibration will be checked, and the parameter remeasured when an outlier is discovered. If after this check the value remains the same, it is considered a valid measurement.

9.1.2. Field and Technical Data Validation

Review of objective field and technical data integrity will be performed at two different levels. On the first level, field personnel at the time of collection will check to ensure that standard operating procedures are followed, all data are recorded, and quality control checks are performed and all forms and notebooks are signed and dated on the day recorded. At the second level, data will be reviewed by a technical peer not involved with the data collection, who will check to ensure that all data are recorded and reported correctly,

including calculations and sample collection information. Ten percent of all calculations will be checked. Any inconsistencies or anomalies discovered will be resolved immediately, if possible, by seeking clarification from the field personnel responsible for collecting the data.

Subjective field and technical data will also be reviewed for reasonableness and completeness by the installation manager. In addition, random checks of sampling and field conditions will be made by the field supervisor, who will check recorded data at that time to confirm the recorded observations. Whenever possible, peer review also will be incorporated into the data review process, particularly for subjective data, to maximize consistency among field personnel. For example, during drilling activities, the field manager will schedule periodic reviews of archived lithologic samples to ensure that the appropriate descriptions and codes are being consistently applied by all field personnel.

After the validity of data in the field notes and on ER Program forms has been evaluated according to the procedures described above, the data administrator will tabulate the data, wherever possible, by entering the data in computer data files. All data hand-entered into computer files will be checked 100 percent by another individual. Where appropriate, the data files will be set up for direct input into the project database. Subjective data will be filed as hard copies for later review by the installation manager and for incorporation into technical reports, as appropriate.

9.1.3. Field and Technical Data Reporting

All field data will be recorded by field personnel in bound field notebooks and on ER Program forms (for specific measurements). For example, during drilling activities, the field team member supervising a rig will keep a chronological log of drilling activities, a vertical descriptive log of lithologies encountered, other pertinent drilling information (staining, odors, field screening, working conditions, water levels, geotechnical data), and a labor and materials accounting in the team member's bound notebook. It will be the responsibility of all field personnel to photocopy all field logs (including notebook pages and ER Program forms) generated during a given field day, at the end of that day. Copies will be given to the site manager or field supervisor, who will maintain field log files. At the completion of a work shift, copies of all field logs, notebook pages, and ER Program forms will be returned to the EG&G subcontractor's office. These copies will be presented to the ER Program site manager and entered into the project file. Entries will be as detailed and descriptive as possible so that a particular situation can be recalled without reliance on the

collector's memory. All records of numerical analyses performed on field and technical data will be legible, reproduction quality, and complete enough to permit logical reconstruction by a qualified individual other than the originator. At the completion of a field program, field logbooks will be returned to the project files. All field records will be kept on file by EG&G for a minimum of 10 years. EPA Region V and the EG&G will be notified prior to any intent to dispose of project files.

Field notebook entries will include, on the inside cover and first pages, the following information:

- name;
- company name and address;
- phone number;
- activity or location;
- phone numbers for supervisors, emergency response, etc.;
- table of contents; and
- the procedures (SOPs) used or followed for each field activity.

Daily entries will include the following information:

- date and time;
- name of individual making the entry;
- description of test/activity;
- quantities of materials used;
- drawings and information related to the activity;
- conditions that might adversely affect the test/activity;
- names of witnesses or observers present;
- samples collected, received, or released;
- deviations from the procedures (SOPs) used or followed;

- data that are not recorded on the ER Program forms or are not recorded by automatic methods;
- calculations performed;
- deviations from procedures, plans, or protocols used;
- date and reason for downtime or delays;
- visitors; and
- weather condition.

All entries will be made using a regular or ballpoint pen with indelible black ink. Corrections to entries will be made by crossing out the error with one line, dating and initialing the error, and entering the correction above or beside the error. Each page entered on in the notebook will be signed and dated by the individual. Once an entry has been signed and dated, changes, deletions, or additions are made only as a entry and refer back to the original entry rather than crossing it out. A new page in the field notebook is started when the previous page is full or when the previous page has been marked, dated, and signed so that no entries can be made. Pages are not removed from the bound notebook.

9.2. LABORATORY DATA

9.2.1. Laboratory Data Reduction

The computation of analytical results from the raw data generated is performed as prescribed in the various analytical methods. The step-by-step calculations are provided in the referenced analytical method. Data reduction procedures unique to the laboratories used are specified in the laboratory specifications attachments. Sample results will not be corrected for method blank results.

Laboratory data is stored separately for each project by the laboratory. Included in the file are calibration records, raw analytical data, processing of data, data validation, quality control samples results, data reports, and project-specific requirements. These records are kept for a minimum of 10 years. The EG&G subcontractor and EPA Region V will be notified of intent to dispose of Mound Plant data.

The laboratory limits access to laboratory data files and the laboratory's electronic database. Only laboratory personnel as designated in their position description are allowed to access the files and the

database. The database will be accessed by individual password only. Each individual will be limited to areas in the database which relate directly to their positional responsibilities.

9.2.2. Laboratory Data Validation

9.2.2.1 Chemical and Radiological Data

Data validation procedures performed in the laboratory are described in the laboratory specifications attachments.

In addition to the data review performed by the appropriate laboratory, an organization external to the one that generated the data will validate the analytical data. Analytical data generated from samples collected at Mound Plant will be reviewed and validated by an ER Program EG&G subcontractor.

Data Generated Under CLP

Validation by the ER Program EG&G subcontractor will be performed on all CLP organic and inorganic analyses in a step-by-step approach. These data will first be evaluated for completeness of the data package and then against the requirements of this QAPP. The CLP-generated data (TCL organic compounds and TAL inorganic parameters) will then be evaluated according to EPA CLP validation procedures ("Laboratory Data Validation - Functional Guidelines for Evaluation of Inorganic Analyses, July 1, 1988;" and "Laboratory Data Validation - Functional Guidelines for Evaluation of Organic Analyses, February 1, 1988," prepared by the EPA Data Review Work Group, latest revisions).

Non-CLP Chemical and Radiological Data

The Mound Plant ER Program will use the criteria described in this section to evaluate the acceptability of all non-CLP data. These non-CLP analyses include volatile organic compounds in groundwater, radiological constituents, common anions, total nitrogen and phosphorous, total dissolved solids, total suspended solids, alkalinity, TOC, explosives and additional organic and inorganic analytes from CLP SOW Modifications A through D.

The non-CLP data validation program for chemical and radiological results includes a review of the following components:

- completeness of data package;
- sample hold times;
- performance of calibration (initial and continuing) (criteria per Table III.2);
- laboratory control samples, MS/MSDs, replicates method blanks, surrogates, and other QC checks specified in Table III.2. (criteria per Tables III.2 and III.3.);
- correct identification of analyte;
- 10 percent check on calculations performed (100 percent if error found);
- contamination of field blanks;
- evaluation of field duplicates against criteria in Table III.2.

Appendix H provides a detailed summary of the guidelines for data validation of non-CLP results.

Data Validation Qualifiers

The following qualifiers will be applied to validated data, in accordance with CLP Functional Guidelines and may also be applied to non-CLP analyses:

U - The material was analyzed for, but was not detected. The associated numerical value is the sample quantitation limit.

J - The associated numerical value is an estimated quantity.

R - The data are unusable (compound may or may not be present).

N - Presumptive evidence of presence of material.

NJ - Presumptive evidence of the presence of the material at an estimated quantity.

UJ - The material was analyzed for, but was not detected. The sample quantitation limit is an estimated quantity.

Data Assessment

The data validation program also includes an overall assessment of data. An assessment is performed to evaluate the usability of the qualified data from data validation. As defined in the completeness equation on Table III.4, valid data is defined as sample results determined usable. The QAM or his/her designee will perform an assessment of all data qualified from data validation. The assessor will have a working knowledge of the project data quality objectives and intended data use. The results of the assessment will be summarized and submitted to the project manager.

Results of data validation give an indication of potential error in numerical results if QC checks are outside acceptance criteria. The impact of the error on the data use is evaluated prior to using the data. All sample results in laboratory batches with quality control checks not meeting the required acceptance criteria (defined in Section 3 and in the USEPA functional guidelines) will be assessed for potential bias. The impact of the amount of bias will be evaluated against how the results will be used. Table IX.1 summarizes examples how qualified results may affect common data uses for the Operable Unit 9 field investigations.

Because it is possible for data to be qualified from many different reasons, Table IX.1 is not inclusive of all assessment evaluations. The decision tree used for assessing data usability will vary depending on the intended data use. However, every data assessment performed will summarize the assessment results and the basis used for rejecting any data beyond what data validators reject. Qualified data which indicate a bias that causes the sample result to be potentially near or above the action level, or leads to inconclusive results for other data uses, will be unusable for the particular data use.

9.2.2.2 Other Laboratory Data

Laboratory reports for geotechnical analyses and X-ray diffraction results will meet at a minimum the requirements for reporting in the standard method.

Table IX.1. Examples of the Data Assessment Process

Data Qualification	Reason Qualified	Data Use	How Data is Assessed	Example of Unusable Data	Example of Usable
UJ,J	Calibration, matrix spike recovery, chromatographic resolution, and poor interferences	Compare to an action level	The amount of bias is evaluated to determine its impact on the comparison. See footnote [a].	Result: 100 ppb Action Limit: 200 ppb MS Recovery: 40% Result may be biased low and correction for maximum bias yields a result greater than action limit.	Result: 100 ppb Action Limit: 400 ppb MS Recovery: 74% Result may be biased low, but correction for maximum bias yields a result less than the action limit.
		Identify nature and extent of contamination	The amount of bias is evaluated and summarized	Result: 5 U Action Limit: NA MS Recovery: 1% Low matrix spike recovery is not necessarily representative of all samples in the lab batch. However, low recovery was noted as a trend in several lab batches therefore data are rejected. See footnote [b].	Result: 10 ppb Action Limit: NA MS Recovery: 5% Low matrix spike recovery, but analyte was detected. Data usable as indication of presence of contaminant. Indicate probable bias for data use.
UJ,J	Holding Time	Compare to an action level	The target analytes are evaluated for the likelihood of degradation. The reported concentration is compared to action level	Result: 100 ppb Action Limit: 120 ppb Compound: N-nitroso-di-n-propylamine Days Exceeded: 40 Criteria: 14 days extraction The compound is reactive to light and deteriorates quickly. Because of potential low bias and grossly exceeded hold time, and proximity to the action limit, the result is rejected.	Result: 5 ppb Action Limit: 50 ppb Compound: Aroclor 1260 Days Exceeded: 30 The compound is stable over time and is not near the action limit. The result is considered usable.
		Identify nature and extent of contamination	The compound is evaluated for likelihood of degradation	Result: 5 U Action Limit: NA Compound: Freon-113 Days Exceeded: 30 Criteria: 14 days analysis Freon-113 is likely to volatilize. Hold time is grossly exceeded. Result is considered unusable.	Result: 100 ppb Action Limit: NA Compound: Freon-113 Days Exceeded: 30 Since compound is detected, but not compared to a numerical value, the result is considered useable.

Table IX.1. Examples of the Data Assessment Process (cont.)

Data Qualification	Reason Qualified	Data Use	How Data Is Assessed	Example of Unusable Data	Example of Usable
U	Method blank or field blank contamination and interferences	Compare to an action level	The impact of a raised reporting limit due to contamination or interference is evaluated against action limit.	Result: 110 ppb Action Limit: 100 pbb Blank: 35 ppb Validator has qualified the data 110 U due to blank contamination. Since the reporting limit is greater than the action limit, the data is considered unusable.	Result: 110 ppb Action Limit: 200 ppb Blank: 35 ppb Validator has marked the data 110 U due to blank contamination. Since the reporting limit did not exceed the action limit, the data is considered usable.
		Identify nature and extent of contamination	The reporting limit is raised due to contamination or interference	No Case Note raised reporting limit for data users.	No Case: Note raised reporting limit for data users.
N,NJ	Tentatively identified compound outside target list. Quantitation estimated	Compare to an action level	The amount of bias is evaluated to determine its impact on the comparison	Result: 100 ppb Action Limit: 100 ppb Sample result is inconclusive. *Result is not considered usable.*	Result: 100 ppb Action Limit: 1000 ppb Data is considered usable since the *action level* is an *order of* magnitude higher than the result.
		Identify nature and extent of contamination	The amount of bias is evaluated and summarized	Sample result is considered usable for tentative identification.	Sample result is considered usable for tentative identification.
R	All Cases	All Cases	No assessment.	Data is considered unusable.	Data is considered unusable.

NOTE: This table does not reflect the complete data assessment process since it is case dependent. However the table provides examples of how sample bias can be evaluated for data users.

*There are laboratory QC results where the amount of bias cannot be quantitatively or qualitatively evaluated. In these cases, the sample result will be flagged as having potential, indeterminable bias.
*All sample results with no detections and significantly low MS recoveries will be suspect, and evaluated on a case by case basis.

9.2.3. Laboratory Data Reporting

9.2.3.1 Chemical and Radiological Data Reporting

Laboratory data reporting will be provided on electronic media (as ASCII files of a specified format) and in hard copy data reports. All data report packages (i.e., hard copy results and supporting data) received from the laboratory will be single copy, legible, paginated, reproducible, and unbound. Complete packages are shipped only with the electronic data deliverable in no greater than three laboratory batches in any given day of shipment. Only data report packages containing all results for a given field batch will be shipped. Laboratory batches cannot be any greater in size than the identified field batch.

The data report packages are reviewed by another individual in the laboratory other than the preparer for the completeness requirements specified in this section. At least one identical copy of the data package must be kept in the project files at the laboratory.

Contents of Data Reports

Laboratory data reports will contain sufficient data to verify each aspect of the analysis, including sample preparation, instrument calibration, sample analysis, and calculation of the final result. All laboratory data report packages for each type of analysis will contain a case narrative that summarizes the following information on the given set of samples analyzed:

- date of issue;
- the laboratory analysis performed;
- any deviations from the stated analytical method;
- the laboratory batch number;
- the laboratory SOP number and revision date;
- example calculation;
- the number of samples and the sample matrices;

- a reference to the quality control procedures performed for the specific methods used,including the reference to the acceptance criteria used.;

- the contents of the laboratory report;

- the project name and number;

- the state of the sample received (e.g., whether preserved and packaged properly);

- whether sample holding times were met and identification of those samples for which they were not met;

- any observations that may have had an impact on the analyses;

- any technical problems affecting the analysis and corrective actions taken;

- laboratory quality control checks that did not meet the project criteria (as specified in the QAPP) and/or laboratory criteria (include any corrective actions taken and any known possible reasons for the results); and

- the laboratory manager's signature approving the issuance of the data package.

A copy of the chain-of-custody form with all relinquished signatures will accompany each data package.

The following summarizes the contents of hard copy laboratory data report packages for each group of analyses. The laboratory-established quantitation limits, other than CLP analysis, will be reported in the packages.

- For those analyses performed under the CLP SOW for inorganic and organic compounds, data report packages will follow the requirements set forth in the CLP SOW. These include volatile organic and semivolatile organic compounds, TCL pesticides and PCBs, and inorganics for water and soil samples. The CLP forms will include the additional parameters outside the TCL and TAL lists. In addition, the following information will be included:

  - instrument settings;

  - established retention time windows;

  - detailed table of contents;

  - for initial and continuing calibrations, a summary of standards analyzed, date, time of analysis, instrument ID, mean/average calibration factor or response factor, the standard deviation and the percent difference;

  - instrument run log containing the analytical sequence with date and time; and

- Laboratory data packages for explosives analyses will at a minimum consist of the following:

  - detailed table of contents;

  - a case narrative for each laboratory batch of samples analyzed;

  - a summary page stating the extraction and analysis dates for each field sample and reported laboratory quality control checks;

  - a cross reference of laboratory sample identification numbers to the project sample identification numbers;

  - a description of all data qualifiers used in the laboratory report;

  - a record of sample extraction of all samples and laboratory quality control checks;

  - instrument settings;

  - applicable instrument run logs containing the analytical sequence with date and time;

  - tabulated sample results for the 11 explosives;

  - established retention time windows;

  - tabulated results of matrix spikes, matrix spike duplicates, method blank, initial calibration, and continuing calibration checks; and

  - labeled and dated chromatograms of sample results, matrix spikes, MSDs, the method blank, and continuing calibration checks.

- Reports covering analysis of common anions (chloride, sulfate, fluoride, nitrite, ammonia, and nitrate-nitrite) total nitrogen, total phosphorus, TOC, total dissolved solids, total suspended solids, alkalinity, and physical soil parameters will contain, at a minimum, the following where applicable:

  - detailed table of contents;

  - a case narrative for each laboratory batch of samples analyzed;

  - a summary page stating the analysis dates for field samples and reported laboratory quality control checks (those listed on Table III.2 for these analyses);

- a cross reference of laboratory sample identification numbers to the project sample identification numbers;
- a description of all data qualifiers used in the laboratory report;
- a record of sample preparation for all field samples and laboratory quality control samples;
- instrument settings;
- applicable instrument run logs containing the analytical sequence with date and time;
- tabulated sample results;
- raw data for each sample result and laboratory quality control sample results.
- results of initial calibration and calibration checks (including date); and
- tabulated results of matrix spikes, MSDs, laboratory replicates, laboratory control samples, and the method blank.

- Data packages for radiochemical analyses will consist of the following elements:
  - detailed table of contents;
  - a case narrative for each laboratory batch of samples analyzed;
  - a cross reference of laboratory sample identification numbers to the project sample identification numbers;
  - a summary page stating the extraction and analysis dates for each field sample and reported laboratory quality control checks;
  - a description of all data qualifiers used in the laboratory report;
  - a record of sample preparation for all field samples and laboratory quality control;
  - instrument calibration results (date, time, technician);
  - minimum detectable activity for each sample result and QC result;
  - results for standards, including instrument blanks and calibration standards;
  - labeled and dated raw data for all sample results and laboratory quality control checks, including counting time and number of disintegrations per sample; and

- calculated activity, per unit mass or liquid volume, with the following associated statistics:
    - relative counting error at the 95% confidence level,
    - lower detection limit, and
    - normalized deviation for method spikes and matrix spikes.

- Data report packages for volatile organic compounds for groundwater samples (Methods 8021, 8030, and 502.2) will consist, at a minimum, of the following items where applicable:
    - detailed table of contents;
    - a case narrative for each laboratory batch of samples analyzed;
    - a cross reference of laboratory sample identification numbers to the project sample identification numbers;
    - a description of data qualifiers used in the laboratory report;
    - a summary page stating the extraction and analysis dates for each field sample and reported laboratory quality control check (those listed on Table III.2 for those analyses);
    - instrument settings;
    - applicable instrument run logs containing the analytical sequence with date and time;
    - tabulated sample results for all respective compounds listed on Table VI.1;
    - tabulated results of matrix spikes, matrix spike duplicates, method blank, initial calibration, continuing calibration checks, replicate samples, laboratory control sample, calibration check compounds, and system performance check compounds;
    - established retention time windows;
    - labeled and dated chromatograms of sample results and the laboratory quality control checks listed above; and
    - results of the first 10/20 tentatively identified compounds as specified in the CLP SOW for organic analyses (for GC/MS confirmations). Data packages for GC/MS confirmation per CLP SOW requirements.

- Data report packages for dioxin/furan analyses (method 8290) will consist, at a minimum, of the following items where applicable:

  - detailed table of contents;

  - a case narrative for each laboratory batch of samples analyzed;

  - a cross reference of laboratory sample identification numbers to the project sample identification numbers;

  - a description of data qualifiers used in the laboratory report;

  - a summary page stating the extraction and analysis dates for each field sample and reported laboratory quality control check (those listed on Table III.2 for those analyses);

  - instrument settings;

  - applicable instrument run logs containing the analytical sequence with date and time;

  - tabulated sample results for all respective compounds listed on Table VI.1;

  - tabulated results of matrix spikes, matrix spike duplicates, method blank, initial calibration, continuing calibration checks, replicate samples, laboratory control sample, GC/MS tune, and internal standard compounds;

  - established retention time windows; and

  - labeled and dated chromatograms and spectra of sample results and the laboratory quality control checks listed above.

- Data packages for lanthanides will contain, at a minimum, the following:
  - detailed table of contents;
  - a case narrative for each laboratory batch of samples analyzed;
  - a cross reference of laboratory sample identification numbers to the project sample identification numbers;
  - a description of data qualifiers used in the laboratory report;
  - a record of sample digestions for all field and laboratory quality control samples;
  - instrument settings;
  - applicable instrument run logs containing the analytical sequence with date and time;
  - tabulated sample results and reporting limits;
  - raw data for each sample result and laboratory quality control sample results;
  - results of initial and continuing calibrations; and
  - tabulated results of laboratory quality control results listed on Table III.2.

Specifications to the above listed contents for all data packages include the following:

- Tabulated results will also include sample ID with corresponding laboratory ID, the analyte of interest with units and actual limit of quantitation, date of sampling, date of sample preparation/extraction/digestion, date of analysis, sample weight/volume, moisture content (where applicable), dilution factor, sample matrix, and instrument ID (including chromatographic column serial number, dimension, and packing/coating, where applicable).
- All laboratory QC results which are required to be reported will be tabulated similar to CLP results and contain the same information as the tabulated sample results, where applicable.
- Initial calibration results will include a summary of the standards analyzed, date and time analysis, instrument id, the mean/average calibration or response factor, standard deviation and acceptance criteria, and raw data (e.g., chromatogram, strip chart, etc.).

- Continuing calibration will include a summary of the standards analyzed, date and time of analysis, instrument ID, a comparison of the standards to the initial calibration, and a calculation of the percent difference from the initial calibration.

- Raw data in the form of instrument printouts, strip charts recordings, chromatograms, etc. will be labelled with the applicable sample ID, date, time of analysis, and instrument conditions.

- An example calculation of one of the sample results illustrating how the actual sample result was obtained will be supplied with each data package. All factors of the equations provided must be accounted for.

Electronic data deliverables (EDDs) are prepared for all radiological and chemical data. The EDD for Operable Unit 9 results will be delivered along with the data packages in the required format as described in Appendix E. The EDD will not be considered complete until it can be successfully loaded in the EG&G subcontractor database management system.

Laboratory Data Qualifiers

The following qualifiers will be applied to the organic analysis results by the laboratory, in accordance with CLP SOW direction:

- U - Indicates compound was analyzed for but not detected. The associated sample quantitation limit will be the CRQL, corrected for dilution and for percent moisture.

- J - Indicates an estimated value. This flag is used under the following circumstances: 1) when estimating a concentration for tentatively identified compounds (TICs) assuming a 1:1 response, 2) when the qualitative data indicated the presence of a compound that meets the volatile, semivolatile, and pesticide/Aroclor identification criteria, and the result is less than the CRQL but greater than zero.

- N - Indicates presumptive evidence of a compound. This flag is used only for tentatively identified compounds, where identification is based on a mass spectral library search.

- P - Used for pesticide/Aroclor target analyte when there is greater than 25% difference for detected concentrations between the two GC columns.

- C - Applies to pesticide results where the identification has been confirmed by GC/MS.

- B - Used when the analyte is found in the associated blank as well as in the sample. This flag must be used for a TIC as well as for a positively identified target compound.

- E - Identifies compounds whose concentrations exceed the calibration range of the GC/MS instrument for that specific analysis.

- D - Identifies all compounds identified in an analysis at a secondary dilution factor.

- A - Indicates that a TIC is a suspected aldol-condensation product.

The following qualifiers will be applied to the inorganic analysis results by the laboratory, in accordance with CLP SOW direction:

- B - Indicates that the reported value was obtained from a reading that was less than the CRDL but greater than or equal to the Instrument Detection Limit (IDL).

- U - Indicates that the analyte was analyzed for but not detected.

- E - Indicates the reported value is estimated because of the presence of interferences.

- M - Duplicate injection precision was not met.

- N - Spiked sample recovery not within control limits.

- S - Reported value was determined by the Method of Standard Additions (MSA).

- W - Post-digestion spike for Furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.

- * - Duplicate analysis not within control limits.

- + - Correlation coefficient for the MSA is less than 0.995.

Method qualifiers for inorganic procedures are detailed in the CLP SOW.

Approval by the EG&G subcontractor is required for any additional data qualifiers used by the laboratory, other than those defined above, prior to submitting hardcopy data packages.

Format of Data Reports

The non-CLP data report package will be organized by the laboratory into the following sections and paginated. Each section and subsection will be separated by a colored divider sheet.

Section I Title and Table of Contents
Certificate of Analysis
Case Narrative

Summary of Quality Control
Summary of Sample Results
Summary of Analysis and Preparation Dates
Cross reference of Sample IDs to Laboratory IDs
Example Calculation

Section II Analytical Results
Raw Data (behind each result)

Section III Standards Data
Initial and Continuing Calibration
Retention Time Windows
Instrument Calibration/Tuning
Raw Data (behind each result)

Section IV Quality Control Results
Raw Data (behind each result)
Sample Preparation/Extraction/Digestion Logs
Moisture Determination Results and Raw Data

Section V Instrument Run Log
Chain-of-Custody
Copy of Telephone Logs

CLP data report packages will be formatted as specified in the CLP SOW. Sections and subsections will be numbered and will be separated by a colored divider sheet.

9.2.3.2 Other Laboratory Data

Laboratory reports for geotechnical analyses and X-ray diffraction results will meet, at a minimum, the requirements for reporting in the standard method.

10. PERFORMANCE AND SYSTEM AUDITS

Performance and system audits will be conducted as a systematic check to determine the quality of operation and to monitor the capability and performance of the total measurement system. A performance audit independently collects measurement data using performance evaluation samples. Performance audits are quantitative in nature. A system audit consists of a review of the total data production process and includes on-site reviews of a field and laboratory's operational systems and physical facilities for sampling, calibration, and measurement protocols. System audits are qualitative in nature.

Formal audits include pre-contract evaluation of subcontracted activity, internal audits of ongoing and completed activities and external audits of subcontracted activities. In addition, limited scope audits may be carried out at any time of procedure use by observation. Internal audits will be conducted by the EG&G subcontractor's QAO.

The QAO is responsible for the audit process, concerns on the audit report, and coordinates with the corporate QAO who is responsible for auditor and lead auditor certification. Auditors shall have knowledge of QA program elements and project documents supplying the QA-related requirements for activities audited, including the QAPP, the FSP, and related SOPs. The QAO shall have corporate lead auditor certification. Certification shall be consistent with NQA-I requirements for auditor/lead auditor certification and include auditor training. Technical Specialists may be audit team members to audit/peer review technical aspects of the work. They shall have the same training as any other audit team member. Audit format shall include audit opening and closeout meetings. The audit report shall be issued within 30 calendar days of the closeout meeting.

External audits will be performed by EPA Region V, the Region V Central Regional Laboratory, and/or the Region V Central District Office.

10.1. FIELD AUDITS

The EG&G subcontractor's QAO or the designated auditor will perform at least one internal field audit during each phase (i.e., drilling, soil sampling, water sampling, etc.) of the investigation. These audits will be

scheduled and executed as part of work on each operable unit. Field sampling and associated activities will be audited at least once. The purpose of field performance audits is to ensure that the methods and protocols detailed in this QAPP and SOPs are being consistently adhered to in the field.

Field audits will be performed using an audit checklist of the format presented in Figure 10.1. The field audit will include a review of the following activities:

- air, soil/sediment, groundwater/surface water, biological tissue sampling procedures;
- field measurements and field screening procedures;
- field logbook documentation;
- sample labeling, handling, and custody procedures;
- completion of ER Program field forms;
- the number and type of quality control samples collected; and
- drilling procedures.

These activities will be reviewed for their adherence to the procedures established in the FSP, Mound Plant ER Program SOPs, and the QAPP. Audit questions will be developed by the QAO. These checklists are used to ensure completeness of the review and to document the results of the audit.

As part of the field audit, field operation records will be reviewed to verify that field-related activities were performed in accordance with appropriate project procedures. Items reviewed will include, but are not limited to, field equipment calibration records, daily field logs, and chain-of-custody documentation. Upon audit completion, an audit report containing observations and any findings and associated corrective actions will be submitted to the ER Program EG&G installation coordinator, ER Program subcontractor project manager, and installation manager. These reports will be delivered to EPA upon their request.

EPA Region V, the Region V Central Regional Laboratory, and/or the Region V Central District Office are responsible for performing external audits of field activities.

SAMPLE AUDIT CHECKLIST

FACILITY	AUDITOR(S)	DATE

ACTIVITY/REQUIREMENT	AUDIT QUESTIONS	ANSWER			AUDITOR COMMENTS
		Yes	No	N/A	

Figure 10.1 Sample Audit Checklist form

10.2. LABORATORY AUDITS

10.2.1. Laboratory System Audits

An audit of the analytical laboratories will be performed by the ER Program EG&G subcontractor QAM prior to the implementation of the RI. The system audit will consist of review of the laboratory quality assurance manual; the instrumentation and/or analytical system developed for the analyses of interest; sample preparation methodologies; laboratory sample handling, log-in, and custody procedures; data reduction and reporting procedures; data validation procedures; instrument calibration procedures; the quality control program developed for the methods; and other laboratory procedures that may impact the laboratory analyses to be performed for this investigation. The laboratory systems audit checklist to be used for the OU 9 investigation is presented in Appendix D. Results of laboratory systems audits including the checklist and reports to the laboratory will be distributed to EG&G Mound and DOE, and US EPA upon their request.

An on-site audit of the analytical laboratories may be performed at least once and as determined necessary (e.g., recurring nonconformances which impact data quality) during this investigation by the ER Program EG&G subcontractor QAM. The audit will evaluate at a minimum the laboratories' performance on the following activities specific to the investigation:

- implementation and follow-through of the laboratory quality control program established for this investigation as defined in the QAPP,
- sample custody and handling procedures,
- analytical methods followed as defined in the QAPP,
- sample tracking,
- data reduction,
- data validation,
- instrument calibration,
- sample preparation, and
- documentation of data analysis/data reduction.

The EG&G subcontractor will perform a GC/MS magnetic tape audit once per year per laboratory on selected data packages. The contents of the hard copy data package will be verified against data on the GC/MS magnetic tape. Results of these on-site audits will be distributed to EG&G Mound, DOE, and US EPA upon their request.

The EPA Region V Central Regional Laboratory will perform external system audits of the laboratories, as necessary, for this program. This audit may include an on-site visit to the laboratories.

10.2.2 Laboratory Performance Audits

The analytical laboratory will participate in one or more of the following, as pertinent:

- USEPA CLP round robin program (laboratories performing chemical analyses);
- USEPA RAD Intercompanies Program Studies (laboratories performing radiological analyses);
- U.S. DOE Environmental Measurements Laboratory Quality Assurance Program (laboratories performing radiological analyses);
- or a comparable cross check program.

The results of the EPA cross-check program are evaluated by the EPA, and the results are published as part of the public record. The DOE Environmental Measurement Laboratory performance samples will be reviewed by the DOE or their subcontractor to ensure acceptable laboratory performance.

The laboratory quality assurance coordinator has responsibility for monitoring the internal quality assurance program. The quality assurance coordinator is responsible for scheduling, coordinating, and conducting internal performance audits and for reviewing data for performance samples received. The quality assurance officer supplies blind performance samples to the laboratory at least semiannually.

External performance audits of the laboratories will also be conducted by the EPA Region V Central Regional Laboratory as necessary. This audit may include an on-site visit to the laboratories.

In addition to laboratory participation in at least one approved cross-check program, the EG&G subcontractor will submit project performance evaluation (PPE) samples to the laboratory. The preparation and submission of these PPE samples is presented in Appendix F.

The project QAM will monitor the results of the cross-check program and the PPE program to ensure acceptable laboratory performance, as described in Appendix F.

10.2.3. Laboratory Monitoring

In addition to the formal auditing procedures above, laboratories conducting analyses on samples collected at the Mound Plant will be routinely monitored by the EG&G subcontractor. The following monitoring activities will be performed:

1) The topics of daily communication with the laboratory will be established prior to receipt of samples. The primary points of contact within the laboratory and the EG&G subcontracting firm will be identified. Daily communication during field sampling and routine communication with the laboratory contact during sample analysis will, at a minimum, include:

    1) Sample receipt
    2) Status of sample analysis
    3) Nonconformances
    4) Data reporting
    5) Other anomalies in program

    Results of the above will be submitted to the EG&G subcontractor by the laboratory as a laboratory monthly progress report.

2) The EG&G subcontractor will ensure the laboratory implements project QAPP requirements by having the laboratory prepare a Quality Assurance Summary (QAS) which is used by the group leaders and analysts. The QAS summarizes project-required sample handling, QC, and methodology which deviates from normal laboratory operations. The QAS is reviewed and approved by the EG&G subcontractor.

3) The laboratory will supply the primary contact a controlled copy of SOPs, including all updates. SOPs will be reviewed by the EG&G subcontractor as they are updated to ensure laboratory

procedures do not conflict with program requirements.

4) Project opening meetings with the laboratory will be conducted prior to field sampling by the EG&G subcontractor to discuss: 1) project requirements, 2) communications, 3) sample shipment, 4) implementation of the QAPP, 5) data reporting, and 6) documentation of nonconformances to the QAPP.

5) Hard copy data packages are reviewed by the EG&G subcontractor for completeness within one month of receipt.

6) Data validation will be initiated within six weeks of complete data package receipt to identify any technical deficiencies in the data.scheduled and executed as part of work on each operable unit. Field sampling and associated activities will be audited at least once. The purpose of field performance audits is to ensure that the methods and protocols detailed in this QAPP and SOPs are being consistently adhered to in the field.

11. PREVENTIVE MAINTENANCE

Proper preventive maintenance of field and laboratory equipment is a necessary element in achieving equipment reliability and minimizing equipment downtime.

11.1. FIELD EQUIPMENT

Field equipment will be properly calibrated, properly charged, and in good general working condition before the beginning of each working day. The required equipment checks and their frequency for each type of field equipment to be used are defined in Mound Plant ER Program SOPs 2.2, Field Measurements on Ground and Surface Water Samples; 3.1, Water Level Measurement; 6.1, Health and Safety Monitoring of Combustible Gas Levels; 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector; 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector; 6.4, Total Alpha Surface Contamination Measurements; and 6.7, Near Surface and Soil Sample Screening for Low-Energy Gamma Radiation Using the FIDLER (all included in Appendix A). Table III.1 in Section 3 summarizes the checks to be performed during the Operable Unit 9 investigation. Any nonoperational field equipment will be removed from service, tagged, segregated, and dispositioned. As required, equipment will be returned to the manufacturer or to instrument stores. Replacement will be obtained as needed. Repairs will only be made by trained staff. Field equipment will not be repaired in the field. The following spare parts will be kept in the field for the groundwater sampling effort: extra titration kit, pH electrodes, pH meter, electrical conductivity meter, water level indicator, dissolved oxygen meter, thermometer, bailer, and pump motor. Maintenance records will be maintained for each field instrument according to a unique number affixed to the instrument. These records will be reviewed prior to their use in the field to ensure that instrument maintenance and calibration are up-to-date.

All field instruments will be properly protected against inclement weather conditions during the field investigation. Each instrument is specially designed to maintain its operating integrity during variable temperature ranges that are representative of ranges that will be encountered during cold-weather working conditions. At the end of each working day, all field equipment will be taken out of the field and placed in a cool, dry room for overnight storage.

All subcontractor equipment (e.g., drill rigs and water trucks) will arrive at the site in proper working condition each day. Before the start of work each day, the field supervisor or field health and safety officer

will assess all equipment for fluid leaks. Cables on drill rigs will also be inspected. If a leak is detected or a cable is frayed, the equipment will be removed from service for repair or replacement. If the equipment belongs to a subcontractor, the subcontractor representative shall be included in the assessment.

11.2. LABORATORY EQUIPMENT

The ability to generate valid analytical data requires that all analytical instrumentation be properly maintained. All analytical laboratories used for the Operable Unit 9 program will have a full service contract or an equivalent maintenance program on all major instruments. Specific preventive maintenance programs for each laboratory are presented in the laboratory specifications attachments.

12. SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

The procedures to assess precision, accuracy, and completeness are presented in section 3. Equations are used to calculate, and acceptance criteria are used to assess precision, accuracy, and completeness (subsections 3.1.1, 3.1.3, 3.2.2, and Tables III.1 through III.4). Accuracy, precision, and completeness are defined in subsections 3.1.1, 3.2.1, and 3.3, respectively.

The precision and accuracy requirements for CLP organic analyses, CLP inorganic analyses, and non-CLP analyses are given in Tables III.2 and III.3. All analytical data are reviewed relative to those criteria. For any quality control checks outside the acceptance criteria, the results will be assessed by the EG&G subcontractor for data usability. The acceptance criteria for field quality control checks do not take into account the interdependencies of the checks. Since many of the quality control checks are interrelated (e.g., both a method blank and a trip blank could have contaminants), each batch of analytical data will be assessed on a case-by-case basis. Field blank results associated with soil/sediment data will be used only to provide information on the potential for contamination to exist in the soil/sediment samples and will not be used for quantitative purposes.

The laboratory will review the results of laboratory quality control checks listed on Table III.2. If the results are outside the acceptance criteria, then the identified corrective actions will be performed.

The initial responsibility for monitoring the quality of an analytical system lies with the analyst. The analyst will verify that all quality control procedures are followed and that results of analysis of quality control samples are within acceptance criteria. If acceptance criteria limits are exceeded, appropriate corrective actions will be taken and out-of-control situations will be described in the analytical report case narrative.

13. CORRECTIVE ACTION PROTOCOLS

13.1. INTERNAL CORRECTIVE ACTIONS

Internal corrective actions may arise in the following ways:

- As the result of audit activities;
- As the result of any staff member discovering a deficiency in a past activity; and
- Deficiencies that are discovered and corrected at the time of occurence.

Examples of corrective actions are given in Table XIII.I. How the corrective action is reported and documented is determined by the time of discovery and whether the immediate corrective action is a possible action.

13.1.1 Corrective Actions Resulting from Audits

The audit team leader is responsible for the audit report. The project QAO and audit team shall sign a formal report of all audit proceedings. The programmatic impact of a negative finding, such as the lack of or failure to use an appropriate procedure, will be determined by project QAO and audit team. A negative response will be transmitted as a formal corrective action reqluest and transmitted to the installation manager, OU manager, and project manager. A corrective action plan and schedule will be requested, and the project manager will be responsible for ensuring that action to correct the deficiency has been developed and initiated, and any special expertise has been made available. The project manager will also be responsible for implementing the corrective action and ensuring that no additional work, dependent on the activity, is performed until the deficiency is corrected. Corrective action may include reanalyzing the samples (if holding time permits), resampling, and evaluating and amending the sampling and analytical procedures.

The project manager will approve the corrective activity and will be responsible for ensuring that the corrective action adequately addresses the deficiency. The project QAO will ensure that corrective actions for deficiencies are implemented by

- evaluating all reported deficiencies,
- controlling additional work on the related activity,

- maintaining the log of CARs, and
- ensuring CARs are included in the site documentation files.

The QAO or lead auditor are responsible for verifying completion of corrrective action. If the corrective action is incomplete, further action will be required. This activity will be documented at the completion of the verification of the corrective action. The corrective action shall be closed and the appropriate managment notified.

13.1.2 Corrective Actions Resulting from a Past Activity

The discoverer notifies the operable unit manager or the field manager for any immediate actions. The site health and safety officer is to be inmmediately notified if any health and safety impacts are suspected. The discoverer of the situation contacts the QAO who originates a formal Corrective Action Report (Figure 13.1).

13.1.3 Corrective Actions Resulting from an Activity at the Time of Occurrence

The deficiency is fully documented in field notebooks. The field manager is to be notified to determine any additional impact or further actions.

13.2. LABORATORY CORRECTIVE ACTION

The initial responsibility for monitoring the quality of an analytical system lies with the analyst. In this pursuit, the analyst will verify that all standard operating procedures and quality control procedures are followed and that the results of analysis of quality control samples are within acceptance criteria.

If his assessment reveals that any of the quality control acceptance criteria are not met, he or she must immediately assess the analytical system to correct the problem. The deficiency is reported to the appropriate supervisor, who will complete and sign a nonconformance memorandum form and notify the Quality Control Coordinator. Written laboratory nonconformances are reported to the Quality Assurance Director monthly.

Figure 13.1. Corrective Action Report

Page__of__

MOUND PLANT ER PROGRAM
CORRECTIVE ACTION REPORT

[1]Responsible Organization	[2]Date	[3] ☐ QF No.__	[4]Work Order No. ____-____
[5]Identified During	[6]Persons Contacted	[7]Manager	Notified/Date

[8]Requirement

[9]Finding/Condition Adverse to Quality

[10a]Significant Condition Adverse to Quality ☐ Yes ☐ No	[10b]Hardware Related ☐ Yes ☐ No Tags applied ☐ Yes ☐ No

[11]Issue Date

[12]Initiator Date	[13]Validation Date	[14]QA Manager Date

[15]Impact On In-Process or Completed Work

[16]Root Cause of the Adverse Condition

[17]Remedial Correction Action

Committed Completion Date:

[18]Corrective Action to Prevent Recurrence

Committed Completion Date:

[19]Response Prepared By Signature: Date:	[20]Project Manager Approval Signature: Date:
[21]Response Evaluation ☐ Accept ☐ Reject Comment _____	[22] QA Manager _____ Date_____ QA Officer _____ Date_____
[23]Verification of Correction Action ☐ Accept ☐ Reject Comment _____	[24] QA Manager _____ Date_____
[25]Closure QA Manager _____ Date _____	[26] QA Officer _____ Date _____

[27]
Tending Codes: _____

Table XIII.1. Corrective Actions to Specific Field Activities

Problem	Corrective Action
Broken sample bottle	Notify laboratory to determine if enough sample volume, with correct preservation and bottle type, is available from other bottles collected for the location. If not, then resample the location. If a well and breakage occurs within 4 hours of collection resample well. If after 4 hours from collection, repurge and resample the well.
Incorrect parameters requested	Notify field manager and laboratory and correct.
Samples collected in wrong bottle bottle or incorrect preservation	Notify field manager and laboratory. Resample the location for the parameters which were sampled incorrectly.
Discrepancy in or incomplete chain-of-custody form	Document the discrepancy. Notify the field manager and laboratory.
Missing ER Program field form	Take available information from field log and transcribe to the form. Note on form the missing data and attach memo documenting the missing information.
Incorrect sample packing	Laboratory will notify the contact in the EG&G subcontractoring firm. Field manager will be notified.
Missing information or incorrect information in field log book.	Responsible field personnel will make correction on the current page of the logbook and will refer to the page with incorrect or missing information.
Incorrect format used in field logbook	Note in logbook at which point it was discovered. Begin using correct format.
Required quality control sample not collected in a given day	Notify field manager. Collect additional quality control sample. If a trip blank is not collected where required, assess impact on associated samples results.

Table XIII.1. (continued)

Problem	Corrective Action
Misidentified sample location	Notify field manager. Contact laboratory and have them not analyze samples. Sample the correct location.
Field instruments and equipment not decontaminated according to the Mound ER Program SOPs	Remeasure parameter or perform the activity again with a properly decontaminated instrument or equipment.
No or incomplete decontamination between samples collected during drilling.	Responsible field personnel will note in logbook if discovered during the activity and will correct. The QAM will include nonconformance in the monthly quality assurance report. Evaluate sample data for usability.
No or incomplete decontamination drilling equipment between sample locations	Responsible field personnel will note in logbook if discovered during the activity and will correct. The QAM will include nonconformance in the monthly quality assurance report. Evaluate sample data for usability.
Chain-of-custody form not sent with samples	If chain-of-custody seals are not broken, notify field manager. Fax copy and send originals overnight to laboratory. Resample if chain-of-custody seals are broken prior to receipt by laboratory.
Measurement of Internal temperature of samples outside specified range	Notify field manager. Resample all associated samples as determined necessary.
Health and safety field screening measurement missed	Notify field manager and site safety coordinator.

The nature of the corrective action obviously depends on the nature of the problem. For example, if a continuing calibration verification is determined to be out of control, the corrective action may require recalibration of the analytical system and reanalysis of all samples since the last acceptable continuing, calibration standard. Specific corrective actions to exceeded acceptance criteria for laboratory quality control checks are summarized in Table III.2. Corrective actions to be taken for CLP analyses (TCL VOCs, semivolatile organic compounds, pesticides/PCBs, and TAL inorganics) are presented in the CLP SOW for organic analyses, and the CLP SOW for inorganic analyses. If samples analyzed under the CLP procedures exceed holding times, the laboratory will analyze new samples at no cost to the client.

The laboratory reports all sample variances (e.g., insufficient sample size, extract loss during concentration, sample matrix problems, solvent contamination) in a nonconformance report which contains the following information:

- client name,
- project name,
- operational unit and task,
- date of occurrence,
- analysis method,
- laboratory batch number,
- affected client sample IDs,
- nature of nonconformance,
- criteria not met,
- responsible analyst or technician,
- corrective action taken,
- signature of project manager,
- signature of section/unit manager, and
- signature of QA coordinator.

14. QUALITY ASSURANCE REPORTS TO MANAGEMENT

Quality Assurance (QA) reports to management are made to allow managers to monitor data quality easily and effectively.

Reports to management include:

- Audit reports;
- Corrective Action Reports;
- Change notices to Plans, Reports, and Procedures;
- Notices of planned training and results of training activities;
- Limitations on the use of any data; and
- Data quality assessment in terms of precision, accuracy, representation, completeness, compatibility, and method detection limits.

Those items that are the responsibility of the QAO are to be reported by the QAO. The QAM copies the QAO on all such reports. Those activities that are the responsibility of the QAM are to be reported by the QAM. Management consists of those individuals responsible for taking action on the items reported.

Activities to be scheduled are scheduled through the monthly RI/FS progress report. This document may be used for more general notification of QA issues and schedules particularly those involving the DOE DAO, EG&G Project management, and regulators and other parties to which the monthly report is distributed.

Reports must be made on a timely basis.

15. REFERENCES

American Fisheries Society. 1989. "Fisheries Techniques." L. A. Nielsen and D. L. Johnson, editors. American Fisheries Society, Special Publications, Bethesda, Maryland.

ASTM. 1991. Annual Book of ASTM Standards, Section 11, Water and Environmental Technology, Volume 11.02 Water (II).

DOE. 1982. "EML Procedures Manual", Environmental Measurements Laboratory U.S. Department of Energy, HASL-300.

DOE. 1986. "Phase 1: Installation Assessment Mound [DRAFT]." Comprehensive Environmental Assessment and Response Program. U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM. April 1986.

Elliot, J. M. 1977. "Some Methods for the Statistical Analysis of Samples of Benthic Invertebrates." Second edition. Freshwater Biological Association Scientific Publication No. 25.

EPA. 1973. "Biological Field and Laboratory Methods for Measuring the Quality of Surface Waters and Effluents." EPA 670/4-73-001.

EPA. 1980. "Prescribed Procedures for Measurement of Radioactivity in Drinking Water", U.S. Environmental Protection Agency, EPA 600/4-80-032.

EPA. 1982. "Sampling Protocols for Collecting Surface Water, Bed Sediment, Bivalves, and Fish for Priority Pollutant Analysis." U.S. EPA, Office of Water Regulations and Standards, Washington, D.C.

EPA. 1983. "Methods for Chemical Analysis of Water and Wastes." U.S. Environmental Protection Agency, EPA-600/4-79-020. March 1983.

EPA. 1986. "Test Methods for Evaluating Solid Waste." *Laboratory Manual Physical/Chemical Methods, SW-846*, Volumes 1A, 1B, and 1C, third edition. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C. November 1986.

EPA. 1987. "Test Methods for Evaluating Solid Waste." Laboratory Manual Physical/Chemical Methods, SW-846, Volumes 1A, 1B, and 1C, third edition. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C. December 1987.

EPA. 1987. Data Quality Objectives for Remedial Response Activities. U.S. Environmental Protection Agency. Office of Emergency and Remedial Response and Office of Waste Programs Enforcement. Report No. EPA 540/G-87/003. Washington, D.C. March 1987.

EPA. 1990. "Test Methods for Evaluating Solid Waste." Laboratory Manual Physical/Chemical Methods, SW-846, Volumes 1A, 1B, and 1C, third edition. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C. November 1990.

EPA. 1990a. "U.S. EPA Contract Laboratory Program, Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration." Document No. ILM01.0 including Revisions 1.1 through 1.8. U.S. Environmental Protection Agency. March 1990.

EPA. 1990b. "U.S. EPA Contract Laboratory Program, Statement of Work for Inorganic Analysis, Multi-Media, Multi-Concentration." Document No. ILM03.0. U.S. Environmental Protection Agency. March 1990.

EPA. 1990c. "Specifications and Guidance for Obtaining Contaminant - Free Sample Containers." U.S. EPA Office of Solid Waste and Emergency Response. April 1990.

FICWD. 1989. "Federal Manual for Identifying and Delineating Jurisdictional Wetlands." Federal Interagency Committee for Wetland Delineation. (U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and U.S.D.A. Soil Conservation Service.)

Vogt, R. C., and R. L. Hine. 1982. "Evaluation of Techniques for Assessment of Amphibian and Reptile Populations in Wisconsin." In: *Herpetological Communities*, N. J. Scott, Jr., Editor. A symposium of the Society for the Study of Amphibians and Reptiles and the Herpetologists League. U.S. Fish and Wildlife Services Research Report 13.

APPENDIX A

STANDARD OPERATING PROCEDURES

PREFACE

These Standard Operating Procedures (SOPs) were developed to provide field personnel with a list of activities to be performed before, during, and after a field activity. The SOPs include a checklist of equipment and supplies and instructions for the procedure.

Field personnel are responsible for logging samples; taking field measurements; decontaminating equipment; and collecting, packaging, and shipping samples. Furthermore, field personnel may be required to supervise subcontractors and alert the project manager about any variances from the work plan(s).

The Mound Plant ER Program SOPs have been revised in response to comments received from EPA and Ohio EPA. Additional changes have also been made in order to comply with guidelines presented in the "Technical Enforcement Guidance Document" (EPA, OSWER-9950.1, September 1986) or to clarify requirements for the U.S. Department of Transportation.

The most recent revision numbers for Mound ER Program SOPs may be found in Section 4, Table IV.1 of the QAPP.

MOUND PLANT ER PROGRAM

STANDARD OPERATING PROCEDURES

Section 1 - General

1.1 General Instructions for Field Personnel

1.3 Sample Control and Documentation

1.4 Sample Containers and Preservation

1.5 Guide to the Handling, Packaging, and Shipping of Samples

1.6 General Equipment Decontamination

1.8 Personnel Decontamination - Level D Protection

1.9 Personnel Decontamination - Level C Protection

1.10 Personnel Decontamination - Level B Protection

1.15 Guide to Waste Management

Section 2 - Water Sampling

2.1 Presample Purging of Wells

2.2 Field Measurements on Ground and Surface Water Samples

2.3 Sampling Monitoring Wells with a Bladder Pump

2.4 Sampling Monitoring Wells with a Bucket-Type Bailer

2.5 Sampling Monitoring Wells with a Submersible Pump

2.6 Sampling Monitoring Wells with a Peristaltic Pump

2.7 Sampling Commercial/Municipal/Domestic Wells

2.8 Sampling for Volatile Organics

2.9 Surface Water Sampling

2.10 Stream Flow Measurements Using Flumes, Velocity-Cross Sectional Area, and Direct Volume

2.11 Stream Flow Measurements Using Weirs

Section 3 - Hydraulic Testing

3.1 Water Level Measurement

3.3 Operational Check of Pressure Transducers Used in Measuring Water Levels in Wells

Section 4 - Drilling and Logging

4.1 Soil Boring

4.1.1 Methods to Control Communication of Subsurface Contaminants With Groundwater

4.2 Rock Boring

4.3 Monitoring Well Installation

4.4 Monitoring Well Development

4.7 Piezometer Installation

4.8 Piezometer Development

Section 5 - Soil Sampling

5.1 Soil and Rock Borehole Logging and Sampling

5.2 Soil Sampling with a Spade and Scoop

5.3 Subsurface Soil Sampling with Hand Auger and Thin-Wall Sampler

5.4 General Soil Gas Sampling and Field Chemical Analysis

5.8 Soil Sampling with a Stainless Steel Surface Soil Sample

Section 6 - Health and Safety

6.1 Health and Safety Monitoring of Combustible Gas Levels

6.2 Health and Safety Monitoring of Organic Vapors with a Photoionization Detector

6.3 Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector

6.4 Total Alpha Surface Contamination Measurements

6.7 Near Surface and Soil Sample Screening for Low-Energy Gamma Radiation Using the FIDLER

STANDARD OPERATING PROCEDURE 1.1

GENERAL INSTRUCTIONS FOR FIELD PERSONNEL

1. PURPOSE

To provide field personnel with instructions regarding activities to be performed before, during, and after field investigations.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about procedures and equipment for a given operation. Refer to the FSP or WP for the type of samples, measurements, and tests to be collected or performed. The collection and documentation of data should be performed as described in specific SOPs. These general instructions are intended to supplement the information supplied in the FSP or WP and associated SOPs and clarify the role of field personnel at remedial investigations. These instructions will ensure that field personnel take the proper precautions to understand the site, the objective and the schedule for the field program, their authority, and their responsibilities described in the FSP or WP.

This SOP is supported by others that describe procedures and rationale for performing reconnaissance geophysical and soil gas surveys; soil and rock boring; sample logging; soil and sediment sample collection; installation and operation of vadose-zone instruments and samplers; groundwater monitoring well installation, development, and sampling; operation of sampling equipment; sample control and data documentation; performance of aquifer testing; collection, preservation, handling, packaging, and shipping of samples; decontamination procedures; health and safety monitoring; and radiological surveys.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of this SOP and SOPs 1.3-1.10 is required. In addition, a review of associated SOPs for each task is necessary. The associated SOPs are listed in Section 3.1 of each task SOP. Constant review of the SOPs will ensure that the work performed in the field is legally defensible, well documented, and cost-effective. The decontamination procedures are important for protecting the health and safety of workers, and to minimize the risk of cross-contamination among samples.

3.2. Preparation

3.2.1. Office

A. Personnel should review the FSP or WP and associated documentation for a specific operation and obtain all information related to the purpose and intent of the field program. This may include (but is not limited to) the documents listed below.

1. The scope of work or work plan described in the FSP or WP
2. Previous reports related to the site
3. Reports related to the area
4. Site maps
5. Area maps
6. Access agreements
7. The subcontractor's work plan
8. Data collection forms and equipment checklists
9. Associated SOPs

B. Field personnel are expected to maintain a good working relationship with the client, community, and subcontractors. With this in mind, field personnel should contact installation staff, members of the community (in coordination with installation staff), and subcontractors before work is initiated. During the initial contact, permission to enter private property or security areas should be obtained.

C. Obtain and test all equipment needed for the task. See checklist in Appendix 5.1.

D. Most sample analyses must be performed within a stringent time period. In addition, laboratories are vulnerable to heavy overloads. Contact the laboratory before sampling activities begin to ensure that the personnel are aware of specific requirements for analyses and can complete the work quickly and efficiently.

E. Delays at the freight office can be eliminated by contacting the carrier before arrival with a shipment. The carrier can supply information on regulations and specifications for shipping, the address of the nearest delivery office, and the time of the next freight pickup in the area.

3.2.2. Documentation

A. Obtain a logbook and ER Program data collection forms. All measurements, observations, and instrument readings should be entered on the forms according to the instructions supplied. All entries should be made in black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or NP for Not Performed. If any procedure was not performed as prescribed, give the reason for the change or omission in the comments field of the form. To change an entry to a form or field log book, draw a single line through it, add the correct information above it, and initial the change. Information that does not require data entry should be entered in the logbook. All logbooks are numbered, bound, and contain numbered pages for quality assurance/quality control purposes. Do not alter the logbook (e.g., tearing out pages) or data collection forms in any manner.

B. The information management codes and sample identification numbers used in data entry are assigned by the data administrator. The data administrator directly transmits the updated codes to the project personnel. This system is necessary to avoid duplication of site identifiers or inaccurate entries. Because the list of codes is continually being updated, SOPs cannot be revised each time a new list is produced.

C. Three days before leaving for any field trip, a previsit/pretravel report form must be submitted to DOE. The report contains information about dates of travel, mode of travel, hotel accommodations, and contact phone numbers. Arrangements for renting field vehicles should be made at this time.

3.2.3. **Field**

A. Check the condition and operation of all supplies and equipment at the site. Perform calibration checks specified in operators' manuals or appropriate SOPs.

B. Establish decontamination zones and barricades to public access.

3.3. **Operation**

A. The field personnel monitor and provide technical direction for the field work, log samples, take measurements, and sometimes pack and ship samples as required.

B. Under direction of the site manager, field personnel may designate sampling or hole locations, depth and completion zones, types of samples and depths of sample (or measured, if *in situ*), and approve and record procedures, materials, and all activities conducted in compliance with the FSP or WP.

NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a label affixed to the sample container--either a Soil Sample Identification Label or a Water Sample Identification Label. SOP 1.3, Sample Control and Documentation, contains copies of these forms and instructions for completing the forms.

C. Additional duties that the field personnel may perform are described below.

1. Keep a logbook to record information concerning equipment, personnel, site visitors, and activities (start and stop times, supplies used, footage drilled/installed, and site observations), as well as weather or site conditions affecting the activities. The field personnel should note all relevant instructions and information and document that proper QA/QC protocols have been followed. All information pertaining to a field activity should be entered in a bound book with consecutively numbered pages (see SOP 1.3, Sample Control and Documentation, for instructions on keeping the logbook). Subcontractors should sign/initial the daily log, thereby certifying that the account records agree with their estimates.

2. Telephone the site manager or office headquarters daily and provide a progress report.

3. Observe that the subcontractor complies with the FSP or WP and all applicable permits and licenses.

4. Complete all data collection forms according to applicable instructions as work progresses.

5. Observe whether the subcontractor follows the applicable health and safety requirements. If violations occur, the field personnel should stop work and immediately notify the site manager or site health and safety officer.

6. Monitor air, personnel, and equipment for contamination and record results on appropriate forms or in the logbook.

7. Supervise decontamination of equipment and personnel. Record procedures used for decontamination in the logbook. Collect decontamination solutions in containers for appropriate disposal as specified in the FSP or WP.

8. Notify the site manager of any modifications to the contract that may be appropriate. Work not defined in the FSP or WP should not be initiated without the approval of the site manager.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to the presampling conditions as specified in the FSP or WP. Restoration can include repair of damage to the land surface (tire ruts) or private property (fences), as well as restoration anticipated at the time the FSP or WP was prepared (for example, revegetation or borehole abandonment).

C. Mark sampling locations or survey points with wooden lathe stakes, wooden survey pegs, or metal fenceposts. Write the location ID on the marker or survey flagging so that it is readily visible. Mark groundwater monitoring wells on the guard pipe and inside the casing cap. Use a black marker for wooden stakes, flagging, and the casing cap. Mark the guard pipes with welds or stencils and paint.

D. Shipping samples is the last task in most field operations. SOPs 1.3-1.5 should be used as guides to sample handling and transport. SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples, is a summary of Department of Transportation regulations pertaining to the transport of hazardous substances most commonly sampled in the field. Use SOP 1.5 in conjunction with the appropriate Code of Federal Regulations and guidance supplied by the freight carrier to ensure that packages are documented and properly labeled.

3.4.2. Documentation

A. Record any restoration work in the logbook.

B. Record any uncompleted work in the logbook. This record may include sampling that could not be performed, damage that could not be repaired, or requirements for long-term monitoring (for example, the need to verify instrument readings at different times of the year).

C. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

D. Review data collection forms for completeness.

E. Submit a travel expense report.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCES

None.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Overshoes

_____ Work gloves (2 pairs)

_____ Acid (10% HCL) bottle

_____ Clipboard case

_____ Strapping tape

_____ Pin hammer

_____ Tape measure (tenths)

_____ Protractor

_____ Hat

_____ First aid kit

_____ Sun screen

_____ Thermoluminescent dosimeter (TLD)

_____ Safety shoes/boots

_____ Ziplock bags

_____ Preprinted labels

_____ Distilled (organic-free) water

_____ Methanol (Nanograde)

_____ Freight forms

_____ Telephone directories

_____ Chain-of-custody forms

_____ Hard hat

_____ Pieces of wood (2 inches x 2 inches x 8 inches) to indicate core loss intervals

APPENDIX 5.1, continued

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Stamped, addressed envelopes (large and regular sizes)

_____ Phone and gas credit cards

_____ Calculator

_____ Pens, pencils, and permanent markers

_____ Package cord

_____ Flagging

_____ Hand lens

_____ Tool box

_____ Rain suit

_____ Camera

_____ Ear plugs

_____ Stopwatch

_____ Cold-weather gear

_____ Alpha meter

_____ Safety glasses

_____ Kitchen screen (determine lithology)

_____ Ice chest

_____ Bound logbook

_____ Data collection forms

STANDARD OPERATING PROCEDURE 1.3

SAMPLE CONTROL AND DOCUMENTATION

1. PURPOSE

To define the steps necessary for sample control and identification, data recording, and chain-of-custody documentation.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the type of samples to be collected and the destination of the collected samples. Collection and measurement of samples and the documentation of data will be performed as described in specific SOPs.

This SOP describes the methodology of sample control and documentation for all projects. Sample control and documentation are necessary to ensure the defensibility of data and to verify the quality and quantity of work performed in the field. Accountable documents include logbooks, data collection forms, correspondence, sample labels or tags, chain-of-custody reports, photographs, and analytical records. Waterproof black ink must be used in recording all data in documents bearing serial numbers.

The logbooks are under the supervision of the quality control officer. There may be several logbooks; for example, there may be a separate logbook for field activities, one for samples, and one for instruments. The QA officer numbers the logbooks and assigns them to individuals designated for specific tasks of the project. All information pertinent to a field activity must be entered into a logbook. A record of uncompleted work is kept in a logbook. All project logbooks are turned over to the document control officer at the end of each work period and to a central file at the end of the field activity.

All logbooks are numbered and bound, and the pages are numbered. Waterproof black ink is used for recording all data. Logbook pages should never be removed, and no data should removed. To change an incorrect entry, the individual draws a line through the entry, writes the change above the entry, dates and initials the change. If anyone other than the person to whom the logbook is assigned makes an entry, that person dates and signs the entry. Blank (skipped) pages in the log-book should be marked so that no additional entries can be made on it.

Record all information pertinent to the sampling activity (for example, date, site, ID number, and location) in the logbook. Note the field conditions, weather conditions, and any unusual circumstances. Notes should be as descriptive and inclusive as possible. A person reading the entries should be able to reconstruct the sampling situation from the recorded information. Language should be objective, factual, and free of personal feelings and inappropriate terminology.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.4	Sample Containers and Preservation
1.5	Guide to the Handling, Packaging, and Shipping of Samples

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

Field preparation requires organizing sample bottles, sample labels, and documentation in an orderly, systematic manner that promotes consistency and traceability of all data. Appropriate items should be completed before a sample is collected.

A. Record all pertinent information (for example, date, site, ID number, and location) in the logbook. Note field conditions, unusual circumstances, and weather conditions.

B. Fill out information on the sample identification label and attach the label to a sample bottle.

C. Complete initial information required on data collection forms.

3.3. Operation

3.3.1. Logbook

Enter all information pertinent to a field activity in a bound logbook with consecutively numbered pages. Enter information that does not require data entry into the logbook. If not included on a data collection form, entries in the logbook should include at least the information listed below.

- Date and time of entry
- Purpose of sampling
- Name and address of field contact
- Site identification
- Type of process producing waste (if known)
- Type of sample (soil, water, sediment, etc.)
- Sample identifier and size of sample taken
- Type of analysis requested
- Description of sampling point or location number
- Date and time for collection of sample
- Collector's sample identification number(s) and/or name
- References of the sampling site (like maps or photographs)
- Field observations and sampling locations
- Associated field measurements
- Method of sample collection, preservation techniques/reagents used, and any deviations or anomalies noted

- Transfer of a logbook to individuals designated for specific tasks of the project

- Any uncompleted work

For water samples, the TEGD suggests the following additional information.

- Presence of immiscible layers and detection method

- Collection method for immiscible layers

- Sample distribution and transporter

- Climatic conditions including air temp

- Internal temperature of field and shipping container

Because sampling situations vary widely, make notes as descriptive and inclusive as possible. A person reading the entries should be able to reconstruct the sampling situation from the recorded information. Use language that is objective, factual, and free of personal feelings or any other inappropriate terminology. If anyone other than the person to whom the logbook was assigned makes an entry, he/she should date and sign the entry. Never remove logbook pages. If a mistake is made, draw a single line through the mistake, write the new information above the line, and date and initial the change.

3.3.2. Photographs

Photographs provide the most accurate record of the field worker's observations. They can be significant during future inspections, informal meetings, and hearings. A photograph must be documented to be a valid representation of an existing situation. For each photograph taken, record the items listed below in the logbook and on the back of each processed photograph.

- Date and time

- Signature of photographer

- Name and identification number of site

- Type of camera, lens, f-stop, shutter speed, and film used

- General direction faced and description of the subject

- Distance from photographer to object

- Location at the site

- Sequential number of photograph and the roll number

Any remarks about the contents of a photograph could jeopardize its value as legal evidence, so limit comments to the photograph's location. Photographs should be taken with a perspective similar to that afforded by the naked eye. Telephoto or wide-angle shots cannot be used in enforcement proceedings.

3.3.3. Sample Labels

Use soil and water sample identification labels to tag or label sample containers. Seal each sample immediately after it is collected and labeled with waterproof black ink. Label tags may be filled out before collection to minimize the handling of the sample containers. Appendix 5.1, Soil Sample and Water Sample Identification Labels, provides examples of the common sample labels to be used. Instructions for completing the labels are included in Appendix 1.3, Data Form Completion.

When appropriate, use an etching tool to mark sample containers in the field, rather than immediately applying a sample label or tag. This avoids possible label contamination problems and subsequent decontamination difficulties. In this case, write the data intended for the sample label in the logbook and transcribe them onto the label after the sample containers have been decontaminated.

Firmly attach the labels to the sample containers. The containers must be dry enough for gummed labels to be securely attached.

3.3.4. Sample Collection and Inventory

The number of persons involved in collecting and handling samples should be kept to a minimum. Use the guidelines established in this SOP and SOP 1.5, Guide to the Handling, Packaging, and Shipping of Samples. Complete data collection forms at the time the sample is collected and have the sample collector(s) sign or initial them. Include the date and time. On liquid containers, mark the liquid level with waterproof black ink. This requirement is not necessary for completely filled volatile organics analysis (VOA) septum vials. If the volume received by the laboratory is different than when collected, the sample container may have leaked, been tampered with, or spilled hazardous materials. Use the Custody Transfer Record/Lab Work Request form, Appendix 5.2, to inventory all samples collected in the field. Instructions for the form are in Appendix 5.3, Data Form Completion.

3.3.5. Chain of Custody

A. Objectives

The primary objective of the chain-of-custody procedure is to create an accurate written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis and introduction as evidence. A sample is in someone's custody when one of the criteria listed below has been satisfied.

1. The sample is in one's actual possession.

2. The sample is in one's view after being in one's physical possession.

3. The sample is in one's physical possession and is then locked up so that no one can tamper with it.

4. The sample is kept in a secured area that is restricted to authorized personnel.

B. Transfer of Custody and Shipment

When transferring the samples, the transferee should sign and record the date and time on the Custody Transfer Record/Lab Work Request form. Custody transfers made to a sample custodian in the field should account for each sample, although samples may be transferred as a group. Every person who takes custody should fill in the appropriate section of the Custody Transfer Record/Lab Work Request form. To reduce the number of custody records, minimize the number of custodians in the chain of possession.

The field custodian is responsible for properly packaging and dispatching samples to the appropriate laboratory. This responsibility includes filling out, dating, and signing the appropriate portion of the Custody Transfer Record/Lab Work Request form. The chain-of-custody form is then placed in a sealed plastic bag and taped to the inside of the cooler lid, where it is immediately visible when the cooler is opened. Signed and dated chain-of-custody seals are also placed on the sample container lids to detect sample tampering.

In general, packaging of environmental samples will include the following: placement of sample containers in zip-lock plastic bags to reduce the chance of both breakage and release of sample if breakage does occur, and placement of the bagged sample containers in a cooler containing sufficient vermiculite to prevent breakage and to absorb any material that leaks. For water samples in 4L amber glass containers, the samples will be wrapped in "bubble wrap" to prevent breakage. Ice or blue ice is used to maintain sample temperatures at 4°C. If ice is used, it must be double-bagged in zip-lock bags. Experience has shown that fully 1/4 to 1/3 of the cooler volume must be ice, packaged around and over the sample containers, to maintain temperatures at 4°C.

Send all packages to the laboratory with the chain-of-custody record and other pertinent forms. Retain a copy of these forms at the originating office (either carbon or photocopy). Register mailed packages with a return receipt requested. For packages sent by common carrier, retain receipts as part of the permanent chain-of-custody documentation. Pack samples so that they do not break in shipment. Seal the cooler with chain-of-custody seals so that any tampering can be readily detected. SOP 1.5, Guide to the Handling, Packaging, and Shipping of Samples, describes these procedures in detail.

3.4. Postoperation

3.4.1. Field

A. Verify that all sample bottles have been correctly identified and labels have all necessary information (location, time, and date).

B. Cross-check filled sample bottles in possession against those recorded in the logbook. Maintain custody of filled sample bottles by keeping them in actual possession, within view, locked or sealed up to prevent tampering, or bringing them into a secure area.

C. Prepare samples for transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record data and any uncompleted work in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial and date all pages.

C. Document the chain of custody on the Custody Transfer Record/Lab Work Request form.

D. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCE

EPA. 1986. "RCRA Ground-water Monitoring Technical Enforcement Guidance Document." U.S. Environmental Protection Agency document. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIXES

5.1. Soil Sample and Water Sample Identification Labels

5.2. Custody Transfer Record/Lab Work Request Form

5.3. Data Form Completion

APPENDIX 5.1

SOIL SAMPLE AND WATER SAMPLE IDENTIFICATION LABELS

SOIL SAMPLE IDENTIFICATION LABEL

FACILITY CODE _____ LOCATION ID _____

SAMPLE ID _____ LOG DATE _____

LAB CODE _____ LOG TIME _____

SAMPLER _____ LOGGER CODE _____

SAMPLE DEPTH INTERVAL FROM DATUM

BEGINNING DEPTH (FT FROM DATUM) _____

ENDING DEPTH (FT FROM DATUM) _____

ANALYSIS REQUESTED _____

COMMENTS _____

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WATER SAMPLE IDENTIFICATION LABEL

FACILITY CODE _____ LOCATION ID _____

SAMPLE ID _____ LOG DATE _____

LAB CODE _____ LOG TIME _____

SAMPLER _____ LOGGER CODE _____

ANALYSIS REQUESTED _____

PRESERVATION METHOD _____

COMMENTS _____

WSL-133

APPENDIX 5.2

CUSTODY TRANSFER RECORD/LAB WORK REQUEST FORM

WESTON Analytics Use Only

Custody Transfer Record/Lab Work Request

WESTON

Client _____
Work Order _____
Date Rec'd. _____ Date Due _____
RFW Contact _____
Client Contact/Phone _____

		Refrigerator#									
		#/Type Container									
		Containers/Volume									
		Preservative									
		ANALYSES REQUESTED ➡									
WA Use Only Lab ID	Client ID/Description	Matrix	Date Collected								

Matrix:
S - Soil
SE - Sediment
SO - Solid
W - Water
O - Oil
A - Air
DS - Drum Solids
DL - Drum Liquids
F - Fish
X - Other

Special Instructions:

Item/Reason	Relinquished by	Received by	Date	Time	Item/Reason	Relinquished by	Received by	Date	Time

WESTON Analytics Use Only

Samples Were:
1 Shipped or Hand-Delivered
NOTES:

2 Ambient or Chilled
NOTES:

3 Received Broken/Leaking (Improperly Sealed)
Y N
NOTES:

4 Properly Preserved
Y N
NOTES:

5 Received Within Holding Times
Y N
NOTES:

COC Tape Was:
1 Present on Outer Package Y N
2 Unbroken on Outer Package Y N
3 Present on Sample Y N
4 Unbroken on Sample Y N
NOTES:

COC Record Was:
1 Present Upon Receipt of Samples Y N

Discrepancies Between Sample Labels and COC Record? Y N
NOTES:

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7 115

APPENDIX 5.3

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NP for Not Performed, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form in the comments field. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

SOIL SAMPLE IDENTIFICATION LABEL

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Sample ID. Four-digit number assigned to ensure that data collected retains uniqueness from other data collected at the same location ID.

3. Lab Code. Three-character code identifying the company responsible for performing the analysis of water, soil, biota, and air samples.

4. Sampler. Name of person(s) collecting sample.

5. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, and radiological samples are collected, and/or other measurements are taken.

6. Log Date. The date the information recorded on the label was obtained in the format DD-MMM-YY (01-JAN-88).

7. Log Time. The time the sample was collected (HH:MM).

8. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

9. Sample Depth Interval from Datum:

   a. Beginning Depth (Ft From Datum). Depth from the ground surface to the top of the sampling interval in the format of feet and tenths of feet.

   b. Ending Depth (Ft From Datum). Depth from the ground surface to the bottom of the sampling interval in the format of feet and tenths of feet.

10. Analysis Requested. Type of analysis requested.

11. Comments. Any additional information.

APPENDIX 5.3, Continued

WATER SAMPLE IDENTIFICATION LABEL FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Sample ID. Four-digit number assigned to ensure that data collected retains uniqueness from other data collected at the same location ID.

3. Lab Code. Three-character code identifying the laboratory responsible for performing the analysis.

4. Sampler. Name of person(s) collecting sample.

5. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, and radiological samples are collected, and/or other measurements are taken.

6. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

7. Log Time. Time the sample was collected (HH:MM).

8. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

9. Analysis Requested. Type of analysis requested from the laboratory.

10. Preservation Method. Type of preservative used.

11. Comments. Any additional information.

CUSTODY TRANSFER/LAB WORK REQUEST FORM

1. Received By. Completed by lab.

2. Date. Completed by lab.

3. Assigned To. Completed by lab.

4. Client. Client name.

5. Client Contact. WESTON person who will be laboratory contact.

6. Phone. Phone number of WESTON contact.

7. RFW Contact. Laboratory contact.

8. Date Due. Date analysis is due from the laboratory.

9. Project Number. Project number under which work is billed.

10. Sample No. Completed by laboratory.

11. Client ID No. Three-part identifier consisting of facility code, location ID, and sample ID and separated by dashes (for example, KCP01-01-01 and PXT02-0002-0001). See the ER Program data administrator for conventions to identify field quality control samples.

12. Description. Any descriptive information about the sample.

13. Matrix. Matrix type for sample; see valid matrix codes on lower half of form.

14. Date Collected. Date the sample was collected in the format DD-MMM-YY (01-JAN-88).

15. Container/Preservative. Container size and type (500-ml glass).

16. Analysis Requested. The type of analysis requested for each sample. The column heading indicating the type.

    PCB=Polychorinated Biphenyl

    HE=High Explosive

    HSL=Hazardous Substance List

    EPTOX=Extraction Procedure Toxicity

    VOA=Volatile Organic Analysis

APPENDIX 5.3, Concluded

CUSTODY TRANSFER/LAB WORK REQUEST FORM

BNA=Base Neutral Acid

TCLD=Toxic Characterization Leach Procedure

PEST=Pesticides

MAJ=Major Cation/Anion

17. Matrix. Valid matrix codes.

18. Special Instructions. Any special instructions.

19. Items/Reason. The reason the custody is transferred for all or selected items of the shipment.

20. Relinquished By. Signature of person sending samples.

21. Received By. Person or (shipping company) who received samples.

22. Date. Date sample is sent.

23. Time. Time sample is sent.

STANDARD OPERATING PROCEDURE 1.4
SAMPLE CONTAINERS AND PRESERVATION

1. PURPOSE

To provide guidance in the selection of suitable containers for samples, container cleaning, required sample volumes, sample collection, holding times, and the recommended preservation techniques for water, wastes, sediments, sludges and soil samples.

2. GENERAL DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information about the scope and details of a given operation and establishes the number, types, and analyses of field samples (including field analyses). Refer to the FSP or WP for the procedures and equipment to be used in collecting samples. Collection and measurement of samples and the documentation of data will be performed as described in the associated procedures.

In choosing a sample container, the ideal material should be nonreactive with the sample and the particular analytical parameter to be tested. Glass or Teflon containers must be used with samples analyzed for organic compounds to prevent the introduction of extraneous organic compounds, such as those that might be leached from plastic containers. The rigid plastic screw caps for the bottles must be Teflon lined to prevent contamination.

Once a sample has been collected, steps must be taken to preserve the sample's chemical and physical integrity during transport and storage before analysis is conducted. The type of sample preservation required will vary according to the sample type and the parameter to be measured.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information on equipment and supplies; sample collection, preservation, packaging, and shipping; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.3	Sample Control and Documentation
1.5	Guide to the Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
2.8	Sampling for Volatile Organics

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Sample Container Preparation

Sample containers will vary according to the matrix and nature of the sample to be collected. Wide-mouth containers are generally used for soils and wastes; narrow-mouth containers are used for water. Calculations should be made to determine the number and type of containers required for the sampling effort, including extra bottles for contingencies.

Procurement of containers should be initiated as early as possible to avoid unavailability and shipping delays and to satisfy cleaning requirements. Obtain the required number of sample bottles included in the FSP or WP of a type consistent with recommendations in EPA-600/4-79-020 (EPA 1979). Sample containers can usually be obtained directly from the laboratory performing the analyses.

A. Container Type

1. Identify the containers required for analysis by matrix as shown in Appendixes 5.2 through 5.7 (for example, amber glass, narrow-mouth bottles for PCB analysis of water samples). Confirm the container requirements with the analytical laboratory and the FSP or WP.

2. Calculate the number of each type of container required by including duplicates and blanks with the number of investigative samples specified in the FSP or WP. Also include extra bottles for contingencies.

B. Container Cleaning

Containers certified as being precleaned to EPA specifications will be obtained from the manufacturer through the laboratory. If certified containers are not obtained, follow the procedures outlined below to wash containers and caps. The person washing containers must wear gloves.

1. Inorganic and general parameters

   a. Wash containers, septa or liners, and closures in hot tap water with laboratory-grade, nonphosphate detergent.

   b. Rinse three times with tap water.

   c. Rinse three times with ASTM Type I deionized water (EPA 1979).

   d. Oven dry containers, septa or liners, and closures.

   e. Remove containers, septa or liners, and closures from oven.

   f. Place liners in closures (Teflon side down) and place on containers. Containers should not be removed from the preparation room until sealed.

2. Trace metals

   For certain parameters, a special cleaning procedure is needed to avoid adsorption or contamination resulting from interaction with container walls. These procedures are outlined below.

   a. Wash containers, closures, and Teflon liners in hot tap water with laboratory-grade, nonphosphate detergent.
   b. Rinse three times with tap water.

c. Rinse one time with 1:1 nitric acid.

d. Rinse three times with ASTM Type I deionized water (EPA 1979).

e. Air dry in a contaminant-free environment.

f. Place liners in closures and place closures on containers. Containers should not be removed from the preparation room until sealed.

3. Extractable Organics

a. Wash glass bottles, Teflon liners, and caps with hot tap water using laboratory-grade, nonphosphate detergent.

b. Rinse three times with tap water to remove detergent.

c. Rinse three times with ASTM Type I organic-free water (EPA 1979).

d. Oven dry bottles, liner, and caps to 105° - 125° for one hour.

e. Rinse with pesticide-grade hexane or pesticide-grade methylene chloride.

f. Oven dry bottles, liner, and caps to 105° - 125° for one hour.

g. Allow bottles, liners, and caps to cool to room temperature in an enclosed contaminant-free environment. Cap the containers after the glassware has been cooled.

h. Store in a contaminant-free area.

4. Volatile Organics Samples Containers

a. Wash glass vial, Teflon-based septa, Teflon liners, and caps in hot water using laboratory-grade, nonphosphate detergent.

b. Rinse three times with tap water.

c. Rinse three times with ASTM Type I organic-free water (EPA 1979).

d. Oven dry vial, caps, septa, and liner at 105° for one hour.

e. Allow vial, caps, septa, and liners to cool to room temperature in an enclosed contaminant-free environment.

f. Seal vials with septa (Teflon side down) and cap.

g. Label each vial with lot number and pack in the case.

h. Store in contaminant-free area.

5. Sterilization

a. For microbiological analyses, sterilize the container and its stopper/cap by autoclaving at 121°C for 15 min or by dry heat at 180°C for 2 hrs.

b. The sample bottles can be wrapped with aluminum foil before sterilization. Remove the protective wrapping after the sample is taken to facilitate cleaning the bottle before shipment to the analytical laboratory.

c. An acceptable alternative for emergency or field use is the sterilization of containers by boiling in water for 15 min.

3.2.4. Sample Volume

The volume of sample collected should be sufficient to perform all the required analyses plus an additional amount to provide for any quality control needs, split samples, or repeat examination. The volumes listed in Appendixes 5.2 through 5.7 are intended as general guidelines. Specific volume requirements to be followed will be those specified in the appropriate Work Plan, and/or Field Sampling Plan. The laboratory receiving the sample should be consulted for specific volume requirements, and these should be specified in the FSP or WP.

NOTE: A sufficient number of containers must be available to ship the proper sample volume. For example, Department of Transportation (DOT) and International Air Transport Association (IATA) regulations limit the size of a sample container to 16 oz if the contents may include hazardous materials. In this case, two 500-mL or four 250-mL containers would be required to ship a one-liter fluid sample. See SOP 1.5, Guide to the Handling, Packaging, and Shipping of samples for additional information.

3.2.5. Sample Preservation

Sample containers may arrive at the site with the proper type and amount of preservatives in them. If onsite preservation of the samples is necessary, the proper reagents should be provided for the field crew in an easily usable form that can be added at the time of sampling. Preservation required for the specific analyses requested may be determined by using Appendixes 5.2 through 5.7. The preservation requirements specified in the Work Plan and/or Field Sampling Plan will take precedence over Appendixes 5.2 through 5.7. Materials commonly needed for sample preservation are listed below.

1. Small bottles of pelletized NaOH

2. Ascorbic acid crystals

3. Lead acetate paper and pH paper

4. Calibrated sampling scoops

5. Reagent-grade acids (HNO_3, HCl, and H_2SO_4) in Safe-Kote bottles

6. Calibrated dispenser bottles (0.5 to 2 mL) for acids.

3.2.6. Field

The appropriate number and type of precleaned containers, along with preservatives, equipment, and packaging containers, should be stored in a facility that can be locked or guarded. The storage facility should be located near the site and decontamination staging area, but should also be accessible to freight trucks that will be delivering new container shipments and transporting samples to the laboratory.

3.3. Operation

A. Soils/Wastes Sample Collection

NOTE: All individuals in the sampling area must wear gloves appropriate to their tasks. Only the persons collecting samples and filling sample containers must discard their gloves between sampling tasks (e.g. sample set).

1. While wearing protective gloves, fill the bottle with the sample. Wet soils should have enough headspace to allow for expansion. Soils collected for VOC analysis should be filled as full as possible with no headspace.

2. Take extreme care to avoid contamination of the bottles or caps. Remove the cap just before filling and replace it as soon as possible after filling. Avoid any personal contact with the inside of the bottle or cap.

3. Clean the exterior of the bottle with a wipe moistened with deionized water, followed by a wipe moistened with methanol. When appropriate, implement SOP 1.6, General Equipment Decontamination. Attach a completed sample label (according to SOP 1.3, Sample Control and Documentation) and cover with clear tape. The tape should extend at least 1/4 inch beyond the edges of the label. Wrap a strip of Parafilm around the junction of the bottle and cap.

4. Preservation of soil samples is usually accomplished by protecting the sample from UV light by using an amber bottle and keeping the sample cool.

5. If required, place the container in a cooler. Maintain the samples at a cool

temperature with frozen packaged ice (for example, Blue Ice) or ice cubes sealed in two plastic bags. Avoid freezing the sample by packing to prevent contact between the coolant and the sample container.

6. If samples are not delivered to the laboratory on a daily basis, check ice chests and insulated boxes every 24 hrs and replace thawed ice or Blue Ice packs as needed.

7. Avoid exposing the sample to extreme hot or cold temperatures and intense sunlight, even if no specific preservation is recommended.

8. EPA guidance recommends that a 4°C temperature be maintained in the sample container before and during shipment. A 40-mL VOA vial is filled with deionized, distilled water and used as a temperature blank for the cooler. The analytical laboratory will use this temperature blank to record the temperature at the time of sample receipt. The temperature should be 4°C ± 2°C or as specified in the QAPP. If the temperature is not within this range, the project manager, or designee, will be notified.

   The temperature should be checked again at the analytical laboratory. Record both temperatures in the special instructions section of the Custody Transfer Record/Lab Work Request form (see SOP 1.3., Sample Control and Documentation). If a continuous temperature record can be obtained during the shipment period, record the maximum temperature in the container on the custody transfer form.

B. Water Sample Collection

NOTE: All individuals in the sampling area must wear gloves appropriate to their tasks. Only the persons collecting samples and filling sample containers must discard their gloves between sampling tasks (e.g., sample set).

1. Before collecting samples for organics and CN, use the Hach Test Kit for residual chlorine and sulfides. If present, preserve samples according to instructions in Appendix 5.2, Recommendation for Sampling and Preservation of Water Samples According to Measurement (for example, $Na_2S_2O_3$ to organic samples).

2. Collect samples directly in the appropriate container, ensuring that the sampling flow rate, if applicable, does not exceed the flow rate used while purging. Collect samples in the order of their volatilization sensitivity (TEGD). When collecting VOAs, follow SOP 2.8, Sampling for Volatile Organics.

   1) Volatile organics

   2) Extractable organics

   3) Dissolved metals

   4) Total metals

   5) Cations

   6) Anions

   7) Radionuclides

3. Do not filter unless specified in the Sampling Plan.

4. Do not rinse the container.

5. Slowly fill each container almost full, except VOAs (see SOP 2.8, Sampling for Volatile Organics).

6. Add any prescribed preservative.

7. Cap the container, shake, and reopen it.

8. If using acid or base preservative, check the pH adjustment with pH paper.

9. If necessary, add more preservative.

10. Complete steps 3 and 5 through 8 from Section 3.3.A.

11. If an error was made in collection, discard the entire bottle and start with a new one.

C. Holding Time

In general, analyze samples as soon as possible after collection. Some parameters are required to be analyzed in the field (See Appendix 5.2). Allowable holding times are listed as guidelines. They represent the maximum times that samples are considered valid. The typical required holding times for each analyte (or analysis group) are presented in Appendix 5.2. However, the Work Plan and/or Field Sampling Plan will specify holding times on a project-specific basis and, if different, take precedence over the Appendix 5.2 limits. There are instructions in the FSP or WP for delivering the samples to the laboratory as soon as possible. (See SOP 1.5, Guide to the Handling, Packaging, and Shipping of Samples).

3.4. Postoperation

3.4.1. Field

A. Store unused, clean sample bottles in a clean environment for later use.

B. Clean acid dispensers and store them dry for the next field operation.

C. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

D. Restore the site to presampling conditions as specified in the FSP or WP.

E. Make sure all wells are labeled, sampling locations are properly staked, and the location ID is readily visible on the guard pipe or location stake.

F. Prepare samples for transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record any cleanup procedures and any uncompleted work (like site restoration or uncompleted sampling) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCES

Korte, Nic, and Peter Kearl. 1985. "Procedures for the Collection and Preservation of Groundwater and Surface Water Samples and for the Installation of Monitoring Wells: Second Edition." U.S. Department of Energy report GJ/TMC-08. Technical Measurements Center, Grand Junction Project Office, Grand Junction, Colorado.

EPA. 1979. "Handbook for Analytical Quality Control in Water and Wastewater." U.S. Environmental Protection Agency report EPA-600/4-79-019. Washington, D.C.: U.S. Government Printing Office.

EPA. 1982. "Handbook for Sampling and Sample Preservation of Water and Wastewater." U.S. Environmental Protection Agency report EPA-600/4-82-029. Washington, D.C.: U.S. Government Printing Office.

EPA. 1983. "Methods for Chemical Analysis of Water and Wastes." U.S. Environmental Protection Agency report EPA-600/4-79-020. Washington, D.C.: U.S. Government Printing Office.

EPA. 1983. "Manual of Groundwater Quality Sampling Procedures." U.S. Environmental Protection Agency report EPA/600/2-81-160. Washington, D.C.: U.S. Government Printing Office.

EPA. 1984. "Test Methods for Evaluation of Solid Waste." 2d ed. U.S. Environmental Protection Agency report EPA-SW-846. Washington, D.C.: U.S. Government Printing Office.

EPA. 1985. "Practical Guide for Groundwater Sampling." U.S. Environmental Protection Agency report EPA/600/2-85/104. Washington, D.C.: U.S. Government Printing Office.

EPA. 1986. "RCRA Groundwater Monitoring Technical Enforcement Guidance Document." U.S. Environmental Protection Agency document OSWER-9950.1. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Recommendation for Sampling and Preservation of Water Samples According to Measurement

5.3. Sampling and Preservation Procedures for RCRA Groundwater Detection Monitoring

5.4. Analysis Plan for Soil/Sediment Samples

5.5. Sample Containers for Waste

5.6. Containers for Aqueous Waste Samples

5.7. Analysis Plan for Soil/Sediment/Waste Samples

APPENDIX 5.1
EQUIPMENT AND SUPPLIES CHECKLIST

_____ Narrow-mouth amber glass bottles with Teflon-lined caps (0.5, 1, and 2 liters)

_____ Amber glass vials with Teflon septa (40-mL)

_____ Blue Ice or equivalent

_____ 250-mL sterile bottle

_____ Cardboard boxes

_____ Insulated coolers

_____ Ballpoint pen (permanent black ink)

_____ Felt-tip marker pen (permanent black ink)

_____ Heavy-duty poly bags and ties

_____ Strapping tape

_____ Wide-mouth polyethylene bottles (0.5, 1, and 2 liters)

_____ Plastic trashcan liners

_____ 1-11 pH indicator paper

_____ Canvas bags

_____ Hach field test kit for sulfides

_____ Hach field test kit for chlorine

_____ Parafilm

_____ Ascorbic acid crystals

_____ Disposable surgical gloves (latex, PVC, other suitable plastic, or rubber)

_____ NaOH pellets

_____ Disposable wipes

_____ Crystalline $Na_2S_2O_3$

_____ Methanol and deionized water in Teflon wash bottles

APPENDIX 5.1, Continued

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Padding for packaging of samples

_____ Concentrated HNO_3, H_2SO_4, and HCl

_____ New or cleaned polyethylene narrow-mouth bottles (1.0 liter, 500 mL, 125 mL, and 60 mL)

APPENDIX 5.2
RECOMMENDATION FOR SAMPLING AND PRESERVATION OF WATER SAMPLES ACCORDING TO MEASUREMENT[1]

Measurement	Volume Requirement (mL)	Container[2]	Preservative[3,4]	Holding Time[5]
Physical Properties				
Color	50	P,G	Cool 4°C	48 Hrs.
Conductance	100	P,G	Cool 4°C	28 Days
Hardness	100	P,G	HNO_3 to pH<2	6 Mos.
Odor	200	G only	Cool 4°C	24 Hrs.
pH	25	P,G	None Required	Analyze Immediately
Residue				
Filterable	1000	P,G	Cool 4°C	7 Days
Nonfilterable	1000	P,G	Cool 4°C	7 Days
Total	100	P,G	Cool 4°C	7 Days
Volatile	100	P,G	Cool 4°C	7 Days
Settleable Matter	1000	P,G	Cool 4°C	48 Hrs.
Temperature	1000	P,G	None Required	Analyze Immediately
Turbidity	100	P,G	Cool 4°C	48 Hrs.
Metals				
Dissolved	1000	P,G	Filter onsite HNO_3 to pH<2	6 Mos.[6] 6 Mos.
Total	1000	P,G	HNO_3 to pH<2	6 Mos.
Chromium^{+6}	200	P,G	Cool 4°C	24 Hrs.

APPENDIX 5.2, Continued
RECOMMENDATION FOR SAMPLING AND PRESERVATION OF WATER SAMPLES ACCORDING TO MEASUREMENT[1]

Measurement	Volume Requirement (mL)	Container[2]	Preservative[3,4]	Holding Time[5]
Mercury				
Dissolved	100	P,G	Filter HNO_3 to pH<2	28 Days from date of collection
Total	100	P,G	HNO_3 to pH<2	28 Days
Inorganics, Nonmetallics				
Acidity	100	P,G	Cool 4°C	14 Days
Alkalinity	200	P,G	Cool 4°C	14 Days
Bromide	100	P,G	None Required	28 Days
Cations	1,000	P	HNO_3 to pH<2	28 Days
Chloride	50	P,G	None Required	28 Days
Chlorine	200	P,G	None Required	Analyze Immediately
Cyanides	1500	P,G	NaOH to pH>12 Cool 4°C	14 Days from date of collection
Fluoride	500	P,G	Cool 4°C	28 Days
Iodide	100	P,G	Cool 4°C	24 Hrs.
Nitrogen				
Ammonia	500	P,G	Cool 4°C H_2SO_4 to pH<2	28 Days
Kjeldahl, Total	500	P,G	Cool 4°C H_2SO_4 to pH<2	28 Days
Nitrate Plus Nitrite	500	P,G	Cool 4°C H_2SO_4 to pH<2	28 Days
Nitrate[9]	100	P,G	Cool 4°C	48 Hrs.
Nitrite	150	P,G	Cool 4°C	48 Hrs.

APPENDIX 5.2, Continued
RECOMMENDATION FOR SAMPLING AND PRESERVATION OF WATER SAMPLES ACCORDING TO MEASUREMENT[1]

Measurement	Volume Requirement (mL)	Container[2]	Preservative[3,4]	Holding Time[5]
Dissolved Oxygen				
Probe	300	G bottle and top	None Required	Analyze Immediately
Winkler	300	G bottle and top and store in dark	Fix onsite	8 Hours
Phosphorus				
Orthophosphate, Dissolved	50	P,G	Filter onsite Cool 4°C	48 Hrs.
Hydrolyzable	50	P,G	Cool 4°C H_2SO_4 to pH<2	28 Days
Total, Dissolved	50	P,G	Filter on site Cool 4°C H_2SO_4 to pH<2	24 Hrs.
Total	500	P,G	Cool 4°C H_2SO_4 to pH<2	28 Days
Silicia	50	P only	Cool 4°C	28 Days
Sulfate	50	P,G	Cool 4°C	28 Days
Sulfide	50	P,G	Cool 4°C add 2 m liter zinc acetate plus NaOH to pH >9	7 Days
Sulfite	50	P,G	None Required	Analyze Immediately
Organics				
BOD	1000	P,G	Cool 4°C	48 Hrs.
COD	50	P,G	Cool 4°C H_2SO_4 to pH<2	28 Days
Oil & Grease	1000	P,G	Cool 4°C H_2SO_4 to pH<2	28 Days

APPENDIX 5.2, Continued
RECOMMENDATION FOR SAMPLING AND PRESERVATION OF WATER SAMPLES ACCORDING TO MEASUREMENT[1]

Measurement	Volume Requirement (mL)	Container[2]	Preservative[3,4]	Holding Time[5]
Total Organic Carbon	250	Amber G, Teflon-lined cap; no headspace	Cool 4°C H_2SO_4 to pH<2	28 Days
Phenolics	500	G only	Cool 4°C H_2SO_4 to pH<2	28 Days
Cyanide	1000	P,G	Cool 4°C 40% NaOH to pH>12, 0.6 g Ascorbic Acid[7]	14 Days from date of collection
Coliform, Fecal and Total	250	P,G	Cool 4°C Sterile	6 Hrs.
Oil and Grease	1000	G	Cool 4°C H_2SO_4 to pH<2	28 Days
Phenols	1000	G, Teflon-lined Cap	Cool 4°C	7 Days until extraction; 40 Days after extraction
Total Organic Halogen and Purgeable aromatics	80	G, Teflon-lined vial septum	Cool 4°C 0.008% $Na_2S_2O_3$[6] HCl to pH<2	7 Days 14 Days
Purgeable aromatics	80	G, Teflon-lined septum	Cool 4°C 0.008% $Na_2S_2O_3$[6] HCl to pH<2	7 Days 14 Days
Acetonitrile and Acrylonitrile	80	G, Teflon-lined cap	Cool 4°C	14 Days
Acrolein and acrylonitrile	1000	G, Teflon-lined septum	Cool 4°C 0.008% $Na_2S_2O_3$[6] HCl to pH<2	7 Days 14 Days
Semivolatile Organic Compounds	2000	Amber G, Teflon-lined cap	Cool 4°C	7 Days until extraction; 40 days after extraction
Phenols	1000	G, Teflon-lined cap	Cool 4°C 0.008% $Na_2S_2O_3$[6]	7 days until extraction; 40 days after extraction

APPENDIX 5.2, Continued
RECOMMENDATION FOR SAMPLING AND PRESERVATION OF WATER SAMPLES ACCORDING TO MEASUREMENT[1]

Measurement	Volume Requirement (mL)	Container[2]	Preservative[3,4]	Holding Time[5]
Benzindines	1000	G, Teflon-lined cap	Cool 4°C 0.008% $Na_2S_2O_3$[6]	7 Days until extraction; 40 days after extraction
Phthalate esters	1000	G, Teflon-lined cap	Cool 4°C 0.008% $Na_2S_2O_3$[6]	7 Days until extraction; 40 days after extraction
Nitrosamines	1000	G, Teflon-lined cap	Cool 4°C store in dark 0.008% $Na_2S_2O_3$[6]	7 Days until extraction; 40 days after extraction
Nitroaromatics and isophorone	1000	G, Teflon-lined cap	Cool 4°C	7 days until extraction; 40 days after extraction
Polynuclear aromatic hydrocarbons	1000	G, Teflon-lined cap	Cool 4°C	7 days until extraction; 40 days after extraction
Haloethers	1000	G, Teflon-lined cap	Cool 4°C	7 days until extraction; 40 days after extraction
Chlorinated hydrocarbons	1000	G, Teflon-lined cap	Cool 4°C	7 days until extraction; 40 days after extraction
TCDD	1000	G, Teflon-lined cap	Cool 4°C	7 days until extraction; 40 days after extraction
Explosives	1000	Amber G, Teflon-lined cap	Cool 4°C	7 days until extraction; 30 days after extraction

APPENDIX 5.2, Continued
RECOMMENDATION FOR SAMPLING AND PRESERVATION OF WATER SAMPLES ACCORDING TO MEASUREMENT[1]

Measurement	Volume Requirement (mL)	Container[2]	Preservative[3,4]	Holding Time[5]
Pesticides Tests				
Pesticides/PCBs	2000	Amber G, Teflon-lined cap	Cool 4°C	7 days from date of collection until extraction; 40 days after extraction
Radiological Tests				
Alpha, beta and radium	1000	P,G	HNO_3 to pH<2	6 mos.
Tritium	250	G	None	None
Gamma Spectrometry	1000	P	HNO_3 to pH<2	None
Isotopic Plutonium	1000	P	HNO_3 to pH<2	None
Isotopic Thorium	1000	P	HNO_3 to pH<2	None
Isotopic Uranium	500	P	HNO_3 to pH<2	6 mos.
Sr-90	1000	P	HNO_3 to pH<2	6 mos.
Radium-226	1000	P	HNO_3 to pH<2	None
Americium-241	1000	P	HNO_3 to pH<2	None

[1]More specific instructions for preservation and sampling are found with each procedure described in this manual. A general discussion about sampling water and industrial wastewater may be found as ASTM, Part 31, p. 72-82 (1976) Method D-3370.
[2]Plastic (P) or Glass (G). For metals, polyethylene with a polypropylene cap (no liner) is preferred.
[3]Sample preservation should be performed immediately upon sample collection. For composite samples, each aliquot should be preserved at the time of collection. When use of an automated sample makes it impossible to preserve each aliquot, then samples may be preserved by keeping cool at 4°C until compositing and sample splitting is completed.
[4]Shipment of preserved and unpreserved samples must comply with SOP 1.5, Guide to the Handling, Packaging, and Shipping of Samples.
[5]Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still considered valid. Samples may be held for longer periods only if the permitted, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer time and has received a variance from the regional administrator. Some samples may not be stable for a shorter time, if knowledge exists to show it is necessary to maintain sample stability.
[6]Should only be used in the presence of residual chlorine.
[7]Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before the pH adjustment in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.
[8]Samples should be filtered immediately onsite before adding preservative for dissolved metals.
[9]For samples from nonchlorinated drinking water supplies, concentrated H_2SO_4 should be added to lower sample pH to less than 2. The sample should be analyzed within 14 days.

APPENDIX 5.3

SAMPLING AND PRESERVATION PROCEDURES FOR RCRA GROUNDWATER DETECTION MONITORING[a]

Parameter	Recommended Container[b]	Preservative[d]	Maximum Holding Time	Minimum Volume Required for Analysis
		Indicators of Groundwater Contamination[c]		
pH	T,P,G	Field determined	None	25 mL
Specific conductance	T,P,G	Field determine	None	100 mL
TOC	G, amber, T-lined cap[e]	Cool 4°C	28 days HCl to pH<2	4 x 15 mL
TOX	G, amber, T-lined septa or caps	Cool 4°C, add 1.1M sodium sulfite	7 days	4 x 15 mL
		Groundwater Quality Characteristics		
Chloride	T, P, G	Cool 4°C	28 days	50 mL
Iron Manganese Sodium	T, P	Field acidified to pH <2 with HNO_3	6 months	200 mL
Phenols	G	Cool 4°C/H_2SO_4 to pH <2		28 days 500 mL
Sulfate	T, P, G	Cool 4°C	28 days	50 mL
		EPA Interim Drinking Water Characteristics		
Arsenic Barium Cadmium Chromium Lead Mercury Selenium Silver	T, P G, Amber	Total Metals Field acidified to pH <2 with HNO_3 Dissolved Metals 1. Field filtration (0.45 micron) 2. Acidify to pH <2 with HNO_3	6 months 28 days 6 months	1000 mL 1000 mL

SAMPLING AND PRESERVATION PROCEDURES FOR RCRA GROUNDWATER DETECTION MONITORING[a]

Parameter	Recommended Container[b]	Preservative	Maximum Holding Time	Minimum Volume Required for Analysis
Fluoride	T, P	Cool 4°C	28 days	300 mL
Nitrate/ Nitrite	T, P, G	Cool 4°C/ H_2SO_4 to pH <2	14 days	1000 mL
Endrin Lindane Methoxychlor Toxaphene 2,4 D 2,4,5 TP Silvex	T, G	Cool 4°C	7 days	2000 mL
Radium Gross Alpha Gross Beta	P, G	Field acidified to pH <2 with HNO_3	6 months	1 gallon
Coliform bacteria	PP, G (sterilized)	Cool 4°C	6 hours	200 mL
		Other Groundwater Characteristics of Interest		
Cyanide	P, G	Cool 4°C, NaOH to pH >12. 0.6 g ascorbic acid[f,g]	14 days from date of collection	500 mL
Oil and Grease	G only	Cool 4°C H_2SO_4 to pH <2	28 days	100 mL
Semivolatile, nonvolatile organics	T, G	Cool 4°C	7 days from date of collection until extraction; 40 days to analysis	60 mL
Volatiles	G, T-lined	Cool 4°C Cool 4°C and HCl to pH<2	7 days 14 days	60 mL

[a]References:

Test Methods for Evaluation Solid Waste - Physical/Chemical Methods, SW-846 (2nd edition, 1982).
Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020.
Standard Methods for the Examination of Water and Wastewater, 16th edition (1985).

APPENDIX 5.3, Continued

SAMPLING AND PRESERVATION PROCEDURES FOR RCRA GROUNDWATER DETECTION MONITORING[a]

[b]Container Types:

P = Plastic (polyethylene)
G = Glass
T = Fluorocarbon resins (PTFE, Teflon, FEP and PFA)
PP = Polypropylene

[c]Based on the requirements for detection monitoring (265.93), the owner/operator must collect a sufficient volume of groundwater to allow for the analysis of four separate replicates.

[d]Shipping containers (cooling chest with ice or ice pack) should be certified as to the 4#C temperature at the time of sample placement into these containers. Preservation of samples requires that the temperature of collected samples be adjusted to 4#C and maintained at 4#C upon placement of sample and during shipment. Field personnel will check the temperature in the container at the time of shipping and ice the samples to maintain a cool temperature during shipment. Maximum-minimum thermometers can be placed into the shipping chest to record temperature history. Chain-of-custody forms will include the temperature in the container at the time of shipment and delivery at the laboratory in addition to in-transit (maximum) temperature, if available.

[e]Do not allow any headspace in the container.

[f]Use ascorbic acid only in the presence of oxidizing agents.

[g]Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before the pH adjustment in order to determine if sulfide is present. If sulfide is present, it can be removed by addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.

APPENDIX 5.4

ANALYSIS PLAN FOR SOIL/SEDIMENT SAMPLES

Analyte*	Sample Container	Sample Volume (g)	Preservations	Holding Time(days)
Volatile Organics	40-mL vial (2) w/Teflon-lined silicon rubber septum	5	Cool 4°C	14 from date of of collection
Semivolatile Organic Compounds	Amber G, Teflon-lined cap	100	Cool 4°C	14/40[2]
Pesticide/PCB	Amber G, Teflon-lined cap	100	Cool 4°C	14/40[2]
Total Organic Carbon	Amber G, Teflon-lined cap	50	Cool 4°C	28 days
Soil pH	P	50	Cool 4°C	48 hrs
Explosives	Amber G, Teflon-lined cap	100	Cool 4°C	7/30[5]
TAL Inorganic[1]	P	100	Cool 4°C	180 Mercury = 28 days from date of collection
Non-TAL Metals	P, G, 1 L	200	Cool 4°C	180
Reactivity	Amber G	—	Cool 4°C	N/A
Chloride	P	100	Cool 4°C	28 days
Fluoride	P	50	Cool 4°C	28 days
Sulfate	P	100	Cool 4°C	28 days
Nitrate-Nitrite	P	100	Cool 4°C	28 days
Cyanide	P	100	Cool 4°C	14 days
Hexavalent Chromium	G, 1 L	100	Cool 4°C	1
Radiological				
Tritium	G	250	N/A	None
Gamma Spectrometry	P	750	N/A	None
Isotopic Plutonium	P	750	N/A	None
Isotopic Thorium	P	750	N/A	None
Isotopic Uranium	P	750	N/A	None
Sr-90	P	750	N/A	None

APPENDIX 5.4, Continued

ANALYSIS PLAN FOR SOIL/SEDIMENT SAMPLES

Analyte*	Sample Container	Sample Volume (g)	Preservations	Holding Time(days)
Geotechnical				
Cation Exchange Capacity	P	100	Cool 4°C	N/A
Grain Size Distribution	P	50 lbs[6]	N/A	N/A
Specific Gravity	P	50 lbs[6]	N/A	N/A
Hydraulic Conductivity	P	50 lbs[6]	N/A	N/A
Relative Density	P	50 lbs[6]	N/A	N/A
Maximum Density	P	50 lbs[6]	N/A	N/A
Moisture Content	P	500	Cool 4°C Airtight	7 days
Organic Content	P	500	Cool 4°C	7 days
Clay Mineralogy	P	100	N/A	N/A

[1]Includes lithium, molybdenum, bismuth, and tin, which are non-TAL metals, but are analyzed using the same methods.
[2]Extract within 7 days from date of collection; analysis within 40 days of extraction.
[3]Soil/sediments will be leached with Laboratory Reagent Water (20 g soil to 50 mL water) and water extract analyzed using procedure in "Methods for Chemical Analysis of Water and Wastes," 1983; EPA 600/4-79-020.
[4]Soil/sediment will be leached with Laboratory Reagent Water (5 g soil and 100 mL of water) by shaking for 2 hours, and the water extract filtered and subsequently analyzed. This is in accordance with method 312B in Standard Methods for Examination of Water and Wastewater, 16th Edition.
[5]Extract within 7 days from date of collection; analysis within 30 days of extraction.
[6]Shelby tubes of sufficient volume may be used to collect samples for these analysis.
*The FSP or WP will define the actual suite of parameters to be analyzed for specific samples. The QAPP will define the actual methodology for analyses.

APPENDIX 5.5

SAMPLE CONTAINERS FOR WASTE

Waste Type	Recommended Container	Closure	Analysis
Photosensitive wastes 1000 or 2000 m liter	Amber HDPE or amber glass caps with Teflon liners for glass bottles	LPE caps for HDPE bottles; Bakelite	Waste characterization per 40 CFR-Part 261
Pesticide hydrocarbon chlorinated hydrocarbons petroleum distillates	Wide-mouth borosilicate glass bottles 1000 or 2000 mL	Bakelite caps with Teflon liner	Waste characterization per 40 CFR-Part 261
Oil wastes	HDPE bottles wide mouth 1000 or 2000 mL	LPE caps	Waste characterization per 40 CFR-Part 261
Strong alkali or hydrofluoric acid	HDPE bottle, wide mouth 1000 mL	LPE caps	Waste characterization per 40 CFR-Part 261
Aqueous wastes–characterization of organics	Borosilicate glass bottles 1000 or 2000 mL	Caps with Teflon liner	Waste characterization per 40 CFR-Part 261
Solids (sludge, soils, and granular)	8-oz, wide-mouth glass bottle	Bakelite caps with Teflon liners	Waste characterization per 40 CFR-Part 261

APPENDIX 5.6

CONTAINERS FOR AQUEOUS WASTE SAMPLES

Analyte*	Sample Container	Sample Volume	Preservation[7]	Holding Time(days)
TCL Volatile	40 mL vial (2)	40 mL	HCl pH<2 with HCl	14 from date of collection
TCL Semivolatile	Amber G, 1L	1 L	Cool 4°C	7/40[5]
TCL Pesticide/PCB	Amber G, 1L	1 L	Cool 4°C	7/40[5]
TAL Inorganic[2]	P,G, 1L	1 L	pH<2,w/HNO_3[6]	180 (Mercury = 28 days from date of collection)
Non-TAL Metals	P,G, 1L	1 L	pH<2,w/HNO_3[6]	180
Cyanide	P,G, 1L	0.5 L	pH>12,w/NaOH	14 from date of collection
pH[3]	P,G	N/A	None	Field Meas.
Sp. Conductivity[3]	P,G	N/A	None	Field Meas.
Temperature[3]	P,G	N/A	None	Field Meas.
Diss. Oxygen[3]	G	N/A	None	Field Meas.
TDS	P,G 1L	0.1 L	Cool 4°C	7
TSS	P,G 1L	0.1 L	Cool 4°C	7
Total Phosphate	P,G, 1L	1 L	Cool 4°C, pH<2[6]	28
Chloride, Sulfate	P,G, 1L	1 L	Cool 4°C	28
Carbonate/Bicarbonate[4]	P,G, 1L	1 L	Cool 4°C	14
Nitrate	P,G, 1L	1 L	Cool 4°C	2
Hexavalent Chromium	P,G, 1L	1 L	Cool 4°C	2

[2]Includes Cesium, Molybdenum, and Strontium, which are non-TAL metals, but are analyzed using the same methods.
[3]Field Measurements are collected at time of sampling.
[4]These are reported as carbonate and biocarbonate alkalinity.
[5]Seven days from date of collection to extraction; analysis within 40 days of extraction.
[6]All samples with the exception of those for total metals will be filtered within 4 hours of sample collection and preservatives added to the filtrate as specified.
[7]All samples will be kept at 4°C after arrival at the laboratory.
*The FSP or WP will define the actual suite of parameters to be analyzed for specific samples.

APPENDIX 5.7

ANALYSIS PLAN FOR SOIL/SEDIMENT/WASTE SAMPLES*

Analyte*	Sample Container	Sample Volume(g)	Preservations	Holding Time(days)
TCL Volatile	40 mL vial (2)	5	Cool 4°C	14 from date of collection
TCL Semivolatile	Amber G, 1 L	10-30	Cool 4°C	7/40[3]
TCL Pesticide/PCB	Amber G, 1 L	10-30	Cool 4°C	7/40[3]
TAL Inorganic[2]	P,G, 1 L	200	Cool 4°C	180
Non-TAL Metals	P,G, 1L	200	Cool 4°C	180 (Mercury = 28 days from date of collection)
TCLP	Amber G	100	Cool 4°C	14 days
Chloride	G, 1 L[4]	20	Cool 4°C	28
Sulfate	G, 1 L[4]	20	Cool 4°C	28
Nitrate	G, 1 L[4]	20	Cool 4°C	28
Cyanide	G, 1 L	200	Cool 4°C	12
Hexavalent Chromium	G, 1 L[5]	200	Cool 4°C	1

[2]Includes Cesium, Molybdenum, and Strontium, which are non-TAL metals.
[3]Extract within 7 days from date of collection; analysis within 40 days of extraction.
[4]Soil/sediments will be leached with laboratory reagent water (20 g soil to 50 m liter water) and water extract analyzed using referenced procedure. Procedure reference: Methods for Chemical Analysis of Water and Wastes, 1983; EPA 600/4-79-020.
[5]Soil/sediment will be leached with laboratory reagent water (5 g soil and 100 m liter of water) by shaking for 2 hours. The water extract is filtered and subsequently analyzed. This is in accordance with method 312B in Standard Methods for Examination of Water and Wastewater, 15th Edition.
*The FSP or WP Sampling Plans will define the actual suite of parameters to be analyzed for specific samples.

APPENDIX 5.7, Continued

ANALYSIS PLAN FOR SOIL/SEDIMENT/WASTE SAMPLES

Method References

Ref. 1. Method 9010 - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

Ref. 2. Method 8240 - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

Ref. 3. Method 8270 - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

Ref. 4. Method 8080 - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

Ref. 5. Method 6010 or 7000 Series Methods - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

Ref. 6. Method 9010 or 9030 Series Methods - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

Ref. 7. Method 1310 - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

STANDARD OPERATING PROCEDURE 1.5

GUIDE TO THE HANDLING, PACKAGING, AND SHIPPING OF SAMPLES

1. PURPOSE

To provide a general guide for packaging and shipping samples of environmental and hazardous materials to the laboratory. In addition, instructions are provided to select the correct category for packaging and shipping samples of unknown contents.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information concerning the scope and details of a specific operation. Refer to the FSP or WP for the type of samples to be collected and the destination for the samples. This SOP describes the procedures used by the ER Program technical assistance subcontractor when handling, packaging, and shipping samples. Other procedures or requirements used by installation subcontractors must conform to this SOP. The transportation of samples must protect the integrity of the sample and prevent any detrimental effects from the potentially hazardous nature of the samples.

Samples collected at a site are classified as environmental or hazardous material samples. In general, environmental samples are collected from streams, farm ponds, small lakes, wells, and offsite soils that are not expected to be contaminated with hazardous materials. Samples of onsite soils or water and materials collected from drums, bulk storage tanks, obviously contaminated ponds, impoundments, lagoons, pools, and leachates from hazardous waste sites are considered samples of hazardous materials. A distinction must be made between the two types of samples for two reasons.

1. The appropriate Department of Transportation (DOT) or International Air Transport Association (IATA) procedures for the transportation of samples must be determined. If there is any doubt, a sample should be considered hazardous and shipped accordingly.

2. The health and safety of laboratory personnel receiving samples must be protected. Special precautions are used at laboratories when samples that are not environmental are received.

Hazardous materials defined by the transportation regulations contained in 49 CFR (Subchapter C, Part 171) or the current edition of IATA regulations for dangerous goods (Sections 3 and 4) should be shipped only by the method of transportation specified in these regulations. Overnight shipments by air (Federal Express, for example) are governed by the IATA regulations. Transportation of hazardous materials exclusively by surface route is governed by the requirements of 49 CFR. This operating practice ensures compliance with the appropriate regulations and at times requires the implementation of packaging instructions that are more conservative and stringent than those required by regulation. Employees should be aware that regulatory bodies with jurisdiction have the authority to levy substantial fines and penalties to violators. Failure on the part of any employee to follow the requirements of these procedures is cause for disciplinary action, including discharge.

This SOP provides general guidance for packaging, marking, labeling, and shipping samples of environmental and hazardous materials and should not be misconstrued as the equivalent of or replacement for the DOT or IATA regulations. When shipping any potentially hazardous samples, the DOT regulations (49 CFR 171-178) and IATA regulations must be followed. This SOP should be used in conjunction with DOT and IATA regulations and advice from the freight carrier to ensure that all regulations governing transportation are being followed.

Any questions about the instructions for shipping environmental samples or hazardous materials in this SOP should be directed to the subcontractor's health and safety officer, who provides technical assistance to the ER Program.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, SOPs 1.1-1.10 must be reviewed. These SOPs contain information on the performance of field activities. They should be consulted for specific information on equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation
1.6	General Equipment Decontamination

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.
B. Coordinate schedules/actions with the installation staff.
C. Obtain appropriate permission for property access.
D. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.
E. Contact the carrier that will transport samples to obtain information on regulations and specifications.

3.3.2. Documentation

A. Obtain a logbook from the QA officer.
B. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).
C. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.3. Operation

Procedures for shipping samples under DOT and IATA regulations are provided in Appendixes 5.1 through 5.4. The following step-by-step procedure will ensure that all applicable requirements for classifying, packing, marking, labeling, and documenting samples can be met.

A. Determine the correct technical name or composition of substances that might be in the samples. Check to see if the substance is forbidden on aircraft. Section 1 of the IATA Regulations for Dangerous Goods contains a list of the substances that cannot be transported by air.

B. All samples must be transported by cargo aircraft or land transport. See Appendixes 5.1 through 5.4 for the appropriate DOT and IATA requirements.

C. Consult the DOT or IATA references to select the appropriate shipping container and packing material.

D. Prepare the consignment according to relevant requirements.

E. Ensure that all appropriate markings are printed on the packages and labels are attached.

F. Make any appropriate advance arrangements with the carrier and obtain current information about regulations and specifications that might affect the shipment.

G. Prepare the cargo airbill, complete, and sign the appropriate declarations for transporting dangerous goods.

H. Deliver the shipment to the local office of the freight carrier or arrange for a pickup at the site. Do not seal the container until the freight carrier is satisfied that the internal packaging meets all applicable regulations.

I. Ensure that all chain-of-custody procedures are observed. The copy of the bill of lading form will be retained as evidence of the chain-of-custody transfer.

3.4. Postoperation

3.4.1. Field

A. When transferring the samples, have the transferee sign and record the date and time on the Custody Transfer Record/Lab Work Request form (see SOP 1.3, Sample Control and Documentation). Custody transfers made to a sample custodian in the field should account for each sample, although samples may be transferred as a group. Every person who takes custody should fill in the appropriate section of the Custody Transfer Record/Lab Work Request form. Minimize the time of possession.

B. The field custodian is responsible for properly packaging and dispatching samples to the appropriate laboratory. This responsibility includes completing, dating, and signing the appropriate portion of the Custody Transfer Record/Lab Work Request form. When samples of hazardous materials are shipped to a laboratory, provide advance notice.

C. Verify that all sample bottles have been correctly identified and labels include necessary information (for example, location, time, and date).

3.4.2 Documentation

A. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

B. As in any other activity that may be used to support litigation, regulatory agencies must be able to provide the chain of possession and custody of any samples that are offered for evidence or that form the basis of analytical test results introduced as evidence. Written procedures must be available and followed whenever samples for evidence are collected, transferred, stored, analyzed, or destroyed. The primary objective of these procedures is to create an accurate, written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis and the introduction as evidence.

A sample is in someone's custody under any of the conditions listed below.

- It is in one's actual possession.

- It is in one's view (after being in one's physical possession).
- It is one's physical possession and then locked up so that no one can tamper with it.
- It is kept in a secured area that is restricted to only authorized personnel.

C. Send all packages to the laboratory with the Custody Transfer Record/Lab Work Request form and other pertinent forms. Retain a copy of these forms at the originating office (either carbon or photocopy). Register mailed packages with a return receipt requested. For packages sent by common carrier, retain receipts as part of the permanent chain-of-custody documentation. Pack samples to eliminate the possibility of breakage during shipment. Seal or lock the package so that any tampering can be readily detected.

D. Additional guidelines for chain of custody, a sample of the form, and instructions for completing the Custody Transfer Record/Lab Work Request form are included in SOP 1.3, Sample Control and Documentation.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCES

International Air Transport Association. 1993. Dangerous Goods Regulations. January 1993. Montreal, Quebec, Canada.

CFR 49. 1985. Code of Federal Regulations, Title 49, U.S. Department of Transportation, Parts 100-199. November 1, 1985. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIXES

5.1 Environmental Samples

5.2 Samples of Hazardous and Radioactive Materials

5.3 Transportation of Unknown Hazardous Materials by 49 CFR

5.4 Transportation of Unknown Hazardous Materials by IATA

APPENDIX 5.1
ENVIRONMENTAL SAMPLES

A. Environmental Samples

Environmental samples which are expected to contain only small quantities of contaminants may be shipped as excepted quantities under IATA. Excepted quantity limitations are defined in Section 2.7 of the IATA Regulations for Dangerous Goods. The following procedure for shipping environmental samples is based on the samples meeting the IATA restrictions.

B. Packaging

Before any samples are placed in their final shipping containers, the exterior of the sample containers should be wiped clean with a damp cloth. Environmental samples must then be packaged according to the following procedures.

1. Place sample container, properly labeled and with a chain-of-custody seal on a sealed lid, into a polyethylene bag and seal the bag.

2. Place sample in a fiberboard container approved by the Department of Transportation (DOT) or picnic cooler.

3. Pack container with enough noncombustible, absorbent cushioning material to minimize the possibility of breakage and absorb any materials that may have leaked from the sample jars. Vermiculite is recommended.

4. If there are multiple samples, be sure there is sufficient cushioning material between the sample containers (each in its individual polyethylene bag) to prevent breakage from dropping or severe shock.

5. Sealed bags of ice are packed with the samples to obtain 4°C.

6. Tape a sealed plastic bag containing the completed chain-of-custody form to the inside of the shipping container lid.

7. Seal outside container with duct tape or strapping tape.

8. On each side of the shipping container, place a signed chain-of-custody seal at the junction between the shipping container and lid.

C. Marking/Labeling

Sample containers must have a completed sample identification tag (see SOP 1.3, Sample Control and Documentation), and the outside container must be marked Environmental Sample. The appropriate side of the container must be marked This End Up, and arrow labels should be used accordingly. Affix a "Excepted Quantities" Label for samples shipped by air on the outside container (fiberboard box or cooler). No DOT placards or labeling are required. Assure that all sample containers are labeled identically to labels on the shipping container.

D. Shipping Papers

No DOT or International Air Transport Association (IATA) shipping papers are required for environmental samples.

E. Transportation

There are no DOT or IATA restrictions on the mode of transportation for environmental samples. An overnight carrier is required.

F. Additional Guidelines for Water Samples

Additional guidelines for the shipment of water samples is given in the TEGD. These include the following activities.

1. When the samples are placed in the shipping cooler, record the internal temperature of the cooler on the chain-of-custody form.

2. Make sure that signed and dated chain-of-custody seals are present on the cap of each individual sample container and on the lid of the shipping cooler.

3. The internal temperature of the shipping container will be measured using a laboratory grade thermometer upon opening the cooler at the contracted laboratory.

APPENDIX 5.2
SAMPLES OF HAZARDOUS AND RADIOACTIVE MATERIALS

A. Samples of Hazardous Material

Samples that are not environmental samples or samples known or expected to contain hazardous substances must be considered samples of hazardous material and transported according to the following requirements.

If the hazardous material in the sample is known or can be accurately identified, it is packaged, marked, labeled, and shipped according to the specific instructions for that material described in the Department of Transportation Hazardous Materials Table (49 CFR 72.101) or the latest edition of the International Air Transport Association Dangerous Goods Regulations.

B. Samples of Radioactive Materials

Samples containing greater than 70 KBq/Kg (2000 ρCi/g) of any radionuclide are considered radioactive materials by DOT (49 CFR 173.403y) and IATA, Section 6. If the material is transported by air, then the IATA rules must be followed. Otherwise the DOT regulations must be followed.

If shipping samples by ground, then Table V.1 summarizes the shipping categories and concentration limits for several radionuclides commonly encountered during investigations. The labeling and packaging requirements for these categories are given in 49 CFR 172 parts D and E.

If shipping radioactive samples by air, then the directions below may be followed. A flow chart, figure 1, describes the process of selecting and shipping containers.

1) Decide whether the samples are radioactive. If the activity is less than 2000 ρCi/g, then no special radiological handling is required. If the activity is greater than 2000 ρCi/g, then check 6.0.3 forbidden radioactive materials. If the samples are not forbidden, continue preparing the samples of shipping. If the samples are forbidden call the project Regional Safety Officer (RSO).

2) Determine whether the sample can be shipped as a excepted quantity. Note: In the radiological section, an excepted quantity is equivalent to limited quantity

If only one radionuclide is known to be present, then compare the sample activity to a modified A_2 value. The A_2 value for a specific isotope can be found in Table 6.1.B, in the IATA regulations. The A_2 value is then modified by a factor before comparing the value to the sample activity for classification as an excepted quantity. The factor for soil samples is 10^{-3} and for water sample is 10^{-4}. For example, given a soil sample containing Plutonium - 237 with an activity of 1 Ci, an A_2 value of 500, and a modification factor of 10^{-3}, the sample could not be shipped as an excepted quantity.

$$1\ Ci < (10^{-3})(500\ Ci)$$

$1\ Ci < 0.5$ not true, Sample can't be shipped as exempt

If the sample activity was equal or less than the modified A_2 value, the sample would be shipped and labeled as an excepted quantity, section 6.2.1. Shipment as excepted quantity requires the inside container to be labeled radioactive and the shipping paper to be marked as indicated in section 6.7.3.a.

If more than one radionuclide is known to be present in the sample, then the activity of each nuclide is divided by a modified A_2 value and summed. If the sum is less than one, then the sample can be shipped as an excepted quantity. The formula for determining whether the mixture is an excepted quantity is, where B(i) is the nuclide activity in the sample, F is the

$$\Sigma \frac{B(i)}{F(A_2)\ (i)}$$

modification factor(10^{-4} for water or 10^{-3} for soil), and A_2 is the value obtained from Table 6.1.B. For example, given a soil sample known to contain Barium-133 with an activity of 0.05 Ci and iron-55 with an activity of 0.2 Ci, the calculation to determine whether it is an excepted quantity

$$1 > \frac{0.05}{(10^{-3})(80)} + \frac{0.2}{(10^{-3})(1000)}$$

$$1 > \frac{0.05}{0.08} + \frac{0.2}{1}$$

$$1 > 0.625 + 0.2$$

$1 > 0.825$ true, therefore ship as an excepted quantity. See section 6.2.1.

Note: The activity used to determine whether a sample is shipped as an excepted quantity is based on activity per shipping unit. In other words, if five samples are shipped in a cooler, then the total activity of the five samples is compared to the modified A_2 value.

3) Determine whether the sample be shipped in a Type A package. The same comparison process described for evaluating whether a sample is an excepted quantity is followed except the modification factor is not used. If the material meets the requirements for a Type A package, see section 6.2.3. Marking and labeling as per 6.3 and 6.4.

For example, given a water sample containing only Iron-55 with an activity of 10 Ci. The activity is compared to the A_2 value of 1000 Ci.

$$B(i) < A_2(i)$$

$$10 < 1000$$

Since 10 is less than 1000, the Type A package is acceptable.

If multiple radionuclides are present, then the formula:

$$\Sigma \frac{B(i)}{A_2(i)} < 1$$

is used to determine whether a Type A package is appropriate. The sum must be less than 1 to use a Type A package. For example, if a soil sample contains Mercury -197 with an activity of 10 Ci and A_2 value of 200 Ci and Iodine -123 with an activity of 90 Ci and an A_2 value of 100 Ci, then

$$\Sigma \frac{B(i)}{A_2(i)} < 1$$

$$\frac{10}{200} + \frac{90}{100} < 1$$

$$0.05 + .90 < 1$$

$$0.95 < 1$$

True, Type A package is acceptable.

If shipping samples in a Type A package, inform the project RSO and check whether the laboratory is permitted to receive samples with the screened level of activity. If samples cannot be shipped in Type A package, call the project RSO. Samples with activities to great to ship as Type A, require very special handling and are not discussed in the SOP.

TABLE V.1
RADIOACTIVE SAMPLE SHIPMENT REQUIREMENTS

Radionuclide	49 CFR Reference	Concentration	Total Quantity	DOT Class
Tritium in water				
	49 CFR 173.403(y)	<2 μCi/L	NA	Environmental
	49 CFR 173.423	2 μCi/L to 1 x 10^5 μCi/L	<1,000 Ci/ package	UN2910 (Limited quantity)
	49 CFR 173.403(n)	1 x 10^5 μCi/L to 5 x 10^6 μCi/L	<1,000 Ci/ package	UN2912 (LSA)
Plutonium-238 in soil or other solids				
	49 CFR 173.403(y)	0.002 μCi/g	NA	Environmental
	49 CFR 173.403 49 CFR 173.423	0.002 μCi/g to 0.1 μCi/g	<30 μCi/ package	UN2910 (Limited quantity)
	49 CFR 173.403(n) 49 CFR 173.435	0.002 μCi/g to 0.1 μCi/g	30 μCi to 3,000 μCi/ package	UN2912 (LSA)
Thorium-232 soil or other solids				
	49 CFR 173.403(y)	<0.002 μCi/g	NA	Environmental
	49 CFR 173.403 49 CFR 173.435	0.002 μCi/g to 300 μCi/g	Unlimited	UN2910 (Limited quantity)
Thorium-230 in soil or other solids				
	49 CFR 173.403(y)	<0.002 μCi/g	NA	Environmental
	49 CFR 173.403 49 CFR 173.423	0.002 μCi/g to 0.1 μCi/g	<30 μCi/ package	UN2910 (Limited quantity)
	49 CFR 173.403(n) 49 CFR 173.435	0.002 μCi/g to 0.1 μCi/g	30 μCi to 3,000 μCi/ package	UN2912 (LSA)

[a]The package refers to the shipment cooler (not the sample jars).
DOT - U.S. Department of Transportation
NA - not applicable
LSA - low-specific activity

APPENDIX 5.3
TRANSPORTATION OF UNKNOWN HAZARDOUS MATERIALS BY 49 CFR

A. Transportation of Unknown Hazardous Materials by 49 CFR

1. For samples of hazardous substances of unknown content that will be shipped by surface carrier under 49 CFR Transportation Regulations, the appropriate transportation category is selected through a process of elimination using the Department of Transportation (DOT) Hazardous Materials Classification system. While it is probable that most unknown samples of hazardous material shipped by field personnel will not contain radioactive materials or Poison A materials, it is essential for the following gradient hierarchy to be considered.

2. If radiation survey instruments demonstrate (or reasonable probability exists) that the unknown hazardous sample is radioactive, the appropriate DOT shipping regulations for radioactive material must be followed. Contact the subcontractor's health and safety officer for ER Program technical assistance for specific details.

3. If radioactive material is eliminated, the sample must then be considered to contain Poison A materials. DOT defines Poison A as an extremely dangerous, poisonous gas or a gas or liquid of the nature that a very small amount of gas (or vapor of the liquid) will be dangerous to life. Most Poison A materials are gases and would not be found in glass or drum-like containers. All samples taken from closed containers do not have to be shipped as Poison As. Based upon information available, judgment must be made as to whether a sample from a closed container is a Poison A. For specific instructions on the proper procedures for shipping Poison A, contact the subcontractor's health and safety officer for ER Program technical assistance.

4. If Poison A is eliminated as a shipment category, the next two classifications are flammable or nonflammable gases. Because an open container is not expected to contain a significant amount of gas, flammable liquid would be the next applicable category. After the categories of radioactive material, Poison A flammable gas, and nonflammable gas have been eliminated, the sample can be classified as a flammable liquid and shipped accordingly.

5. These procedures would also suffice for shipping any other samples classified below Poison A in the DOT classification table.

6. These procedures would also suffice for shipping any other samples classified below flammable liquids in the DOT classification table.

B. Shipment of Flammable Liquid by 49 CFR

The following instructions apply to the shipment of a flammable liquid by rail car, truck, or other common carrier.

1. Collect the sample in a glass or polyethylene container with a metallic, Teflon-lined screw cap. The container may be no larger than 16 fluid oz. To prevent leakage, fill the container no more than 90% full. Mark the fluid level on the outside of the sample container. If an air space in the sample container would affect sample integrity (for example, the case of a volatile organics analysis vial), place that container within a second container to meet the 90% requirement. Before any samples are placed in the final shipping container, the exterior should be wiped clean with a detergent solution.

2. Complete the sample identification tag (see SOP 1.3, Sample Control and Documentation) and attach it securely to the sample container. The sample identification tag should contain information needed to trace the sample to its point of origin and sample taker, as well as any quality assurance/quality control information.

3. Seal the container and place it in a 2-mL-thick (or thicker) polyethylene bag with one sample in each bag. Position the identification tag so that it can be read through the bag. Seal the bag.

4. Place the sealed bag inside a metal can and cushion it with enough noncombustible, absorbent material (for example, vermiculite) between the bottom and sides of the can and bag to prevent breakage and absorb leakage. Pack one bag per can. Use clips, tape, or other positive means to secure the lid onto the can.

5. Place one or more metal cans into a strong outside container (like a picnic cooler or a DOT-approved fiberboard box). Surround cans with noncombustible, absorbent cushioning material for stability during transport. Total sample volume in the picnic cooler or fiberboard box should not exceed 10 gallons. A separate air bill and shipping declaration must be processed for each container or combination of containers so that the total sample volume on any air bill will not exceed 10 gallons.

C. Shipment by Land

The following instructions apply for shipment of samples of hazardous material by car or truck (not by common carrier).

1. The above instructions for flammable liquids will apply.
2. Additionally, sample containers must be firmly secured so that they will not bounce against the sides of the vehicle during transit or in an accident.
3. Limit shipments to 1000 lbs or less. Under 1000 lbs, there are no placarding requirements under 49 CFR 172.504 (c) (1).

D. Chain of Custody

Include the Custody Transfer Record/Lab Work Request form (properly executed) in the outside container. It is also recommended to use chain-of-custody tape over each can lid.

E. Marking and Labeling Samples Classified as Flammable Liquid

1. Use abbreviations only where specified.
2. Place the information listed below on each paint can.

   - Laboratory name and address
   - Flammable Liquid, N.O.S. UN 1993. The designation N.O.S. means not otherwise specified. Use an approved DOT label.

3. Information placed on cans should also be placed on at least one side of the outside shipping containers. If labelling is placed on more than one side, it must be attached to all visible sides.

F. Shipping Papers for Samples Classified as Flammable Liquid

Shipping papers must be provided for the shipment of all samples (including those transported by rental, government, company, or personal cars).

G. Bill of Lading/Certification Statement

Complete the bill of lading and sign the certification statement. If the carrier does not provide it, use a standard industry form. Provide the information listed below in the order listed. One form may be used for more than one outside container.

- Flammable Liquid, N.O.S. UN 1993
- Limited Quantity (or Ltd. Qty.)
- Net weight or net volume (weight or volume may be abbreviated) just before or after the UN or ID number.
- Further description (like Laboratory Samples) is allowed if it does not contradict required information.

H. Transportation

1. Transport samples of unknown hazardous material that are classified as flammable liquid by rented or common carrier truck or railroad, as appropriate.

2. Do not transport by any air transport system.

APPENDIX 5.4
TRANSPORTATION OF UNKNOWN HAZARDOUS MATERIAL BY IATA

A. Transportation of Unknown Hazardous Material by International Air Transport Association (IATA)

For samples containing unknown material that will be shipped by air carrier, the most appropriate classification in the IATA regulations is the classification of other regulated substances. In order to use this designation, the categories shown below must be eliminated.

- Radioactive Materials
- Poison A Materials
- Flammable Gases
- Nonflammable Gases

Use of Appendix 5.4 is inappropriate, when the shipper suspects only specific regulated contaminants are present in the samples based on site knowledge or field measurements. If sufficient information is available, to suspect only certain contaminants are present at concentration greater than permitted by excepted quantities, then the samples must be shipped under the appropriate IATA classification, Section 3, as determined by the contaminants. If site contaminants are unknown and both site history and field instruments, preclude classifying the samples within one of the specific IATA classifications, then the samples can be shipped as Class 9 as described below

B. Shipment of Other Regulated Substances

The instructions below will apply for the shipment of other regulated substances by cargo-carrying aircraft, rail car, or other common carrier.

1. Collect the sample in a glass or polyethylene container with a nonmetallic, Teflon-lined screw cap. The container may be no larger than 16 fluid oz. To prevent leakage, fill the container no more than 90% full. If an air space in the sample container would affect sample integrity (for example, the case of a volatile organics analysis vial), place that container within a second container to meet the 90% requirement. Before any samples are placed in the final shipping container, the exterior should be wiped clean with detergent solution.

2. Complete the sample identification tag (see SOP 1.3, Sample Control and Documentation) and attach it securely to the sample container. The sample identification tag should contain information needed to trace the sample to its point of origin and sample taker, as well as any quality assurance/quality control information.

3. Seal the container and place it in a 2-mL-thick (or thicker) polyethylene bag with one sample in each bag. Position the identification tag so that it can be read through the bag. Seal the bag.

4. Place the sealed bag inside a metal can and cushion it with enough noncombustible, absorbent material (for example, vermiculite) between the bottom and sides of the can and bag to prevent breakage and absorb leakage. Pack one bag per can. Use clips, tape, or other positive means to secure the lid onto the can.

5. Place one or more metal cans into a strong outside container (like a picnic cooler or a DOT-approved fiberboard box). Surround cans with noncombustible, absorbent cushioning material for stability during transport. Total sample volume in the picnic cooler or fiberboard box should not exceed 40 liters.

C. Chain of Custody

Include the Custody Transfer Record/Lab Work Request form (properly executed) in the outside container. It is also recommended to use chain-of-custody tape over each can lid.

D. Marking and Labeling Samples Classified as Other Regulated Substances

1. Use abbreviations only where specified.

2. Place the information listed below on each paint can.

   - Laboratory name and address
   - Other regulated substances, UN8027. Hazardous Class # 9

3. Information placed on cans should also be placed on at least one side of the outside shipping containers. If labelling is placed on more than one side, it must be attached to all visible sides.

4. Cargo Aircraft Only must be printed on all outside shipping containers.

5. Print Laboratory Samples and This End Up or This Side Up clearly on top of the outside shipping container. Outside containers also must contain the statement" Inside Packages to Comply with Prescribed Specifications." Put upward pointing arrows on all four sides of the container.

E. Shipping Papers for Samples Classified as Other Regulated Substances

Shipping papers must be provided for the shipment of all samples (including those transported by rental, government, company, or personal cars).

F. Bill of Lading/Certification Statement

Complete the bill of lading and sign the certification statement. If the carrier does not provide it, use a standard industry form. Provide the information listed below in the order listed. One form may be used for more than one outside container.

- Other Regulated substances, UN8027
- Class or Division # 9

- Net weight or net volume (weight or volume may be abbreviated) just before or after the UN or ID number.
- Further description (like Laboratory Samples) is allowed if it does not contradict required information.

G. Transportation

1. Transport samples of unknown hazardous material that are classified as other regulated substances by rented or common carrier truck, railroad, express overnight package services, or other appropriate means.

2. Do not transport by any passenger-carrying air transport system. Ship by air carriers that transport only cargo (for example, Federal Express).

STANDARD OPERATING PROCEDURE 1.6

GENERAL EQUIPMENT DECONTAMINATION

1. PURPOSE

To describe methods for the decontamination of field equipment potentially contaminated during sample collection.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information about the scope and details of a given operation. The FSP or WP also contains specifications for the use of decontamination agents, areas where decontamination will be performed, and quality assurance procedures to verify the effectiveness of the decontamination procedures. Decontamination is performed as a quality assurance measure and a safety precaution. It prevents cross-contamination among samples and helps maintain a clean working environment for the safety of all field personnel.

Decontamination is mainly achieved by rinsing with liquids that include soap or detergent solutions, tap water, deionized water, and methanol. Equipment is allowed to air dry after being cleaned or wiped dry with chemical-free cloths or paper towels. It can then be reused immediately. Steam cleaning should be used whenever visible contamination exists or for large machinery/vehicles.

It is the primary responsibility of the site manager to assure that proper decontamination procedures are followed and that all waste materials produced are properly stored or disposed of. It is the responsibility of all personnel involved with sample collection or decontamination to maintain a clean working environment and ensure that contaminants are not negligently introduced into the environment.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
6.4	Total Alpha Surface Contamination Measurements

6.11 Beta-Gamma Radiation Measurements Using a Geiger-Mueller Detector

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1.

E. Notify the analytical laboratory of the decontamination blank sample and the approximate arrival date.

F. Contact the carrier that will transport the sample to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. There are no forms required to document decontamination procedures and the degree of decontamination attained.

3.2.3. Field

A. Assemble containers and equipment for decontamination.

B. Decontaminate all equipment before use.

3.3. Operation

The extent of known contamination determines the extent to which equipment must be decontaminated. If the extent of contamination cannot be readily determined, clean the equipment on the assumption that it is highly contaminated until enough data are available to allow an accurate assessment of the level of contamination.

Adequate supplies of rinsing liquids and all materials should be available. Perform decontamination in the same level of protective clothing as sampling activities unless a different level of protection is specified in the FSP or Health and Safety Plan.

The procedure for full field decontamination follows. Any deviations from this procedure for a specific project are included in the FSP or WP.

Decontamination Steps

1. The purpose of the initial step is to remove gross contamination. Remove any solid particles from the equipment or material by brushing and then

rinsing with available tap water. For drilling equipment, steam cleaning is necessary.

2. Wash equipment with a nonphosphate soap or detergent solution, such as Alconox®.

3. Rinse with tap water by submerging or spraying.

4. For organic contaminants, rinse with methanol then hexane. Methanol must be of a laboratory-reagent grade and hexane a "pesticide" grade.

5. Rinse thoroughly with distilled water.

6. Air dry equipment or rinse with nanograde methanol to expedite drying.

7. If radiation screening is required by the FSP or WP, screen the equipment with a radiation detector according to SOP 6.4, Total Alpha Surface Contamination Measurements; or SOP 6.12, Radon-222 Flux Measurements Using Charcoal Canisters. If activity above the limits for unrestricted use is detected, repeat steps 1-6.

8. Samples of drippings from the last rinse in step 5 may be collected and analyzed to verify the effectiveness of the decontamination procedure. This type of sample is called a decontamination blank. The results of these analyses are not usually available for at least one week after they arrive in the laboratory, so it is important to do a thorough decontamination from the start of the sampling activity to minimize the potential for a positive hit in the decontamination drippings.

3.4. Postoperation

3.4.1. Field

A. Decontaminate as much sampling equipment as possible and properly dispose of expendable items that cannot be decontaminated. Proper disposal may involve onsite drumming of liquids and solids in approved containers for subsequent disposal. Expensive items like machinery may require a more advanced decontamination analysis.

B. Prepare the decontamination blank sample and transport it according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

C. Store containers of solutions produced during decontamination in a secure area.

D. Dispose of any soiled materials as designated in the FSP or WP.

3.4.2. Documentation

A. Record radiological measurements in the logbook before leaving the site.

B. There are no forms required to document decontamination procedures and the degree of contamination attained.

3.4.3. Office

A. Deliver original logbooks to the site manager for technical review. He/she will review and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that the sample arrives safely and instructions for analyses are clearly understood.

D. After receiving the results of the laboratory analyses, arrange for the disposal of wastes generated during the investigation.

4. SOURCE

NIOSH, OSHA, USCG and EPA. 1985. "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities." prepared by the National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard (USCG), and the U.S. Environmental Protection Agency (EPA). U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, NIOSH report, October 1985. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Decontamination solutions preselected by the laboratory

_____ Cleaning liquids: soap or detergent solutions, tap water, deionized water, and methanol

_____ Chemical-free paper towels

_____ Cleaning brushes

_____ Cleaning containers: plastic buckets and galvanized steel pans

_____ Waste storage containers: drums and plastic bags

STANDARD OPERATING PROCEDURE 1.8

PERSONNEL DECONTAMINATION--LEVEL D PROTECTION

1. PURPOSE

To describe the equipment and procedures required for the decontamination of persons who have performed field activities in Level D protective clothing.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information about the scope and details of a specific operation. Refer to the FSP or WP Health and Safety Plan for recommendations about the level of protection worn to enter a site and the criteria for upgrading to higher levels of protection.

Level D protective clothing is primarily a work uniform. This level of protection is worn when work functions preclude splashes, immersion, inhalation, or exposure to materials above the action limits specified in the FSP or WP.

Although Level D protection is worn under these conditions, workers may be wearing disposable coveralls and gloves, safety boots/shoes, a hard hat, and safety glasses. Therefore, the site Health and Safety Plan must address the proper disposition of disposable clothing and decontamination measures that should be implemented. The disposition of disposable items must follow installation requirements and any applicable state and federal regulations.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information on equipment and supplies; sample collection, preservation, packaging, and shipping; documentation procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
1.9	Personnel Decontamination--Level C Protection

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. The FSP or WP Health and Safety Plan will specify the procedures and equipment required for the decontamination and disposal of Level D protective clothing. All onsite personnel will be informed about the proper disposal of protective clothing and any decontamination solutions used.

C. Appendix 5.1 lists the items suggested for Level D decontamination. This list provides general guidelines and can be modified in order to meet site-specific work activities or features.

D. Obtain necessary clothing, protective gear, and equipment. Read the Health and Safety Plan and ensure that necessary decontamination materials are available.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. There are no forms required to document decontamination procedures and the degree of decontamination attained.

3.2.3. Field

Before initiating field activities, designate an area for decontamination activities. Although Level D areas should be minimally contaminated, always use caution to prevent the potential spread of any unknown contaminants.

3.3. Operation

The following decontamination procedures are recommended for Level D protection. These measures represent suggested guidelines and may be modified to meet site-specific conditions.

A. Remove any disposable coveralls, rubber gloves, and boot covers and place in a plastic trash sack.

B. If dusty conditions have been encountered, use water-dampened paper towels to remove the dust from hard hats and safety glasses/goggles. Place used paper towels in a trash sack.

C. If necessary, decontaminate safety boots with water and a steel brush. Do not wear muddy or dusty boots out of the exclusion zone.

D. All workers should wash hands and face before leaving the site.

E. All workers should change clothing and shower as soon as possible after the day's work activities.

3.4. Postoperation

3.4.1. Field

Collect all trash sacks containing disposable clothing. Dispose of trash sacks according to the requirements of the site Health and Safety Plan. The site manager or field team leader is responsible for the safe disposal of any items.

3.4.2. Documentation

A. Record radiological measurements in the logbook before leaving the site.

B. There are no forms required to document decontamination procedures and the degree of decontamination attained.

3.4.3. Office

Return all unused items to the equipment manager. The equipment manager should be informed of all stock items that need to be ordered to replenish the inventory.

4. SOURCES

NIOSH, OSHA, USCG and EPA. 1985. "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities." Prepared by the National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard (USCG) and the U.S. Environmental Protection Agency (EPA). U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, NIOSH report, October 1985. Washington, D.C.: U.S. Government Printing Office.

EPA. 1984. "Standard Operating Safety Guides." Environmental Response Branch, Hazardous Response Support Division, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, November 1984. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Plastic trash sacks
30-gallon size: (no. of boxes) _____
20-gallon size: (no. of boxes) _____

_____ Plastic wash tub: (number) _____

_____ Paper towels: (no. of rolls)_____

_____ Liquid hand soap

_____ Wet wipe towelettes

_____ Water container
(size) 1 gallon_____ 5 gallon_____

_____ Brushes (scrub or wire)

_____ Alpha scintillation detector

STANDARD OPERATING PROCEDURE 1.9

PERSONNEL DECONTAMINATION--LEVEL C PROTECTION

1. PURPOSE

To describe the equipment and procedures required for the decontamination of persons who have performed field activities in Level C protective clothing.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information regarding the scope and details of a specific operation. Refer to the FSP or WP Health and Safety Plan for recommendations about the level of protection worn to enter a site and the criteria for upgrading or downgrading to other levels of protection.

Protective clothing and equipment must be worn by personnel when known or suspected hazardous substances are involved. The necessary equipment and procedures for decontaminating personnel in Level C protection are addressed in this SOP. The procedures include maximum and minimum decontamination measures.

The establishment of decontamination lines is site specific; these lines depend upon the types of contamination and the work performed. When the decontamination line is no longer required, contaminated wash and rinse solutions and articles must be contained and disposed of appropriately. Disposal must follow installation requirements and any applicable state and federal regulations.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information on equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
1.8	Personnel Decontamination--Level D Protection

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. The selection of the appropriate level of personnel decontamination is site specific and is given in the site Health and Safety Plan. Coordinate any changes with the site health and safety coordinator. Considerations for selection include work activity, known or suspected contaminants, previous experience at the site, and health and safety requirements.

C. The site Health and Safety Plan should include details of the procedures for the ultimate disposal of protective clothing and waste water. The packaging and disposal procedures must be approved by the installation authorities responsible for waste disposal. Inform all onsite personnel about the proper disposal of protective clothing and decontamination solutions.

D. Appendix 5.1 includes recommendations for equipment and supplies used in maximum decontamination measures. Appendix 5.2 includes recommendations for equipment and supplies used in minimum decontamination measures. These appendixes contain general equipment guidelines. The selection of equipment must be site specific to incorporate unusual work activities or site features. Detailed information is in the FSP or WP.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. There are no forms required to document decontamination procedures and the degree of decontamination attained.

3.2.3. Field

A. Before field activities begin, establish site work zones to prevent the accidental spread of hazardous substances. The establishment of work zones is site specific and coordinated with the site health and safety coordinator at the time the Health and Safety Plan is prepared. Considerations for establishing work zones should include wind direction, weather conditions, emergency situations, changes in site activities, and access.

B. Appendix 5.3 shows an example of a maximum decontamination layout for Level C protection. Appendix 5.4 shows an example of the minimum decontamination layout for Level C protection.

NOTE: The layouts may be modified according to site-specific conditions.

3.3. Operation

3.3.1. Maximum Decontamination Measures

The maximum decontamination measures for Level C are described in Appendix 5.5. These measures are guidelines and may be modified according to site-specific conditions.

3.3.2. Modification of Maximum Decontamination Measures

Depending upon site-specific conditions and circumstances, modifications to the maximum decontamination measures may be permissible. Two example situations in which the maximum decontamination measures may be modified are described below.

A. Situation 1--The individual entering the contamination reduction zone is expected to be minimally contaminated. Extremely skin-corrosive materials are not present. Outer gloves and boot covers are worn. The inner gloves and safety boots are not contaminated.

   The following decontamination stations described in Appendix 5.5 would be utilized in this situation: Station Numbers 1, 4 through 8, 10, 11, and 14 through 17.

B. Situation 2--The individual entering the contamination reduction zone is expected to be minimally contaminated. Extremely toxic or skin-corrosive materials are not present. Outer gloves and boot covers are worn. The inner gloves and safety boots are not contaminated. The individual needs a new canister or mask and will return to the exclusion zone.

   The following decontamination stations described in Appendix 5.5 would be utilized in this situation: Station Numbers 1 and 4 through 9.

3.3.3. Minimum Decontamination Measures

The minimum decontamination measures for Level C are described in Appendix 5.6. These measures are guidelines and may be modified according to site-specific conditions.

3.4. Postoperation

3.4.1. Field

After the completion of field activities, all contaminated wash and rinse waters, decontamination solutions, and contaminated articles must be properly disposed of. The disposal methods must follow installation requirements. The site manager or field team leader is responsible for the safe disposal of contaminated materials. Planning for the proper disposal should be included during office preparation before field activities begin.

3.4.2. Documentation

A. Record radiological measurements in the logbook before leaving the site.

B. There are no forms required to document decontamination procedures and the degree of decontamination attained.

3.4.3. Office

Return all unused or properly decontaminated equipment will be returned to the equipment manager. The equipment manager should be informed of all stock items that need to be ordered to replenish the inventory.

4. SOURCES

NIOSH, OSHA, USCG and EPA. 1985. "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities." Prepared by the National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard (USCG), and the U.S. Environmental Protection Agency (EPA). U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, NIOSH report, October 1985. Washington, D.C.: U.S. Government Printing Office.

EPA. 1984. "Standard Operating Safety Guides." Environmental Response Branch, Hazardous Response Support Division, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency document, November 1984. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIXES

5.1. Equipment and Supplies for Maximum Decontamination Measures for Level C

5.2. Equipment and Supplies for Minimum Decontamination Measure for Level C

5.3. Maximum Decontamination Layout for Level C Protection

5.4. Minimum Decontamination Layout for Level C Protection

5.5. Maximum Measures for Level C Decontamination

5.6. Minimum Measures for Level C Decontamination

APPENDIX 5.1

EQUIPMENT AND SUPPLIES FOR MAXIMUM DECONTAMINATION MEASURES FOR LEVEL C

Station 1:
a. Various Size Containers
b. Plastic Liners
c. Plastic Drop Cloths

Station 2:
a. Containers (20-30 Gallons)
b. Decon Solution or Detergent Water
c. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 3:
a. Containers (20-30 Gallons)
or
High-pressure Spray Unit
b. Water
c. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 4:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 5:
a. Containers (20-30 Gallons)
b. Plastic Liners
c. Bench or Stools

Station 6:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 7:
a. Containers (20-30 Gallons)
b. Decon Solution or Detergent Water
c. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 8:
a. Containers (20-30 Gallons)
or
High-pressure spray Unit
b. Water
c. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 9:
a. Air Tanks or Face Masks and Cartridge, Depending on Level
b. Tape
c. Boot Covers
d. Gloves

Station 10:
a. Containers (20-30 Gallons)
b. Plastic Liners
c. Bench or Stools
d. Boot Jack

Station 11:
a. Rack
b. Drop Cloths
c. Bench or Stools

Station 12:
a. Table

Station 13:
a. Basin or Bucket
b. Decon Solution
c. Small Table

Station 14:
a. Water
b. Basin or Bucket
c. Small Table

Station 15:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 16:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 17:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 18:
a. Water
b. Soap
c. Small Table
d. Basin or Bucket
e. Field Showers
f. Towels

Station 19:
a. Dressing Trailer in Inclement Weather
b. Tables
c. Chairs
d. Lockers
e. Cloths

Sources: NIOSH, OSHA, USCG and EPA, October 1985.
U.S. EPA, November 1984.

APPENDIX 5.2

EQUIPMENT AND SUPPLIES FOR MINIMUM DECONTAMINATION MEASURES FOR LEVEL C

Station 1:
- a: Various Size Containers
- b. Plastic Liners
- c. Plastic Drop Cloths

Station 2:
- a. Containers (20-30 Gallons)
- b. Decon Solution
- c. Rinse Water
- d. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 3:
- a. Containers (20-30 Gallons)
- b. Plastic Liners
- c. Bench or Stools

Station 4:
- a. Air Tanks or Masks and Cartridges, Depending Upon
- b. Tape
- c. Boot Covers
- d. Gloves

Station 5:
- a. Containers (20-30 Gallons)
- b. Plastic Liners
- c. Bench or Stools

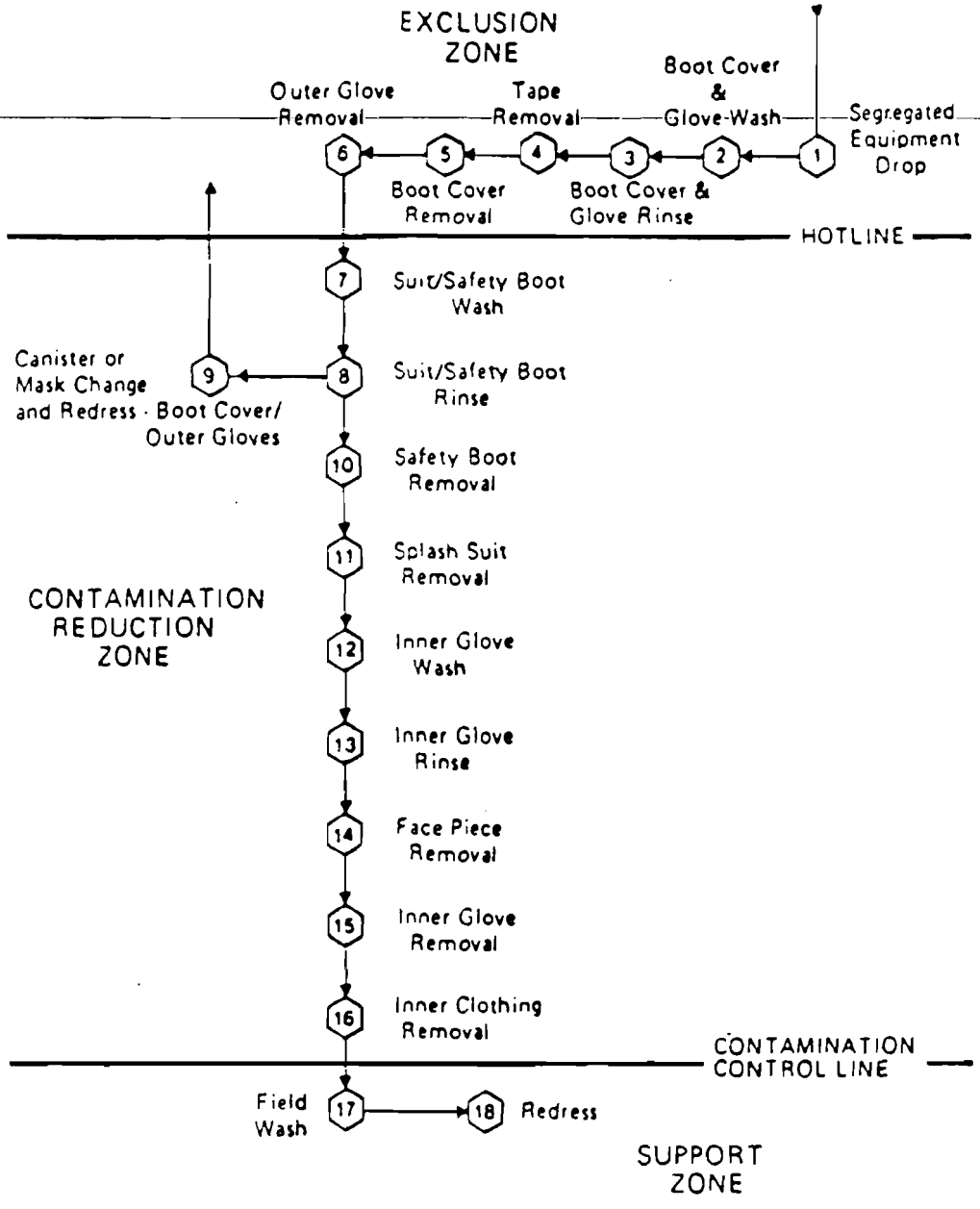
Station 6:
- a. Plastic Sheets
- b. Basin or Bucket
- c. Soap and Towels
- d. Bench or Stools

Station 7:
- a. Water
- b. Soap
- c. Tables
- d. Wash Basin or Bucket

Sources: NIOSH, OSHA, USCG and EPA, October 1985.
U.S. EPA, November 1984.

APPENDIX 5.3

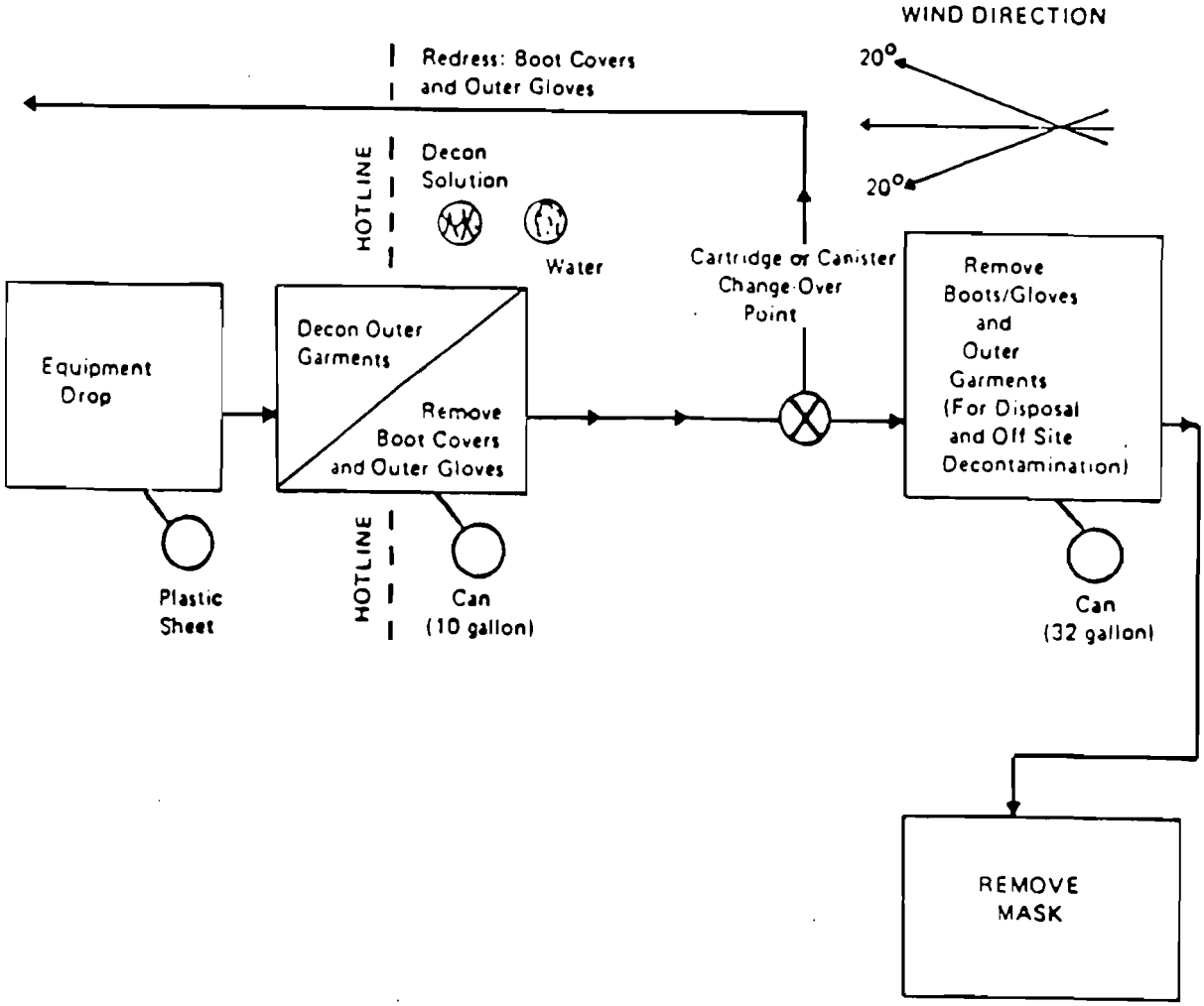
MAXIMUM DECONTAMINATION LAYOUT FOR LEVEL C PROTECTION



SOURCES: NIOSH, OSHA, USCG and EPA, October 1985
U.S. EPA, November 1985

APPENDIX 5.4

MINIMUM DECONTAMINATION LAYOUT FOR LEVEL C PROTECTION



SOURCES: NIOSH, OSHA, USCG and
EPA, October 1985
U.S. EPA, November 1985

APPENDIX 5.5

MAXIMUM MEASURES FOR LEVEL C DECONTAMINATION

Station 1:	Segregated Equipment Drop	1. Deposit equipment used at the site (tools, sampling devices and containers, monitoring instruments, radios, and clipboards) on plastic drop cloths or in different containers with plastic liners. Segregation at the drop reduces the probability of cross-contamination. During hot weather operations, a cool-down station may be set up within this area.
Station 2:	Boot Cover and Glove Wash	2. Scrub outer boot covers and gloves with decon solution or detergent and water.
Station 3:	Boot Cover and Glove Rinse	3. Rinse off decon solution from station 2 using copious amounts of water.
Station 4:	Tape Removal	4. Remove tape around boots and gloves and deposit in container with plastic liner.
Station 5:	Boot Cover Removal	5. Remove boot covers and deposit in containers with plastic liner.
Station 6:	Outer Glove Removal	6. Remove outer gloves and deposit in container with plastic liner.
Station 7:	Suit and Boot Wash	7. Wash splash suit, gloves, and safety boots. Scrub with long-handled scrub brush and decon solution.
Station 8:	Suit and Boot and Glove Rinse	8. Rinse off decon solution using water. Repeat as many times as necessary.
Station 9:	Canister or Mask Change	9. If worker leaves exclusion zone to change canister (or mask), this is the last step in the decontamination procedure. The worker's canister is exchanged. New outer gloves and boot covers are put on, and joints are taped. The worker returns to duty.

APPENDIX 5.5, Continued

MAXIMUM MEASURES FOR LEVEL C DECONTAMINATION

Station 10:	Safety Boot Removal	10. Remove safety boots and deposit in container with plastic liner.
Station 11:	Splash Suit Removal	11. With assistance of helper, remove splash suit. Deposit in container with plastic liner.
Station 12:	Inner Glove Rinse	12. Wash inner gloves with decon solution.
Station 13:	Inner Glove Wash	13. Rinse inner gloves with water.
Station 14:	Face Piece Removal	14. Remove face piece. Deposit in container with plastic liner. Avoid touching face with fingers.
Station 15:	Inner Glove Removal	15. Remove inner gloves and deposit in lined container.
Station 16:	Inner Clothing Removal	16. Remove clothing soaked with perspiration and place in lined container. Do not wear inner clothing away from the site, because there is a possibility that small amounts of contaminants might have been transferred in removing the outer clothing. When applicable, begin a gross alpha contamination survey.
Station 17:	Field Wash	17. Shower if highly toxic, skin-corrosive, or skin-absorbable materials are known or suspected to be present. Wash hands and face if shower is not available.
Station 18:	Redress	18. Put on clean clothes.

Sources: NIOSH, OSHA, USCG and EPA, October 1985.
U.S. EPA, November 1984.

APPENDIX 5.6

MINIMUM MEASURES FOR LEVEL C DECONTAMINATION

Station 1:	Equipment Drop	1. Deposit equipment used at the site (tools, sampling devices and containers, monitoring instruments, radios, and clipboards) on plastic drop cloths. Segregation at the drop reduces the probability of cross-contamination. During hot weather operations, a cool-down station may be set up within this area.
Station 2:	Outer Garment, Boots, and Gloves Wash and Rinse	2. Scrub outer boots, outer gloves, and splash suit with decon solution or detergent water. Rinse off using water.
Station 3:	Outer Boot and Glove Removal	3. Remove outer boots and gloves. Deposit in container with plastic liner.
Station 4:	Canister or Mask Change	4. If worker leaves exclusive zone to change canister (or mask), this is the last step in the decontamination procedure. The worker's canister is exchanged. New outer gloves and boot covers are put on, and joints are taped. The worker returns to duty.
Station 5:	Boots, Gloves, and Outer Garment Removal	5. Boots, chemical-resistant splash suit, and inner gloves are removed and deposited in separate containers lined with plastic.
Station 6:	Face Piece Removal	6. Face piece is removed. Avoid touching face with fingers. Face piece deposited on plastic sheet.
Station 7:	Field Wash	7. Hands and face are thoroughly washed. Shower as soon as possible.

Sources: NIOSH, OSHA, USCG and EPA, October 1985.
U.S. EPA, November 1984.

STANDARD OPERATING PROCEDURE 1.10

PERSONNEL DECONTAMINATION--LEVEL B PROTECTION

1. PURPOSE

To describe the equipment and procedures required for decontamination of persons who have performed field activities in Level B protective clothing.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information about the scope and details of a specific operation. Refer to the FSP or WP Health and Safety Plan for recommendations about the level of protection worn to enter a site and the criteria for upgrading or downgrading to other levels of protection.

Protective clothing and equipment must be worn by personnel when known or suspected hazardous substances are involved. The necessary equipment and procedures for decontaminating personnel in Level B protection are addressed in this SOP. The procedures include maximum and minimum decontamination measures.

The establishment of decontamination lines is site specific. These lines depend upon the types of contamination and the work performed. When the decontamination line is no longer required, contaminated wash and rinse solutions and articles must be contained and disposed of appropriately. Disposal must follow installation requirements and any applicable state and federal regulations.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information on equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Other procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
1.8	Personnel Decontamination--Level D Protection
1.9	Personnel Decontamination--Level C Protection

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. The selection of the appropriate level of personnel decontamination is site specific and determined by the site health and safety coordinator. Consult the site Health and Safety Plan for the level of protection. Considerations for selection include work activity, known or suspected contaminants, previous experience at the site, and the installation of health and safety requirements specified by the facility's management company.

C. The site Health and Safety Plan should include details of the plans for ultimate disposal of protective clothing, waste water, and potentially contaminated articles. The packaging and disposal procedures must be approved by the installation authorities responsible for waste disposal. Inform all onsite personnel about the proper disposal of protective clothing and decontamination solutions.

D. Appendix 5.1 includes recommendations for equipment and supplies used in maximum decontamination measures. Appendix 5.2 includes recommendations for equipment and supplies used in minimum decontamination measures. These appendixes contain general equipment guidelines. The selection of equipment must be site specific to incorporate unusual work activities or site features. Detailed information is in the FSP or WP.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. There are no forms required to document decontamination procedures and the degree of documentation attained.

3.2.3. Field

A. Before field activities begin, establish site work zones to reduce the accidental spread of hazardous substances. The establishment of work zones is site specific and coordinated with the site health and safety coordinator at the time the site Health and Safety Plan is prepared. Considerations for establishing work zones should include wind direction, weather conditions, emergency situations, changes in site activities, and access.

B. Appendix 5.3 shows an example of a maximum decontamination layout for Level B protection. Appendix 5.4 shows an example of the minimal decontamination layout for Level B protection.

NOTE: These layouts may be modified according to site-specific conditions.

3.3. Operation

3.3.1. Maximum Decontamination Measures

The maximum decontamination measures for Level B are described in Appendix 5.5. These measures are guidelines and may be modified according to site-specific conditions.

3.3.2. Modification of Maximum Decontamination Measures

Depending upon site-specific conditions and circumstances, modifications to the maximum decontamination measures may be permissible. Two example situations in which the maximum decontamination measures may be modified are described below.

A. Situation 1--The individual entering the contamination reduction zone is expected to be minimally contaminated. Extremely toxic or skin-corrosive materials are not present. Outer gloves and boot covers are worn. The inner gloves and boots are not contaminated.

   The following decontamination stations described in Appendix 5.5 would be utilized in this situation: Station Numbers 1, 4-8, 10-12, and 15-19.

B. Situation 2--The individual entering the contamination reduction zone is expected to be minimally contaminated. Extremely toxic or skin-corrosive materials are not present. Outer gloves and boot covers are worn. The inner gloves and boots are not contaminated. The individual needs a new air tank and will return to the exclusion zone.

   The following decontamination stations described in Appendix 5.5 would be utilized in this situation: Station Numbers 1, and 4-9.

3.3.3. Minimum Decontamination Measures

The minimum decontamination measures for Level B are described in Appendix 5.6. These measures are only guidelines and may be modified according to site-specific conditions.

3.4. Postoperation

3.4.1. Field

At the completion of field activities, all contaminated wash and rinse water, decontamination solutions, and contaminated articles must be properly disposed of. The disposal must follow installation requirements and any applicable state and federal regulations. The site manager or field team leader is responsible for the safe disposal of contaminated materials. Planning for proper disposal should be included during office preparations before field activities begin.

3.4.2. Documentation

A. Record radiological measurements in the logbook before leaving the site.

B. There are no forms required to document decontamination procedures and the degree of decontamination attained.

3.4.3. Office

All unused or properly decontaminated equipment will be returned to the equipment manager. The equipment manager should be informed of all stock items that need to be ordered to replenish the inventory.

4. SOURCES

NIOSH, OSHA, USCG and EPA. 1985. "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities." Prepared by the National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard (USCG), and the U.S. Environmental Protection Agency (EPA). U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, NIOSH report, October 1985. Washington, D.C.: U.S. Government Printing Office.

EPA. 1984. "Standard Operating Safety Guides", Environmental Response Branch, Hazardous Response Support Division, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency document, November 1984. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIXES

5.1. Equipment and Supplies for Maximum Decontamination Measures for Level B

5.2. Equipment and Supplies for Minimum Decontamination Measures for Level B

5.3. Maximum Decontamination Layout for Level B Protection

5.4. Minimum Decontamination Layout for Level B Protection

5.5. Maximum Measures for Level B Decontamination

5.6. Minimum Measures for Level B Decontamination

APPENDIX 5.1

EQUIPMENT AND SUPPLIES FOR MAXIMUM DECONTAMINATION MEASURES FOR LEVEL B

Station 1:
a. Various Size Containers
b. Plastic Liners
c. Plastic Drop Cloths

Station 2:
a. Containers (20-30 Gallons)
b. Decon Solution or Detergent Water
c. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 3:
a. Containers (20-30 Gallons)
or
High-pressure Spray Unit
b. Water
c. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 4:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 5:
a. Containers (20-30 Gallons)
b. Plastic Liners
c. Bench or Stools

Station 6:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 7:
a. Containers (20-30 Gallons)
b. Decon Solution or Detergent Water
c. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 8:
a. Containers (20-30 Gallons)
or
High-pressure Spray Unit
b. Water
c. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 9:
a. Air Tanks
b. Tape
c. Boot Covers
d. Gloves

Station 10:
a. Containers (20-30 Gallons)
b. Plastic Liners
c. Bench or Stools
d. Boot Jack

Station 11:
a. Rack
b. Drop Cloths
c. Bench or Stools

Station 12:
a. Table

Station 13:
a. Basin or Bucket
b. Decon Solution
c. Small Table

Station 14:
a. Water
b. Basin or Bucket
c. Small Table

Station 15:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 16:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 17:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 18:
a. Water
b. Soap
c. Small Table
d. Basin or Bucket
e. Field Showers
f. Towels

Station 19:
a. Dressing Trailer Needed in Inclement Weather
b. Tables
c. Chairs
d. Lockers
e. Cloths

Sources: NIOSH, OSHA, USCG and EPA, October 1985.
U.S. EPA, November 1984.

APPENDIX 5.2

EQUIPMENT AND SUPPLIES FOR MINIMUM DECONTAMINATION MEASURES FOR LEVEL B

Station 1:
a. Various Size Containers
b. Plastic Liners
c. Plastic Drop Cloths

Station 2:
a. Containers (20-30 Gallons)
b. Decon Solution
c. Rinse Water
d. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 3:
a. Containers (20-30 Gallons)
b. Plastic Lines
c. Bench or Stools

Station 4:
a. Air Tanks or Masks and Cartridges, Depending Upon the Concentration and Types of Airborne Contamination
b. Tape
c. Boot Covers
d. Gloves

Station 5:
a. Containers
b. Plastic Liners
c. Bench or Stools

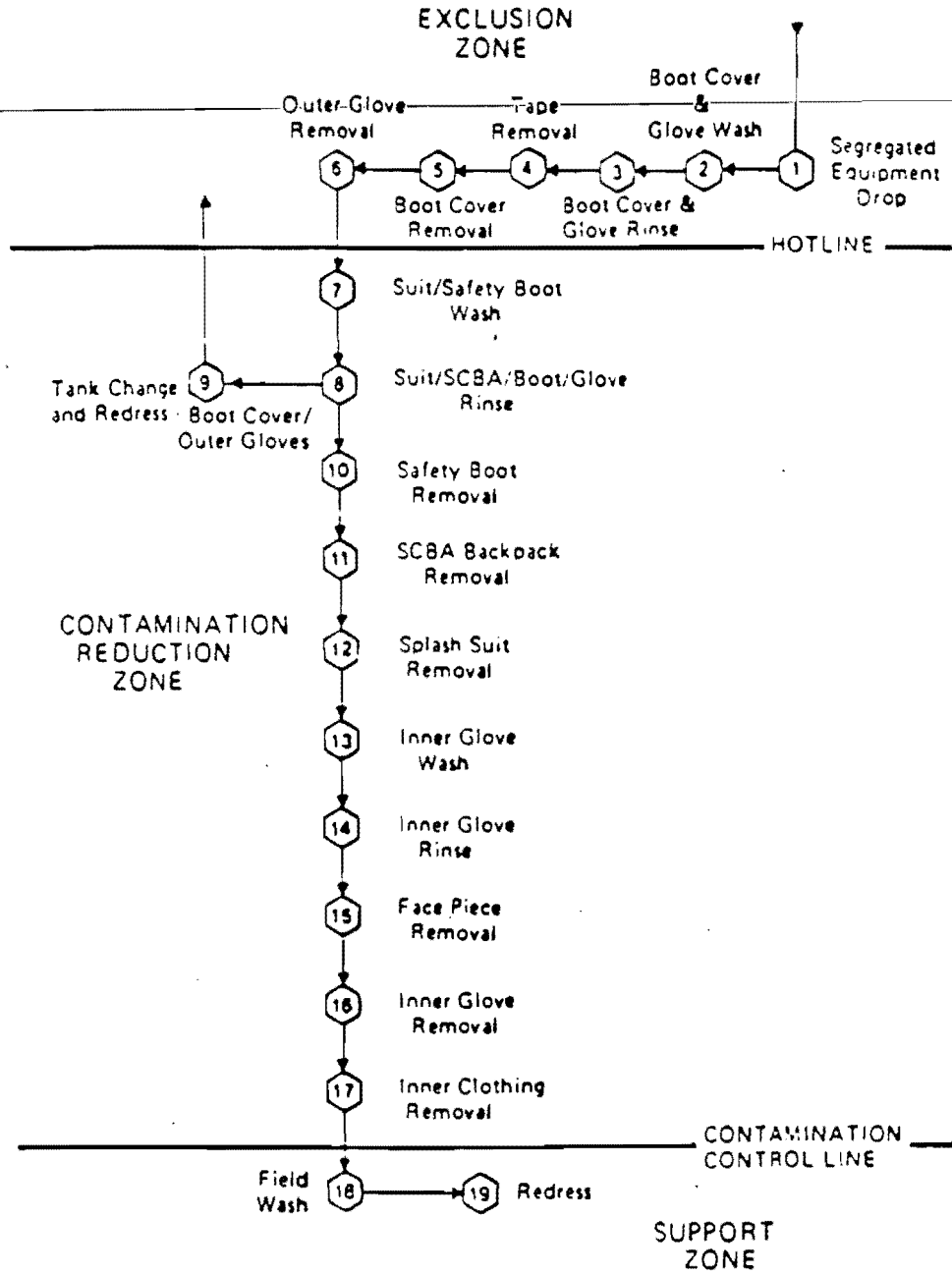
Station 6:
a. Plastic Sheets
b. Basin or Bucket
c. Soap and Towels
d. Bench or Stools

Station 7:
a. Water
b. Soap
c. Tables
d. Wash Basin or Bucket

Sources: NIOSH, OSHA, USCG and EPA, October 1985.
U.S. EPA, November 1984.

APPENDIX 5.3

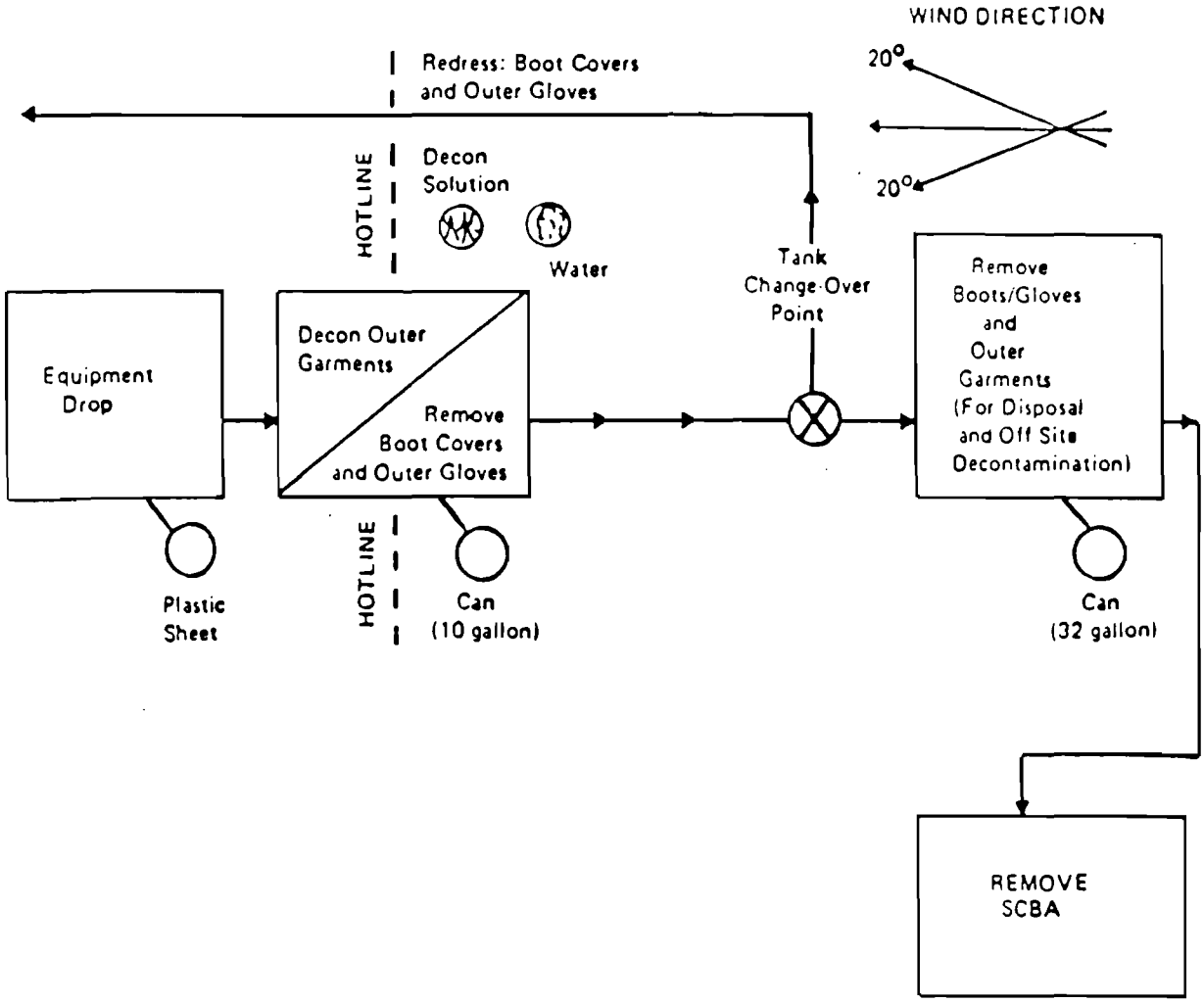
MAXIMUM DECONTAMINATION LAYOUT FOR LEVEL B PROTECTION



SOURCES: NIOSH, OSHA, USCG, and EPA, October 1985
U.S. EPA, November 1984

APPENDIX 5.4

MINIMUM DECONTAMINATION LAYOUT FOR LEVEL B PROTECTION



SOURCES: NIOSH,OSHA,USCG, and
EPA, October 1985
U.S. EPA, November 1984

APPENDIX 5.5

MAXIMUM MEASURES FOR LEVEL B DECONTAMINATION

Station 1:	Segregated Equipment Drop	1.	Deposit equipment used at the site (tools, sampling devices and containers, monitoring instruments, radios, and clipboards) on plastic drop cloths or in different containers with plastic liners. Segregation at the drop reduces the probability of cross-contamination. During hot weather operations, a cool-down station may be set up within this area.
Station 2:	Boot Cover and Glove Wash	2.	Scrub outer boot covers and gloves with decon solution or detergent and water.
Station 3:	Boot Cover and Glove Rinse	3.	Rinse off decon solution from station 2 using copious amounts of water.
Station 4:	Tape Removal	4.	Remove tape around boots and gloves and deposit in container with plastic liner.
Station 5:	Boot Cover Removal	5.	Remove boot covers and deposit in container with plastic liner.
Station 6:	Outer Glove Removal	6.	Remove outer gloves and deposit in container with plastic liner.
Station 7:	Suit and Safety Boot Wash	7.	Wash chemical-resistant splash suit, SCBA, gloves, and safety boots. Scrub with long-handled scrub brush and decon solution. Wrap SCBA regulator (if belt-mounted type) with plastic to keep out water. Wash backpack assembly with sponges or cloths.

APPENDIX 5.5, Continued

MAXIMUM MEASURES FOR LEVEL B DECONTAMINATION

Station 8:	Suit, SCBA, Boot, and Glove Rinse	8.	Rinse off decon solution using copious amounts of water.
Station 9:	Tank Change	9.	If worker leaves exclusion zone to change air tank, this is the last step in the decontamination procedure. The worker's air tank is exchanged. New outer gloves and boot covers are put on, and joints are taped. The worker returns to duty.
Station 10:	Safety Boot Removal	10.	Remove safety boots and deposit in container with plastic liner.
Station 11:	SCBA Backpack Removal	11.	While still wearing face piece, remove back-pack and place on table. Disconnect hose from regulator valve.
Station 12:	Splash Suit Removal	12.	With the assistance of a helper, remove splash suit. Deposit in container with plastic liner.
Station 13:	Inner Glove Wash	13.	Wash inner gloves with decon solution.
Station 14:	Inner Glove Rinse	14.	Rinse inner gloves with water.
Station 15:	Face Piece Removal	15.	Remove face piece. Deposit in container with plastic liner. Avoid touching face with fingers.
Station 16:	Inner Glove Removal	16.	Remove inner gloves and deposit in lined container.

APPENDIX 5.5, Concluded

MAXIMUM MEASURES FOR LEVEL B DECONTAMINATION

Station 17:	Inner Clothing Removal	17. Remove inner clothing. Place in container with liner. Do not wear inner clothing away from the site, because there is a possibility that small amounts of contaminants might have been transferred in removing the outer clothing. Begin a gross alpha radiation survey, when applicable.
Station 18:	Field Wash	18. Shower if highly toxic, skin-corrosive, or skin-absorbable materials are known or suspected to be present. Wash hands and face if shower is not available.
Station 19:	Redress	19. Put on clean clothes.

Sources: NIOSH, OSHA, USCG and EPA, October 1985.
U.S. EPA, November 1984.

APPENDIX 5.6

MINIMUM MEASURES FOR LEVEL B DECONTAMINATION

Station 1:	Equipment Drop	1.	Deposit equipment used at the site (tools,sampling devices and containers, monitoring instruments, radios, and clipboards) on plastic drop cloths. Segregation at the drop reduces the probability of cross-contamination. During hot weather operations, a cool-down station may be set up within this area.
Station 2:	Outer Garment, Boots, and Gloves Wash and Rinse	2.	Scrub outer boots, outer gloves, and chemical-resistant splash suit with decon solution or detergent water. Rinse off with water.
Station 3:	Outer Boot and Glove Removal	3.	Remove outer boots and gloves. Deposit in container with plastic liner.
Station 4:	Tank Change	4.	If worker leaves exclusive zone to change air tank, this is the last step in the decontamination procedure. The worker's air tank is exchanged. New outer gloves and boot covers are put on, and joints are taped. The worker returns to duty.
Station 5:	Boots, Gloves and Outer Garment Removal	5.	Boots, chemical-resistant splash suit, and inner gloves removed and deposited in separate containers lined with plastic.
Station 6:	SCBA Removal	6.	SCBA backpack and face piece are removed. Avoid touching face with fingers. SCBA is deposited on plastic sheets.
Station 7:	Field Wash	7.	Hands and face are thoroughly washed. Shower as soon as possible.

Sources: NIOSH, OSHA, USCG and EPA, October 1985.
U.S. EPA, November 1984.

STANDARD OPERATING PROCEDURE 1.15

GUIDE TO MANAGEMENT OF INVESTIGATION-DERIVED MATERIAL

1. PURPOSE

The purpose of this standard operating procedure (SOP) is to provide general guidance and specific procedures for the management of investigation-derived material (IDM) at the U.S. Department of Energy's (DOE) Mound Plant in Ohio. This SOP describes the procedures used by the Environmental Restoration (ER) Program technical assistance contractors for the sampling of IDM, and provides guidance on the sampling and disposition of IDM. A discussion on material segregation and drum reuse is also included. Other procedures or requirements used by installation subcontractors must conform to this SOP. The disposal of hazardous, radioactive, or mixed IDM is covered under separate policies and procedures.

2. DISCUSSION

In general, IDM is material derived from environmental site investigation activities such as soil boring procedures, well construction and installation, aquifer testing, water quality sampling of wells, and decontamination of sampling and drilling equipment (rinsate). These materials are potentially subject to various regulations governing storage and disposal. Mound Plant is a CERCLA Site, therefore, applicable or relevant and appropriate requirements (ARARs) must be followed. Also, the response is required to comply with the substantive requirements for permits, but is not required to obtain permits. Figure 1 is a decision tree illustrating the management of IDM.

2.1. Sampling and Staging

The IDM is sampled for analytical testing and placed in labeled drums. Drums containing solid IDM, such as soil, are staged at the original sampling site, if possible, or moved to the Central Staging Area. All drums containing liquid IDM, such as purge water, are moved to the Central Staging Area. The containerized IDM is held until results of the analytical testing are used to classify the IDM and determine what actions are to be followed.

2.2. Classification Criteria

IDM can be classified as hazardous, radioactive, mixed, solid, or clean, depending on its characteristics. Each class is managed differently. Solid IDM that is not classified as hazardous, radioactive, or mixed by the CERCLA, RCRA, and DOE criteria described below is handled as solid waste in accordance with State of Ohio Environmental Protection Agency (OEPA) regulations.

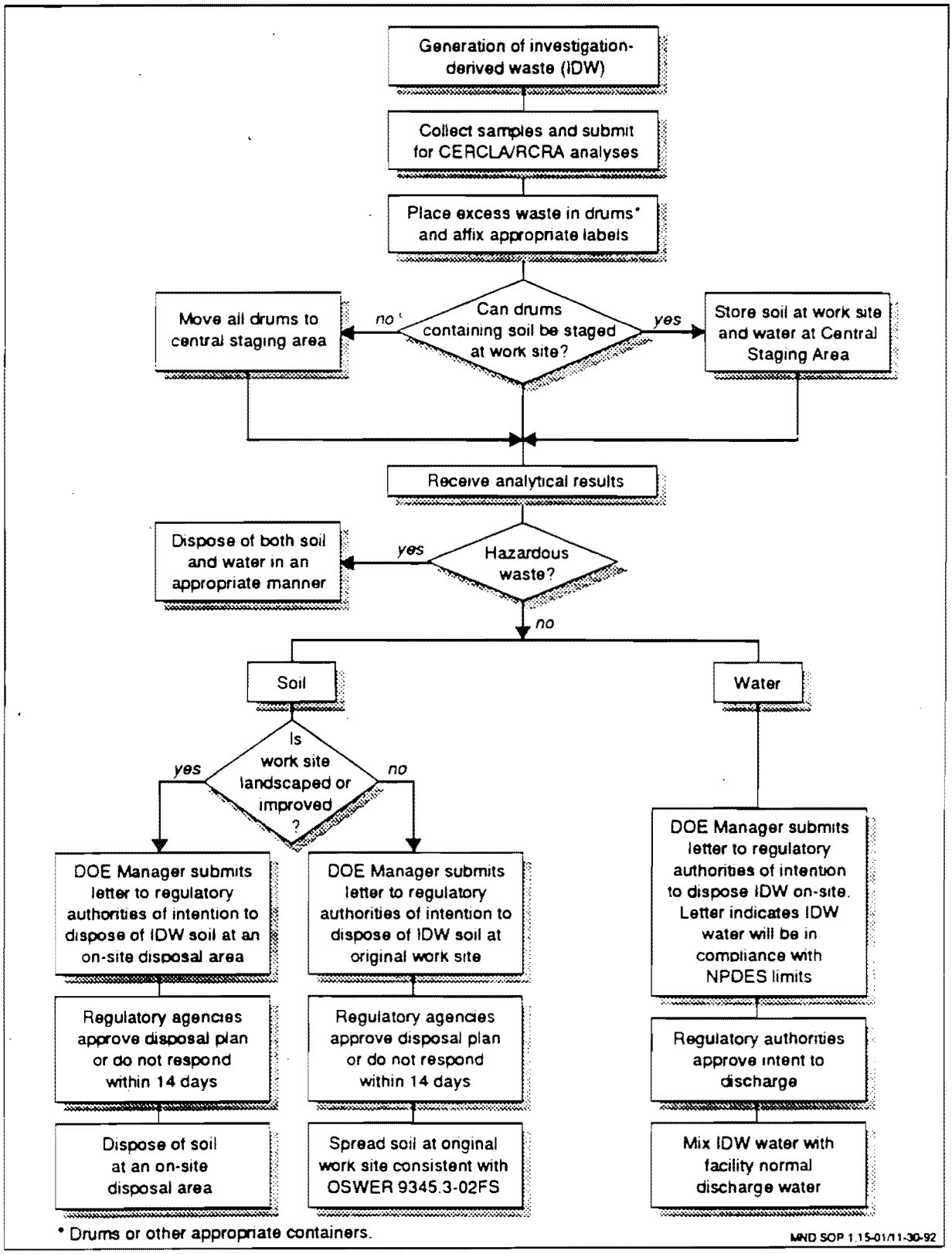
Hazardous IDM is material exhibiting the characteristics of ignitability, corrosivity, reactivity, or toxicity as specified in 40 CFR 261, Subpart C, or mixtures of IDM and hazardous wastes specifically listed in 40 CFR 261, Subpart D.

Radioactive IDM is material containing concentrations of plutonium-238 and thorium-232 greater than 25 picoCuries per gram (pCi/g) and 5 pCi/g, respectively.

Mixed IDM is material that meets the definition of both hazardous and radioactive IDM.

Solid IDM is material that cannot be classified as hazardous, radioactive, or mixed, yet exhibits concentrations of identified potential chemical contaminants above background levels.

Clean IDM is material which contains identified potential chemical contaminants at concentrations less than background levels.



Management of investigation-derived waste.

2.3. Actions

Liquid IDM (purge water) that is nonhazardous will be added to Mound Plant normal discharge water and discharged through NPDES Outfall 001.

IDM classified as clean may be moved to Mound Plant's IDM Area, yet to be approved and constructed. IDM classified as solid waste will be disposed of at an OEPA approved landfill (off site).

IDM classified as hazardous, radioactive, or mixed will be disposed of or treated as dictated by federal and state regulations. There are currently (February 1993) only limited alternatives for mixed waste, so it would be held until alternatives could be evaluated as directed by CERCLA.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, SOPs 1.1 through 1.10 must be reviewed. These SOPs contain information on the performance of field activities. They should be consulted for specific information on equipment and supplies, decontamination procedures, and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.5	Guide to the Handling, Packaging and Shipping of Samples
1.6	General Equipment Decontamination

3.2. Preparation

3.2.1. Office

A. Review the Work Plan or Sampling and Analysis Plan, and SOPs listed in subsection 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Determine that a sufficient number of drums and labeling materials are available for the IDM.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Obtain a sufficient number of the appropriate ER Program data collection forms. Consult Mound Plant OU-9 Quality Assurance Project Plan (QAPP) Table of Contents (DOE-1992).

C. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms and drum labels.

3.3. Operation

The following step-by-step procedure will ensure that all agreed-to practices are followed in the management of the IDM.

3.3.1. Drum Labeling

Drums will be marked with waterproof labels with the following information:

- date material was placed in the drum;
- source location ID (release site/well number (for decon water));
- medium (soil, water, or personal protective equipment);
- statement to the effect: "Investigation-derived material from CERCLA RI/FS; for more information contact subcontractor manager (name, phone number), EG&G Operable Unit Manager (name, phone number), or Monte Williams (x 4543)";
- FIDLER screening value;
- head space analysis value, if applicable; and
- sample numbers

3.3.2. Soil

A. Samples of soil cuttings will be collected at the work site, analyzed for radioactivity, and transmitted to the laboratory for CERCLA- and RCRA-type analyses.

B. Remaining soil that is not sampled will be placed in labeled, open-top (removable lid), metal drums and held at either the original sampling site, if possible, or moved to the Central Staging Area, currently the Waste Oil Drumfield.

C. Drum groups within the staging area will be placed on wooden pallets and covered with tarps to prevent weathering of the drums and protect label integrity.

D. A sign posted within the staging area will identify the drums as "Investigation-Derived Material" and will include the same information described in Section 3.3.1.

E. After receiving analytical results from the laboratory, the IDM will be classified as solid, hazardous, radioactive, or mixed in accordance with OEPA regulations and RCRA, CERCLA, and DOE criteria.

F. If the soil is determined to be solid, hazardous, or radioactive, it will be disposed of or treated at an appropriate disposal or treatment facility. Mixed waste will be held for further evaluation of alternatives.

G. Solid waste, other than soils, generated by the technical assistance contractor and subcontractor(s) (e.g., wipes, protective clothing that is not LSA, visqueen, garbage) will be segregated and placed in a dumpster for off-site disposal.

H. Bulk (large pieces) of asphalt or demolition material generated by breaking through pavement will be segregated and disposed of separately in an approved on-site area.

3.3.3. Water

A. Samples of water produced at the work site will be collected, analyzed for radioactivity, and transmitted to the laboratory for CERCLA analyses.

B. The remaining water that is not sampled will be placed in labeled, closed-top (non-removable lid), polyethylene drums and held at the Central Staging Area, currently the Waste Oil Drumfield.

C. Drum groups will be placed on wooden pallets and covered with tarps to prevent weathering of the drums and protect label integrity.

D. A sign posted within each staging area will identify the drums as "Investigation-Derived Material" and will include the same information described in Section 3.3.1.

E. After receiving analytical results from the laboratory, the IDM will be classified as nonhazardous, hazardous, radioactive, or mixed in accordance with OEPA regulations and RCRA, CERCLA, and DOE criteria.

F. If the water is nonhazardous, the remedial project manager at DAO will submit a letter to the OEPA water quality branch indicating that the IDM water will be added to normal Mound Plant discharge and will be in compliance with NPDES limits. Analytical results will be included in the submission. A copy of this letter will be submitted to U.S. EPA by DAO. Upon approval from OEPA, the water will then be discharged through Mound Plant NPDES Outfall 001 and directed off site to the Great Miami River. DAO will simultaneously notify U.S. EPA of the intent to discharge.

G. If the water is determined to be hazardous or radioactive, it will be disposed of or treated at an appropriate disposal or treatment facility. Mixed waste will be held for further evaluation of alternatives.

H. Liquid waste generated by the technical assistance contractor and subcontractor(s) (e.g., motor oil, additives, detergent solutions) will be segregated and disposed of or recycled separately at an appropriate facility.

3.3.4. Central Staging Area

A. The Central Staging Area is currently the Waste Oil Drumfield. It will be used for:

- purge water from wells;
- soil that cannot be stored at the work site because it hinders Mound Plant operations; and
- soil from areas off the site (e.g., the Miami-Erie Canal).

B. The Waste Oil Drumfield will be used immediately with the knowledge that it is a potential release site and remedial activities are in progress. Surface and subsurface samples obtained from the Waste Oil Drumfield will be analyzed for radioactivity and submitted to the laboratory for CERCLA analyses.

C. After results of surface and subsurface sampling and analysis are available, assuming that no remediation is required, the Waste Oil Drumfield will become a semi-permanent staging area for CERCLA wastes. It will be fenced and locked, with ER Program (EG&G and its contractors) to retain control of the area. It is presumed that at the conclusion of the ER Program, the area may need to be sampled again to verify that it was not contaminated by spills.

3.3.5. Waste Segregation

A. Waste Segregation will occur at a Central Staging Area. Drums presumed to contain radioactive soil (e.g., from Miami-Erie Canal) will be labeled as such and will be kept in a separate zone away from those presumed to contain hazardous waste. This is to prevent the accidental creation of mixed waste.

B. When information is available indicating the nature of the contents, containers may be stored separately from other noncompatible materials which may interact with the waste in a hazardous manner.

3.3.6. Drum Database

A database will be created and maintained to track the drums and their contents for the duration of time that they contain IDM. The database will contain information described in Section 3.3.1 and include a timeline documenting waste management procedures.

3.3.7. Drum Reuse

A. Empty drums used to move solid, nonhazardous IDM to an off-site landfill will be rinsed of visible solid residue. Rinsate from these drums will be handled in the same manner as the purge water as described in section 3.3.3. Empty drums used for nonhazardous liquid IDM that has been disposed of into NPDES Outfall 001 are not expected to contain solid residue and will not be rinsed. When these procedures are completed, empty drums may then be reused for subsequent IDM generated by the ER Program (it is assumed that drums will be reused only within the ER Program).

B. Drums that previously held low-specific activity (LSA) waste and have been emptied into LSA containers will be marked and retained only for radioactive soil that is unlikely to be hazardous.

C. It is assumed that drums containing IDM that is determined to be hazardous will be used to transport the waste off site.

3.4. Post Operation

3.4.1. Documentation

Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

3.4.2. Office

Deliver original forms and logbooks to the site manager for technical review. The site manager will review and sign the forms, and transmit them to the document control officer (copies to the files) for eventual delivery to the DOE.

4. REFERENCES

DOE. 1992. "Remedial Investigation/Feasibility Study, Operable Unit 9, Site-Wide Quality Assurance Project Plan, Draft Final, Mound Plant Environmental Restoration Program, U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, New Mexico, December 1992.

EPA. 1991. "Guide to Management of Investigation-Derived Wastes." U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Publication: 9345.3-02FS, May 1991.

STANDARD OPERATING PROCEDURE 2.1

PRESAMPLE PURGING OF WELLS

1. PURPOSE

To identify well-purging procedures for evacuation of stagnant water from the well bore and its replacement by groundwater in sufficient quantities so that a water sample representative of the formation of completion can be collected.

2. DISCUSSION

The choice of procedure and equipment for well evacuation depends on the Field Sampling Plan (FSP) or Work Plan (WP), the yield of the well, water depth, well size, and the type of water analysis. This procedure describes various methods for well evacuation. Collection and measurement of samples and the documentation of data should be performed as described in the associated procedures.

Peristaltic Pump

Using a peristaltic pump for well evacuation is particularly advantageous because the same system may be used for sample collection. In addition, the flow rate is easily controlled with a peristaltic pump. The pump can be used in wells of any diameter and nonplumb wells, and the pump is highly portable and readily available. However, peristaltic pumps can only be used in wells with a potentiometric level less than 25 ft below the land surface. Additionally, low pumping rates make it difficult to evacuate the wellbore in a reasonable amount of time. An electric power source is required, and there is a high likelihood of stripping the volatiles.

Bladder Pump

The bladder pump (Middelburg type or diaphragm) is a particularly good choice when the well depth is beyond the capability of the peristaltic pump. In addition, the relatively high pumping rate allows rapid well evacuation. Bladder pumps are portable, though the accessory equipment may be cumbersome. With deep purging, large volumes of gas and longer cycles are required. Operating time and expense are increased as a result.

Bailer

For shallow, small-diameter wells with low yields, evacuation of the well by bailer is recommended. Bailers are mechanically simple, lightweight and highly portable, constructed in many sizes, and require no external power source. Bailers are easily operated and cleaned and inexpensive. The primary disadvantage of bailers is their limited-volume purging capability, especially in deep wells where purging is labor and time consuming. Another disadvantage is that sampling personnel are directly exposed to contaminants.

Electric Submersible Pump

The submersible pump is commonly used for purging deep, large-diameter wells requiring high pumping rates. The pump is portable and self-contained except when auxiliary power sources are employed. The primary disadvantage is that the pump can be difficult to decontaminate and transport. Other disadvantages are damage caused by dry pumping, damage to the gears (when the water contains high levels of suspended soils), and the high cost of these large-capacity pumps.

Reciprocating Piston Submersible Pumps

The reciprocating piston submersible pump is a portable system for purging wells with water depths up to 500 ft. These pumps develop high pumping rates and can be operated in 2-inch-diameter wells. The system is operated by compressed gas (air or nitrogen) and driven by an air motor. The pump is self-priming, and the gas that drives the pump does not contact the purged water. The pump is constructed from stainless steel and can be decontaminated easily.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
2.2	Field Measurements on Ground and Surface Water Samples
2.3	Sampling Monitoring Wells with a Bladder Pump
2.4	Sampling Monitoring Wells with a Bucket-Type Bailer
2.5	Sampling Monitoring Wells with a Submersible Pump
2.6	Sampling Monitoring Wells with a Peristaltic Pump
3.1	Water Level Measurement
6.1	Health and Safety Monitoring of Combustible Gas Levels
6.2	Health and Safety Monitoring of Organic Vapors with a Photoionization Detector

6.3 Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Have the site manager order the standard solutions for specific conductance and pH/alkalinity calibrations to be performed either before departing for the site or upon arrival at the site.

F. Consult with the site manager about purging techniques and the disposal of purged water and other sampling expendables.

G. Make arrangements to buy or lease an air compressor or bottled nitrogen.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Locate the monitoring wells to be sampled and the appropriate decontamination area. Locate the staging area and areas for managing purged water and expendable sampling materials. Check decontamination zones and barricades to public access. Plan to purge the wells, moving from the least contaminated to most contaminated.

B. Decontaminate the purging pump or bailer before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and the FSP or WP).

3.3. Operation

A. Record all calculations and field measurements according to SOP 2.2, Field Measurements on Ground and Surface Water Samples.

B. Calculate the amount of water in the well (casing or bore volume) with the formula shown below.

$$(pi) \times \frac{(d^2)}{4} \times (h_1 - h_2) \times 7.48 = \text{gallons per bore volume}$$

where

pi = 3.1416
d = inner diameter of well bore (ft)
h_1 = depth of well from top of well casing (ft)
h_2 = depth to water from top of casing (determined in field) (ft)
bore volume = volume of water equivalent to the standing water in a well

3.3.1. Peristaltic (Suction-Lift) Pump

The peristaltic pump is a self-priming, low-volume pump consisting of a rotor and ball-bearing rollers. Tubing inserted around the pump rotor is squeezed by the rollers as the rotor revolves. One end of the precleaned tubing is placed into the well while the other end is connected to a flow-through bath. As the rotor revolves, water is drawn (up to one gallon per minute) from the well.

For purging with a peristaltic pump, proceed as described below.

1. Using clean equipment, determine the total depth of the well and water level with an electric sounder or steel tape (see SOP 3.1, Water Level Measurement). Calculate the fluid volume in the casing, using the casing volume or the bore volume (the FSP or WP may require considering the latter).

2. Determine the depth from the casing top to the midpoint of the screen or well section open to aquifer. Consult the well completion and water level measurement records or sound for the bottom.

3. If depth to midpoint of screen exceeds 25 ft, choose an alternate system.

4. Lower intake into the well a short distance below the water level and begin water removal. Collect or dispose of the purged water in containers of the type specified in the FSP or WP. Lower suction intake to maintain submergence and allow for successive purging of the water column.

5. Monitor the air above the wellhead (as specified in SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels; SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector; and SOP 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector) to determine the potential for explosion, fire, and any toxic effect on workers.

6. Record the amount of water purged and discharge rates. A calibrated bucket and stopwatch are most commonly used to obtain this measurement.

7. Purge a minimum of three casing volumes and continue purging until the discharge parameters (pH, temperature, and specific conductance) stabilize. Stabilization of field parameters is defined as consecutive readings (taken with at least 0.5 casing volumes between readings) within ±0.1 units for pH, ±1 degree for temperature, and ±10 percent for conductivity. It should be realized that groundwater from some wells may not readily stabilize, either due to effects of improper well construction or the presence of contaminants. In these instances, a maximum of 10 casing volumes will be removed before sampling, and the lack of stabilization of parameters should be noted in the comments field of the appropriate field forms.

8. After pumping, monitor the water level recovery. The recovery rate may be useful in determining the sample rate.

9. Decontaminate the tubing and fittings according to SOP 1.6, General Equipment Decontamination.

3.3.2. Bladder (Gas-Operated, Squeeze-Type) Pump

Bladder pumps consist of a membrane enclosed in stainless steel housing. Water enters the membrane through a lower check valve; compressed gas is injected into the cavity between the housing and bladder. Water is transported through an upper check valve and into a discharge line. The process is repeated to cycle the water to the surface and into the flow-through bath.

For purging with a bladder pump, proceed as described below.

1. Using decontaminated equipment, determine the total depth of the well and the water level with an electronic level indicator (see SOP 3.1, Water Level Measurement). Then calculate the fluid volume in the well casing (either casing or bore volume).

2. Determine the depth from the casing top to the midpoint of the screen or well section open to aquifer (consult well completion and water level measurement records). If two or more screen sections are present, determine at which section to set intake and note in logbook.

3. Lower pump assembly into the well until the pump is near the middle of the screened interval.

4. Attach compressed gas and discharge lines. Adjust cycle.

5. Begin water removal; collect or dispose of the purged water in containers of the type specified in the FSP or WP.

6. Monitor the air above the wellhead according to the FSP or WP to determine the potential for fire, explosion, and any toxic effect on workers.

7. Measure the rate of discharge frequently (every two gallons). A calibrated bucket and stopwatch are commonly used to obtain this measurement.

8. Purge a minimum of three casing volumes and continue purging until the discharge parameters (pH, temperature, and specific conductance) stabilize. Stabilization of field parameters is defined as consecutive readings (taken with at least 0.5 casing volumes between readings) within ±0.1 units for pH, ±1 degree for temperature, and ±10 percent for conductivity. It should be realized that groundwater from some wells may not readily stabilize, either due to effects of improper well construction or the presence of contaminants. In these instances, a maximum of 10 casing volumes will be removed before sampling, and the lack of stabilization of parameters should be noted in the comments field of the appropriate field forms.

9. After pumping, monitor the water level recovery. The recovery rate may be useful in determining the sample rate.

10. Decontaminate the pump assembly (see SOP 1.6, General Equipment Decontamination).

3.3.3. Bailer

Water is removed from the bore by a vessel of known volume. The vessel fills with water, and the unit is retrieved with a line or rope.

For purging with a bailer, proceed as described below.

1. Using decontaminated equipment, determine the total depth of the well and the water level with an electric sounder or steel tape (see SOP 3.1, Water Level Measurement). Then calculate the fluid volume in the well casing (either casing or bore volume). If considering the amount of water in the well casing and the filter pack is required, consult the FSP or WP for the appropriate calculations.

2. Lower the bailer into the well and begin water removal. Collect or dispose of purged water in containers of the type specified in the FSP or WP.

3. The air above the wellhead must be monitored (as specified by SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels; SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector; and SOP 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector) to determine the potential for explosion, fire, and any toxic effect on workers.

4. Record the amount of water purged and discharge rates frequently (every two gallons). A calibrated bucket and stopwatch are commonly used to obtain this measurement.

5. Purge a minimum of three casing volumes and continue purging until the discharge parameters (pH, temperature, and specific conductance) stabilize. Stabilization of field parameters is defined as consecutive

readings (taken with at least 0.5 casing volumes between readings) within ±0.1 units for pH, ±1 degree for temperature, and ±10 percent for conductivity. It should be realized that groundwater from some wells may not readily stabilize, either due to effects of improper well construction or the presence of contaminants. In these instances, a maximum of 10 casing volumes will be removed before sampling, and the lack of stabilization of parameters should be noted in the comments field of the appropriate field forms.

6. Once the well has been bailed, monitor the water level recovery. The recovery rate may be useful in determining the sampling rate.

7. Decontaminate the bailer (see SOP 1.6, General Equipment Decontamination).

3.3.4. Electric and Reciprocating Piston Submersible Pumps

The pump assembly is suspended from the discharge tubing and submerged in the well. Water is transported through the discharge tube to the surface by centrifugal or piston action. A portable generator (or battery) is used to provide a power source for the electric pump and a winch in some cases. A portable air compressor is used to drive the piston-type pump.

For purging with a submersible pump, proceed as described below.

1. Purge the well as prescribed in steps 1-3 and 5-9 in method 3.3.1.

2. Decontaminate the pump assembly (see SOP 1.6, General Equipment Decontamination).

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to the presampling conditions specified in the FSP or WP.

3.4.2. Documentation

A. Record cleanup procedures and any uncompleted work (like site restoration or incomplete purging) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document

control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to equipment manager and report incidents of malfunction or damage.

4. SOURCES

Barcelona, M. J., J. P. Gibb, J. A. Helfrich, and E. E. Garske. 1985. "Practical Guide to Groundwater Sampling." U.S. Environmental Protection Agency report EPA/600/2-85/104. Washington, D.C.: U.S. Government Printing Office.

Korte, N., and P. Kearl. 1984. "Procedures for the Collection and Preservation of Groundwater and Surface Water Samples and for the Installation of Monitoring Wells." U.S. Department of Energy, Grand Junction, Colorado.

Morrison, R.D. 1983. "Ground Water Monitoring Technology, Procedures, Equipment and Applications." TIMCO Manufacturing, Inc., 85-90, Evanston, Illinois.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Purging pump or bailer

_____ Water level sounding device

_____ Calculator

_____ Conductivity meter

_____ pH meter

_____ Digital titration kit

_____ Calibration solutions

_____ Air compressor or bottled nitrogen (as needed)

STANDARD OPERATING PROCEDURE 2.2

FIELD MEASUREMENTS ON GROUND AND SURFACE WATER SAMPLES

1. PURPOSE

To obtain reliable and accurate measurements of the field chemistry (pH, temperature, electrical conductivity, alkalinity, dissolved oxygen, redox potential) of water quality samples. It should be noted that dissolved oxygen is not routinely measured as part of groundwater monitoring. Refer to the Field Sampling Plan (FSP) or Work Plan (WP) for details on the measurements to be performed.

2. DISCUSSION

For several reasons, taking measurements of water chemistry in the field is preferable to taking measurements in the laboratory. If it is suspected that a particular sample is not representative or valid, resampling and reanalyzing can be immediately performed at the site. In addition, the values of pH, specific conductance, and alkalinity in water chemistry measurements in the field may differ from those in the laboratory. Disadvantages encountered in obtaining field measurements usually relate to the reliability of the particular method and equipment used for the test.

The FSP or WP contains specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the type of samples to be collected. Collection and measurement of samples and the documentation of data will be performed as described in the associated procedures.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
2.1	Presample Purging of Wells
2.3	Sampling Monitoring Wells with a Bladder Pump
2.4	Sampling Monitoring Wells with a Bucket-Type Bailer

2.5	Sampling Monitoring Wells with a Submersible Pump
2.6	Sampling Monitoring Wells with a Peristaltic Pump
2.8	Sampling for Volatile Organics
2.9	Surface Water Sampling
3.1	Water Level Measurement
4.3	Monitoring Well Installation

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment. Ensure that there are sufficient quantities of reagents, solutions, and filters.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

G. Consult the site manager about purging techniques, the disposal of purged water and other sampling expendables, and the purchase of standard solutions for electrical conductivity and pH/alkalinity calibrations.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Locate the monitoring wells to be sampled and the appropriate decontamination area. Locate the staging area and areas for managing purged water and expendable sampling materials. Check decontamination zones and barricades to public access. Plan to purge and sample the wells,

moving from the least contaminated well to the well with the highest level of contamination.

B. Assemble the appropriate sampling equipment (tubing, flow-through bath, water quality meters, and other equipment). Check the condition of all supplies and the operation of the equipment. It should be noted that a flow-through bath cannot be used if a bailer is being used for the water sampling.

C. Decontaminate all sampling equipment before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and the FSP or WP). Rinse pH and conductivity probes with distilled water between measurements. Collect all decontamination solutions and rinsate liquids in a container or drum and dispose of them at the conclusion of the sampling event. If data exist that show that the decontamination and rinsate liquids will not contribute to contamination at the site, they may be disposed of at the site. Rinsate liquids can be disposed of at the wellsite as long as the disposal area is at least 10 ft from the nearest well.

D. Perform field calibrations for all instrumentation.

3.3. Operation

Procedures for measuring the parameters are discussed below. When practical, take final field measurements after at least three bore volumes have been pumped from the well and as close to the time of sampling as possible. Record measurements, instrument readings, calibration runs, and alkalinity determinations on the appropriate forms included in Appendixes 5.2 through 5.5. Complete the forms as described in Appendix 5.6.

3.3.1. Determining pH

A. Connect the probe to the meter. If a flow-through bath is being used, immerse the meter in the bath after pumping has begun. (A flow-through bath is an enclosed container made of inert material that houses the pH probe and calibration buffer solutions.) The bath allows the buffer solutions to reach the same temperature as the water being withdrawn, and this results in the proper calibration/standardization of the pH meter. The flow-through bath will reduce or eliminate drift. If a flow-through bath is not being used, pour an aliquot of the water into a beaker and immerse the probe in the beaker.

B. Bring the standard solutions to the temperature of the water in the flow-through bath. If the meter has a temperature adjustment, set it to the temperature of the water.

C. Rinse the probe in distilled water and pat completely dry with a clean tissue before putting it in a calibrating solution. Avoid rubbing the probe, which may cause a static charge that will disrupt measurements.

D. Standardize the meter immediately before taking the measurement. The calibrating solutions must bracket the sample--either pH 7.0 and pH 4.0 or

pH 7.0 and pH 10.0. Use the procedure described below to standardize the meter.

1. Put the probe in the pH 7.0 (or in the pH 4.0 solution if the pH is less than 4.0) and adjust the standardization knob to achieve a reading of 7.0 (or 4.0 for pH less than 4.0).

2. Put the probe in the other solution and adjust the standardization knob to achieve a reading of 4.0 or 10.0, as appropriate.

3. Repeat those two steps until adjustment is no longer required.

E. Clean the probe with distilled water and clean tissues.

F. If a flow-through bath is being used, put the probe in the bath. Record the measurement within 5 min or after drift has ceased, whichever is sooner. If a bath is not being used, place the probe into a beaker containing an aliquot of water. Record the measurement as described.

G. Immediately rinse and dry the probe and put it in each calibrating solution for about 30 sec. Record the readings.

NOTE: During storage and between measurements, keep the probe immersed in the pH 4.0 solution.

H. If a flow-through bath is being used, keep hoses leading to the bath out of direct sunlight because the water can heat up quickly at low discharge rates.

3.3.2. Measuring Temperature

A. Use a Celsius thermometer to measure the temperature in a small Teflon or plastic bucket. Record measurements in the logbook periodically during pumping.

B. Place the bucket close to the wellhead. Keep the bucket and discharge hose away from direct sunlight.

3.3.3. Measuring Electrical Conductivity

A. Use three KCl solutions of known concentrations (approximately 500, 1000, and 1500 μmhos, depending on vendor availability); these concentrations must bracket the expected electrical conductivity (Ec) of water samples collected in the field. Record the electrical conductivity of the known solutions after the meter probes have been submersed and equilibrated in them. The temperature of the known solutions must be 25°C and recorded from a laboratory-grade thermometer.

B. Cool one KCl known solution to 0°C. Then record electrical conductivity measurements as the temperature of the KCl solution is warmed to 25°C. During this calibration procedure, also record the temperature scale of the Ec meter to confirm the accuracy of the Ec meter thermometer to the known accuracy of the laboratory-grade thermometer.

C. Calibrate the conductivity meter with at least three standard KCl solutions, the extremes of which bracket the anticipated conductivity of the samples. Perform this calibration at least before and after sampling. Keep a record of each calibration and record the temperature of each calibrating solution.

D. Clean the probe and cable with distilled water and clean tissues.

E. Measure conductivity in a Teflon or plastic bottle. Record conductivity periodically (after every two gallons) throughout the time of pumping. Record the position of each setting on the meter.

NOTE: Rinse the probe in distilled water and dry it completely before putting it in a calibration solution.

F. Keep the probe at least two inches away from the cell walls or bucket because most conductivity probes produce an electrical field that may be disturbed if the probe is near a solid object.

3.3.4. Alkalinity Testing

Use a digital titration kit (Hach Kit) to test for alkalinity. Field techniques can be tested by performing alkalinity tests on known solutions prepared by the quality control laboratory. When using the standard solutions, record only the value of alkalinity at a pH of 4.5 on the Standard Alkalinity Record form (Appendix 5.5). The alkalinity of three standard solutions will be determined in triplicate. Perform these tests at the start of field sampling. Report the results to the site manager for confirmation with the known values reported by the laboratory. At the discretion of the site manager, additional standard alkalinity tests may be performed periodically during or after the field sampling period.

Determine the alkalinity of each water sample at the time that the sample is collected; record the results in the appropriate sections of the Groundwater Quality Sampling Record (Appendix 5.3) or Surface Water Quality Sampling Record (Appendix 5.2). Enter alkalinity values for 13 different pH values into the table on the forms and plot the results on the graph. Perform a minimum of two tests on each sample to verify the reproducibility of the values obtained. If possible, have different field personnel run these two tests. If the calculated error is greater than 10%, perform a third test for a redetermination of the error. Three trials are usually sufficient to determine a reasonable field value. At the conclusion of the titration tests, record the pH meter readings in the pH 4.0 and 7.0 buffer solutions. The procedure used to determine alkalinity values is described below.

A. Bring the temperature of the pH 4.0 and 7.0 standard buffer solutions to the temperature of the sample in the flow-through bath. If a flow-through bath is not being used, bring the temperature of the standard solutions to the temperature of the water in the beaker. Standardize the meter with the electrode in each of these buffers according to the accepted method. Leave the electrode in the pH 4.0 buffer solution.

B. Rinse the titration flask and the volumetric flask with distilled water, followed by raw sample. Remove droplets of water by vigorous shaking.

C. Measure 100 ml of fresh, unfiltered sample in the volumetric flask and pour it into the titration flask with as little agitation as possible.

D. Rinse the pH electrode, pat it dry, and put it into the titration flask.

E. Record the titrant lot number and date on the water quality data form. Eject a few drops of titrant from the tip of the titrator and wipe the tips with a clean tissue. Reset the counter to 0000.

F. Titrate the solution with acid, gently stirring the solution to ensure mixing. Whenever feasible, use magnetic stirrers. Record pairs of pH and alkalinity readings for the pH values on the data form(s).

G. Rinse all glassware with distilled water.

3.3.5. Measuring Dissolved Oxygen

A. Connect the YSI 5739 probe to the YSI Model 50B Dissolved Oxygen meter. Place probe in calibration bottle containing a moist sponge. Allow the temperature to equilibrate (3-5 minutes).

B. Set function switch to "°C". From the solubility of oxygen chart (Table I on back of meter) find the mg/L value for the temperature indicated on the display.

C. To determine the calibration value, multiply the value in mg/L found in step B. by .97 (the value in .97 is from Table II on back of meter using an elevation of 841' for Mound Plant).

D. Set function switch to "mg/L CAL". Using the keys beneath the digit positions in the display, set the calibration value determined in step C. Set function switch to "mg/L". The display will show "CAL", then the calibration value entered will appear. Observe the reading for stability for two or three minutes.

E. Place probe in sample. Set function switch to "mg/L". Allow 3-5 minutes for the probe to come to temperature equilibrium with the sample. Begin stirring and observe the reading when the display has stabilized.

F. Record observed reading in the comment section of the field form (Appendix 5.2 or 5.3).

G. When storing probe, keep in humid environment to prevent drying out.

3.3.6. Measuring Oxidation-Reduction Potential

A Hach One Portable pH Meter may be used to measure oxidation-reduction potential with the proper electrode (Hach OPR Electrode). First the meter must be zeroed for millivolt measurements.

A. With meter turned off, insert a paper clip into the BNC connector to electrically short the circuit.

B. Press and hold the button labeled "mV", simultaneously press and release button labeled"!" then release "mV" button. The mv indicator will light, and after 10 seconds, the meter will read 0.0 mV+.2 mV. Remove paper clip and attach OPR electrode.

C. Verify the electrode response by measuring the oxidation-reduction potential of a prepared solution. No calibration can be done with this meter, if electrode is not reading correct value, replace it with a new one.

Note: Calibration solution preparation is given in manual for Hach OPR Electrode.

D. Record observed reading in the comment section of the field form (Appendix 5.2 or 5.3).

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to the presampling conditions and fill open sampling holes as specified in the FSP or WP.

C. Make sure all survey or sampling locations are properly staked and the location ID is readily visible on the location stake.

D. Examine electrical conductivity and temperature calibrations (red line location). Adjust data as indicated.

E. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration) in the logbook.

B. Record the sampling and operating data in the logbook.

C. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

D. Make any necessary changes on data forms after examining electrical conductivity and temperature calibrations.

E. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document

control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCES

EPA. 1979. "Methods for Chemical Analysis of Water and Wastes." U.S. Environmental Protection Agency document EPA/600/4-79-020. Washington, D.C.: U.S. Government Printing Office.

Korte, N., and P. Kearl. 1984. "Procedures for the Collection and Preservation of Groundwater and Surface Water Samples and for the Installation of Monitoring Wells." U.S. Department of Energy, Grand Junction, Colorado.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Surface Water Quality Sampling Record

5.3. Groundwater Quality Sampling Record

5.4. Standard Electrical Conductivity Data Form

5.5. Standard Alkalinity Test Record

5.6. Data Form Completion

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

Complete all blanks before going to the field.

_____ Reagents: Alkalinity kit

- _____ Check reagent volumes
- _____ Check glass for breakage

_____ pH meter(s) (circle one)

- _____ Electrode full of fluid
- _____ Electrode glass intact
- _____ Immerse electrode in tap water
- _____ Calibrate electrode, rinse, fill, and replace cap
- _____ Temperature probe in tap water
- _____ Temperature probe in hot water

_____ Ec Meter

- _____ Battery: Ok___ Dead___
- _____ Tap water: Ok___ Faulty___
- _____ Against calibration solution
- _____ Solution temp
- _____ Conductivity of solution

_____ Hand-held thermometer

- _____ Temperature in ice water
- _____ Temperature agrees with lab thermometer

_____ KCl solutions

_____ Filters and tubing

_____ Flow-through bath

_____ Teflon or plastic bucket

_____ Teflon or plastic bottle

APPENDIX 5.1, Continued

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Titration flask

_____ Volumetric flask

_____ YSI Model 50B dissolved oxygen meter

- _____ YSI 5739 dissolved oxygen probe
- _____ YSI 5740 detachable cable
- _____ Calibration bottle and sponge
- _____ Beaker
- _____ Stirrer

_____ Hach One Portable pH meter (for redox measurements)

- _____ No. 1 steel paper clips
- _____ Hach ORP electrode
- _____ Prepared solution:

  10 mL 10N H_2SO_4 + 90 mL deionized/ distilled H_2O + 2.000g Fe $(NH_4)_2$ $(SO_4)_2$ 6 H_2O + 0.081g $KMnO_4$
- _____ Beaker
- _____ Stirrer

APPENDIX 5.2

SURFACE WATER QUALITY SAMPLING RECORD

SURFACE WATER QUALITY SAMPLING RECORD

PAGE ____ OF ____

FACILITY CODE _____

LOCATION ID _____ LOT CONTROL NO _____

SAMPLE ID _____ SAMPLE TYPE _____

LOG DATE _____ ACCEPTANCE CODE _____

ANALYTICAL LAB CODE _____ LOGGER CODE _____

SAMPLING PERIOD: START _____ COMPLETE _____

SAMPLING METHOD _____ DATE SENT _____

COMMENTS _____

PARAMETER MEASUREMENTS:

POTENTIAL OF HYDROGEN	pH	S.U.	_____
SPECIFIC CONDUCTANCE	Ec	umhos/cm	_____
REDOX POTENTIAL	Eh	mvolts	_____
TEMPERATURE	TMP	°C	_____
ALKALINITY ($CaCO_3$)	ALK	mg/l	_____
DISSOLVED OXYGEN	DO	mg/l	_____

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

SAMPLE TYPES:

F – FIELD R – REPLICATE
K – KNOWN A – ACID BLANK

SAMPLING METHODS:

G – GRAB SP – SUBMERSIBLE PUMP
PP – PERISTALIC PUMP O – OTHER (SPECIFY)

COMPLETE BOLDED DATA FOR ENTRY INTO TMS
WQD–007 (1/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

SURFACE WATER QUALITY SAMPLING RECORD

FACILITY CODE _____ PAGE ____ OF ____

LOCATION ID _____ **LOG DATE** _____

SAMPLING INFORMATION

WITHDRAWAL METHOD _____

FILTER SIZE _____

THERMOMETER ID _____

Ec METER ID _____

pH METER ID _____

PUMP ID _____

ALKALINITY KIT ID _____

FIELD REP _____

INSTRUMENT(S) USED _____

_____

CALIBRATION INFORMATION

DATE/TIME OF LAST Ec CALIBRATION _____

TIME OF pH CALIBRATION _____

FOR STANDARD SOLUTION pH 7, INSTRUMENT READING _____

FOR STANDARD SOLUTION pH 4, INSTRUMENT READING _____

FOR STANDARD SOLUTION pH 10, INSTRUMENT READING _____

Eh OF CALIBRATION SOLUTION _____

Eh READING IN CALIBRATION SOLUTION AFTER INSTRUMENT MEASUREMENT _____

TEMP. OF CALIBRATION SOLUTION (°C) _____

SHIPPING INFORMATION

LAB(S) SHIPPED TO: _____ _____ _____

DATE(S) SHIPPED: _____ _____ _____

METHOD OF SHIPMENT: _____ _____ _____

COMMENTS _____

_____

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
WQO-007 (1/88)

_____ FORM COMPLETED BY/DATE

_____ TECHNICAL REVIEWER/DATE

SURFACE WATER QUALITY SAMPLING RECORD

PAGE ____ OF ____

FACILITY CODE _____

LOCATION ID _____

LOG DATE _____

ERROR AT 4.50: $\left| \frac{X1 - X2}{X5} \right| \times 100 =$ ____%

1st = ____%

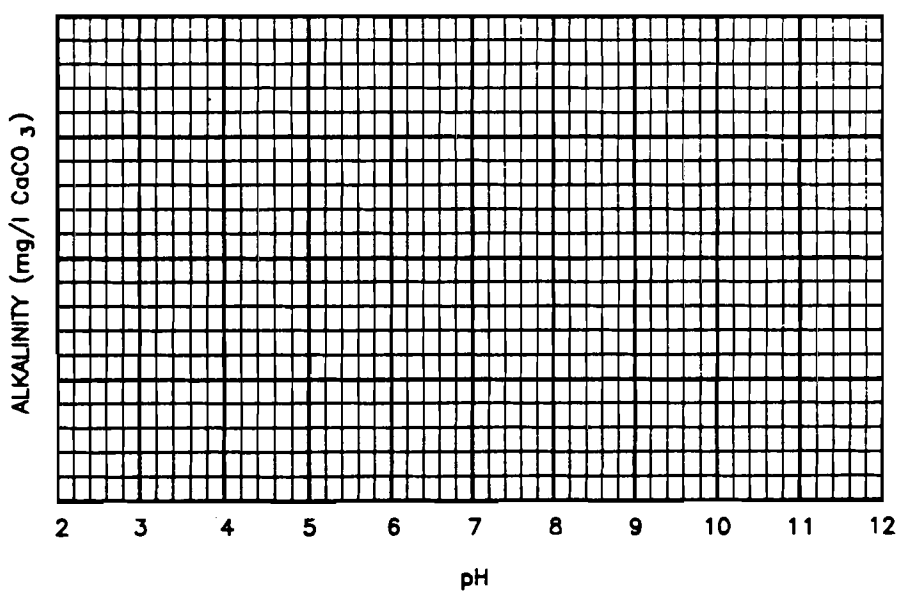
2nd = ____%

pH CHECK AFTER TITRATION

7.00 = _____

4.00 = _____

pH	ALKALINITY (mg/l Ca CO_3)		
	1st	2nd	3rd
8.90			
8.60			
8.30			
8.05			
7.80			
7.50			
6.50			
5.70			
5.10			
4.80			
4.50			
4.25			
4.00			



COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
WQO-007 (3/88)

SURFACE WATER QUALITY SAMPLING RECORD

FACILITY CODE _____ PAGE ____ OF ____

LOCATION ID _____ LOG DATE _____

SAMPLE ID	TEST KIT ID	pH (S.U.)	ALKALINITY (mg/l $CaCO_3$)		UNCERTAINTY (%)
			TRUE VALUE	FIELD VALUE	

COMMENTS _____

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TMS
WGD-007 (3/88)

APPENDIX 5.3

GROUNDWATER QUALITY SAMPLING RECORD

GROUNDWATER QUALITY SAMPLING RECORD

PAGE ___ OF ___

FACILITY CODE _____ **LOT CONTROL NO** _____

LOCATION ID _____ **SAMPLE TYPE** _____

SAMPLE ID _____ **ACCEPTANCE CODE** _____

LOG DATE _____ **LOGGER CODE** _____

ANALYTICAL LAB CODE _____

INITIAL GROUNDWATER DEPTH (FT) _____ SAMPLE DEPTH (FT) _____

SAMPLING PERIOD: START _____ COMPLETE _____

SAMPLING METHOD _____ DATE SENT _____

COMMENTS _____

FINAL PARAMETER MEASUREMENTS:

POTENTIAL OF HYDROGEN	pH	S.U.	_____
SPECIFIC CONDUCTANCE	Ec	umhos/cm	_____
REDOX POTENTIAL	Eh	mvolts	_____
TEMPERATURE	TMP	°C	_____
ALKALINITY ($CaCO_3$)	ALK	mg/l	_____
DISSOLVED OXYGEN	DO	mg/l	_____

TIME	TOTAL VOLUME WITHDRAWN		pH	Ec (umhos/cm)	TEMP (°C)	COMMENTS
	(GALS)	(Bore Volume)				
	0.0	0.0	--	--	--	START PUMPING

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

SAMPLE TYPES:

F – FIELD R – REPLICATE
K – KNOWN A – ACID BLANK

SAMPLING METHODS:

G – GRAB SL – SUCTION LIFT PUMP BP – BLADDER PUMP
B – BAILER SP – SUBMERSIBLE PUMP O – OTHER (SPECIFY)
PP – PERISTALIC PUMP AL – AIR–LIFT SAMPLER

COMPLETE BOLDED DATA FOR ENTRY INTO TMS

WQD–005 (1/88)

_____ FORM COMPLETED BY/DATE

_____ TECHNICAL REVIEWER/DATE

GROUNDWATER QUALITY SAMPLING RECORD

PAGE ___ OF ___

FACILITY CODE _____

LOCATION ID _____ LOG DATE _____

TIME	TOTAL VOLUME WITHDRAWN		pH	Ec (umhos/cm)	TEMP (°C)	COMMENTS
	(GALS)	(Bore Volume)				

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS

WQD-008 (1/88)

GROUNDWATER QUALITY SAMPLING RECORD

PAGE ___ OF ___

FACILITY CODE _____

LOCATION ID _____ LOG DATE _____

BORE VOL CALCULATION (GAL)

$$\frac{d^2\pi}{4}(h_1 - h_2) \times 7.48$$

DEPTH OF WELL (h_2) (FT) _____

DEPTH TO WATER (h_1) (FT) _____

WELL DIAMETER (FT) _____

ONE BORE VOLUME (GAL) _____

SCREENED INTERVAL (FT) _____

FIELD REP _____

INSTRUMENT(S) USED _____

_____

SAMPLING INFORMATION

WITHDRAWAL METHOD _____

FILTER SIZE _____

THERMOMETER ID _____

Ec METER ID _____

pH METER ID _____

PUMP ID _____

ALKALINITY KIT ID _____

CALIBRATION INFORMATION

DATE/TIME OF LAST Ec CALIBRATION _____

TIME OF pH CALIBRATION _____

FOR STANDARD SOLUTION pH 7, INSTRUMENT READING _____

FOR STANDARD SOLUTION pH 4, INSTRUMENT READING _____

FOR STANDARD SOLUTION pH 10, INSTRUMENT READING _____

Eh OF CALIBRATION SOLUTION _____

Eh READING IN CALIBRATION SOLUTION AFTER MEASUREMENT _____

TEMP OF CALIBRATION SOLUTION (° C) _____

SHIPPING INFORMATION

LAB(S) SHIPPED TO: _____ _____ _____

DATE(S) SHIPPED: _____ _____ _____

METHOD OF SHIPMENT: _____ _____ _____

COMMENTS _____

_____

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
WSD-008 (3/88)

GROUNDWATER QUALITY SAMPLING RECORD

PAGE ___ OF ___

FACILITY CODE _____

LOCATION ID _____

LOG DATE _____

ERROR AT 4.50: $\left| \frac{X1 - X2}{XS} \right| \times 100 =$ ___%

1st = ___%

2nd = ___%

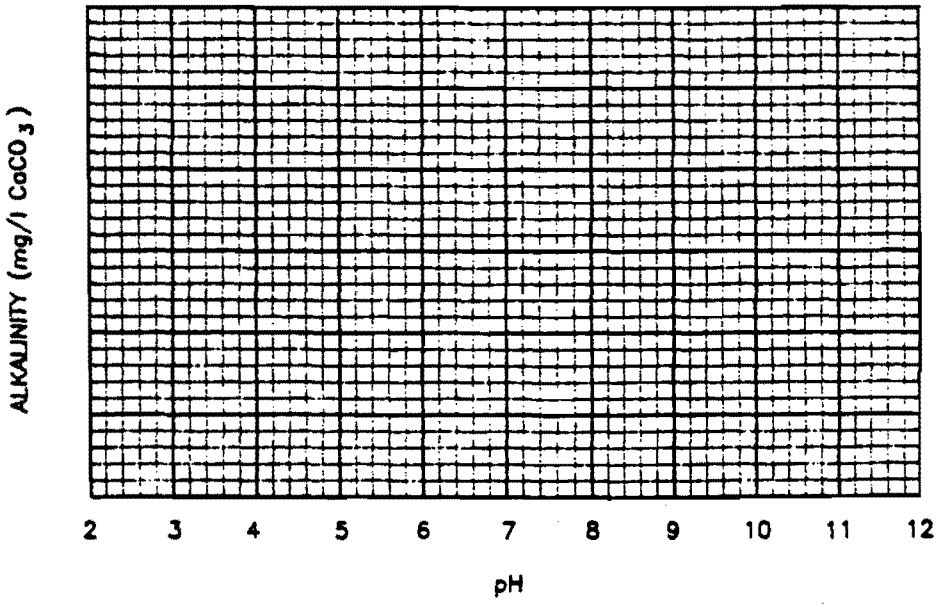
INITIAL pH _____

pH CHECK AFTER TITRATION

7.00 = _____

4.00 = _____

pH	ALKALINITY (mg/l Ca CO_3)		
	1st	2nd	3rd
8.90			
8.60			
8.30			
8.05			
7.80			
7.50			
6.50			
5.70			
5.10			
4.80			
4.50			
4.25			
4.00			



COMPLETE BOLDED DATA FOR ENTRY INTO TMS
WQD-005 (3/92)

APPENDIX 5.4

STANDARD ELECTRICAL CONDUCTIVITY FORM

STANDARD ELECTRICAL CONDUCTIVITY DATA

FACILITY CODE _____ LOG DATE _____

LOGGER CODE _____ ACCEPTANCE CODE _____

MANUFACTURER/Ec METER ID _____

ELECTRICAL CONDUCTIVITY OF KNOWN SOLUTIONS AT 25° C:	
KNOWN (mg/l KCl)	Ec (meter)

Ec	TEMPERATURE (°C) (LAB THERMOMETER)	TEMPERATURE (°C) (Ec METER)
	0	
	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	
	11	
	12	
	13	
	14	
	15	
	16	
	17	
	18	
	19	
	20	
	21	
	22	
	23	
	24	
	25	

COMMENTS _____

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS

SEC–046 (1/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.5

STANDARD ALKALINITY TEST RECORD

STANDARD ALKALINITY TEST RECORD

FACILITY CODE _____

FIELD REP _____ **LOG DATE** _____

ALKALINITY TEST KIT:

MANUFACTURER _____ ALKALINITY TEST KIT ID _____

pH METER:

MANUFACTURER _____ SERIAL NO _____

LAB CODE	STANDARD SOLUTION ID	KNOWN VALUE (mg/l $CaCO_3$)	ALKALINITY TEST VALUES (at pH endpoint = 4.5) mg/l $CaCO_3$

COMMENTS _____

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
SAT-131 (2/88)

APPENDIX 5.6

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

SURFACE WATER QUALITY SAMPLING RECORD

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, radiological, and other measurements are taken.

3. Sample ID. A four-digit number assigned to ensure that collected data retain uniqueness.

4. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

5. Analytical Lab Code. A three-character code identifying the company responsible for preparing the standard solution.

6. Lot Control Number. A two-digit number denoting that a given set of samples should be analyzed as a lot or group. Normally, this number is not assigned by persons in the field collecting surface water samples.)

7. Sample Type. A one-character code distinguishing the type of sample collected. This classification permits the analysis of data for specific groups of samples. The codes used for water samples are listed below.

D--Duplicate	F--Field Blank
R--Replicate	T--Trip Blank
S--Spike	L--Lab Blank
K--Known	

8. Acceptance Code. A one-character code assigned by the facility manager.

9. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

10. Sampling Period. Record the starting and completion times when field measurements were taken in the 24-hr format of hours:minutes (for example, 08:37 for 8:37 a.m. and 19:12 for 7:12 p.m.). See the conversion table below.

    Start--the time that collection of water sample begins.

    Complete--the time that collection of water sample ends.

Conversion Table

Conventional Time	24-Hour Time
1:00 a.m.	1:00
12:00 Noon	12:00
1:00 p.m.	13:00
2:00 p.m.	14:00
3:00 p.m.	15:00
4:00 p.m.	16:00
5:00 p.m.	17:00
6:00 p.m.	18:00
7:00 p.m.	19:00
8:00 p.m.	20:00
9:00 p.m.	21:00
10:00 p.m.	22:00
11:00 p.m.	23:00
12:00 Midnight	24:00

11. Sampling Method. A two-character code identifying the method used to collect a soil, rock, or water sample. The codes used for various water sampling methods are listed below.

B--Bailer	AL--Air Lift Sampler
C--Composite	BP--Bladder Pump
G--Grab	PP--Peristaltic Pump
R--Random	SL--Suction Lift Pump
S--Systematic	SP--Submersible Pump

12. Date Sent. The date the water sample was sent from the field collection site to the analytical laboratory in the format DD-MMM-YY (01-JAN-88).

13. Comments. Includes preservation method, acidified or nonacidified, type of acid (if acid was used to preserve water sample), and any additional information.

14. Parameter Measurements. The measurements listed below are recorded at the time the sample is collected.

    a. Potential of Hydrogen--the pH of the water sample in S.U. units at the time of collection.

b. Specific Conductance--The specific conductance of the water sample in micromhos/cm (mhos/cm) at the time of collection.

c. Redox Potential--The redox potential of the water sample in millivolts (mV) at the time of collection.

d. Temperature--The temperature of the water sample in degrees Celsius (°C) at the time of collection.

e. Alkalinity ($CaCO_3$)--The alkalinity of the water sample in milligrams per liter (mg/liter) at the time of collection.

f. Dissolved Oxygen--The dissolved oxygen content of the water sample in milligrams per liter (mg/liter) at the time of collection.

15. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

16. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, radiological, and other measurements are taken.

17. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

18. Withdrawal Method. The sampling device used to collect the surface water sample.

19. Filter Size. Size of filter in use.

20. Thermometer ID. The identification of the thermometer used.

21. Ec Meter ID. The control number and manufacturer of the meter used to measure the specific conductance of samples or calibration solutions.

22. pH Meter ID. The control number and manufacturer of the meter used to measure the pH of samples of standard solutions.

23. Pump ID. Identification of the pump in use.

24. Alkalinity Kit ID-identification and model or serial number of the alkalinity kit used.

25. Field Rep. Name of the field representative.

26. Instruments Used. The types of instruments used to obtain measurements, monitor air quality, or facilitate the collection of a sample or test performance.

27. Calibration Information. After performing the alkalinity titration test and immediately before sample collection, record the information listed below.

    a. Date/Time of Last Ec Calibration. Date and time that the specific conductivity meter was last calibrated in format of year:month:day/hour:minute.

    b. Time of pH Calibration. Time the pH meter was calibrated in hours:minutes.

    c. Standard Solution pH Readings. The pH readings are to be recorded as the probe is immersed in standard solutions of pH 7.0, 4.0 and 10.0.

    d. Eh of Calibration Solution. The Eh of the solution supplied by the laboratory to calibrate the specific conductance meter.

    e. Eh Reading in Calibration Solution after Measurement. The numerical value obtained after immersing the Eh probe in the standard solution.

    f. Temp of Calibration Solution (°C). The temperature of the Eh standard solution measured during the time that the probe is immersed.

28. Shipping Information. Information that includes the date, method, laboratory where the samples were shipped, and a comments section.

29. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

30. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, radiological, and other measurements are taken.

31. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

32. Error at 4.50. Error calculation to test the precision of the alkalinity measurement. Two tests for alkalinity are performed on the same sample, and the values are written on the pH/Alkalinity chart. The alkalinity at pH = 4.50 for test number one (x1) is subtracted from alkalinity determined in test number two (x2), and the result is divided by sx (the value of x1 or x2, whichever is smaller). The absolute value of the result is multiplied by 100 to obtain a percentage. If the calculated error is less than 10%, no further runs are necessary. If the calculated error is greater than 10%, a third test must be run. After the third test, the field sampler should use

his/her judgement to recalculate the error using the value from the third test.

33. Alkalinity (mg/*l* $CaCO_3$). The alkalinity of the water sample in milligrams per liter (mg/liter) at different values of pH during titration.

34. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

35. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, radiological, and other measurements are taken.

36. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

37. Sample ID. A four-digit number assigned to ensure that collected data retain uniqueness.

38. Alkalinity Test Kit ID. The control number used to identify the kit being utilized to measure the alkalinity of a sample or standard solution.

39. Potential of Hydrogen. The pH of the water sample in S.U. units at the time of collection.

40. Alkalinity ($CaCO_3$). Enter the field alkalinity of the water sample in milligrams per liter (mg/liter) at the time of collection in the field value column.

41. True Value. Each standard solution will be prepared to a specific alkalinity as specified by the site manager. This value will not be disclosed to the field samplers until they have completed their calibration runs. After the calibration runs are complete, the samplers must contact the site manager and report the values determined in the field. If the values are within 10% of the known value, the site manager will authorize the sampling and supply the values that are to be entered in this data entry field.

42. Field Value. The alkalinity value that samplers determined in the field on the calibration run.

43. Uncertainty (%) = $(100) \bullet \left(\frac{\text{Field Value - True Value}}{\text{True Value}}\right)$

44. Comments. Any additional information.

APPENDIX 5.6, Continued

GROUNDWATER QUALITY SAMPLING RECORD

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, radiological, and other measurements are taken.

3. Sample ID. A four-digit number assigned to ensure that collected data retain uniqueness.

4. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

5. Analytical Lab Code. A three-character code identifying the company responsible for preparing the standard solution.

6. Lot Control Number. A two-digit number denoting that a given set of samples should be analyzed as a lot or group. Normally, this number is not assigned by persons in the field collecting surface water samples.

7. Sample Type. A one-character code distinguishing the type of sample collected. This classification permits the analysis of data for specific groups of samples. The codes used for water samples are listed below.

D--Duplicate	F--Field Blank
R--Replicate	T--Trip Blank
S--Spike	L--Lab Blank
K--Known	

8. Acceptance Code. A one-character code assigned by the facility manager.

9. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

10. Initial Groundwater Depth. Distance in feet from the top of the casing to the surface of the water in the well. This length is determined by using the well sounder before measuring the depth of the well. Measure depth-to-water to the nearest tenth of a foot.

11. Sample depth. The depth at which the sample was taken.

12. Sampling Period. Record the starting and completion times when field measurements were taken in the 24-hr format of hours:minutes (for example, 08:37 for 8:37 a.m. and 19:12 for 7:12 p.m.). See the conversion table below.

Start--the time that collection of water sample begins.

Complete--the time that collection of water sample ends.

Conversion Table

Conventional Time	24-Hour Time
1:00 a.m.	1:00
12:00 Noon	12:00
1:00 p.m.	13:00
2:00 p.m.	14:00
3:00 p.m.	15:00
4:00 p.m.	16:00
5:00 p.m.	17:00
6:00 p.m.	18:00
7:00 p.m.	19:00
8:00 p.m.	20:00
9:00 p.m.	21:00
10:00 p.m.	22:00
11:00 p.m.	23:00
12:00 Midnight	24:00

13. Sampling Method. A two-character code identifying the method used to collect a soil, rock, or water sample. The codes used for various water sampling methods are listed below.

B--Bailer	AL--Air Lift Sampler
C--Composite	BP--Bladder Pump
G--Grab	PP--Peristaltic Pump
R--Random	SL--Suction Lift Pump
S--Systematic	SP--Submersible Pump

14. Date Sent. The date the water sample was sent from the field collection site to the analytical laboratory in the format DD-MMM-YY (01-JAN-88).

15. Comments. Includes preservation method, acidified or nonacidified, type of acid (if acid was used to preserve water sample), and any additional information.

16. Final Parameter Measurements. The following measurements are recorded at the time the sample is collected.

    a. Potential of Hydrogen. The pH of the water sample in S.U. units at the time of collection.

    b. Specific conductance. The specific conductance of the water sample in micromhos/cm (mhos/cm) at the time of collection.

c. Redox Potential. The redox potential of the water sample in millivolts (mV) at the time of collection.

d. Temperature. The temperature of the water sample in degrees Celsius (°C) at the time of collection.

e. Alkalinity ($CaCO_3$). The alkalinity of the water sample in milligrams per liter (mg/liter) at the time of collection.

f. Dissolved Oxygen. The dissolved oxygen content of the water sample in milligrams per liter (mg/liter) at the time of collection.

17. The Groundwater Quality Record form contains data that are collected during well purging. These are described below.

    a. Time. The time when a field measurement of purged water was performed in the format HH:MM.

    b. Total Volume Withdrawn. Using a bucket or flow meter, the field sampler will note the number of gallons of water purged from the well at the time that a field measurement is taken. This entry is cumulative and represents the total volume of water purged before sampling may begin. A second column is provided so that the field sampler can equate gallons as bore volumes purged.

    c. pH. The pH readings of water sampled during the purging process.

    d. Ec. The specific conductance readings of water sampled during the purging process in micromhos/cm (mhos/cm).

    e. Temp (°C). The temperature of the water sampled during the purging process.

    f. Comments. Includes preservation method, acidified or nonacidified, type of acid (if acid was used to preserve water sample), and any additional information.

18. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

19. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, radiological, and other measurements are taken.

20. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

21. Depth of Well (h_2). Distance in feet from the top of the casing to the bottom of the well. This length can be determined by bottoming out a water level sounder against the bottom cap of the well. Measure the depth of the well to the nearest tenth of a foot.

22. Depth-to-Water (h_1). Distance in feet from the top of the casing to the surface of the water in the well. This length is determined by using the well sounder before measuring the depth of the well. Measure depth-to-water to the nearest tenth of a foot.

23. Well Diameter. The inside diameter of the well casing measured to the nearest tenth of a foot.

24. One Bore Volume. The volume of water contained in the well before purging is started. One bore volume is determined by the equation included on the form.

25. Screened Interval (Ft). Depth from the top of the casing to the midpoint of the screen or well section open to the aquifer. Well completion information must be consulted to determine the length and position of the screen.

26. Field Rep. Name of the field representative.

27. Instruments Used. Well sounding instruments and the type of system used to purge the well.

28. Withdrawal Method. The method used to sample the well.

29. Filter Size. The filter size being used.

30. Thermometer ID. The identification of the thermometer being used.

31. Ec Meter ID. The control number and manufacturer of the meter used to measure the specific conductance of samples or calibration solutions.

32. pH Meter ID. The control number and manufacturer of the meter used to measure the pH of samples of standard solutions.

33. Pump ID. Identification and model or serial number of the alkalinity kit used.

34. Alkalinity Kit ID. Identification and model or serial number of the alkalinity kit used.

35. Calibration Information. After performing the alkalinity titration test and immediately before sample collection, the information listed below will be recorded.

a. Date/Time of Last Ec Calibration. Date and time that the specific conductivity meter was last calibrated in format of year:month:day/hour:minute.

b. Time of pH Calibration. Time the pH meter was calibrated in hours:minutes.

c. Standard Solution pH readings. The pH readings are to be recorded as the probe is immersed in standard solutions of pH 7.0, 4.0, and 10.0.

d. Eh of Calibration Solution. The Eh of the solution supplied by the laboratory to calibrate the specific conductance meter.

e. Eh Reading in Calibration Solution after Measurement. The numerical value obtained after immersing the Eh probe in the standard solution.

f. Temp of Calibration Solution (°C). The temperature of the Eh standard solution measured during the time that the probe is immersed.

36. Shipping Information. Information that includes the date, method, laboratory where the samples were shipped, and a comments section.

37. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

38. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, radiological, and other measurements are taken.

39. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

40. Error at 4.50. Error calculation to test the precision of the alkalinity measurement. Two tests for alkalinity are performed on the same sample, and the values are written on the pH/Alkalinity chart. The alkalinity at pH = 4.50 for test number one (x1) is subtracted from alkalinity determined in test number two (x2), and the result is divided by sx (the value of x1 or x2, whichever is smaller). The absolute value of the result is multiplied by 100 to obtain a percentage. If the calculated error is less than 10%, no further runs are necessary. If the calculated error is greater than 10%, a third test must be run. After the third test, the field sampler should use his/her judgement to recalculate the error using the value from the third test.

41. Alkalinity (mg/*l* $CaCO_3$). The alkalinity of the water sample in milligrams per liter (mg/liter) at different pH values during titration.

APPENDIX 5.6, Continued

STANDARD ELECTRICAL CONDUCTIVITY FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

3. Ec Meter ID. The control number and manufacturer of the meter used to measure the specific conductance of samples or calibration solutions.

4. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

5. Acceptance Code. A one-character code assigned by the facility manager.

6. Known Value. Each standard solution will be prepared to a specific alkalinity as specified by the site manager. This value will not be disclosed to the field samplers until they have completed their calibration runs. After the calibration runs are complete, the samplers must contact the site manager and report the values determined in the field. If the values are within 10% of the known value, the site manager will authorize the sampling and supply the values that are to be entered in this data entry field.

7. Ec. The specific conductance of the water sample in micromhos/cm (mhos/cm) at the time of collection.

8. Temperature (°C). The temperature of the water sample in degrees Celsius (°C) at the time of collection.

9. Comments. Any other information.

APPENDIX 5.6, Concluded

STANDARD ALKALINITY TEST RECORD

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Field Rep. Name of the field representative.

3. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

4. Manufacturer. The company that manufactures the alkalinity test kit.

5. Alkalinity Test Kit ID. The control number used to identify the kit being utilized to measure the alkalinity of a sample or standard solution.

6. pH Meter ID. The control number and manufacturer of the meter used to measure the pH of samples of standard solutions.

7. Lab Code. A three-character code identifying the company responsible for preparing the standard solution.

8. Standard Solution ID. The control number used to identify the standard solution prepared by the quality control laboratory. The control number is assigned by the laboratory and conforms to the internal numbering system.

9. Known Value. Each standard solution will be prepared to a specific alkalinity as specified by the site manager. This value will not be disclosed to the field samplers until they have completed their calibration runs. After the calibration runs are complete, the samplers must contact the site manager and report the values determined in the field. If the values are within 10% of the known value, the site manager will authorize the sampling and supply the values that are to be entered in this data entry field.

10. Alkalinity Test Values ($CaCO_3$). The alkalinity of the water sample in milligrams per liter (mg/liter) at the endpoint of titration (pH = 4.50).

11. Comments. Includes preservation method, acidified or nonacidified, type of acid (if acid was used to preserve water sample), and any additional information.

STANDARD OPERATING PROCEDURE 2.3

SAMPLING MONITORING WELLS WITH A BLADDER PUMP

1. PURPOSE

To use a bladder pump to obtain representative groundwater samples at shallow depths that are beyond the capabilities of a peristaltic pump.

2. DISCUSSION

Each site-specific Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the type of samples to be collected. The collection and measurement of samples and documentation of data will be performed as described in the associated procedures.

For this procedure, a Middleburg squeeze-type bladder pump made completely of stainless steel and Teflon (for example, IEA, TIMCO, Well Wizard, Geoguard, and others) provides the least amount of material interference to the sample (Barcelona 1985). Analyses for a wide variety of metals, radionuclides, and organics, as well as field parameters, are valid for a sample obtained with this system. The water comes into contact with the inside of the bladder (Teflon) and the sample tubing (also Teflon) that may be dedicated to each well. Some wells may have permanently installed bladder pumps (for example, Well Wizard or Geoguard) that will be used to sample for all parameters.

Testing has shown that the nongas, contact positive-displacement pump causes less aeration in the sample than do various other retrieval methods (Barcelona 1984 and Nielsen 1985). Although no system can provide a true *in situ* sample, this method (if employed correctly) can yield a sample that is valid for numerous field measurements and chemical analyses, including organics. Although volatile organics may be collected by this method, sampling for volatile organics is so highly specialized that it is presented separately in SOP 2.8, Sampling for Volatile Organics.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel

1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation
1.5	Guide to Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
2.1	Presample Purging of Wells
2.2	Field Measurements on Groundwater and Surface Water Samples
3.1	Water Level Measurement

Monitoring wells are sampled immediately after the field measurements are taken by connecting the pump outlet tubing directly to the filter unit for filtered samples. Decrease the pump pressure so that the pressure buildup on the filter does not blow out the pump bladder or rupture the filter. Collect nonfiltered samples directly from the outlet tubing into the sample bottle.

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

G. Ensure that permission to discharge or a containment vessel for purged water has been obtained.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Locate the monitoring wells to be sampled and the appropriate decontamination area. Locate staging area and areas for managing purged water and expendable sampling materials. Check decontamination zones and barricades to public access.

B. Decontaminate all sampling equipment before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and the FSP or WP).

C. Sample monitoring wells from least to most contaminated to reduce the possibility for cross-contamination.

NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Water Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains copies of the form and label and instructions for completing the form and label.

3.3. Operation

3.3.1. Procedure for Operating a Bladder Pump

A. Unlock the well and use a stiff brush to brush away any dirt or debris from around the well cap. Remove the cap.

B. Use a petroleum detection probe to determine the presence of any floating organics in the wellbore water column. The probe can also be used to determine the total depth of the well and the depth-to-water.

C. Lower the precleaned water level probe or petroleum detection probe down the well until the indicator sounds (see SOP 3.1, Water Level Measurement). Measure (to the nearest 0.01 ft) the depth-to-water from the mark on the well casing. Record this measurement in the logbook.

D. For bladder pump purging, proceed as described below.

1. Whenever a well is purged or sampled with the bladder pump, record all field measurements and chemistry determinations on either the Groundwater Level or the Groundwater Levels and Gasoline Thickness Data form, as well as the Groundwater Quality Sampling Record form.

   Copies of these forms and instructions for completing the forms are provided in SOP 2.2, Field Measurements on Ground and Surface Water Samples, and SOP 3.1, Water Level Measurement.

2. Purge the well as described in SOP 2.1, Presample Purging of Wells.

3. Attach the pump to the dedicated Teflon tubing and begin pumping.

4. To avoid pumping the well dry, reduce the pumping rate after the water level has fallen to the screened level so that the rate of water removal does not exceed the rate of recovery after the water level has fallen to the screened level from the formation.

E. Allow the well to recover to 80% of its initial volume (.8 bore volumes) before sampling. Use the water level probe to monitor well recovery. If a well is not recovering rapidly, the site manager may choose to have the well sampled before the 80% recovery has been achieved.

3.3.2. Procedure for Collecting Samples

NOTE: Consult the associated SOPs for information about collecting and measuring samples and the documentation of data.

A. Before collecting data, calibrate probes for the required measurements (see SOP 2.2, Field Measurements on Ground and Surface Water Samples).

B. To collect samples, lower the pump down the well until the bottom (intake) of the pump is just at the top of the well screen. The well-dedicated pumps should have been installed at this depth.

C. The type of analysis for which a sample is collected determines the type of bottle, preservative, holding time, and filtering requirements (see SOP 1.4, Sample Containers and Preservation).

D. Adjust the pump and pressure rates with the cycle time so that the flow is not violent. In this way, the sample can be obtained in a timely manner.

E. Do not filter the samples unless so directed by the FSP or WP.

F. If filtration is required, be sure the non-dedicated Teflon elbow is removed. Then insert the .45 micron filter end of the delivery tube. Continue to collect samples. Upon completion, remove filter and dispose of properly. Field filtration for metals must be performed within 15 minutes of collection, prior to the addition of preservative.

G. Ensure that all samples specified in the FSP or WP have been collected.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to presampling conditions as specified in the FSP or WP.

C. Make sure all monitoring wells are properly labeled and the location I.D. is readily visible on the protective casing.

D. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record cleanup procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCES

Barcelona, M. J., J. A. Helfrich, E. E. Garske, and J. P. Gibb. 1984. "A Laboratory Evaluation of Groundwater Sampling Mechanisms." Groundwater Monitoring Review, Spring 1984: 32-41.

Barcelona, M. J., J. A. Helfrich, and E. E. Garske. 1985. "Sampling Tubing Effects on Groundwater Samples." Analy. Chem. No. 57: 460-63.

EPA. 1981. "Manual of Groundwater Quality Sampling Procedures." U.S. Environmental Protection Agency report EPA-600/2-81-160. Washington, D.C.: U.S. Government Printing Office.

EPA. 1982. "Handbook for Sampling and Sample Preservation of Water and Wastewater." U.S. Environmental Protection Agency report EPA-600/4-82-029. Washington, D.C.: U.S. Government Printing Office.

EPA. 1983. "Methods for Chemical Analysis of Water and Wastes." U.S. Environmental Protection Agency report EPA-600/4-79-020. Washington, D.C.: U.S. Government Printing Office.

EPA. 1984. "Test Methods for Evaluation of Solid Waste." 2d ed. U.S. Environmental Protection Agency report EPA-SW-846. Washington, D.C.: U.S. Government Printing Office.

EPA. 1985. "Practical Guide for Groundwater Sampling." U.S. Environmental Protection Agency report EPA/600/2-85/104. Washington, D.C.: U.S. Government Printing Office.

EPA. 1986. "RCRA Groundwater Monitoring Technical Enforcement Guidance Document." U.S. Environmental Protection Agency report OSWER-9950.1. Washington, D.C.: U.S. Government Printing Office.

Korte, Nic, and Dennis Ealey. 1983. "Procedures for Field Chemical Analyses of Water Samples." U.S. Department of Energy, GJ/TMC-07, Technical Measurements Center, Grand Junction Projects Office, Grand Junction, Colorado.

Korte, Nic, and Peter Kearl. 1985. "Procedures for the Collection and Preservation of Groundwater and Surface Water Samples and for the Installation of Monitoring Wells: Second Edition." U.S. Department of Energy, GJ/TMC-08, Technical Measurements Center, Grand Junction Projects Office, Grand Junction, Colorado.

Neilsen, David M., and Gillian L. Yeates. 1985. "A Comparison of Sampling Mechanisms Available for Small-Diameter Groundwater Monitoring Wells." Groundwater Monitoring Review, Spring 1985: 83-99.

CFR 49. 1985. Code of Federal Regulations, Title 49, U.S. Department of Transporatation, Parts 100-177. November 1, 1985. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Nongas contact bladder pump (with Teflon tubing)

_____ Compressor/batteries/battery chargers

_____ Amber glass bottles with Teflon-lined caps (0.5, 1, and 2 liters)

_____ Clear glass vials with Teflon septa (40 ml)

_____ Plastic bottles (1 liter)

_____ Teflon or other chemically inert tubing

_____ Stiff brush

_____ Concentrated H_2SO_4 (if needed)

_____ 40% NaOH (if needed)

_____ Insulated coolers

_____ Blue Ice or equivalent

_____ Padding for packaging of samples

_____ Swagelok fittings

_____ Plastic sheet

_____ Any additional supplies listed in associated procedures, as needed

STANDARD OPERATING PROCEDURE 2.4

SAMPLING MONITORING WELLS WITH A BUCKET-TYPE BAILER

1. PURPOSE

To obtain a representative groundwater sample at depths beyond the range (or capability) of suction lift pumps when volatile air stripping is of concern, well-casing diameters are too narrow to accept submersible pumps, or other difficult conditions are present.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the type of samples to be collected. Collection and measurement of samples and documentation of data will be performed as established in the associated procedures.

Bucket-type bailers are tall, narrow buckets equipped with a check valve on the bottom. A check valve allows water to enter from the bottom as the bailer is lowered and prevents its release as the bailer is raised. A bailer with a controlled flow, bottom-emptying assembly is recommended because this type of bailer greatly increases the ease with which water samples can be discharged to the sample containers (especially VOA vials).

Because of the aeration associated with most other recovery systems, the bucket-type bailer is the preferred method for collecting samples that are susceptible to volatile component air stripping or degradation. Samples can be recovered with a minimum of aeration if care is taken to gradually lower the bailer until it contacts the water surface and to allow it to sink as it fills. Teflon is generally the best construction material, but other materials (like PVC or stainless steel) are acceptable if compatible with the designated sample analysis outlined in the FSP or WP. The primary disadvantages of bailers are their limited sample volume and inability to collect discrete samples from a depth below the water surface.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activity. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel

1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation
1.5	Guide for Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
2.1	Presample Purging of Wells
2.2	Field Measurements on Ground and Surface Water Samples
2.8	Sampling for Volatile Organics
3.1	Water Level Measurement

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

G. Ensure that a containment system is available to collect purged water, as appropriate.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Locate the monitoring wells to be sampled and the appropriate decontamination area. Locate staging area and areas for managing purged water and expendable sampling materials. Check decontamination zones and barricades to public access.

B. Decontaminate all sampling equipment before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and the FSP or WP).

C. Sample monitoring wells from least to most contaminated to reduce the possibility for cross-contamination.

3.3. Operation

3.3.1. Procedures for Operating a Bucket-Type Bailer

A. Unlock the well and use a stiff brush to brush away any dirt or debris from around the well cap. Remove the cap.

B. Use a petroleum detection probe to determine the presence of any floating organics in the wellbore water column. The probe can also be used to determine the total depth of the well and the depth-to-water.

C. Lower the precleaned water level probe or petroleum detection probe down the well until the indicator sounds (see SOP 3.1, Water Level Measurement). Measure (to the nearest 0.01 ft) the depth-to-water from the mark on the well casing. Record this measurement in the logbook.

D. Collect a sample from the first bailer if specified in the FSP or WP. Otherwise, purge the well as described in SOP 2.1, Presample Purging of Wells, or SOP 2.3, Sampling Monitoring Wells with a Bladder Pump.

E. Allow the well to recover to 80% of its initial volume (.8 bore volumes) before sampling. Use the water level probe to monitor well recovery. If a well is not recovering rapidly, the site manager may choose to have the well sampled before the 80% recovery has been achieved.

F. Set up the reel and tripod wellhead and attach the bailer to the cable or line.

G. Slowly lower the bailer into the well until it contacts the water surface.

H. Allow the bailer to sink and fill with a minimum of surface disturbance.

I. Slowly raise the bailer out of the well. Do not allow the bailer line to contact the ground, either by coiling it on a plastic sheet or by looping it from arm to arm as the line is extracted from the well. The use of a reel greatly simplifies this process.

3.3.2. Procedure for Collecting Samples

NOTE: Also consult the associated SOPs for information on collecting and measuring samples and the documentation of data.

A. Whenever a well is sampled, record all field measurements and chemistry determination on either the Groundwater Level or the Groundwater Levels and Gasoline Thickness Data form, as well as the Groundwater Quality Sampling Record form.

   Copies of these forms and instructions for completing the forms are provided in SOP 2.2, Field Measurements on Ground and Surface Water Samples, and SOP 3.1, Water Level Measurement.

B. If a bailer with a controlled flow, bottom-emptying assembly is being used, connect the flow control device (stop-cock valve) to the bottom of the bailer, and open the stop-cock to allow water to gently flow into the sample containers. If a controlled flow device is not being used, tip the bailer to allow a slow discharge to flow gently down the inside wall of the sample bottle with minimal entry turbulence.

C. Filter or preserve the sample as specified in the FSP or WP. If filtration is required, use a 0.45 micron filter assembly; samples mustn be filtered within 15 minutes of collection prior to the addition of preservative.

D. Repeat the necessary steps as needed to acquire a sufficient volume of sample (see SOP 1.4, Sample Containers and Preservation).

   NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Water Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains copies of the form and label and instructions for completing the form and label.

E. Use a Teflon-lined cap if necessary. Secure the cap tightly.

F. Thoroughly decontaminate the bailer before sampling the next well, according to specific laboratory instructions or the general guidelines in SOP 1.6, General Equipment Decontamination. In some cases, especially where trace analysis is desired, it may be prudent to use a dedicated bailer for each well.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to presampling conditions and fill open sampling holes as specified in the FSP or WP.

C. Make sure all monitoring wells are properly labeled and the location ID is readily visible on the protective casing.

D. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. **Documentation**

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and that instructions for sample analyses are clearly understood.

4. SOURCES

Dunlap, W. J., J. F. McNabb, M. R. Scalf, and R. L. Crosby. 1977. " Sampling for Organic Chemicals and Microorganism in the Subsurface." U.S. Environmental Protection Agency report EPA/600/2-77/176. August 1977. Washington, D.C.: U.S. Government Printing Office.

Ford, Patrick J., Paul J. Turina, and Douglas E. Seely. 1984. "Characterization of Hazardous Waste Sites - A Methods Manual", in Vol. II of Available Sampling Methods. 2d ed. U.S. Environmental Protection Agency report EPA/600/4-84/076. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Teflon bailers

_____ Amber glass bottles with Teflon-lined caps (0.5, 1, and 2 liters)

_____ Clear glass vials with Teflon septa (40 ml)

_____ Plastic bottles (1 liter)

_____ Stiff brush

_____ Concentrated H_2SO_4 (if needed)

_____ 40% NaOH (if needed)

_____ Insulated coolers

_____ Blue Ice or equivalent

_____ Padding for packaging of samples

_____ Plastic sheet

_____ Any additional supplies listed in associated procedures, as needed

STANDARD OPERATING PROCEDURE 2.5

SAMPLING MONITORING WELLS WITH A SUBMERSIBLE PUMP

1. PURPOSE

To obtain a representative sample of the groundwater at depths beyond the capabilities of peristaltic pumps when bailing and bladder pumps are ineffective.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the type of samples to be collected. Collection and measurement of samples and the documentation of data will be performed as described in the associated procedures.

If submersible pumps are constructed from suitably noncontaminating materials, they can be used for sample collection. The chief drawbacks to their use are the lack of control over flow rates, the possible necessity for replacing the Teflon gears frequently, and the potential for cavitation processes at the drive mechanism. The use of submersible pumps in multiple well-sampling programs should be carefully compared with other sampling mechanisms (bailers and bladder pumps). Dedicated pumps should be considered for the sampling of deep wells. In most cases, a sample can be collected by bailer after purging the well with a submersible pump; however, submersible pumps may be the only practical sampling mechanism for extremely deep wells (more than 500 ft to water). Under these circumstances, dedicated pump systems should be installed in the deep well to eliminate possible cross-contamination of well samples.

Submersible pumps are generally constructed from plastics, rubber, and metal parts that could affect the analysis of samples for certain trace organics and inorganics. As a consequence, submersible pumps may be inappropriate for investigations requiring the analysis of samples for trace concentrations of contaminants. However, they may still be useful for presample purging. The FSP or WP provides guidance for using a submersible pump in sampling or purging a specific monitoring well.

Submersible pumps generally use one of two types of power supplies, electric or compressed gas. Electrically powered pumps can run off a 12-volt (V) DC rechargeable battery or a 110-V or 220-V AC power supply. Those units powered by compressed gas normally use a small electric compressor that also needs 12-V DC or 110-V AC power. They may also use compressed gas from bottles or high-performance hand pumps.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation
1.5	Guide to Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
2.1	Presample Purging of Wells
2.2	Field Measurements on Ground and Surface Water Samples
3.1	Water Level Measurement

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

G. Ensure that permission to discharge or a containment system is available to collect purged water.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Locate monitoring wells to be sampled and the appropriate decontamination area. Locate the staging area and areas for managing purged water and expendable sampling materials. Check decontamination zones and barricades to public access.

B. Decontaminate all sampling equipment before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and the FSP or WP).

C. Sample monitoring wells from least to most contaminated to reduce the possibility for cross-contamination.

3.3. Operation

3.3.1. Procedure for Operating a Submersible Pump

A. Unlock the well. Use a stiff brush to brush away any dirt or debris from around the well cap, and remove the cap.

B. Use a petroleum detection probe to determine the presence of any floating organics in the wellbore water column. The probe can also be used to determine the total depth of the well and the depth-to-water.

C. Lower the precleaned, water level probe or petroleum detection probe down the well until the indicator sounds (see SOP 3.1, Water Level Measurement). Measure (to the nearest 0.01 ft) the depth-to-water from the mark on the well casing. Record this measurement in the logbook.

D. Purge the well as described in SOP 2.1, Presample Purging of Wells.

E. Allow the well to recover to 80% of its initial volume (.8 bore volumes) before sampling. Use the water level probe to monitor well recovery. If a well is not recovering rapidly, the site manager may choose to have the well sampled before the 80% recovery has been achieved.

3.3.2. Procedure for Collecting Samples

NOTE: Also consult the associated SOPs for information on collecting and measuring samples and the documentation of data.

A. Whenever a well is purged, record all field measurements and chemistry determinations on either the Groundwater Level or the Groundwater Levels and Gasoline Thickness Data form, as well as the Groundwater Quality Sampling Record form. Copies of these forms and instructions for completing the forms are provided in SOP 2.2, Field Measurements on Ground and Surface Water Samples, and SOP 3.1, Water Level Measurement.

B. Fill the appropriate sample bottles by allowing pump discharge to flow gently down the side of the bottle with minimal entry turbulence. The order in which the bottles should be filled may be specified in the FSP or WP. If no order is specified, sample the semivolatile organics, radiological, conventional parameters, inorganics, and field measurements. Submersible pumps are not suitable for the collection of volatile organics. If the sample for inorganics is to be filtered (if dissolved inorganics are required, rather than total inorganics), refer to SOP 2.3, Sampling Monitoring Wells with a Bladder Pump.

   NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Water Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains copies of the form and label and instructions for completing the form and label.

C. If necessary, use a Teflon-lined cap. Secure the cap tightly.

D. Allow the pump system to drain; disassemble and remove it from the well (if necessary).

E. Decontaminate (according to SOP 1.6, General Equipment Decontamination) before sampling the next well.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to the presampling conditions as specified in the FSP or WP.

C. Make sure all wells are properly labeled and the location ID is readily visible on the guard pipe.

D. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record cleanup procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCES

deVera E. R., B. P. Simmons, N. D. Stephen, and D. L. Storm. 1980. "Samplers and Sampling Procedures for Hazardous Waste Streams." U.S. Environmental Protection Agency report EPA-600/2-80-018. Washington, D.C.: U.S. Government Printing Office.

DOI. n.d. "National Handbook of Recommended Methods for Water-Data Acquisition." U. S. Department of the Interior publication. Washington, D.C.

EPA. 1977. "Procedures Manual for Groundwater Monitoring at Solid Waste Disposal Facilities." U.S. Environmental Protection Agency report EPA-530/SW-611, August 1977. Washington, D.C.: U.S. Government Printing Office.

Ford, Patrick J., Paul J. Tarina, and Douglas E. Seely. 1984. "Characterization of Hazardous Waste Sites - A Methods Manual". Vol. II of Available Sampling Methods. 2d ed. U.S. Environmental Protection Agency report EPA/600/4-84/076. Washington, D.C.: U.S. Government Printing Office.

Gibb, J. P., R. M. Schuller, and R. A. Griffin. 1980. "Monitoring Well Sampling and Preservation Techniques." U.S. Environmental Protection Agency report EPA-600/9-80-010, March 1980. Washington, D.C.: U.S. Government Printing Office.

National Council of the Paper Industry for Air and Stream Improvement, Inc. 1982. "A Guide to Groundwater Sampling." National Council for the Paper Industry Technical Bulletin No. 362, January 1982.

Scalf, M. J., J. F. McNabb, W. Dunlap, R. Crosby, and J. Fryberger. 1980. Manual for Groundwater Sampling Procedures. R. S. Kerr Environmental Research Laboratory, Office of Research and Development, Cincinnati, Ohio.

Sisk, S. W. 1981. "NEIC Manual for Ground/Surface Investigations at Hazardous Waste Sites." U.S. Environmental Protection Agency report EPA-330/9-81-002. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Johnson Keck submersible pump

_____ Grumfus submersible pump

_____ Standard reta submersible pump

_____ Red jacket submersible pump

_____ Fultz submersible pump

_____ Alconox

_____ Trash bags

_____ Garden pressure sprayer

_____ Teflon or other chemically inert tubing

_____ Stiff brush

_____ Extension cord

_____ Jumper cables

_____ 12-V DC power source

_____ Tool kit

_____ Sample containers and preservatives

_____ 110-V AC power source

_____ Plastic sheet

_____ Any additional supplies listed in associated procedures, as needed

STANDARD OPERATING PROCEDURE 2.7

SAMPLING COMMERCIAL/MUNICIPAL/DOMESTIC WELLS

1. PURPOSE

To define guidelines for field personnel to follow in sampling commercial, municipal, and domestic wells.

2. DISCUSSION

Water samples may be collected from industrial, public, and private water supply wells to support the site characterization of a facility. The Field Sampling Plan (FSP) or Work Plan (WP) contains site-specific sampling instructions and locations, as well as specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the analyses that are to be performed. The collection and measurement of samples and documentation of data will be performed as described in the associated procedures.

In most instances, details concerning well installation and development will be either unknown or fragmentary. Procedures for sample collection must be carefully followed and well documented so that any questionable data can be attributed to factors beyond the control of the FSP or WP. Noninert materials in the well and pipes can alter the chemistry of the sample. Therefore, it is important to collect the sample as close to the wellhead as possible (Freeze 1979).

Care must be taken to promote strong community relations with private, public, and industrial neighbors in the vicinity of the facility. Successful completion of well sampling by following an SOP will impress neighbors with the professionalism and quality management of the program. Following properly documented field procedures will ensure that privately owned wells do not become damaged or contaminated through sampling activities.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation

1.5	Guide to the Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
2.1	Presample Purging of Wells
2.2	Field Measurement on Ground and Surface Water Samples
2.6	Sampling Monitoring Wells with a Peristaltic Pump
2.8	Sampling for Volatile Organics
3.1	Water Level Measurement

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Contact the well owner and set up a time to collect water samples and perform field chemistry measurements. If possible, arrange for

commercial, municipal, and domestic wells to be sampled before the monitoring wells.

B. Decontaminate all sampling equipment before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and the FSP or WP).

3.3. Operation

Consider specific sampling protocol on an individual basis; each sampling well will have a different pump, construction material, pipe, and access point for sample collection. Consult the FSP or WP for specific instructions for each well.

Groundwater samples will be grabbed from a discharge pipe or water faucet. Under no circumstances will the field technician pull a pump or insert a sampling device directly into a well unless specified in the FSP or WP or with documented approval from the site manager.

For collection of groundwater from public and private water supply wells, proceed as outlined below.

3.3.1. Preliminary Arrangements

A. Whenever a well is purged or sampled, record all field measurements and chemistry determinations on either the Groundwater Level or the Groundwater Levels and Gasoline Thickness Data form, as well as the Groundwater Quality Sampling Record form. Copies of these forms and instructions for completing the forms are provided in SOP 3.1, Water Level Measurement, and SOP 2.2, Field Measurements on Ground and Surface Water Samples, respectively.

B. If possible, discuss your activity with the well owner and set up the sampling vehicle in a location that will cause no inconvenience to anyone.

C. Determine if the discharge pipe or water faucet is on a water treatment system of some type (water softener, for example). Note this in the comments section of the Groundwater Quality Sampling Record (see SOP 2.2, Field Measurements on Ground and Surface Water Samples).

D. If possible, take a water level measurement (see SOP 2.1, Water Level Measurement).

E. If well documented, well completion data can be obtained. Calculate the bore volume as described in SOP 2.1, Presample Purging of Wells.

3.3.2. Sampling Procedures

A. Connect the appropriate sampling apparatus (cleaned tubing, connectors, and flow-through bath) to the discharge pipe. Obtain the sample as close as possible to the source and directly from the wellhead when feasible.

B. Set up and calibrate the equipment.

C. Begin withdrawing water from the well. If possible, run the water for at least 10 min to ensure that pipes have been thoroughly flushed. Record the volume of water purged.

D. Perform field measurements according to SOP 2.2, Field Measurements on Ground and Surface Water Samples, and SOP 2.8, Sampling for Volatile Organics.

E. Collect water samples according to SOP 1.4, Sample Containers and Preservation.

NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Water Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains copies of the form and label and instructions for completing the form and label.

F. Samples collected for dissolved metals must be filtered; analysis for total metals must not be filtered.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to presampling conditions and fill open sampling holes as specified in the FSP or WP.

C. Make sure all survey or sampling locations are properly staked and the location ID is readily visible on the location stake.

D. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record cleanup procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCE

Freeze, R. A., and J. A. Cherry. 1979. Groundwater. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Teflon tubing

_____ Pump fittings

_____ Water level probe

_____ Calibrated bucket

_____ Stopwatch

_____ Sample containers and preservatives

_____ Foam sleeves, vermiculite coolers, and Blue Ice (or equivalent)

_____ Plastic sheet

_____ Any additional supplies listed in associated procedures, as needed

STANDARD OPERATING PROCEDURE 2.8

SAMPLING FOR VOLATILE ORGANICS

1. PURPOSE

To outline procedures for collecting a representative groundwater sample and transporting it from its original environment to the laboratory for analysis of trace volatile organics.

2. DISCUSSION

The growing concern over the past several years about low levels of volatile organic compounds in water supplies has led to the development of highly sophisticated analytical methods that can provide detection limits at parts-per-trillion levels. Although laboratory methods are extremely sensitive, well controlled, and quality assured, they cannot compensate for a poorly collected sample. The collection of a sample should be as sensitive, highly developed, and quality assured as the analytical procedures.

A sample to be analyzed for dissolved volatile organics must be collected with minimal disturbance of the sample to limit aeration, which would cause a loss of volatiles from the sample.

Sample retrieval systems suitable for the valid collection of volatile organic samples are positive-displacement bladder pumps; reciprocating piston-type, submersible pumps; gear-driven, submersible pumps; syringe samplers; and bailers (Barcelona 1984; Bennett 1988; Nielsen 1985). Field conditions and other considerations will limit the choice of system. The focus of concern must be to provide a valid sample for analysis, one that has been subjected to the least amount of turbulence possible.

Materials of construction for bladders, pumps, bailers, and tubing are limited to stainless steel, Teflon, and glass. The tendency of organics to leach into and out of many materials makes the selection of materials critical for these trace analyses. The use of plastics, for example, Tygon, must be avoided. There are numerous ways of introducing foreign contaminants into a sample; these must be avoided by following strict sampling procedures and using only trained personnel.

Treatment of the sample with sodium thiosulfate preservative is required only when there is residual chlorine in the water. Residual chlorine could cause free, radical chlorination and change the identity of the original contaminants.

Holding time for the analysis of volatiles is seven days. It is imperative that the samples are shipped or delivered to the analytical laboratory daily. The bottles must be shipped on their sides to aid in maintaining the airtight seal during shipment, with adequate packing and cooling to ensure that they arrive intact. The sensitivity of the analysis and the fragility of the samples require that all volatile samples are collected in duplicate.

The Field Sampling Plan (FSP) or Work Plan (WP) contains site-specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the analyses that are to be performed. Collection and measurement of samples and the documentation of data will be performed as described in the associated procedures.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation
1.5	Guide to the Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
2.1	Presample Purging of Wells
2.2	Field Measurement on Ground and Surface Water Samples
2.3	Sampling Monitoring Wells with a Bladder Pump
2.4	Sampling Monitoring Wells with a Bucket-Type Bailer

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

G. Obtain appropriate discharge permits or containment vessels for purged water.

3.2.2. **Documentation**

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. **Field**

A. Locate monitoring wells to be sampled and the appropriate decontamination area. Locate the staging area and areas for managing purged water and expendable sampling materials. Check decontamination zones and barricades to public access.

B. Decontaminate all sampling equipment before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and the FSP or WP). Perform other sampling tasks before collecting the volatile samples (see SOP 2.1, Presample Purging of Wells; SOP 2.2, Field Measurements on Ground and Surface Water Samples; and SOP 2.8, Sampling for Volatile Organics).

C. Sample monitoring wells from least to most contaminated to reduce the possibility for cross-contamination.

3.3. **Operation**

3.3.1. **Preliminary Determinations**

A. Floating Organics. If floating organics are of concern (as determined in the FSP or WP and by field measurement for floating organics), obtain the sample with a bucket-type or bottom-valve bailer (see SOP 2.4, Sampling Monitoring Wells with a Bucket-Type Bailer).

B. Purging. Purge the well before sampling, as specified in the FSP or WP and according to SOP 2.1, Presample Purging of Wells. Ensure that the well was not pumped dry and that high flow rates were not employed to cause turbulence in the formation.

C. Residual Chlorine. Using the Hach Field Test Kit for Chlorine, determine if there is residual chlorine in the water to be sampled. If there is, treat the sample vial with a crystal of sodium thiosulfate before sample collection (see SOP 1.4, Sample Containers and Preservation).

3.3.2. Sample Retrieval

A. Bladder Pumps. Using a nongas, contact positive-displacement bladder pump is often mandated when dedicated pumps have been installed on wells. These bladder pumps are also suitable for shallow wells (less than 100 ft). They are somewhat difficult to clean, but can be used with well-dedicated sample tubing to avoid some cleaning. These pumps require a power supply and a compressed gas supply (or compressor). They may be operated at variable flow and pressure rates, which makes them ideal for both purging and sampling.

1. Increase the cycle time and reduce the pressure to the minimum that will allow the sample to come to the surface.

2. Open both vials, set caps in a clean place, and collect the sample during the middle of the cycle. Collecting both samples at the same time provides more similar samples than those collected at different times, but may be difficult. At a minimum, collect two samples from consecutive discharge cycles.

3. Holding the edge of the sample line at the top edge of the sample vial, allow the water to run down the side into the vial. Do not allow the water to drop or fall into the vial; avoid splashing. The discharge rate cannot exceed 100 mL/minute.

4. Fill the vials just to overflowing. Do not rinse the vials or excessively overflow them. There should be a convex meniscus on the top of the vials.

5. Be sure the caps have not been contaminated (splashed) and carefully cap the vials. Place the caps directly over the top and screw down firmly. Do not overtighten and break the cap.

6. Invert the vials and tap gently. Observe vials for at least 10 sec. If an air bubble appears, discard the sample and begin again. It is imperative that no entrapped air is in the sample vial.

7. Immediately place the vials in the protective foam sleeve and place into the cooler. They should be on their sides, rather than straight up.

8. Ship or deliver samples to the laboratory daily. Ensure that the samples are iced, but do not allow them to freeze.

NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Water Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains copies of the form and label and instructions for completing the form and label.

B. Reciprocating Piston-Type, Submersible Pumps. These systems are portable, self-contained, and capable of delivery flow rates of 30 gallons per hour at lifts up to 500 ft. The pump fits into 2-inch wells, which is the most common monitoring well diameter. The flow rate of the pump is

varied by increasing or decreasing the driving pressure supplied to the pump from a compressed air container. The gas driving the pump does not contact the sample being purged, making this type of pump the preferred tool to collect samples for volatile organic analyses in deep wells. The samples are collected as described in steps 2-8 of Section 3.3.2.A.

C. Gear-Driven, Submersible Pumps. These pumps are not as complicated or expensive as the bladder pumps. They provide comparable samples and are often easier to handle and clean than are other pumps. However, they do not have good control of flow rate, and more care must be exercised when sampling with them.

Collect the sample as described in steps 2-8 of Section 3.3.2.A. Use more care with this kind of a pump because the flow rate is not controllable and there is a greater potential for splashing and aeration of the sample.

D. Syringe Samplers. Only a limited number of commercial, syringe-type samplers are available (two are manufactured by IEA and TIMCO). Although some homemade devices apparently provide good, quality samples for volatile analysis, these devices are severely limited in sample volume and are specific to sampling for volatiles. Essentially, they operate with an evacuated chamber that is lowered down the well and allowed to fill from the pressure of the water. The entire mechanism is then brought to the surface with the sample. The sample can then be transferred to a sample vial, or the entire unit may be sent as the sample container.

1. If necessary, evacuate the syringe and lower the sampling device to just below the well screen.

2. Remove the constriction from the device and allow the syringe to fill with sample, applying slight suction.

3. Bring unit to the surface. If necessary, transfer the sample to vials (see steps 2-8 of Section 3.3.2.A).

E. Bailers. The positive-displacement, volatile-sampling bailer by GPI is the most appropriate bailer to collect water samples for volatile analysis. Other bailer types (messenger and bottom fill) are less desirable, but may be mandated by cost and site considerations. Generally, bailers can provide an acceptable sample, provided that the sampling personnel use extra care in the collection process.

1. If using the GPI bailer, insert a volatile organic analysis (VOA) vial into the clamp and assemble the unit.

2. Securely attach the bailer to the cable that is on a reel.

3. Lower the bailer slowly and gently into the well, taking care not to shake the casing sides or splash the bailer into the water.

4. Check the reel meter to note the location of the bailer in the well. Stop when the bailer reaches the screened interval.

5. Retrieve the bailer from the well slowly and gently, avoiding bumping and splashing.

6. Once the bailer reaches the surface, detach the bailer from the cable. Repeat steps 1-6 for the second vial.

7. Carefully open the GPI bailer unit and remove the vial. If using a conventional bailer, skip the next step. If using a GPI bailer, repeat steps 1-7 to collect the duplicate sample.

8. Begin slowly pouring from the bailer; collect the duplicate samples from the midstream sample.

9. Proceed as described in steps 2-8 of Section 3.3.2.A.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to presampling conditions as specified in the FSP or WP.

C. Make sure all wells are properly labeled and the location ID is readily visible on the protective casing.

D. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCES

Barcelona, M. J., J. A. Helfrich, E. E. Garske, and J. P. Gibb. 1984. "A Laboratory Evaluation of Groundwater Sampling Mechanisms." Groundwater Monitoring Review, Spring 1984: 32-41.

Barcelona, M. J., J. A. Helfrich, and E. E. Garske. 1985. "Sampling Tubing Effects on Groundwater Samples." Analy. Chem. 57: 460-63.

Nielsen, David M., and Gillian L. Yeates. 1985. "A Comparison of Sampling Mechanisms Available for Small-Diameter Groundwater Monitoring Wells." Groundwater Monitoring Review, Spring 1985: 83-99.

Robert Bennett Co. 1988. " Operation Manual for the Bennett Sampling Pump." Amarillo, Texas.

EPA. 1981. "Manual of Groundwater Quality Sampling Procedures." U.S. Environmental Protection Agency report EPA-600/2-81-160. Washington, D.C.: U.S. Government Printing Office.

EPA. 1982. "Handbook for Sampling and Sample Preservation of Water and Wastewater," U.S. Environmental Protection Agency report EPA-600/4-82-029. Washington, D.C.: U.S. Government Printing Office.

EPA. 1985. "Practical Guide for Groundwater Sampling.: U.S. Environmental Protection Agency report EPA/600/2-85/104, September 1985. Washington, D.C.: U.S. Government Printing Office.

DOE. 1985. "Field Technical Representative Manual." 2d ed. U.S. Department of Energy, Uranium Mill Tailings Remedial Action Project Office, Albuqucrque Operations Office document, June 1985. Albuquerque, New Mexico.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Teflon stainless steel bladder pump

_____ Teflon stainless steel gear-driven submersible pump

_____ Syringe sampler; stainless steel, Teflon, or glass

_____ Teflon stainless steel bailer (positive-displacement or point-retrieval)

_____ Teflon or other chemically inert tubing

_____ Fittings for pump

_____ 40-ml amber glass vials; Teflon-lined septa

_____ Hach field kit for chlorine

_____ $Na_2S_2O_4$ crystals

_____ Foam sleeves, coolers, and Blue Ice (or equivalent)

_____ Cable, reel, and tripod

_____ Air compressor or bottled nitrogen

_____ Plastic sheet

_____ Any additional supplies listed in associated procedures, as needed

STANDARD OPERATING PROCEDURE 2.9

SURFACE WATER SAMPLING

1. PURPOSE

To define guidelines followed by field personnel in sampling surface water bodies and documenting all aspects of surface water sample collection.

2. DISCUSSION

The sampling of streams, rivers, ponds, and lakes requires care to avoid contamination and collect representative samples.

The preferred method for collecting surface water samples uses a peristaltic pump (Korte and Kearl 1984). The pump system allows the union of the filtration assembly with the pump and the sample container. In this method, surface samples are filtered and collected directly with minimal elapsed time. With a peristaltic pump, only inert materials contact the sample. The inert pump tubing is relatively inexpensive and easily replaced.

An alternate method for this sampling is to collect surface water as grab samples. This method involves dipping a beaker, dipper, or other transfer device into the surface water to retrieve samples. The water sample can also be collected directly by dipping the collection bottle into the water and filling, removing, and capping it. This method has several drawbacks, including problems associated with sampling shallow waters like seeps, springs, or shallow streams. The likelihood of extensive air contact during the filtering of a sample and the time lapse before preservatives are added to samples are also problems. The only advantage of the grab-sample method is the low cost.

The Field Sampling Plan (FSP) or Work Plan (WP) includes guidelines for selecting sampling equipment and analytical methods to be used at each sampling location. The FSP or WP also has specific details about the procedures for this SOP. Collection and measurement of samples and the documentation of data will be performed as described in the associated procedures.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation
1.5	Guide to the Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
2.1	Presample Purging of Wells
2.2	Field Measurement on Ground and Surface Water Samples
2.6	Sampling Monitoring Wells with a Peristaltic Pump
2.8	Sampling for Volatile Organics

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. **Field**

A. Locate sampling sites along the surface water body and the appropriate decontamination area. Check decontamination zones and barricades to public access.

B. Locate a docking area for the boat, when appropriate.

C. Decontaminate all sampling equipment before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and the FSP or WP).

3.3. **Operation**

3.3.1. **Surface Water Sampling with a Peristaltic Pump**

A. Whenever a sample is collected, record all field measurements and chemistry determinations on the Surface Water Quality Sampling Record form. A copy of the form and instructions for completing the form are provided in SOP 2.2, Field Measurements on Ground and Surface Water Samples.

B. Refer to the general discussion about the operation of peristaltic pumps in SOP 2.1, Presample Purging of Wells, and SOP 2.6, Sampling Monitoring Wells with a Peristaltic Pump.

C. To collect a sample, use the procedure outlined below.

1. Attach tubing to peristaltic pump.

2. Lower intake into surface water and begin water removal. Collect or dispose of water in an acceptable container, as specified in the FSP or WP.

3. Record amount of water removed and discharge rates. A calibrated bucket and stopwatch are commonly used for this step.

4. If possible, remove enough surface water to ensure that field chemistry parameters are stabilized. Refer to SOP 2.2, Field Measurements on Ground and Surface Water Samples.

5. Perform final field measurements (see SOP 2.2, Field Measurements on Ground and Surface Water Samples).

6. Sampling surface water tends to clog filters rapidly. Attach clean filter (if applicable) and prepare to collect raw water samples into empty bottles.

NOTE: If filtering is required, run a few hundred milliliters (ml) of raw water through the filter before filling the sample bottles.

Filtering is required for dissolved metals; filtering must not be done for samples for total metals.

7. Fill the sample bottle, allowing the sample stream to flow gently down the side of the bottle with minimal entry turbulence. Do not allow dirt or dust to blow into the bottle or bottle cap. Shield bottles or bottle cap, as necessary, to eliminate entry of windblown material.

8. Rinse the inside of the bottle cap with raw water (using a Teflon-lined cap, if applicable). Screw the cap onto bottle tightly and shake the bottle if a preservative (for example, HNO_3, H_2SO_4, or HCl) has been added.

9. Immediately put the samples requiring refrigeration into an insulated cooler with Blue Ice or the equivalent. Put all other samples into a box and keep away from direct sunlight. For additional instructions, refer to SOP 5.4, Sample Containers and Preservation.

NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Water Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains copies of the form and label and instructions for completing the form and label.

3.3.2. Surface Water Sampling with a Transfer Device

A. Collect grab samples with a transfer device constructed of inert material like Teflon or stainless steel. Use the transfer device to transfer liquid and liquid wastes from surface waters to a sample bottle. This method prevents unnecessary contamination that would result if the outer surface of the sample bottle were directly immersed in the liquid. In general, field personnel must avoid using metal transfer devices for trace-metal analysis or plastic devices for sampling trace organics.

B. Use the transfer device in some sampling situations unless aeration must be avoided or significant material could be lost through adhesion to the transfer container.

C. Base the exact sampling location and number of grab samples obtained on the known tendency of waste to mix slowly in surface water (Korte and Kearl 1984). The site manager or field personnel should designate the number of samples to be gathered and the sampling locations.

D. To collect a sample, follow the procedure outlined below.

1. Rinse a carboy container several times with distilled water before introducing the sample.

2. Use the transfer device to fill the carboy slowly. Make sure the sample stream flows gently down the sidewall. For samples some distance offshore, an extension device might be required. If so, firmly attach the transfer device to the dipper and tighten all bolts.

3. Record the amount of water removed.

4. Perform field chemistry on raw water in the carboy (see SOP 2.2, Field Measurements on Ground and Surface Water Samples).

5. Perform steps 5-9 in Section 3.3.1.C (Surface Water Sampling with a Peristaltic Pump).

6. When collecting a sample from a frozen body of water, a carboy may not be effective because of its narrow mouth. In that event, use an appropriate receptacle and document its use in the logbook. The procedure for this kind of sampling is described below.

   a. Rinse the receptacle with distilled water.

   b. Grab or cut pieces of ice and fill the carboy or receptacle. If necessary, crush ice to fit.

   c. Prepare the sample as described in the procedures for surface sampling with a transfer device.

7. If the raw water is collected directly into the collection bottle, add preservatives after the sample is collected. Rinse the bottle thoroughly and shake it if a preservative (for example, HNO_3, HCL, or H_2SO_4) has been added.

8. Consult the FSP or WP for specific instructions for filtering or preserving the sample in the field. Store the sample immediately according to the proper procedures (see SOP 1.4, Sample Containers and Preservation).

NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Water Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains copies of the form and label and instructions for completing the form and label.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Place a permanent reference (sampling point) marker (for example, a wooden or metal stake with flagging that includes the location and site code) as close to the sampling location as possible.

3.4.2. Documentation

A. Record cleanup procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCES

Berg, E. L. 1982. "Handbook for Sampling and Sample Preservation of Water and Wastewaters." U.S. Environmental Protection Agency report EPA/600/4-82/029, September 1982. Washington, D.C.: U.S. Government Printing Office.

EPA. 1979. "Methods of Chemical Analysis of Water and Wastes." U.S. Environmental Protection Agency report EPA-600/4-79-020. Washington, D.C.: U.S. Government Printing Office.

Korte, N., and P. Kearl. 1984. "Procedures for the Collection and Preservation of Ground-water and Surface Water Samples and for the Installation of Monitoring Wells." Bendix Field Engineering Corporation report, Grand Junction, Colorado.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Peristaltic pump

_____ Filtration unit

_____ Teflon bore and fittings

_____ Clean filters and prefilters

_____ Transfer device for grab samples

_____ 2 or 5-gallon carboy container

_____ Wooden stakes

_____ Survey flagging

_____ Plastic or Teflon bucket

_____ Stopwatch

_____ Sample containers and preservatives

_____ Blue Ice or equivalent

_____ Any additional supplies listed in associated procedures, as needed

STANDARD OPERATING PROCEDURE 2.10

STREAM FLOW MEASUREMENTS USING FLUMES, VELOCITY-CROSS SECTIONAL AREA, AND DIRECT VOLUME

1. PURPOSE

To define guidelines that will be followed by field personnel for measuring surface water flow rates in ditches, creeks, and springs using flumes, velocity-cross sectional area method, and the bucket and stopwatch method.

2. DISCUSSION

A flume is an open channel flow-measuring device in which depth of flow is measured to compute flow volume. The Parshall flume is commonly used and is specially configured so as to be easily cleaned. The Cutthroat flume, in contrast to the Parshall, has a flat bottom that allows relatively easy temporary installation in existing channels. The velocity-cross sectional area method involves the measurement of width, depth, and time/velocity in order to calculate the stream flow. The bucket and stopwatch method involves the measurement of time required to fill a known volume.

The Subcontractor Site Manager is responsible for selecting flow measurement locations. The Field Team Leader is responsible for measuring flow rates immediately before collecting surface water quality samples in order to prevent contamination.

3. PROCEDURES

Procedures are described below for measuring surface flows by four methods. Existing Parshall and portable Cutthroat flumes are the preferred methods of measurement. Procedures are also presented for the velocity-cross sectional area method and for the bucket and stopwatch method, although these methods are to be used only when the Subcontractor Site Manager determines that the preferred methods are infeasible.

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1 through 1.10 is necessary. These SOPs contain general information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging and shipping; decontamination procedures/ and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
2.2	Field Measurements on Ground and Surface Water Samples
2.9	Surface Water Sampling

3.2. Preparation

3.2.1. Office

A. Review the SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1.

E. Ensure the proper operation of all field equipment listed in Appendix 5.1.

3.2.2. Documentation

A. Obtain a logbook form the QA officer.

B. Obtain copy of Streamflow Measurement Data Sheet (Appendix 5.2) and the data form completion instructions (Appendix 5.3).

3.2.3. Field

A. Locate installation sites to be measured along the stream and the appropriate decontamination area. Check decontamination zones and barricades to public access.

B. If appropriate, decontaminate all measuring equipment that may come in contact with surface water (see SOP 1.6, General Equipment Decontamination).

3.3. Operation

3.3.1. Existing Parshall Flumes (Leupold and Stevens 1978)

A. Remove any material that may have been deposited in the flume. Check that flume is level using carpenter's level. Inspect strip chart on recorder to be sure that it is operating. Report any deterioration of the station immediately to the Subcontractor Site Manager.

B. Read the depth of flow on the upstream permanent scale and the downstream permanent scale, if submerged, and record.

C. Measure and record throat width.

D. Record time and date of data collection.

3.3.2. Portable Cutthroat Flume

A. Estimate flow rate and select appropriate throat width for Cutthroat flume.

B. Assemble flume with nuts on outside of flow cross section.

C. Place the flume in the stream bed at the surface water station and level using the carpenter's level. The actual location of the station should be established in the field during the initial measurement event using the following criteria.

1. Channel cross section is small enough that flow can be easily channeled through the flume.

2. Sufficient sediments are available for use in diverting the flow.

3. There is sufficient gradient that free-flowing downstream conditions can be achieved.

D. Use sandbags and local sediments to divert the flow through the flume.

E. Check that there are no backwater effects downstream of the flume. Read the depth of flow from the attached scale and record.

F. Record the throat width.

G. Record the time and date of the measurements.

3.3.3. Velocity - Cross Sectional Area Method (DOI 1977) OR FLOAT METHOD

A. Mark off a convenient length (10 to 20 feet) along the bank where the width and depth of flow remain relatively constant and smooth with normal current. Record the marked-off length.

B. Measure and record the width and depth of flow at both the upstream and downstream ends of the marked-off length.

C. Measure and record the time required for a cork to pass through the length.

D. Record the time and date of measurement. Repeat process several times as this method provides only an approximate determination of velocity.

3.3.4. Bucket and Stopwatch Method (DOI 1977)

A. Dam the flow using local sediments so that all of the flow goes through the one-foot length of PVC pipe. Make sure the pipe is high enough off the ground that the flow will enter the selected vessel.

B. Place either the five-gallon bucket of the one-liter beaker under the pipe so that all of the flow is collected. Use the five-gallon bucket for flows in excess of one gallon per minute unless there is insufficient topographic relief to direct the flow into the bucket.

C. Measure the time required to fill the vessel.

D. Record the time and date of the measurement, the time required to fill the vessel, and the volume of the vessel.

3.4. Postoperation

3.4.1. Field

A. Complete logbook and stream flow measurement data sheet entries, verify the accuracy of entries, and sign/initial all pages.

B. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment or reuse.

C. Restore the site to presampling or premeasurement conditions. Record clean-up procedures in the field logbook.

D. Record any work left uncompleted in the field logbook (i.e. site restoration or long-term gauging.

E. Place a permanent reference (sampling point) marker (i.e. a wooden stake with flagging that includes the location and site code) as close to the measurement locations as possible.

F. Make a record of any equipment that malfunctioned or was damaged.

3.4.2. Office

A. Make calculations necessary to determine flow rate and review field forms for completeness. Deliver original forms and logbooks to the site manager for technical review.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage to the site manager.

4. SOURCES

Chow, 1964, Handbook of Applied Hydrology, A Compendium of Water-resources Technology.

Leupold and Stevens, Inc., 1978, Stevens Water Resource Data.

U.S. Department of the Interior, 1977, National Handbook of Recommended Methods for Water-Data Acquisition, revised August 1984.

5. APPENDICES

5.1. Equipment Checklist

5.2. Stream Flow Measurement Data Sheet

5.3. Data Form Completion Instructions

APPENDIX 5.1

EQUIPMENT CHECKLIST

_____ Portable Cutthroat flume
_____ Carpenter's level
_____ Tools for assembling flume
_____ Shovel and sandbags
_____ Twenty-foot tape measure graduated to 0.1 feet
_____ Twelve-foot steel tape measure graduated in 0.1 feet
_____ Cork
_____ One foot of PVC pipe
_____ Five-gallon bucket
_____ One-liter beaker
_____ Stopwatch
_____ Pencils
_____ Stream Flow measurement data sheet
_____ Field log book (containing control number)

APPENDIX 5.2

STREAM FLOW MEASUREMENT DATA SHEET

STATION NO.:_____

QA Review By/Date:_____

Location:_____ Date:_____

_____ Time:_____

Personnel:_____ W.O. #:_____

_____

	CALCULATIONS
FOR FLUME MEASUREMENT: • Depth of flow (ft) Upstream Scale:_____ Downstream Scale:_____ Throat Width (ft):_____ FOR WEIR MEASUREMENT: • H (in tenths of feet):_____ • L (in tenths of feet):_____ (Use appropriate calculation for particular weir.) FOR VELOCITY-CROSS SECTIONAL AREA METHOD: • Test Section Length (ft):_____ • Test Section Width (ft): Upstream Scale:_____ Downstream Scale:_____ • Test Start Time (min.):_____ • Test Stop Time (min.):_____ FOR BUCKET AND STOP WATCH METHOD: • Test Start Time (min.):_____ • Test Stop Time (min.):_____ • Collection Vessel Size:_____ • Volume of Water Collected:_____	

* This stream flow measurement data sheet is amended from WESTON SOP 2-10, and can be incorporated into stream flow measurement programs using weirs as flow measurement methods.

APPENDIX 5.3

DATA FORM COMPLETION INSTRUCTIONS

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

STREAM FLOW MEASUREMENT DATA SHEET

1. Station No. Designated Station ID Number.

2. QA Review By/Date. Signature of person completing QA of the form followed by the date the QA was completed.

3. Location. Facility name and specific area within the facility from which the sample was collected.

4. Personnel. Crew members.

5. Date. Date measurement was taken.

6. Time. Military time that measurement was obtained.

7. W.O.#. Work order or job number.

8. Measurement Method. Brief description of method used to obtain the stream flow measurement.

9. Fill in appropriate blanks for the measurement method used.

10. Calculations. Space for calculating flow rate.

11. Flow Rate. Calculated flow rate (cfs).

STANDARD OPERATING PROCEDURE 2.11

STREAM FLOW MEASUREMENTS USING WEIRS

1. PURPOSE

To define guidelines that will be followed by field personnel for measuring surface water flow rates in rivers, creeks, springs, and ditches using weirs.

2. DISCUSSION

A weir is an obstruction or dam built across an open channel over which liquid flows, often through a specially shaped opening or notch. The most common types of weirs are the rectangular weir, the trapezoidal (Cipolletti) weir, and the triangular (or V-notch) weir.

The Site Manager is responsible for selecting the specific weir type in accordance with stream characteristics. Each stream condition that will allow weir placement will be evaluated prior to field work. Subsequent to evaluation, the appropriate weir will be designed and constructed under supervision of the Field Team Leader. The Field Team Leader will also be responsible for measuring flow rates prior to collecting surface water samples and at other specified times.

3. PROCEDURES

Procedures are described below for measuring surface flows by the above listed methods. In some instances, weir construction may be abandoned after further evaluation of field conditions deem necessary. At this point, stream flow procedures will be incorporated in accordance with accepted SOPs.

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions For Field Personnel
1.6	General Equipment Decontamination
2.2	Field Measurements on Ground and Surface Water Samples
2.9	Surface Water Sampling

3.2. Preparation

3.2.1. Office

A. Review the SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1.

E. Ensure the proper operation of all field equipment listed in Appendix 5.1.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Obtain copy of streamflow measurement data sheet (Appendix 5.2) and data form completion instructions (Appendix 5.3).

3.2.3. Field

A. Locate installation sites to be measured along the stream and the appropriate decontamination area. Check decontamination zones and barricades to public access.

B. Clear any built-up debris from upstream and downstream area from weir.

C. Check weir plate and bulkhead for integrity, bends or bulges.

D. Make sure weir plate is level.

E. If appropriate, decontaminate all measuring equipment that may come in contact with surface water (see SOP 1.6, General Equipment Decontamination).

3.3. Operation

As previously mentioned, the three basic weir types are triangular (V-notch), rectangular, and trapezoidal (Cipolletti). Listed below are descriptions of the operations of each type and the equations used to calculate flow rates for each. Figure 3-1 displays an example of each weir, and Figure 3-2 describes components of weir and flow system.

3.3.1. Triangular (V-notch) Weirs

The triangular or V-notch sharp-crested weir (Figure 3-1) consists of an angular notch cut into a bulkhead in the flow channel. The apex of the notch is at the bottom and the sides are set equally on either side of a vertical line from the apex. The angle of the notch (α) most commonly used is 90°, although V-notch weirs with angles of 120°, 60°, 45°, 30°, and 22-1/2° are also used.

The discharge (head vs. flow rate) equation of a free flowing V-notch weir takes the form:

$$Q = KH^{2.5}$$

where:
Q = flow rate
H = head on the weir
K = a constant, dependent on the angle of the notch and units of measurement

THREE COMMON TYPES OF SHARP-CRESTED WEIRS

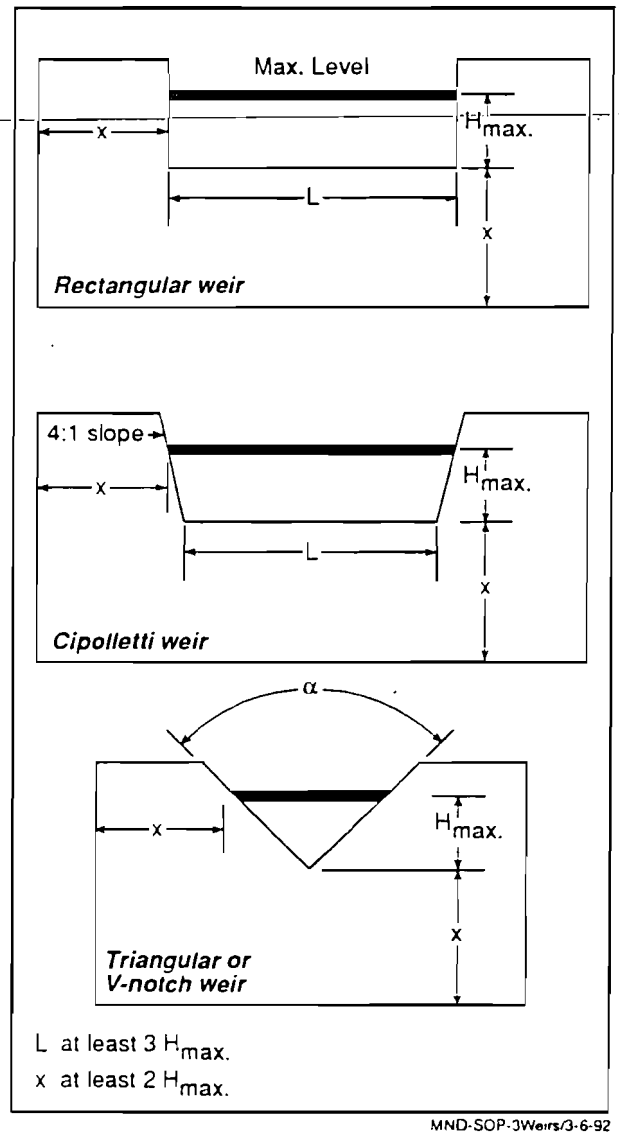


Figure 3-1. Types of Weirs

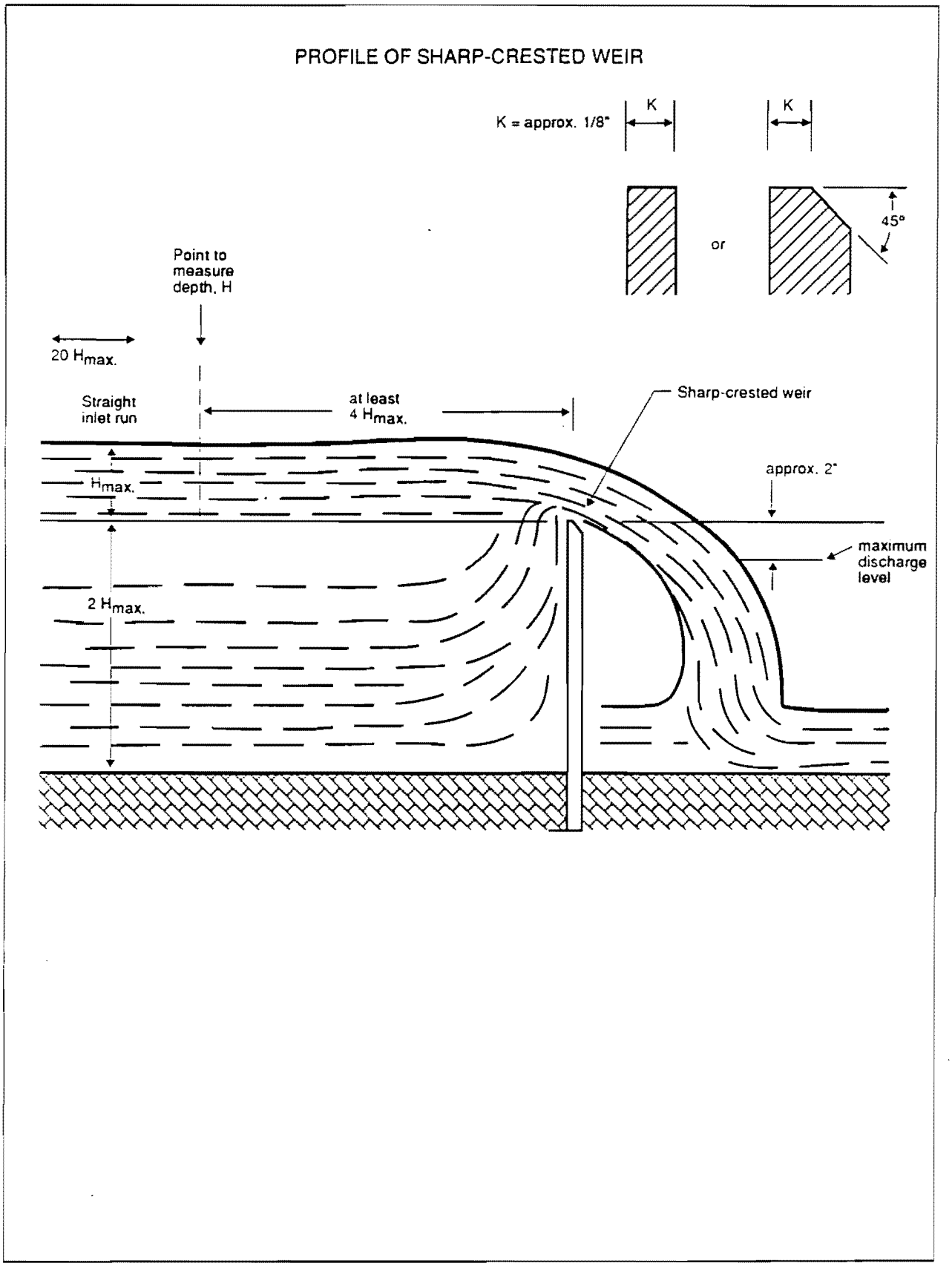


Figure 3-2. Weir Profile

For flow rate in cubic feet per second (cfs), millions gallons per day (mgd), and gallons per minute (gpm), and head in feet, the discharge equations for the common V-notch weirs are as follows:

α	CFS	MGD	GPM
22-1/2°	$Q = 0.4790\ H^{2.5}$	$Q = 0.3212\ H^{2.5}$	$Q = 223.1\ H5$
30°	$Q = 0.6760\ H^{2.5}$	$Q = 0.4369\ H^{2.5}$	$Q = 303.4\ H^{2.5}$
45°	$Q = 1.035\ H^{2.5}$	$Q = 0.6689\ H^{2.5}$	$Q = 464.5\ H^{2.5}$
60°	$Q = 1.443\ H^{2.5}$	$Q = 0.9326\ H^{2.5}$	$Q = 647.6\ H^{2.5}$
90°	$Q = 2.500\ H^{2.5}$	$Q = 1.616\ H^{2.5}$	$Q = 1{,}122\ H^{2.5}$
120°	$Q = 4.330\ H^{2.5}$	$Q = 2.798H^{2.5}$	$Q = 1{,}943\ H^{2.5}$

To calculate flow rates using the before mentioned formulas and constant angle values, the following steps should be followed.

A. Remove any debris in and around the weir plate. Inspect measuring gauge (if present) for accuracy.

B. Measure and record H from water level to notch. Calculate flow by using prescribed formula or equation.

C. Measure and record (see Figure 3-1), both from stream to notch, and from bulkhead to where liquid contacts V-notch. These distances should be pre-measured, and this exercise is mainly for QA/QC purposes.

D. Measure and record time, weather, and applicable field data in field logbook.

3.3.2. Rectangular

The rectangular type weir is classified into two types: contracted rectangular and suppressed rectangular. Contracted rectangular weirs have built-up ends on either end of the bulkhead. Suppressed rectangular weirs are open on both sides of the bulkhead, with no built-up ends.

- WITH END CONTRACTIONS

The discharge (head vs. flow rate) equation of a free flowing rectangular weir with end contractions takes the form:

$$Q = K\ (L - 0.2H)H^{1.5}$$

where:
Q = flow rate
H = head on the weir
L = crest length of weir
K = constant dependent upon units

For flow rate in cubic feet per second, millions gallons per day, and gallons per minute, and head in feet, the discharge equation for a rectangular weir with end contractions is as follows:

CFS: $Q = 3.330\ (L - 0.2H)H^{1.5}$
MGD: $Q = 2.152\ (L - 0.2H)H^{1.5}$
GPM: $Q = 1495\ (L - 0.2H)H^{1.5}$

where: L = crest length of weir in feet

- WITHOUT END CONTRACTIONS

The discharge equation of a free flowing rectangular weir without end contractions takes the form:

$$Q = K L H^{1.5}$$

where: Q = flow rate
H = head on the weir
L = crest length of weir
K = constant dependent upon units

For flow rate in cubic feet per second, million gallons per day, and gallons per minute, and head in feet, the discharge equation for a rectangular weir without end contractions is as follows:

CFS: $Q = 3.330\ L\ H^{1.5}$
MGD: $Q = 2.152\ L\ H^{1.5}$
GPM: $Q = 1495\ L\ H^{1.5}$

where: L = crest length of weir in feet

For both contracted and suppressed and type weirs, calculate flow rate as follows:

- Measure H and L and insert values into the appropriate calculation for the selected unit of discharge.

- Follow steps A, C, and D as described in the triangular weir section.

3.3.3. Trapezoidal (Cipolletti)

The trapezoidal sharp-crested weir is similar to a rectangular weir with end contractions except that the sides incline outwardly, producing a trapezoidal opening.

The discharge (head vs. flow rate) equation of a free flowing Cipolletti weir takes the form:

$$Q = K L H^{1.5}$$

where: Q = flow rate
H = head on the weir
L = crest length of weir
K = constant dependent upon units

For flow rate in cubic feet per second, millions gallons per day, and gallons per minute, and head in feet, the discharge equation for a rectangular weir with end contractions is as follows:

CFS: $Q = 3.67\ L\ H^{1.5}$
MGD: $Q = 2.176\ L\ H^{1.5}$
GPM: $Q = 1511\ L\ H^{1.5}$

where: L = crest length of weir in feet

- For measurements, follow steps A-D as described previous in triangular and rectangular weir descriptions.

3.4. Postoperation

3.4.1. Field

A. Complete logbook and streamflow measurement data sheet entries, verify the accuracy of entries, and sign/initial all pages.

B. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment or reuse.

C. Restore the site to presampling or premeasurement conditions. Record clean-up procedures in the field logbook.

D. Record any work left uncompleted in the field logbook (i.e., site restoration or long-term gauging).

E. Place a permanent reference (sampling point) marker (i.e., a wooden stake with flagging that includes the location and site code) as close to the measurement locations as possible.

F. Make a record of any equipment that malfunctioned or was damaged.

3.4.2 Office

A. Make calculations necessary to determine flow rate and review field forms for completeness. Deliver original forms and logbooks to the site manager for technical review.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage to the site manager.

4.0. SOURCES

Water Measurement Manual, 1967, United States Department of the Interior, Bureau of Reclamation, Denver, Colorado.

A Guide to Methods and Standards for the Measurement of Water Flow, 1975, Kulin, Gershon, and Compton, Philip R, National Technical Information Service, Springfield, Virginia.

Open Channel Flow Measurement Handbook, 1989, ISCO.

5. APPENDICES

5.1. Equipment Checklist

5.2. Streamflow Measurement Data Sheet

5.3. Data Form Completion Instructions

APPENDIX 5.1

EQUIPMENT CHECKLIST

_____ Carpenter's Level

_____ Hammer

_____ Shovel and sandbags

_____ Twenty-foot tape measure graduated to 0.1 feet

_____ Twelve-foot steel tape measure graduated in 0.1 feet

_____ Pliers and crescent wrench

_____ Waterproof pens

_____ Stream flow measurement data sheet

_____ Field book

APPENDIX 2
STREAM FLOW MEASUREMENT DATA SHEET*

STATION NO.:_____

QA Review By/Date:_____

Location:_____ Date:_____

_____ Time:_____

Personnel:_____ W.O. #:_____

_____

	CALCULATIONS
FOR FLUME MEASUREMENT: • Depth of flow (ft) Upstream Scale:_____ Downstream Scale:_____ Throat Width (ft):_____ FOR WEIR MEASUREMENT: • H (in tenths of feet):_____ • L (in tenths of feet):_____ (Use appropriate calculation for particular weir.) FOR VELOCITY-CROSS SECTIONAL AREA METHOD: • Test Section Length (ft):_____ • Test Section Width (ft): Upstream Scale:_____ Downstream Scale:_____ • Test Start Time (min.):_____ • Test Stop Time (min.):_____ FOR BUCKET AND STOP WATCH METHOD: • Test Start Time (min.):_____ • Test Stop Time (min.):_____ • Collection Vessel Size:_____ • Volume of Water Collected:_____	

* This stream flow measurement data sheet is amended from WESTON SOP 2-10, and can be incorporated into stream flow measurement programs using weirs as flow measurement methods.

APPENDIX 5.3

DATA FORM COMPLETION INSTRUCTIONS

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where this is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

STREAM FLOW MEASUREMENT DATA SHEET

1. Weir No. Designated Weir ID Number.

2. QA Review By/Date. Signature of person completing QA of the form followed by the date the QA was completed.

3. Location. Facility name and specific area within the facility from which the sample was collected.

4. Personnel. Crew members.

5. Date. Date measurement was taken.

6. Time. Military time that measurement was obtained.

7. W.O.#. Work order or job number.

8. Measurement Method (weir type). Brief description of method used to obtain the stream flow measurement.

9. Fill in appropriate blanks for the measurement method used.

10. Calculations. Space for calculating flow rate.

11. Flow Rate. Calculated flow rate (cfs, mgd, or gpm) using appropriate formula for given unit desired.

STANDARD OPERATING PROCEDURE 3.1

WATER LEVEL MEASUREMENT

1. PURPOSE

To determine the depth-to-water in an open borehole, cased borehole, monitoring well, or potentiometer.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) for the site contains specific details about the procedures, equipment, and frequency of measurements for this SOP. The documentation of water level measurements, air quality for the health and safety of field personnel, and equipment calibration will be performed as described in the associated procedures.

Generally, water level measurements from boreholes, potentiometers, or monitoring wells are used to construct potentiometric surface maps. Therefore, water level measurements at a given site should be collected within a 24-hr period. Under the following conditions, all measurements must be taken within a shorter interval.

- A range of observed changes between wells that is too large to be indicative of natural gradient groundwater
- Drastic atmospheric pressure changes
- Tidally influenced aquifers
- Aquifers affected by river stage, impoundments, or unlined ditches
- Aquifers stressed by intermittent pumping of production wells
- Aquifers being actively recharged because of precipitation event

The device used to measure water levels should be adequate to attain an accuracy of 0.01 ft. Generally acceptable devices are listed below.

- Steel tape
- An electric sounder
- A petroleum product probe
- A reflection sounder
- A transducer
- An airline

Place a survey mark on the casing as a reference measuring point. The mark should be permanent; a groove cut with a file is recommended. Mark another measuring reference on the grout apron and guard pipe. Document the measuring point in the logbook and on the data form.

Allow water levels in potentiometers and monitoring wells to stabilize for a minimum of 24 hrs after well construction and development before measurements are taken. Recovery may take longer in wells completed in tight formations.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
3.3	Operational Check of Pressure Transducers Used in Measuring Water Levels in Wells
6.1	Health and Safety Monitoring of Combustible Gas Levels
6.2	Health and Safety Monitoring of Organic Vapors with a Photoionization Detector
6.3	Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment. Be sure the water level measuring device has been calibrated.

E. Contact the carrier that will transport samples to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

E. Record the most recent calibration date for the water level measuring device in the logbook.

3.2.3. Field

A. Locate monitoring wells to be measured and the appropriate decontamination area. Check decontamination zones and barricades to public access.

B. Decontaminate all sampling equipment before taking the first measurement and between each well (see SOP 1.6, General Equipment Decontamination, and the FSP or WP).

C. When taking a number of water level measurements, it is preferable to start at those wells that are the least contaminated and proceed to those wells that are the most contaminated.

3.3. Operation

A. Whenever a water level is measured, enter a description of the sampling location and record of the measured value onto the Groundwater Level Data (Appendix 5.2) or the Groundwater Levels and Gasoline Thickness Data (Appendix 5.3) form. Use the latter when a petroleum or gasoline product is floating on the static water in the well. Fill out the forms as described in Appendix 5.4, Data Form Completion.

B. Place equipment on a Teflon or plastic sheet.

C. Remove locking well cap. Note the location, time of day, and date in the logbook and on the appropriate data form.

D. Remove the well casing cap.

E. If required by site-specific conditions, monitor the headspace of the well with a photoionization detector or a flame ionization detector to determine the presence of volatile organic compounds and record the measurements in the logbook or on appropriate forms. For the use of air monitoring instruments, see SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels; SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector; and SOP 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector.

F. Lower an electric, water level measuring device or equivalent (for instance, permanently installed transducers or airline) into the well until the water surface is encountered.

G. Measure the distance from the water surface to the reference measuring point on the well casing and record this distance in the logbook and on the data form in the comments column. Measurements will be taken to 0.01 ft. The reference points will be established in relation to an established National Geodetic Vertical Datum (NGVD). If the well casing is damaged, measure from some other permanently fixed structure or the ground surface and note this modification in the logbook and data form.

H. Measure depth-to-water at least twice or until results are reproduced and record each measurement in the logbook and in the comments column of the data form. Record the reproduced measurement in the depth-to-water column on the field form.

I. Lower the water level measuring device until the bottom of the well is encountered. Record the depth. Repeat procedure until a consistent depth of the well is obtained.

J. Remove all downhole equipment; replace the well casing cap and locking steel caps.

K. Rinse all downhole equipment and store for transport to the decontamination area.

L. Note any physical changes (like erosion or cracks) in the protective concrete pad or variation in the total depth of the well in the logbook.

M. If using pressure transducers to measure water levels, refer to SOP 3.3, Operational Check of Pressure Transducers Used in Measuring Water Levels in Wells.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to presampling conditions as specified in the FSP or WP.

C. Make sure the monitoring well is labeled or the borehole is properly staked and the location ID is readily visible on the location stake or protective casing.

D. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCE

EPA. 1986. "RCRA Groundwater Monitoring Technical Enforcement Guidance Document.: U.S. Environmental Protection Agency unnumbered document. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIXES

5.1 Equipment and Supplies Checklist

5.2 Groundwater Level Data Form

5.3 Groundwater Levels and Gasoline Thickness Data Form

5.4 Data Form Completion

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Site map showing well locations

_____ Steel tape and blue surveyor's chalk

_____ Electric sounder

_____ Reflection sounder

_____ Transducer and data logger

_____ Airline

_____ Petroleum product detection probe

_____ Plastic or Teflon sheeting

_____ Decontamination solutions

_____ Keys to well locks

_____ Tape measure graduated in 0.01 ft

_____ Nonwater-soluble black ink pens

APPENDIX 5.2

GROUNDWATER LEVEL DATA FORM

GROUNDWATER LEVEL DATA

PAGE ____ OF ____

FACILITY CODE _____ LOGGER CODE _____

LOG-DATE _____ ACCEPTANCE CODE _____

LOCATION ID	LOG TIME (HH:MM)	DEPTH TO WATER (FT) *	COMMENTS

* MEASUREMENT REFERENCE POINT FROM ☐ TOP OF GROUND OR ☐ TOP OF CASING

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS

GWD–012 (1/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.3

GROUNDWATER LEVELS AND GASOLINE THICKNESS DATA FORM

GROUNDWATER LEVELS AND GASOLINE THICKNESS DATA

FACILITY CODE _____ LOGGER CODE _____

LOG DATE _____ TYPE OF PROBE _____

ACCEPTANCE CODE _____

LOCATION ID	LOG TIME (HH:MM)	DEPTH TO WATER (FT) *	DEPTH TO GAS (FT)	COMMENTS

*MEASUREMENT REFERENCE POINT FROM ☐ TOP OF GROUND OR ☐ TOP OF CASING

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

TYPES OF PROBES: ROD–TEFLON ROD WITH PASTE OWI–OIL WATER INTERFACE PROBE OTH–OTHER (SPECIFY)

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
CSG–044 (1/88)

_____ FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE

APPENDIX 5.4

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

GROUNDWATER LEVEL DATA FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Logger Code. Three-character code identifying the company responsible for performing field measurements.

3. Log Date. The date when the measurement was made in the format DD-MMM-YY (01-JAN-88).

4. Acceptance Code. One-character code assigned by the installation manager.

5. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, radiological, and other measurements are taken.

6. Log Time. Using the 24-hr clock, time when the water level measurement was recorded. Must be in the format of hours:minutes.

Conversion Table

Conventional Time	24-Hour Time
1:00 a.m.	1:00
12:00 Noon	12:00
1:00 p.m.	13:00
2:00 p.m.	14:00
3:00 p.m.	15:00
4:00 p.m.	16:00
5:00 p.m.	17:00
6:00 p.m.	18:00
7:00 p.m.	19:00
8:00 p.m.	20:00
9:00 p.m.	21:00
10:00 p.m.	22:00
11:00 p.m.	23:00
12:00 Midnight	24:00

7. Depth-to-Water. The water level measurement in feet, tenths of feet, or hundredths of feet, depending on instructions provided in the FSP or WP.

8. Measuring Reference Point. Inscribe, ink, or paint a permanently marked measuring point on the PVC well casing from where all water level measurements for individual wells should be measured. This provides consistency in future water level measurements. If the measuring point is missing, record the water level relative to the ground surface, but mark the casing at the point the measurement was made. Record the distance from the new mark to the ground surface on the data form and in the logbook and describe the new measuring point in the comments column of the data form.

9. Comments. Any additional information.

GROUNDWATER LEVELS AND GASOLINE THICKNESS DATA FORM

Items 1 through 9 of the Groundwater Level Data form also apply to this form. In addition, use the following instructions that are unique to investigations where a gasoline (or other petroleum) product is floating on the water in the well.

1. Depth-to-Gas. The level measurement in feet, tenths of feet, or hundredths of feet, depending on instructions provided in the FSP or WP.

2. Type of Probe. The manufacturer's name and serial number (if available) of the petroleum probe being used.

STANDARD OPERATING PROCEDURE 3.3

OPERATIONAL CHECK OF PRESSURE TRANSDUCERS USED IN MEASURING WATER LEVELS IN WELLS

1. PURPOSE

To describe procedures for conducting office and field checks of pressure transducers.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) for the site contains specific details about the frequency of measurements for this SOP. The documentation of water level measurements will be performed as described in the associated procedures. Pressure transducers measure hydrostatic pressure, which can then be converted to groundwater elevations. A transducer measures pressures over a specific range of submergence. Outside this range, measurements will not be accurate. If it is submerged more than two times its design range or subjected to negative pressures, the transducer can be damaged. This SOP describes a method to ensure that the transducer is working properly.

Take several precautions when using transducers of submergence. Vent the transducer cable so that the temperature and barometric pressure will not cause variations in the transducer reading. If the vent port is plugged, inaccurate readings will result. If water enters the vent and flows downward into the transducer, the transducer may be destroyed. The transducer cable is susceptible to physical damage (for example, abrasions on sharp well casings) and chemical degradation from solvents. If the cable is damaged and submerged, the transducer may be destroyed or inaccurate readings may result.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
3.1	Water Level Measurement
3.2	Aquifer (Slug) Testing
3.4	Aquifer Pumping Test

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Ensure the proper operation of the electronic data logger and pressure transducer. Review guidelines in the operator's manual for the electronic data logger. Be sure that the data logger or its battery pack is fully charged. Using a 3- to 4-ft column of water (for example, capped PVC casing), test the response of the electronic data logger and pressure transducer. Conduct a test for the proper depth response and a test for the drift of readings in this column.

Depth Response Test

1. Mark the length of the transducer cable at measured intervals appropriate for the column of water. Using a 4-ft column of water, for example, mark the cable with tape at 1-ft intervals (for a 3-ft length), beginning at the transducer end.

2. Lower the transducer and cable to the bottom of the water column.

3. Connect the cable to the electronic data logger and begin the logging sequence.

4. Wait one minute and raise the transducer a measured length. Wait one more minute.

5. Continue raising the transducer cable to the measured segments and logging the results for one minute until all segments have been measured.

6. Check the lengths recorded on the data logger against the measured lengths. If the difference is greater than 2% to 5% of the measured length, return the transducer to the manufacturer for calibration.

Drift Test

1. Lower the transducer into the water column and tape to the edge of the column.

2. Connect the transducer cable to the electronic data logger and begin a 15-min logging sequence.

3. Check the results for noticeable drift of the depth measurement. An unacceptable amount of drift is 5% or more.

4. Notify the manufacturer if an unacceptable drift is occurring.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms for use during the field water level measurement task (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes and location IDs used in the completion of data forms.

3.2.3. Field

A. Locate the monitoring wells where the pressure transducers will be calibrated and locate the appropriate decontamination areas.

B. Assemble the testing equipment.

C. Decontaminate the transducer and cable as specified in the Sampling Plan and SOP 1.6, General Equipment Decontamination.

D. Make an initial water level measurement for the calibration monitoring well using a tape or water level sounder according to SOP 3.1, Water Level Measurement.

E. Before beginning the calibration, record the information and enter it into the electronic data logger. The type of information may vary, depending on the model used. When using different models, consult the operator's manual for the proper data entry sequence to be used. The following data are entered into the Enviro-Labs Model DL-120-MCP Data Logger as an example.

1. Baud rate
2. Station ID
3. Date (YY/MM/DD)
4. Time (HH:MM:SS)
5. Scale factors for each channel
6. Set logging sequence (use a logging sequence that will last for at least 3 min).

3.3. Operation

A. Cover sharp edges of the well casing with duct tape to protect the transducer cables.

B. Repeat the depth response test and drift test described in Section 3.2.1.E.

C. Continue the water level measurement task specified in the FSP or WP (for example, slug test or pumping test).

3.4. Postoperation

3.4.1. Field

A. After completing the aquifer test, decontaminate the transducer and cable according to SOP 1.6, General Equipment Decontamination. Do not use solvents to decontaminate the transducer cable.

B. Repeat 3.2.1.E: depth response test and drift test for closing calibration check.

C. Complete the shutdown of the electronic data logger:

D. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

3.4.2. Documentation

A. Complete initial and final calibration documentation (data logger printout).

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

3.4.3. Office

A. Deliver documentation to the site manager for technical review. He/she will review and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Arrange for the repair of any transducers that were damaged or could not be calibrated.

4. SOURCES

Enviro-Labs, Inc. 1986. "Operation manual: El-200 Groundwater Monitoring System with Model EL-120-MCP Data Logger," April 1986. Milford, New Hampshire.

In-Situ, Inc. 1984. "Owner's Manual: Hydrologic Analysis System, Model SE200," April 1984. Laramie, Wyoming.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Electronic data logger

_____ Pressure transducer and cable

_____ Water level sounder

_____ Tape measure graduated in 0.01 ft

_____ Capped PVC casing

_____ Duct tape

_____ Clean water

STANDARD OPERATING PROCEDURE 4.1.1

ADDENDUM TO STANDARD OPERATING PROCEDURE 4.1

METHODS TO CONTROL COMMUNICATION OF SUBSURFACE CONTAMINANTS WITHIN AND BETWEEN SATURATED ZONES DURING DRILLING AND WELL INSTALLATION

1. PURPOSE

To ensure that acceptable, consistent drilling and well installation procedures are used to prevent communication of subsurface contaminants in vadose zone soils with underlying groundwater and to prevent communication of contaminants between saturated zones.

2. DISCUSSION

The Field Sampling Plan (FSP) and Work Plan (WP) provide information about the scope and details of the drilling operation at a given site, including specifications for drilling techniques. This Standard Operating Procedures (SOP) serves as an Addendum to SOP 4.1 when drilling is performed in areas in which suspected subsurface contaminants may be encountered in vadose zone soils, landfill materials, or perched or regional saturated zones. This Addendum outlines special procedures to prevent communication of contaminants with underlying groundwater. Four specific potential cases of cross-contamination are addressed:

1) The potential for transporting vadose zone contamination including landfill materials into the Buried Valley aquifer (BVA);

2) The potential for transporting contamination between the upper and lower zones of the BVA, if and where they may exist;

3) The potential for transporting contamination between the BVA and the underlying saturated bedrock; and

4) The potential for transporting contamination from a perched saturated zone in bedrock to the regional groundwater.

3. PROCEDURES

Four sets of procedures are described. Each set relates specifically to one of the potential cases of cross-contamination described above.

3.1. Vadose Zone Contamination

The following procedures will be implemented when high concentrations of contaminants are encountered or anticipated during drilling in vadose zone soils or landfill materials. The intent is to minimize communication of known or suspected vadose zone contamination to the BVA. This will be accomplished by drilling through surface casing that isolates the entire thickness of contaminated vadose zone material from the borehole.

A. Commence drilling using a sonic rig with an 8-inch diameter casing and attached drive shoe.

B. Collect continuous soil samples or rock core.

C. Monitor soil samples or core for volatile vapors using a photoionization detector and an organic vapor analyzer. A significant reading is defined as any reading that would require Level C personal protective equipment, which is a reading greater than 3 units above background. Monitor soil samples or core for radiological hazards using a Pancake GM probe, MicroR meter, an Alpha scintillometer, or other equivalent instruments as specified in the site-specific Health and Safety Plan. A significant radiation level is defined as a reading of greater than 3 times the background level or any other action level that is exceeded as specified in the Health and Safety Plan.

D. Identify the depth of the soil contamination or the depth of the compacted clay landfill liner. This identification will be based on two criteria:

1. When the photoionization detector and the organic vapor analyzer indicate levels above background; and

2. The soil samples indicate that the compacted landfill liner has been encountered. If the liner cannot be identified in the soil samples, the as-built construction drawings may be required.

E. When drilling through landfill materials, examine the soil samples for the artificial-fill/compacted clay landfill liner contact.

F. Drill one foot into the top of the identified compacted landfill liner.

G. For a 4-inch diameter monitoring well,

1) Withdraw the sonic tool.

2) Drill an oversize hole with a cable tool to the depth of the sonic hole, simultaneously driving 10-inch steel casing to depth of core hole;

3) Resume drilling with the sonic rig and collect continuous core to the prescribed depth of the borehole.

4) Install the well and grout to land surface.

H. For a 2-inch diameter piezometer,

1) Withdraw the sonic tool.

2) Using the sonic rig, vibrate/drive a 7-inch casing and simultaneously feed a bentonite slurry from the bottom, outside the casing.

3) Resume drilling with the sonic rig and collect continuous core to the prescribed depth of the borehole.

4) Install the well and grout to land surface.

3.2. Buried Valley Aquifer

A. Commence drilling using a sonic rig with an 8-inch diameter casing and attached drive shoe.

B. Collect continuous soil samples or rock core.

C. Monitor soil samples or core for volatile vapors using a photoionization detector and an organic vapor analyzer. A significant reading is defined as any reading that would require Level C personal protective equipment, which is a reading greater than 3 units above background. Monitor soil samples or core for radiological hazards using a Pancake GM probe, MicroR meter, an Alpha scintillometer, or other equivalent instruments as specified in the pertinent Health and Safety Plan. A significant level is defined as a radiation reading of greater than 3 times the background level or any other action level that is exceeded as specified in the Health and Safety Plan.

D. Examine the soil samples or core for visible signs of contamination, such as artificial coloration or unusual textural changes.

E. Examine the soil samples or core for evidence of a till layer, which may serve as a confining layer. The presence of a confining layer will be determined by three criteria:

1. The texture of the soil samples or cored material can be defined as a true till, not just a gradation of outwash with greater silt and sand content;

2. The layer is at least 5 ft thick, as determined from the soil samples or core; and

3. The top of the layer occurs below the zone of saturation. All three criteria must be satisfied for the encountered material to be considered a confining layer.

F. If significant overlying contamination is found by the criteria listed in C or D, and it is determined that a confining layer exists by the criteria listed in E, then the following procedures should be followed:

1. Discontinue drilling.

2. Notify the WESTON project manager and await approval to proceed with Step 3.

3a. For a 4-inch diameter monitoring well,

i) Withdraw the sonic tool.

ii) Drill an oversize hole with a cable tool to the depth of the sonic hole, simultaneously driving 10-inch steel casing to depth of core hole;

iii) Install 2 to 3 ft of bentonite at bottom of casing and wait 24 hours for bentonite to set up.

iv) Resume drilling with the sonic rig and collect continuous core to the prescribed depth of the borehole.

v) Install the well and grout to land surface.

3b. For a 2-inch diameter piezometer,

i) Withdraw the sonic tool.

ii) Using the sonic rig, vibrate/drive a 7-inch casing and simultaneously feed a bentonite slurry from the bottom, outside the casing.

iii) Resume drilling with the sonic rig and collect continuous core to the prescribed depth of the borehole.

iv) Install the well and grout to land surface.

3.3. Buried Valley Aquifer and Underlying Bedrock

The following procedures will be implemented when the potential for cross-communication exists between the BVA and the underlying bedrock in an area of potentially significant levels of contamination. The intent of this procedure is to minimize the possibility of contamination within one zone from being transported to the other zone.

A. Commence drilling using a sonic rig with an 8-inch diameter casing and attached drive shoe.

B. Collect continuous soil samples or rock core.

C. Monitor soil samples or core for volatile vapors using a photoionization detector and an organic vapor analyzer. A significant reading is defined as any reading that would require Level C personal protective equipment, which is a reading greater than 3 units above background. Monitor soil samples or core for radiological hazards using a Pancake GM probe, MicroR meter, an Alpha scintillometer, or other equivalent instruments as specified in the pertinent Health and Safety Plan. A significant level is defined as a radiation reading of greater than 3 times the background level or any other action level that is exceeded as specified in the Health and Safety Plan.

D. Examine soil samples or core for visible signs of contamination, such as artificial coloration or unusual textural changes.

E. When bedrock is encountered during drilling and if significant overlying contamination is found by the criteria listed in C or D, then the following procedures should be followed:

1. Discontinue drilling.

2. Notify the WESTON project manager and await approval to proceed with Step 3.

3a. For a 4-inch diameter monitoring well,

i) Withdraw the sonic tool.

ii) Drill an oversize hole with a cable tool to the depth of the sonic hole, simultaneously driving 10-inch steel casing to depth of core hole;

iii) Ensure seal between casing and bedrock by cleaning out bottom of hole and waiting a minimum of 2 hours to see if water collects in borehole; if it does not, go to iv. If it is apparent that water is leaking past the casing, such as a water level rise in the casing, install 2 to 3 ft of bentonite at bottom of casing and wait 24 hours for bentonite to set up;

iv) Resume drilling with the sonic rig and collect continuous core to the prescribed depth of the borehole.

v) Install the well and grout to land surface.

3b. For a 2-inch diameter piezometer,

i) Withdraw the sonic tool.

ii) Using the sonic rig, vibrate/drive a 7-inch casing and simultaneously feed a bentonite slurry from the bottom, outside the casing.

iii) Resume drilling with the sonic rig and collect continuous core to the prescribed depth of the borehole.

iv) Install the well and grout to land surface.

3.4. Perched Saturated Zone Underlying Regional Groundwater

The following procedures will be implemented when the regional water table could be contaminated by seepage from a perched saturated zone. Specifically, this section applies to boreholes that will be drilled on the Main Hill in search of a regional potentiometric surface. Contamination of the uppermost weathered bedrock and overlying fill and soil has been identified on the Main Hill. Contamination has been measured at the seeps exiting from this uppermost perched zone at an elevation of approximately 820 ft above mean sea level. If a regional potentiometric surface exists below the Main Hill, it may lie at an elevation of approximately 680 ft above mean sea level, which corresponds with the Great Miami River stage.

A. Commence drilling using a air rotary rig with a 4-inch nominal diameter coring bit.

B. Collect continuous soil samples or rock core.

C. Monitor soil samples or core for volatile vapors and radiological hazards as prescribed in the Health and Safety Plan. Observe core for signs of saturation. Note the contact between weathered and competent bedrock. Drill 1-ft in to competent bedrock.

D. Withdraw the coring tool.

E. Drill an oversize hole with a cable tool to the depth of the core hole, simultaneously driving 10-inch steel casing to depth of core hole;

F. Ensure seal between casing and bedrock by cleaning out bottom of hole and waiting a minimum of 2 hours to see if water collects in borehole; if it does not, go to G. If it is apparent that water is leaking past the casing, such as a water level rise in the casing, install 2 to 3 ft of bentonite at bottom of casing and wait 24 hours for bentonite to set up;

G. Resume drilling with the core rig and collect continuous core to the prescribed depth of the borehole.

H. Upon completion of the borehole and removal of the drill pipe, set a packer below the surface casing and suspected seepage from perched zones and above the suspected depth of the regional potentiometric surface. Monitoring of the packer for pressure loss will be performed to ascertain effectiveness of the downhole seal. Additionally, it may be necessary to periodically pump water from above the packer to lessen the head pressure and to reduce potential for leakage.

I. Prior to removal of the packer, all water in the borehole above the packer will be removed.

J. Set up to perform downhole geophysical logging. Remove packer just prior to logging. Install the well within 48 hours of completion of the geophysical logging. If the well cannot be installed in 72 hours, then reinstall packers.

K. After geophysics are completed, the borehole will require reaming by air rotary rig to allow well installation.

STANDARD OPERATING PROCEDURE 4.1

SOIL BORING

1. PURPOSE

To ensure acceptable, consistent soil-boring procedures for all pertinent aspects of hazardous waste investigations.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information about the scope and details of the soil-boring operation, including specifications for drilling techniques. Refer to the FSP or WP for the type, number, and depth intervals at which samples will be collected. Collection and measurement of samples and the documentation of data will be performed as specified in the associated procedures.

To the extent possible, the boring process should not alter the medium that is being investigated. Various methods can be used for soil boring. These include, but are not limited to, hollow-stem augering, cable tool, mud rotary, and air rotary. For most investigations, dry hollow-stem augering or cable tool are the preferred drilling methods. Additional information concerning boring techniques is contained in the SOP 4.2, Rock Boring.

When drilling is performed in areas in which suspected subsurface-source contaminants may be encountered in the vadose zone, special protocols may be implemented to prevent communication of these contaminants with underlying soil or groundwater. Information regarding the potential for these conditions will be specified in the appropriate FSP or WP. Specific procedures are contained in an Addendum to Mound Plant ER Program SOP 4.1. The Addendum is titled, Methods to Control Communication of Subsurface Contaminants with Groundwater.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation

1.5	Guide to Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
4.2	Rock Boring
4.3	Monitoring Well Installation
5.1	Soil and Rock Borehole Logging and Sampling
6.1	Health and Safety Monitoring of Combustible Gas Levels
6.2	Health and Safety Monitoring of Organic Vapors with a Photoionization Detector
6.3	Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. If samples are to be collected for analyses, notify the laboratory of sample types, the number of samples, and the approximate arrival date. In addition, contact the carrier that will transport samples to obtain information on regulations and specifications.

F. Ensure that boring or well-drilling permits required by state or local authorities have been obtained, as well as procedures for compliance with state or local regulations regarding the submission of well logs and samples.

G. Research the site hydrogeology to estimate the key parameters (for example, anticipate the aquifer depth and thickness and types of contaminants).

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Before drilling, decontaminate all downhole drilling and sampling equipment, as well as the back of the drilling rig (as described in SOP 1.6, General Equipment Decontamination).

B. Clear the work site of all brush and minor obstructions.

C. Stake the location of utilities and the proposed boring areas.

NOTE: Ensure that proposed boring areas are not traversed by utility transmission ways.

D. If drilling fluid or grout is required, the source(s) of any water to be used in grouting and well installation must be approved by the site manager before field operations.

3.3. **Operation**

A. Decontaminate sampling equipment between sampling events (as described in SOP 1.6, General Equipment Decontamination).

B. Inventory all samples as specified in SOP 1.3, Sample Control and Documentation.

C. Handle all samples as specified in SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

D. Soil sampling and borehole logging must conform to SOP 5.1, Soil and Rock Borehole Logging and Sampling.

E. If field screening of samples for organic vapors is required, conduct the survey as described in SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector, and SOP 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector.

F. If the boring is to be completed as a monitoring well, review SOP 4.3, Monitoring Well Installation, for pertinent information.

G. Ensure that the back of the drilling rig is free of any leaking hydraulic lines. Do not grease surfaces to the point that excess grease could be dislodged during drilling.

H. Conduct work in compliance with all Occupational Safety and Health Administration (OSHA) regulations regarding drilling safety and the detection of underground utilities. If required by safety considerations, staked boring should be moved.

I. For each operating drill rig, designate an individual to be responsible for logging the samples, preparing the boring logs and well sketches, and the well installation

of that rig. More than one rig at a time may be supervised by a qualified individual.

J. Log the samples, prepare the boring logs and well sketches, and supervise the well installation.

NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Soil Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains copies of the form and label and instructions for completing the form and label.

K. Do not use dyes, tracers, or other substances or introduce them into borings, wells, lysimeters, grout, backfill, groundwater, or surface water unless specifically required by the contract.

L. If drilling fluids are required, maintain portable recirculation tanks for accurate records of fluid loss.

M. If specified, air systems include an air line oil filter that requires frequent replacement to remove all oil residue from the air compressor. Describe the air system manufacturer's name, model number, air pressures used, the frequency of changing the air line oil filter, and the evaluation of air line filtering in the logbook.

N. Follow the sampling interval and type of sampling equipment specified in the FSP or WP unless directed by the site manager.

O. Record all field measurements and comments on the Borehole Log (Soil) form (see SOP 5.1). Complete all lines on the forms. Use the letter designation NA for not applicable, ND for not done, or UNK for unknown when applicable. If some steps or procedures are not performed as described, state the reason (as is practicable) on the Borehole Log (Soil) form or submit it as an attachment.

P. Maintain a daily detailed driller's report during drilling. Resolve all disputes concerning drilling time, standby time, and work progress at the end of each day. The driller's representative should sign and initial the daily report to indicate concurrence. The report should provide a complete description of all formations encountered, the number of feet drilled, the number of hours on the job, any shutdowns because of breakdown, the feet of casing set, and other pertinent data.

Q. Collect, containerize, and store all excess soil cuttings, waste materials, and decontamination solutions for proper disposal as specified in the FSP or WP.

R. If temporary casing is specified in the FSP or WP, advance the casing to the specified depth. Remove all loose material within the casing before sampling. Advance the casing according to project requirements. Use the type of casing-advance technique that is specified in the FSP or WP. The casing will be of the flush-joint or flush-couple type and of sufficient size to allow for soil sampling, coring, or well installation. All casing sections should be straight and free of any obstructions. If hollow-stem augers are used, equip the bit with a plug device that can be removed at the required sampling depth.

S. The abandonment of any boring should follow any appropriate state regulations and be approved before any casing removal or sealing/backfilling. Seal borings by grouting from the bottom of the boring or well to the ground surface. This can be accomplished by placing a tremie pipe at the bottom of the boring and pumping grout through this pipe until undiluted grout flows from the boring at ground surface. The grout or tremie pipe may be gradually withdrawn, as long as the end of the pipe is at least 10 ft below the grout surface. The grout should consist of a neat cement with 4 lbs of commercial bentonite and approximately 7.5 gallons of water added for every 94-lb bag of cement. After the grout has set (about 72 hrs), the contractor should check the abandoned site for grout settlement. Fill any depression in the grout with the grout mix described above. Methods other than those described here may be implemented as dictated by appropriate state or local agencies. Do not use any grout additives except the 4% bentonite.

T. Safety equipment should be specified by the site health and safety officer. In all cases, the minimum physical protection worn by drilling personnel should include a hard hat, safety glasses, gloves, steel-toed leather boots, and hearing protection.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to presampling conditions and fill open sampling holes as specified in the FSP or WP.

C. Make sure all borehole locations are properly staked and the location ID is readily visible on the location stake.

D. Have the driller approve and initial the report of progress at the end of each operating day.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

D. If required by local or state law, file well-installation reports.

E. After a land survey, verify that the drilling permit describes the site location accurately. If necessary, modify and resubmit the permit.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. If samples have been collected for analysis, contact the laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

D. If drilling wastes were stored, determine the appropriate disposal (based on laboratory analysis) of the soils from the borings.

4. SOURCES

Barcelona, M. J., J. P. Gibb, J. A. Helfrich, and E. E. Garske. 1985. "Practical Guide to Groundwater Sampling." U.S. Environmental Protection Agency report EPA/600/2-85/104. Washington, D.C.: U.S. Government Printing Office.

DOE. 1985. "Field Technical Representaive Manual." 2d ed. U.S. Department of Energy, Uranium Mill Tailings Remedial Action Project Office, Albuquerque Operations Office document, June 1985. Albuquerque, New Mexico.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Sample containers

_____ Appropriate clothing

_____ Sprayer with clean water for dust control

_____ Any applicable licenses and permits

_____ Camera and film

_____ Measuring tape

_____ Plastic sheets

_____ Any additional supplies listed in associated procedures, as needed

STANDARD OPERATING PROCEDURE 4.2

ROCK BORING

1. PURPOSE

To ensure acceptable, consistent rock boring procedures for all pertinent aspects of hazardous waste investigations.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information about the scope and details of the rock-boring operation, including specifications on drilling techniques to be used at a site. Refer to the FSP or WP for the type, number, and depth intervals at which samples will be collected. Collection and measurement of samples and the documentation of data will be performed as specified in the associated procedures.

Rock boring provides samples for logging, geotechnical analysis, and monitoring well installation. The boring process should not (to the extent practicable) alter the medium that is being investigated. Rock-boring techniques include, but are not limited to, cable tool, rotary, reverse-circulation rotary, and coring.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation
1.5	Guide to Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
4.3	Monitoring Well Installation
5.1	Soil and Rock Borehole Logging and Sampling

6.1	Health and Safety Monitoring of Combustible Gas Levels
6.2	Health and Safety Monitoring of Organic Vapors with a Photoionization Detector
6.3	Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. If samples are to be collected for analyses, notify the laboratory of sample types, the number of samples, and the approximate arrival date. In addition, contact the carrier that will transport samples to obtain information on regulations and specifications.

F. Obtain all boring or well-drilling permits required by state or local authorities and informtion required for compliance with state or local regulations regarding the submission of well logs and samples. Obtain utility maps for the site and coordinate boring locations with utility companies.

G. Research the site hydrogeology to estimate the key parameters (for example, anticipated aquifer depth and thickness, types of contaminants, and grain-size distribution).

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Before drilling, decontaminate all downhole drilling and sampling equipment, as well as the back of the drilling rig (as described in SOP 1.6, General Equipment Decontamination).

B. Clear the working areas of brush and minor obstructions.

C. Stake the location of utilities and locations for proposed borings.

NOTE: Ensure that proposed boring areas are not traversed by utility transmission ways.

D. If drilling fluid or grout is required, the source(s) of any water to be used in grouting and well installation must be approved by the site manager before field operations.

3.3. **Operation**

A. Decontaminate sampling equipment between sampling events as described in the SOP 1.6, General Equipment Decontamination.

B. Handle all samples as described in the SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

C. Rock sampling and borehole logging must conform to the specifications defined in the SOP 5.1, Soil and Rock Borehole Logging and Sampling.

D. If field screening of samples for organic vapors is required, conduct it as described in the SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector, and SOP 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector.

E. If the boring is to be completed as a monitoring well, review the SOP 4.3, Monitoring Well Installation, for pertinent information.

F. The back of the drilling rig must be free of any leaking hydraulic lines. Do not grease surfaces to the point that excess grease could be dislodged during drilling.

G. Conduct work in compliance with Occupational Safety and Health Administration (OSHA) regulations regarding drilling safety and the detection of underground utilities. If required by safety considerations, relocate the borings.

H. For each operating drill rig, designate an individual to be responsible for logging samples, preparing boring logs and well sketches, and the well installation of that rig. More than one rig at a time may be supervised by a qualified individual.

I. Do not use dyes, tracers, or other substances or introduce them into borings, wells, soil moisture (water) samplers, grout, backfill, groundwater, or surface water unless specifically required by the contract.

J. If drilling fluids are required, do not use dug (lined) sumps; portable recirculation tanks are required.

K. Log the samples, prepare the boring logs and well sketches, and supervise the well installation.

NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Soil Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains copies of the form and label and instructions for completing the form and label.

L. If specified, air systems should include an air line oil filter that requires frequent replacement to remove all oil residue from the air compressor. The use of any air system should be fully described in the driller's log and include an equipment description, the manufacturer's name, model name, air pressures used, the frequency of changing the air line oil filter, and an evaluation of the air line filtering.

M. Follow the sampling interval and type of sampling equipment specified in the FSP or WP unless directed by the site manager.

N. Record all field measurements and comments on the Borehole Log (Rock) form (see SOP 5.1). Complete all lines on the forms. Use the letter designation NA for not applicable, ND for not done, or UNK for unknown when applicable. If some steps or procedures were not performed as described, state the reason (as practicable) on the Borehole Log (Rock) or submit it as an attachment.

O. During drilling, maintain a daily detailed driller's report and have a qualified person submit it if requested by the site manager. The report will provide a complete description of all formations encountered, the number of feet drilled, the number of hours on the job, any shutdowns because of breakdown, the feet of casing set, and other pertinent data.

P. If rock coring is specified, follow the procedure described below.

1. Casing is required for the full depth of the overburden in borings when rock is cored.

2. Advance the casing according to specifications in the FSP or WP. The casing should be of the flush-joint or flush-couple type and of sufficient size to allow for soil sampling, coring, and well installation. All casing sections should be straight and free of any obstructions. If hollow-stem augers are to be used, equip the bit with a plug device that can be removed at the required sampling depth.

3. Use drill rods for drilling rock that are NW in size to minimize vibration and chattering. Rock core size should be NX, NQ (wire line), or a size specified in the FSP or WP.

4. Use core barrels of the improved double-tube varieties (like the Christensen Series C or D models or the equivalent) that are equipped with a split inner tube.

5. Use five-ft barrels at the discretion of the site manager.

6. Make every effort to use clear water as a drilling fluid. In the event that this is impractical, recirculated water may be used at the discretion of the site manager, as long as a settling tank and filtering system are provided.

7. To minimize core losses in soft, erodable rock, the measures listed below should be required by the supervising field technician.

   a. Restrict drilling to short runs of 2 to 3 ft.

   b. Keep drilling water pressure low (under 150 psi).

   c. Keep feed pressure under 100 psi.

8. The supervising geologist should not permit a full coring run to be drilled if he/she suspects that core was left in the hole on the previous run. If this is believed to have occurred, shorten the next coring run by the length of core believed to have been left in the hole. This is necessary to prevent blocking the core barrel and grinding the core.

9. Upon removal of the core barrel from the drill hole, the driller should remove and open the split inner tube and deliver it to the field technician. If necessary to facilitate accurate logging, wipe off the core while it rests in the inner half.

10. Store rock cores in cardboard or wood core boxes so that their relative position by depth is preserved. Note intervals of lost core in the core sequence. Clearly mark the top of the core sequence. Mark boxes with the boring number, cored interval, and box number in cases of multiple boxes. The weight of each fully loaded box should not exceed 75 lbs. No data should appear on or within the box that is not specified on the Boring Log (Rock).

11. Each box should contain core from only one borehole. If spacers are required to separate intervals of core runs, use wooden blocks that have been clearly marked with the missing interval of core.

Q. If tri-cone rotary drilling is used, record the items below.

1. Rate of drilling

2. Percent of drilling fluid recovery

3. Changes in drilling fluid and water color

4. Lithologic description

   Determine lithologies by using a kitchen screen to separate rock particles from the return waters. Describe the cuttings according to SOP 5.1, Soil and Rock Borehole Logging and Sampling. Place the

cuttings on plastic sheets for easier tracking of depth and examination.

R. In the abandonment of any boring, follow any appropriate state regulations and obtain approval before any casing removal or sealing/backfilling. Seal borings by grouting from the bottom of the boring or well to the ground surface. This will be accomplished by placing a tremie pipe at the bottom of the boring and pumping grout through this pipe until undiluted grout flows from the boring at the ground surface. The grout or tremie pipe may be gradually withdrawn, as long as the end of the pipe is at least 10 ft below the grout surface. The grout should consist of a neat cement with 4 lbs of commercial bentonite and approximately 7.5 gallons of water added for every 94-lb bag of cement. After the grout has set (about 72 hrs), the contractor should check the abandoned site for grout settlement. Fill any depression in the grout with the grout mix described above. Methods other than those described here may be implemented as dictated by appropriate state or local agencies. Do not use any grout additives except the 4% bentonite.

S. Safety equipment should be specified by the site and safety officer. In all cases, the minimum physical protection worn by drilling personnel should include a hard hat, safety glasses, gloves, steel-toed boots, and hearing protection.

3.4 . Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to presampling conditions as specified in the FSP or WP.

C. Make sure all borehole locations are properly staked and the location ID is readily visible on the location stake or protective casing.

D. Have the driller approve and initial the report of progress at the end of each operating day.

E. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

D. If required by local or state law, file well-installation reports.

E. After a land survey, verify that the drilling permit describes the site location accurately. If necessary, modify and resubmit the permit.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. If samples have been collected for analysis, contact the laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

D. If drilling wastes were stored, determine the appropriate disposal (based on laboratory analysis) of the soils from the borings.

4. SOURCES

Barcelona, M. J., J. P. Gibb, J. A. Helfrich, and E. E. Garske. 1985. "Practical Guide to Groundwater Sampling." U.S. Environmental Protection Agency report EPA/600/2-85/104. Washington, D.C.: U.S. Government Printing Office.

DOE. 1985. "Field Technical Representaive Manual." 2d ed. U.S. Department of Energy, Uranium Mill Tailings Remedial Action Project Office, Albuquerque Operations Office document, June 1985. Albuquerque, New Mexico.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1.

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Sprayer with clean (potable) water for dust control

_____ Core boxes

_____ Wood block or lath

_____ Measuring tape (tenths)

_____ Large, black permanent marker

_____ Strapping tape

_____ Appropriate clothing

_____ Sprayer with clean water for dust control

_____ Any applicable licenses and permits

_____ Camera and film

_____ Sample containers

_____ Plastic sheets

_____ Any additional supplies listed in associated procedures, as needed

STANDARD OPERATING PROCEDURE 4.3

MONITORING WELL INSTALLATION

1. PURPOSE

To ensure acceptable, consistent monitoring well installation.

2. DISCUSSION

Monitoring well installation creates a permanent access for collecting groundwater samples and measuring aquifer characteristics. Ideally, the well should not alter the medium that is being sampled.

The Field Sampling Plan (FSP) or Work Plan (WP) provides information about the scope and details of monitoring well installation at a given site. A list of critical issues involved in monitoring well installation are listed below.

- Soil/rock boring technique
- Casing and screen materials
- Casing and screen diameter, screen length and size, and screened interval
- Filter pack, annular seal, grout, protective cap, and protective casing

Monitoring wells with a minimum borehole diameter of 8 inches will be installed using appropriate drilling techniques. All well construction materials should be chemically inert and also of sufficient strength to provide long-term structural integrity during well development and use. Therefore, it is recommended that four-inch-diameter, stainless steel, 0.010-inch slot well screen (or as specified in the work plan) be coupled with 4-inch-diameter, Schedule 40 PVC or stainless steel riser pipe as specified in the work plan. The location and completion depth of each well will be outlined in the applicable work plan or field sampling plan. A 10-ft long well screen is recommended for most monitoring well installations. In rare cases, well screens greater or less than 10 ft in length can be installed based on field conditions or as specified in the work plan. A quartz sand filter pack as specified in the work plan will stem the annulus between the well string and the borehole wall from the bottom of the borehole to no more than 2 ft above the top of the well screen. Grain size of the geologic medium will be evaluated by the onsite geologist to confirm that the proper filter pack size is used. It is recommended that the filter pack be emplaced as a sand slurry (composed of silica sand and project-approved potable water) using a tremie pipe. This procedure will help the sand to settle and compact within the borehole annulus and prevent the sand from bridging along the well screen interval. During emplacement, the depth to the top of the filter pack will be frequently tagged using a weighted measuring tape. A 2- to 4-ft interval of bentonite pellets or slurry will be emplaced on top of the filter pack using a tremie pipe. The bentonite will adequately seal the zone of completion. The remaining borehole annulus will be stemmed to the ground surface using a cement/bentonite grout mixture.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Borehole drilling, development of the wells, collection and measurement of samples, and the documentation of data will be performed as described in the associated procedures. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
2.2	Field Measurements on Ground and Surface Water Samples
3.1	Water Level Measurement
4.1	Soil Boring
4.2	Rock Boring
4.4	Monitoring Well Development
5.1	Soil and Rock Borehole Logging and Sampling
6.1	Health and Safety Monitoring of Combustible Gas Levels
6.2	Health and Safety Monitoring of Organic Vapors with a Photoionization Detector
6.3	Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Research site hydrogeology to estimate key parameters (for example, anticipated aquifer depth and thickness, types of contaminants, and grain-size distribution).

E. If water/sand slurry or grout is required, the source(s) of any water used must be approved by the site manager before field operations.

3.2.2. **Documentation**

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

E. Record all pertinent information (date, site, ID #, and location) in the logbook or on the appropriate form. Include field conditions, unusual circumstances, and weather. Instructions for logbook entries are in SOP 1.3, Sample Control and Documentation.

3.2.3. **Field**

A. Decontaminate all equipment before monitoring well installation, as specified in SOP 1.6, General Equipment Decontamination.

3.3. **Operation**

A. Monitoring wells must be installed in such a manner as to minimize disturbance and prevent introduction of contaminants to the subsurface environment. This is especially important if rotary drilling techniques using circulation fluid are employed. Any use of solvents, glues, soap, or cleaners is prohibited below grade unless otherwise stated in the specifications. When they are used, describe the material and include the manufacturer and type (specification). The use of pipe dope, grease, and oil is also prohibited; however, the use of teflon pipe dope is acceptable.

B. Monitor downhole and the breathing zone according to SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels; SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector; and SOP 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector. Perform readings as often as necessary to ensure the safety of workers. Record all measurements on the data collection forms included with these SOPs.

C. Record all field measurements and comments on the Well Completion Information or the Borehole/Well Construction Field Data Log form. Complete all lines on the forms. Use the letter designation NA for not applicable, ND for not done, or UNK for unknown when applicable. If some steps or procedures were not performed as described, state the reason (as practicable) on the form or submit it as an attachment. Copies of these forms are in Appendix 5.1 and Appendix 5.2, respectively. Fill out the forms as described in Appendix 5.6. For a current list of codes used in the data form completion, consult the ER Program data administrator.

D. Record the diagram of the well installation on the Well Completion Information form and show the depth from surface grade, the bottom of the boring, sump, screen location, coupling design and location, granular backfill, seals, grout, cave-in, centralizers, and the height of the riser above the ground surface. Record the actual composition of the grout, seals, and granular backfill on each Borehole/Well Construction Field Data Log form. Include the screen slot size (in inches), slot configuration, and screen manufacturer.

E. If appropriate, include the protective casing detail on all well sketches.

F. If a quartz sand filter pack is specified, follow the instructions listed below.

   1. Base the average grain size of the sand on the expected grain-size distributions in the screened formation and the size of predesigned well-screened openings. Use sand having a gradation that will allow no more than 10% of pack material to pass through the screen slots.

   2. Take at least one sample (1/2 to 1 pint in size) from each shipment of granular material, assign an identification number, and store it with the soil samples. Record the identification number on the sketch of each installation for which that material was used.

   3. The specifications of the proposed sand-pack material should be submitted by the contractor for approval before use. Describe each sample in terms of lithology, grain-size distribution, and source (company from which it was purchased and the pit or quarry of origin). This material should be clean, inert, and siliceous. Use well-sorted (poorly graded) sand, like No. 8-12 or a similar material, with approximately 10% passing the design slot size.

G. It is desirable that all padlocks at a given site can be opened by the same key. The numbers on the locks should be noted and then rubbed off the back.

H. Safety equipment should be specified by the site health and safety officer. In all cases, the minimum physical protection should include a hard hat, safety glasses, gloves, steel-toed leather boots, hearing protection, and coveralls for splash protection and cold weather.

I. Typical well construction features are in Appendixes 5.3 and 5.4. However, specific contract requirements may alter some of the components or values. After well development (SOP 4.4) is complete, indicate the water level on the well construction diagram of the Well Completion Information Form (Appendix 5.1).

J. When applicable, use stainless steel centralizers to assure the uniform and complete annular filling by granular backfill, seal, and grout materials. Fasten centralizers to the well casing by mechanical fasteners and radially space them around the casing at 120° or 90° intervals. On the Borehole/Well Construction Field Data Log form (Appendix 5.2), provide a description of the fastening device and centralizer that includes their locations.

K. If specified, place a quartz sand filter pack in the annulus next to the well screen in all monitoring wells. The sand pack ensures continuous flow capability from the natural formation to the well bore.

1. Fill the annulus between the well screen and borehole wall with a sand slurry (composed of silicon sand and project-approved potable water) using a tremie pipe. Frequently tag the depth to the top of the filter pack using a weighted measuring tape during this process to insure proper placement.

2. It is necessary to emplace sufficient sand slurry to stem the annular interval between the bottom of the borehole to no more than 2 ft above the top of the well screen after the sand pack has compacted and settled.

3. Ascertain the depth of the top of the sand with an acceptable measuring device or the tremie pipe and verify the thickness of the sand pack. If necessary, add more sand to bring the top of the sand pack to the proper elevation (no more than 2 ft above the top of the screen).

4. Under no circumstances should the sand pack extend into any aquifer other than the one to be monitored. In most cases, the well design can be modified to allow for a sufficient sand pack without the threat of cross flow between producing zones.

5. The site manager is the only individual authorized to modify an existing well design.

6. In materials that will not maintain an open hole, leave the hollow-stem augers in the hole during sand pack placement to the extent practical. Remove them as the level of the sand pack rises above the bottom of the augers.

L. Place a bentonite seal between the sand pack and grout to prevent infiltration of cement into the filter pack and the well. In special circumstances, an open borehole may be drilled to a depth below where the screen is set. If grout is used to seal off a lower aquifer or as backfill up to the proper level, place a bentonite seal above the grout before the casing, screen, and sand pack are introduced. Allow the grout to set up for a minimum of 12 to 24 hrs before placing the seal. Place the bentonite seal in the monitoring well as described below.

1. Fill the annulus between the well casing and borehole with a bentonite seal at least 2- to 4-ft thick (vertically) above the filter pack.

2. For wells less than approximately 50 ft in depth, use bentonite pellets. The pellets should have a minimum purity of 90% montmorillonite clay and a minimum dry bulk density of 75 lb/ft^3 for 1/2-inch pellets (as provided by American Colloid) or the equivalent. Pour the bentonite pellets directly down the annulus. Avoid introducing pellets into the well bore. Place a cap over the top of the well casing before pouring the bentonite pellets from the bucket. Pour the pellets

from different points around the casing to ensure even application. A tremie pipe may be used to redistribute and level out the top of the seal.

3. For the wells deeper than approximately 50 ft, the bentonite seal may either be poured as pellets or introduced as a slurry. The method should be determined by the site manager after evaluating the condition of the well and borehole wall. If there are no centralizers in the upper portions of the casing, manipulate the casing to prevent pellets from hanging up in the narrow annulus and to allow them to settle to the bottom as rapidly as possible.

4. If a slurry of bentonite is used as annular seal, prepare the slurry by mixing powdered or granular bentonite with potable water. The slurry should be of sufficiently high specific gravity and viscosity to prevent its displacement by the grout that will be placed above. Regardless of depth and depending on fluid viscosity, a few handfuls of bentonite pellets may be dumped in to solidify the surface of the bentonite slurry as a precaution.

5. Before adding bentonite pellets or slurry, be sure the sand pack has ceased settling by measuring the depth of the top of the sand with the tremie pipe. The sand pack should provide an adequate cover over the screen.

6. If a bentonite slurry is used, visually check the condition of the slurry by pumping into a bucket or onto the ground. Retract the tremie pipe 3 ft from the top of the sand pack and begin pumping.

7. In materials that will not maintain an open hole, leave the hollow-stem augers in the hole during bentonite seal placement to the extent practical. Remove them as the level of the bentonite rises above the bottom of the augers.

8. In all situations, use a 2 to 4-ft bentonite seal. Tag the top of the seal by an acceptable measuring device or tremie pipe to verify that the proper thickness of seal has been placed in the annulus.

9. Until the specified quantity of bentonite has been placed in the well annulus, repeat the application and verification.

M. Place grout from the top of the bentonite seal to the surface and allow a minimum of 24 to 48 hrs after the bentonite seal has been placed to allow it to set up. Only Type I or Type II cement without accelerator additives may be used. Place grout in the monitoring wells as described below.

1. Fill the annulus between the well casing and borehole wall with grout.

2. Place the grout from a grout tremie pipe.

3. The tremie pipe should normally consist of 1.25-inch PVC or steel pipe. One-inch rolled, thin-walled polypipe has been used with success in some cases.

4. Pump the grout through this pipe to the bottom of the open annulus until undiluted grout flows from the annulus at the ground surface.

5. The grout should consist of a neat cement mix composed of 4 lbs of commercial bentonite and approximately 7.5 gallons of water added to each 94-lb bag of cement. Use only grout mixed with approved water.

6. In materials that will not maintain an open hole, leave the hollow-stem augers in the hole during grouting to the extent practical. Remove them as the level of the grout rises above the bottom of the augers.

7. While the grout is still green, add more grout to compensate for the removed casing or auger and tremie pipe and to ensure that the top of the grout is at or above the ground surface.

8. The protective casing should now be placed.

9. After the grout has set (about 48 hrs), fill any depression in the grout caused by settlement with a grout mix similar to that described above.

N. Install protective casing around all monitoring wells. Exceptions may be made on a case-by-case basis. The minimum elements in the protection design include those listed below.

1. The protective steel cap should keep precipitation out of the protective casing and should be secured to the casing by padlocks.

2. Set a 5-ft (minimum) length of black iron pipe or galvanized pipe so that the top of the pipe is about 1.5 to 3 ft above the ground surface and grout it in place as shown in Appendixes 5.3 and 5.4.

3. Use the pipe diameter of 8 inches for 4-inch wells and 6 inches for 2-inch wells (depending on approved borehole size). A drain hole near ground level that is 0.5 inch in diameter is permitted.

4. Provide a protective steel cap and secure it to the top of each protective casing.

5. Mark the location ID on the inside and outside of the cover with indelible ink and on the protective casing with paint.

O. Install a concrete well apron or pad around each monitoring well as shown in Appendix 5.5. The apron will be constructed with minimum radius of 3-ft (6- by 6-ft) and 4 inches thick. The body of the apron should contain a 4- by 4 inch wire mesh to reinforce the structure. The concrete surface should be roughened for traction and bevelled at an angle of 2 degrees to drain runoff. A 10-inch diameter sona tube should surround the protective casing with bentonite powder, filling the annulus between the casing and the tube. This will prevent the apron from cracking during periods of frost heave. A surveyor's pin stamped with the well location ID should be installed on the well apron surface before the concrete hardens.

P. The installation of guard posts around the periphery of the well apron is recommended in areas where vehicle traffic might pose a hazard.

Guard posts shown in Appendix 5.6 consist of steel posts that are 3 inches in diameter or tee-bar driven steel posts. Three are radially located 4 ft around each well and driven 2 ft below the ground surface, having a minimum of 4 ft above the ground surface with flagging in areas of high vegetation. Each post may be cemented in place.

Q. Drilling through a suspected zone of contamination within the vadose zone could create a more permeable conduit for infiltrating groundwater to enter and leach potential contaminants to the static water table. The following protocols are supplemental to information described in Section 3.3 for borehole drilling and installation of monitoring wells in this type of situation. Borehole and well construction details are shown in Appendix 5.7.

1. Use appropriate drilling techniques to collect continuous core.

2. Monitor core for volatile vapors as described in Section 3.3.B.

3. Examine core as described in SOP 5.1, Soil and Rock Borehole Logging and Sampling, to determine the vertical extent of contaminated soils.

4. Remove drill string and enlarge the borehole to 1 ft below the base of the zone of contamination.

5. Set surface casing from the bottom of the enlarged borehole to the ground surface and pressure grout the annulus between the outside of the surface casing and the borehole wall. Use Type I or Type II cement without accelerator additives. The grout should be mixed according to specifications outlined in Section 3.3.M.5.

6. Allow a minimum of 24 hours for the grout to set up.

7. Trip the drill string to the base of the surface casing and drill a telescoped borehole to the depth specified in the applicable work plan or field sampling plan.

8. Install the monitoring well according to specifications outlined in Section 3.3.

R. In the event that a borehole must be abandoned for failure to reach the specified depth (or any other cause), grout the borehole with a tremie pipe from the bottom up with grout mixed to the specifications described in Section 3.3.M.5.

S. In the event that a well must be abandoned for failure to reach specified depths, loss of tools, or inadvertent contamination, rip the screened interval with an appropriate tool. Grout the well with a tremie pipe (from the bottom up) with grout mixed to the specifications described in Section 3.3.M.5.

3.4 Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to predrilling conditions as specified in the FSP or WP.

C. Make sure all monitoring wells are properly labeled and the location ID is readily visible on the protective casing.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

4. SOURCES

Barcelona, M. J., J. P. Gibb, J. A. Helfrich, and E. E. Garske. 1985. "Practical Guide to Groundwater Sampling." U.S. Environmental Protection Agency report EPA/600/2-85/104. Washington, D.C.: U.S. Government Printing Office.

DOE. 1985. "Field Technical Representative Manual." 2d ed. U.S. Department of Energy, Uranium Mill Tailings Remedial Action Project Office, Albuquerque Operations Office document, June 1985. Albuquerque, New Mexico.

5. APPENDIXES

5.1. Well Completion Information Form

5.2. Borehole/Well Construction Field Data Log Form

5.3. Typical Construction of Overburden Well

5.4. Typical Construction of Bedrock Well

5.5. Typical Construction of Well Apron

5.6. Post Placement Around Well

5.7. Typical Construction of Telescoped Well with Surface Casing

5.8. Data Form Completion

APPENDIX 5.1

WELL COMPLETION INFORMATION FORM

WELL COMPLETION INFORMATION

PAGE 1 OF 2

FACILITY CODE _____

LOCATION ID _____

ACCEPTANCE CODE _____

OWNER CODE _____

INSTALLER CODE _____

INSTALLATION DATE _____

CASING ELEVATION (FT MSL) _____

CASING LENGTH (FT) _____

CASING DIAMETER (IN) _____

SEAL END DEPTH (FTFD) _____

SCREEN MATERIAL _____

RISER MATERIAL _____

FILTER PACK LENGTH (FT) _____

FORMATION OF COMPLETION (US/RC) _____

WELL TYPE CLASSIFICATION _____

WELL COMPLETION METHOD _____

ZONE OF COMPLETION _____

OPEN/SCREEN DEPTH (FTFD) _____

OPEN/SCREEN LENGTH (FT) _____

OPEN/SCREEN AREA (IN^2 /FT) _____

FLOW RELATIONSHIP _____

CAP MATERIAL _____

CAP TYPE _____

WELL TYPE CLASSIFICATIONS:
- M – MONITOR WELL
- P – PRODUCTION WELL
- T – TEST WELL
- O – OTHER (SPECIFY)

CAP TYPES:
- LC – LOCKING
- SL – SLIP–ON
- TR – THREADED
- NO – NONE
- SC – SCREW ON
- OT – OTHER (SPECIFY)

CASING, CAP, RISER MATERIALS :
- BR – BRICK
- CI – CONCRETE
- CU – COPPER
- FI – FIBERGLASS
- GI – GALVANIZED IRON
- WI – WROUGHT IRON
- SS – STAINLESS STEEL
- OM – OTHER METAL
- TE – TEFLON
- PV – PVC
- RS – ROCK OR STONE
- ST – STEEL
- TI – TILE
- CS – COATED STEEL
- WO – WOOD
- NO – NONE
- OT – OTHER (SPECIFY)

FLOW RELATIONSHIPS:
- U – UPGRADIENT
- D – DOWNGRADIENT
- C – CROSS GRADIENT
- O – ON SITE
- N – NOT KNOWN
- B – BACKGROUND

ZONES OF COMPLETION:
- A – ARTESIAN
- B – ANISOTROPIC
- C – CONFINED
- H – AQUITARD
- G – AQUICLUDE
- I – ISOTROPIC
- M – MULTI–SYSTEM
- S – SEMI–CONFINED
- U – UNCONSOLIDATED

WELL COMPLETION METHODS:
- C – POROUS CONCRETE
- F – GRAVEL PACK
- H – HORIZONTAL GALLEY
- O – OPEN END
- P – PERFORATED/SLOTTED
- S – SCREEN
- T – SAND POINT
- W – WALLED OR SHORED
- X – OPEN
- O – OTHER (SPECIFY)

NOTE : FTFD = FEET FROM DATUM

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS

WCD–008 (3/88)

FORM COMPLETED BY/DATE _____

TECHNICAL REVIEWER/DATE _____

APPENDIX 5.1, Continued

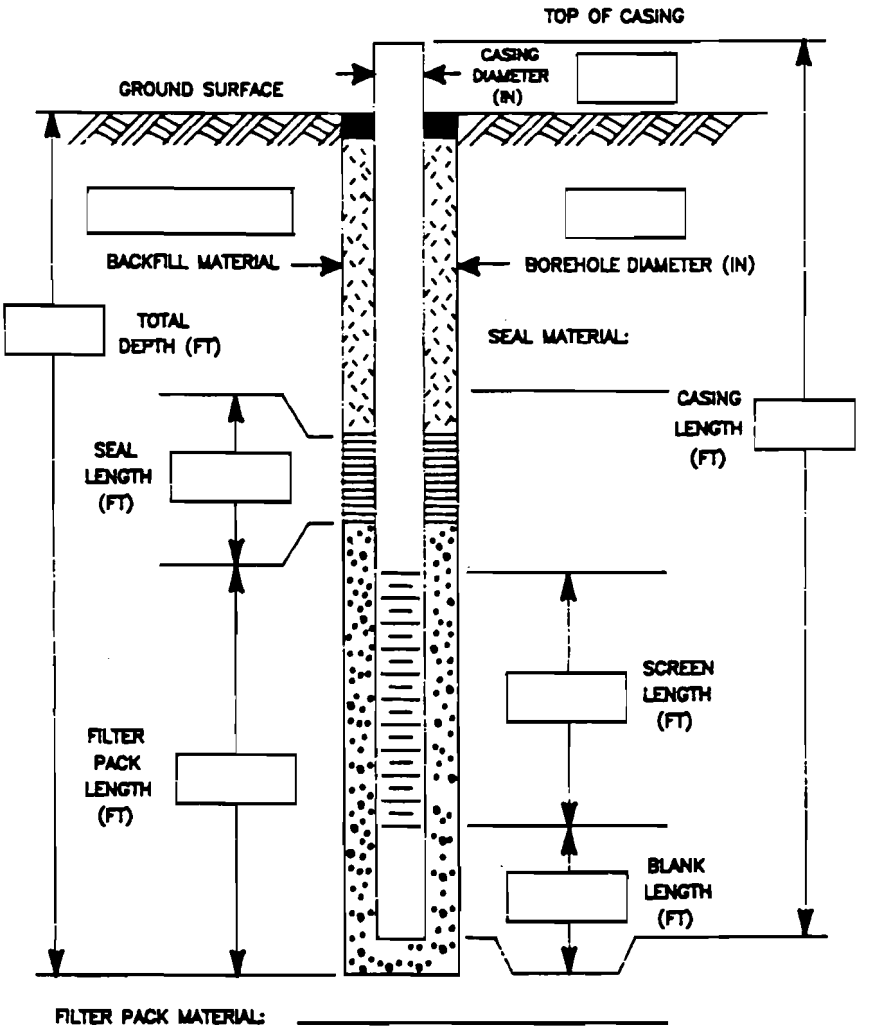
WELL COMPLETION INFORMATION FORM

WELL COMPLETION INFORMATION

PAGE 2 OF 2

FACILITY CODE _____

LOCATION ID _____ INSTALLATION DATE _____



FILTER PACK MATERIAL: _____

COMMENTS _____

COMPLETE BOLDED DATA FOR ENTRY INTO TMS

WCD-005 (1/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.2

BOREHOLE/WELL CONSTRUCTION FIELD DATA LOG

BOREHOLE / WELL CONSTRUCTION FIELD DATA LOG

FACILITY CODE _____ LOCATION ID _____ FIELD REP _____

LOGGER CODE _____ DRILLER CODE _____ RIG TYPE _____

INSTALLER CODE _____ COMPLETION DATE _____ ACCEPTANCE CODE _____

BOREHOLE SUMMARY

BIT TYPE	HOLE DIAM (in)	END ● DEPTH (ft)	FLUID TYPE

CASING SUMMARY

CASING* TYPE	DESCRIPTION	DIAM (in)	END ▲ DEPTH (ft)

* P – Protective S – Screen O – Open N – None

▲ Depth from Top of Casing

CONSTRUCTION TIME LOG

ACTIVITY	START DATE	START TIME	END TIME
DRILLING			
CASING			
FILTER PACK			
SEAL			
BACKFILL			
DEVELOPMENT			
OTHER			

WELL CONSTRUCTION

TYPE* CODE	DESCRIPTION	END ● DEPTH (ft)

* B – Backfill S – Seal F – Filter Pack

● Depth From Ground Surface

WELL DEVELOPMENT

COMMENTS _____

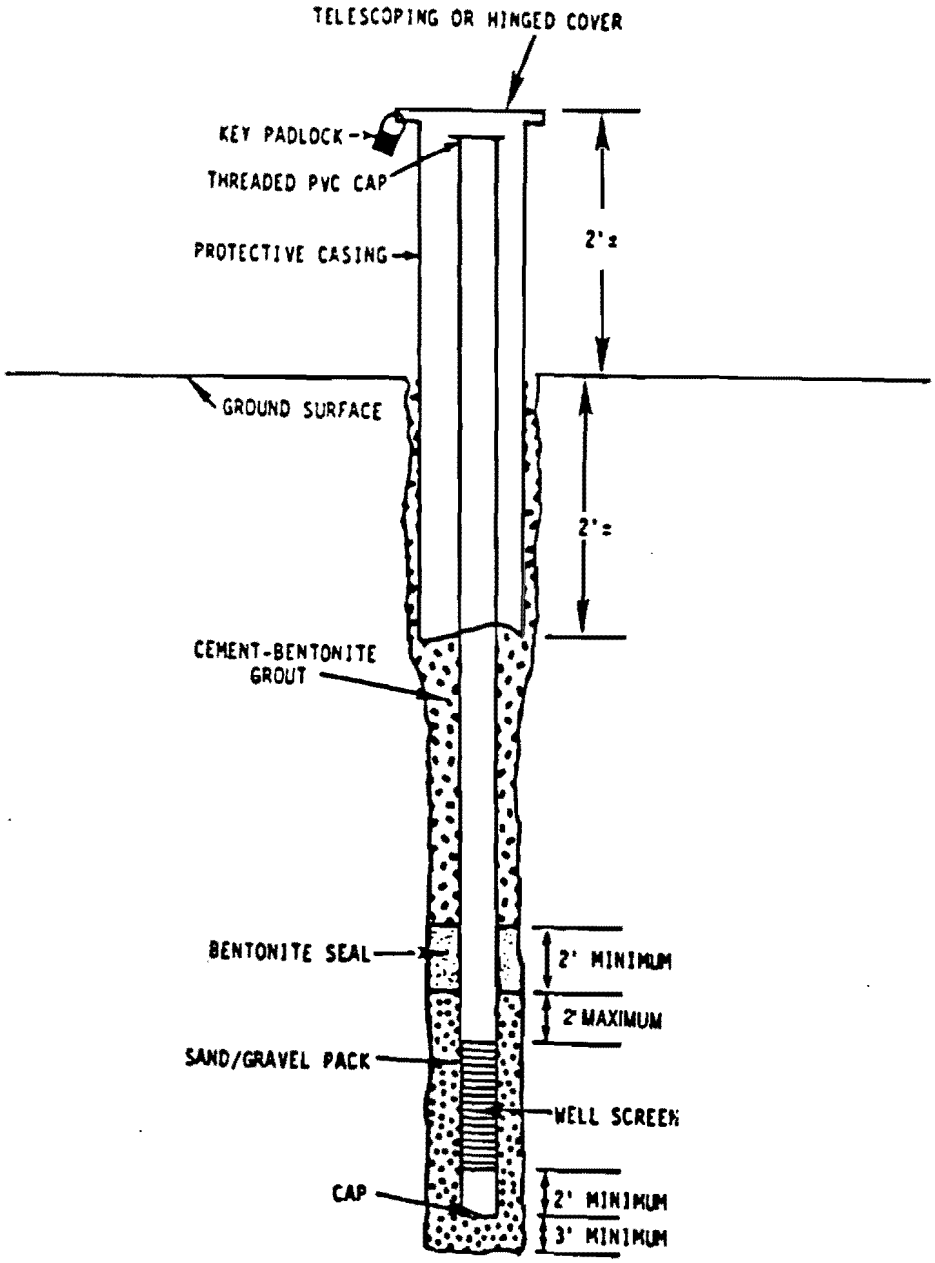
ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS

BWC-044 (1/88) FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.3

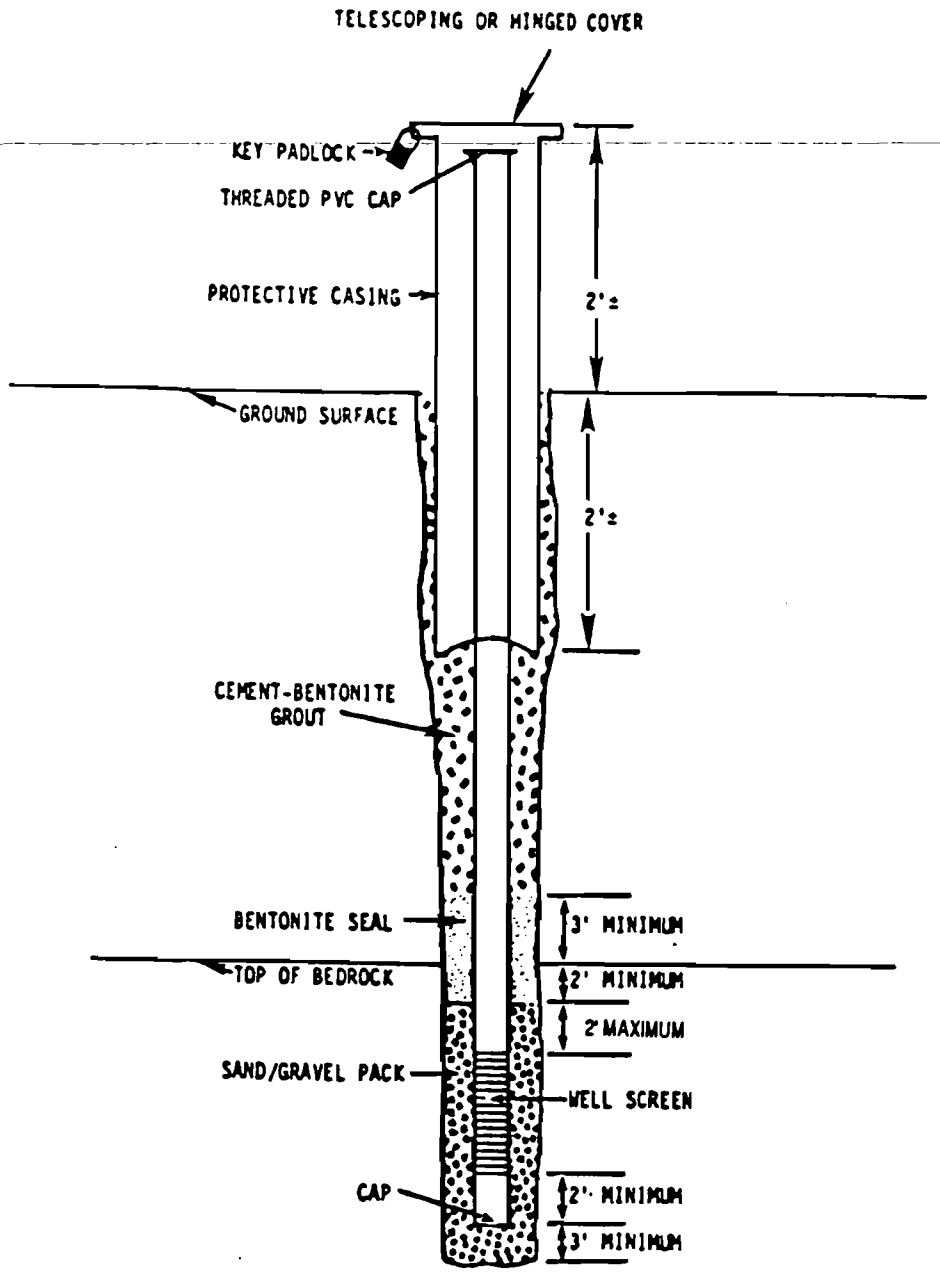
TYPICAL CONSTRUCTION OF OVERBURDEN WELL



TYPICAL CONSTRUCTION OF OVERBURDEN WELL

APPENDIX 5.4

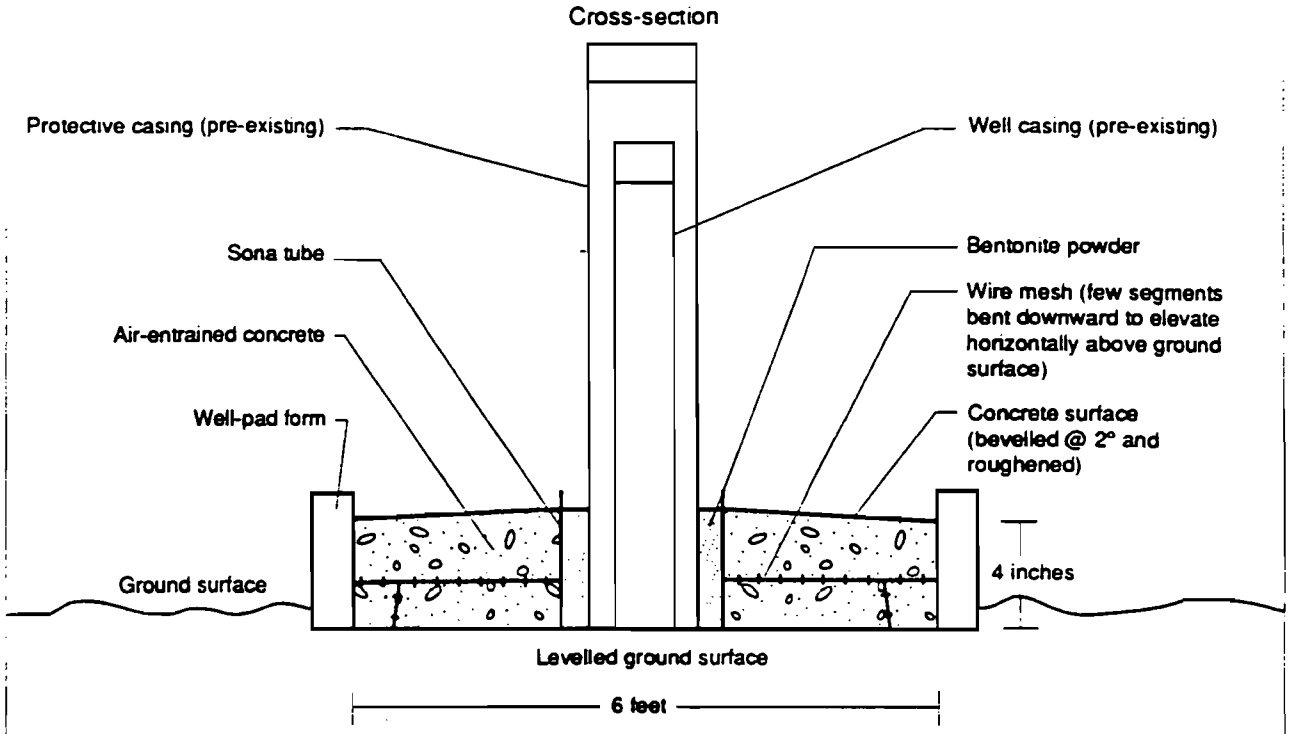
TYPICAL CONSTRUCTION OF BEDROCK WELL

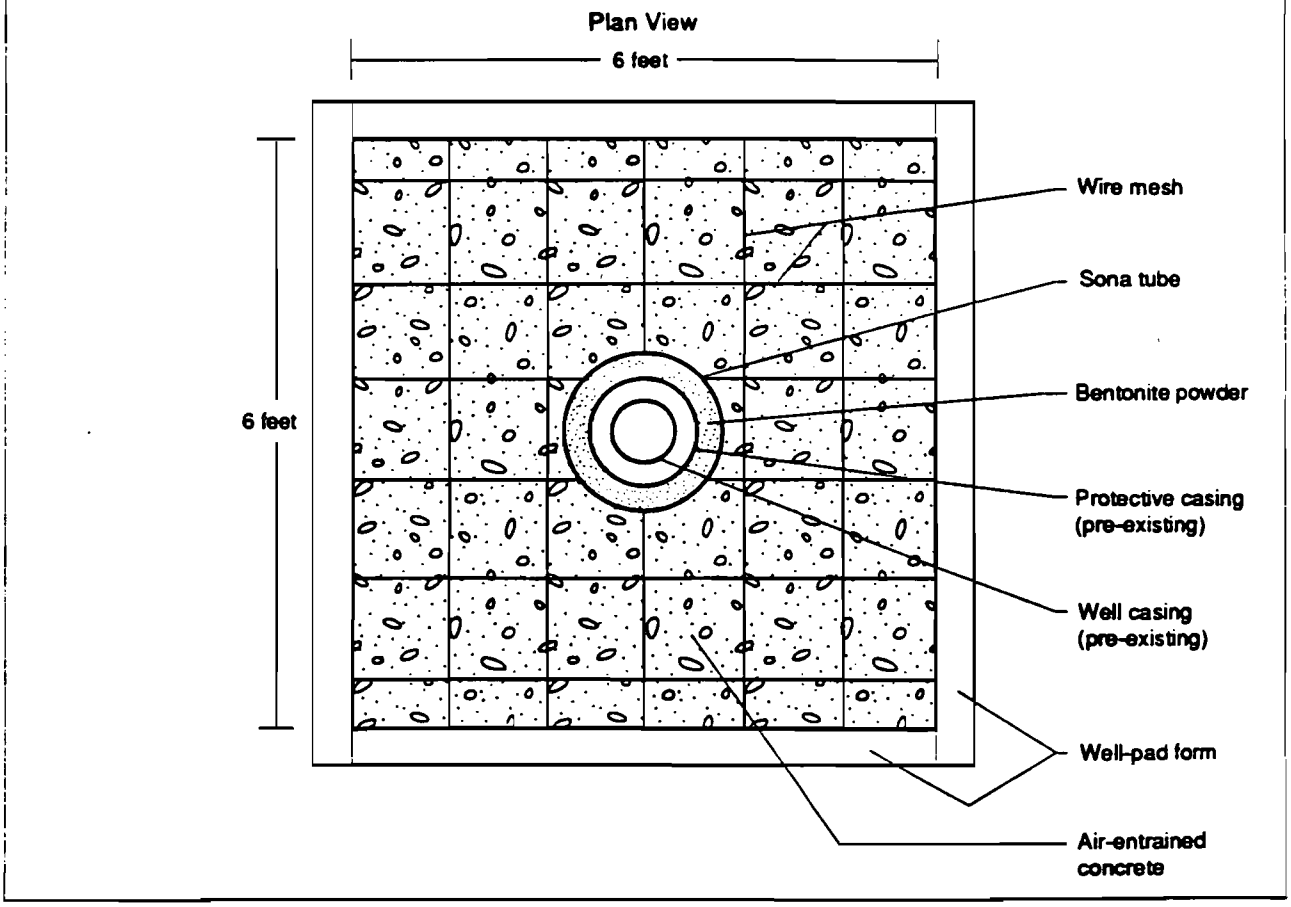


TYPICAL CONSTRUCTION OF BEDROCK WELL

APPENDIX 5.5

TYPICAL CONSTRUCTION OF WELL APRON

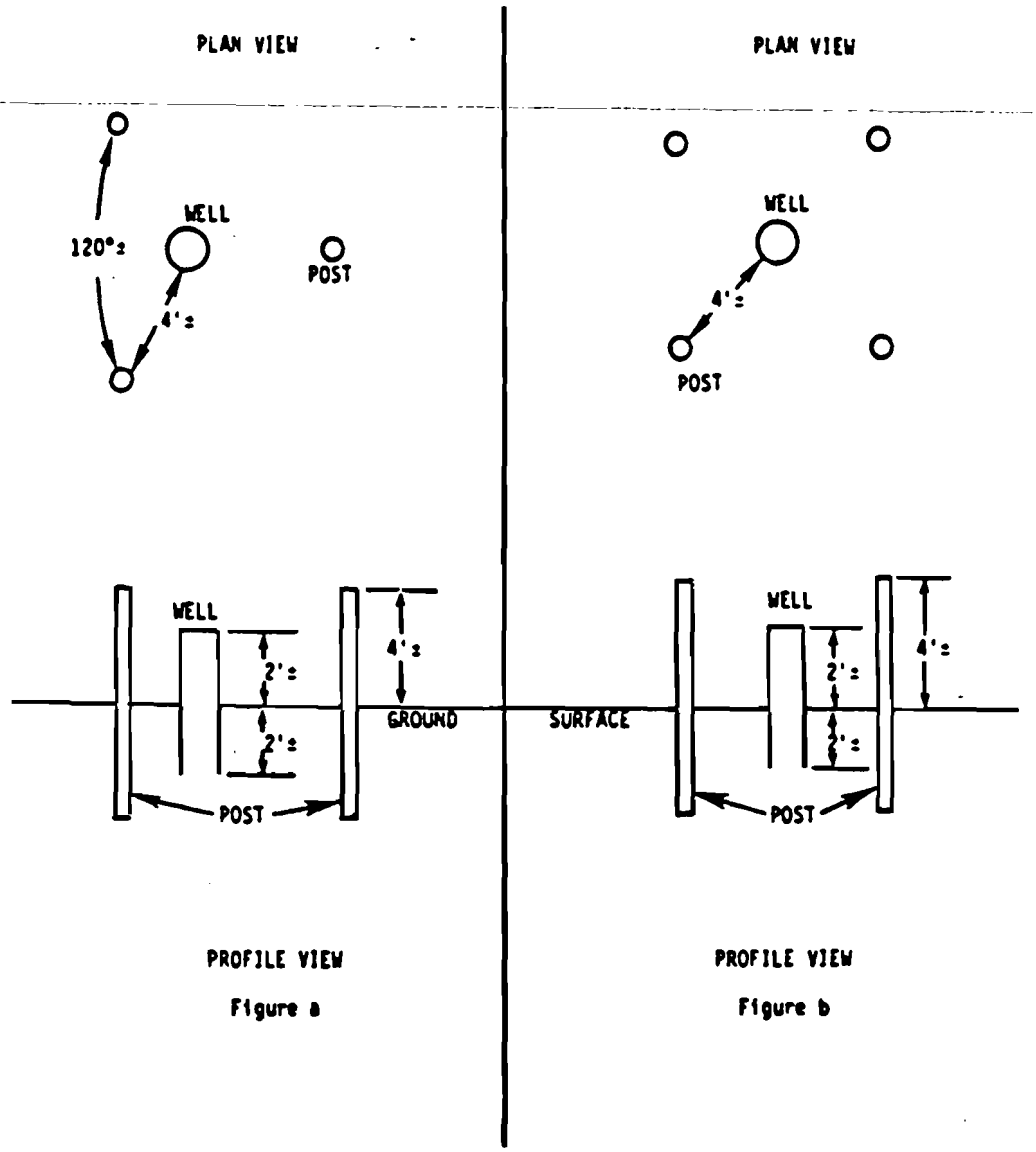




Appen5.5 2-24-92

APPENDIX 5.6

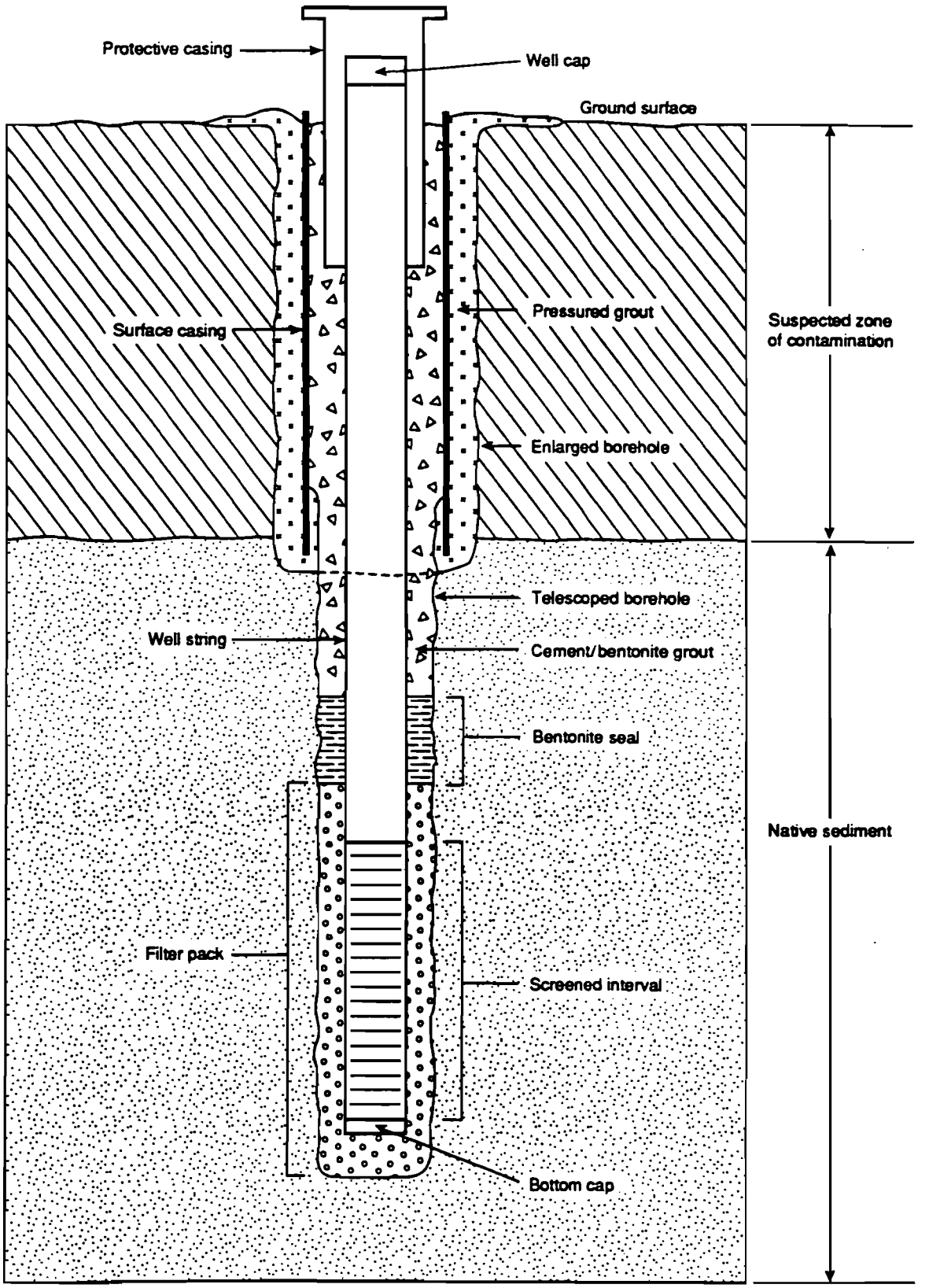
POST PLACEMENT AROUND WELL



POST PLACEMENT AROUND WELL

APPENDIX 5.7

TYPICAL CONSTRUCTION OF TELESCOPED WELL WITH SURFACE CASING



Appen5.7 2-24-92

APPENDIX 5.8

DATA FORM COMPLETION INSTRUCTIONS

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

WELL COMPLETION INFORMATION FORM

1. Facility code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Location ID. A four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

3. Acceptance Code. One-character code assigned by the installation manager.

4. Owner Code. A three-character or four-character code identifying the owner of a well that is being installed.

5. Installer Code. Three-character or four-character code identifying the company responsible for installing and completing a well.

6. Installation Date. The date when the well was installed in the format DD-MMM-YY (01-JAN-88).

7. Filter Pack Length (Ft). The length of the filter pack surrounding the screened portion of the casing.

8. Formation of Completion (US/RC). (US/RC) designation.

9. Well Type Classification. One-character code that designates the type of well being constructed. Valid codes are listed on page 1 of the Well Completion Information form.

10. Well Completion Method. One-character code describing the method used to complete a well or the nature of the openings that allow water to enter a well. Valid codes are listed on page 1 of the Well Completion Information form.

11. Zone of Completion. One-character code designating the basic water-bearing zones at which a well is completed. Valid codes are listed on page 1 of the Well Completion Information form.

12. Casing Elevation (Ft MSL). Top of casing elevation. Casing elevation will be filled out at completion of the field investigation.

13. Casing Length (Ft). Distance from the top of casing (in feet and tenths of feet) at which the bottom of the casing is placed.

14. Casing Diameter (In). Diameter of casing installed in inches.

15. Seal End Depth (FTFD). Depth below ground surface (in feet and tenths of feet) at which the bottom of the seal is placed.

16. Screen Material. A two-character code describing the type of screen material. Valid codes are listed on page 2 of the Well Completion Information form.

17. Riser Material. A two-character code describing the riser material. Valid codes are listed on page 1 of the Well Completion Information form.

18. Open/Screen Depth (FTFD). Depth in feet and tenths of feet from top of casing to top of screen.

19. Open/Screen Length (Ft). Total length of the screen in feet and tenths of feet.

20. Open/Screen Area (In^2/Ft). Open area of screen in inches squared per foot.

21. Flow Relationship. One-character code designating the flow relationship. Valid codes are listed on page 1 of the Well Completion Information form.

22. Cap Material. Two-character code describing the cap material. Valid codes are listed on page 1 of the Well Completion Information form.

23. Cap Type. A two-character code describing the type of cap used in the installed well. Valid codes are listed on page 2 of the Well Completion Information form.

24. Comments. Any additional information.

APPENDIX 5.8, Continued

BOREHOLE/WELL CONSTRUCTION FIELD DATA LOG

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Location ID. A four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

3. Field Rep. The name of the field representative.

4. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

5. Driller code. Three-character or four-character code identifying the company responsible for drilling the borehole.

6. Rig Type. Manufacturer and model of rig.

7. Installer Code. Three-character or four-character code identifying the company responsible for installing and completing a well.

8. Completion Date. Date when well was completed in the format DD-MMM-YY (01-JAN-88).

9. Acceptance Code. One-character code assigned by the facility manager.

10. Borehole Summary

    a. Bit Type. The type of bit used.

    b. Hole Diam (In). Diameter of borehole in inches.

    c. End Depth (Ft). Depth from the ground surface to the bottom of the borehole (in feet and tenths of feet).

    d. Fluid Type. Type of fluid used during the drilling phase of well installation.

11. Casing Summary

    a. Casing Type. One-character code describing the type of casing material used. The codes are listed below.

    b. Description. Describes the casing materials used (for example, Schedule 40 PVC) in well construction.

c. Diameter (In). Diameter of casing in inches.

d. End Depth (Ft). Depth (in feet and tenths of feet) from the top of the casing to the bottom of the casing.

12. Well Construction

a. Type Code. One-character code describing the material used for filling the annulus space in borehole.

b. Description. Describes the materials used in well construction (bentonite pellets, for example) to fill the annulus space in borehole.

c. End Depth (Ft). Depth (from the ground surface) where the materials for well construction are placed in the borehole in feet and tenths of feet.

13. Construction Time Log

a. Start Date. The date construction started.

b. Start Time. The time construction started.

c. End Time. The time when construction ended.

14. Well Development. Any further developments during well construction.

15. Comments. Any additional information.

STANDARD OPERATING PROCEDURE 4.4

MONITORING WELL DEVELOPMENT

1. PURPOSE

To remove foreign materials that may have been introduced into the groundwater, well annulus, or well screen during well installation and to facilitate hydraulic communication between the screened formation and the monitoring well.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the method and equipment to be used for developing the monitoring well. Collection and measurement of samples and documentation of data will be performed as described in the associated procedures.

Monitoring well development removes the fines from the well or aquifer formation near the screen and corrects damage that occurs during drilling. All well installation procedures create a skin on the borehole wall. There are four primary methods for developing monitoring wells: overpumping, rawhiding, jetting, and surging.

A. Overpumping involves pumping the well down as low as possible and allowing it to refill. The increased velocities created by refilling remove fines. This method is not very effective, because the water flow is in one direction and at relatively low velocities.

B. Rawhiding is a modification of overpumping. After the water is pumped to the surface, it is either allowed to run back into the well through a foot valveless pump or poured back down the well. This method generates two-directional flow and is superior to overpumping.

C. Jetting involves lowering a pipe into the well with a series of water jets on the end. The jets point horizontally. The high-pressure water pumped through the jets flushes fines from the formation and breaks the skin caused by drilling. As with the other methods, fines must occasionally be pumped from the well during development. An external water supply is needed for jetting. External water is introduced into the formation and alters the hydrochemistry. These are two major disadvantages of the jetting method.

D. Surging involves raising and lowering a surge or swab block inside the well. The resulting motion of the water removes the borehole skin and fines from the formation. The fines and water must occasionally be removed from the well with a sand bailer to prevent sand locking of the surge block. The rubber or viton seals on the surge block are the same diameter as the inside of the well or 1/2 inch smaller if surging is conducted inside the screened interval. A 3-ft stroke is typical.

Surging can also be implemented with high-pressure air. A high-pressure air pipe is lowered into the well, and surges of air are introduced. Water may be literally blown out of the top of the well, and water can be pumped out as the air surging progresses. However, air surging can introduce air into the formation (altering the hydrochemistry) and become entrained in the screens (reducing flow rates). Plastic screens can also be damaged if the air surge is too violent. A specially fabricated air swab can be used to prevent these types of damage.

E. Surging with a vented (pressure-relief) block (Appendix 5.2) and rawhiding are the preferred methods for well development, although no one method is appropriate for all situations.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
2.2	Field Measurements on Ground and Surface Water Samples
3.1	Water Level Measurement
4.3	Monitoring Well Installation
6.1	Health and Safety Monitoring of Combustible Gas Levels
6.2	Health and Safety Monitoring of Organic Vapors with a Photoionization Detector
6.3	Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector

3.2. Preparation

3.2.1 Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. If samples are to be collected for analyses, notify the laboratory of sample types, the number of samples, and the approximate arrival date. In addition, contact the carrier that will transport samples to obtain information on regulations and specifications.

F. Ensure that permission to discharge development water has been obtained or coordinate efforts to purchase appropriate containment vessels for development.

3.2.2. **Documentation**

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. **Field**

A. Decontaminate all equipment before developing each well according to SOP 1.6, General Equipment Decontamination.

B. Assemble containers for the temporary storage of water produced during well development. The containers must be structurally sound, compatible with anticipated contaminants, and field manageable.

NOTE: Truck-mounted tanks may be required for this operation.

3.3. **Operation**

Perform the development as soon as practical after well installation, but no sooner than 48 hrs after grouting is completed. Do not use any dispersing agents, acids, or disinfectants to enhance the development of the well. Do not add water to aid development except under the special conditions defined below. If problems or unusual conditions are encountered, notify the site manager as soon as possible.

A. Assemble the necessary equipment on a plastic sheet outside of the splash range.

B. Record pertinent information in the logbook and on the Well Completion Information form. A copy of this form and instructions for completing the form are provided in SOP 4.3, Monitoring Well Installation.

C. Open the monitoring well and take the air monitoring reading at the top of the casing and in the breathing zone (see SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels; SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector; and SOP 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector).

D. Measure depth-to-water and the total depth of the monitoring well according to SOP 3.1, Water Level Measurement.

E. Develop the well until the well is free of sediment and the appropriate volumes of water have been removed (see E.4. below). Sediment free is loosely defined as 0.01 ml of sediment in a 1000-ml Imhoff cone. If the well is not free of sediment after the appropriate volumes of water have been removed, continue until twice the appropriate volume of water has been removed. Do not exceed twice the volume without consulting the site manager.

1. Note the initial color, clarity, and odor of the water.

2. Measure and record the initial pH, temperature, and specific conductance of the water according to SOP 2.2, Field Measurements on Ground and Surface Water Samples.

3. Containerize all water produced by development in contaminated areas or areas suspected of contamination. Clearly label each container with the location ID. Base the determination of an appropriate disposal method on the first round of analytical results from each well.

4. For those wells where the boring was installed <u>without</u> the use of drilling fluid (bentonite mud or water), remove 5 times the standing water volume in the well (well screen and casing plus saturated annulus). Should recharge be so slow that 5 volumes could not be removed in one day or the water is not sediment free after this 5-volume removal, the site manager will select an alternate procedure for verifying that the well is properly developed.

5. For those wells that cannot be cleaned of formation fines (clays and silts) resulting in low yields of formation water, small amounts of project-approved potable water should be added to the well bore. Once the majority of fines have been removed from the well, continue development with formation water only. During this process, it is essential that at least 5 times the amount of water injected must be withdrawn from the well to assure that all potable water has been removed from the formation. Do not add water to the well to assist development without prior approval by the site manager.

6. For those wells where the boring was installed/enlarged with the use of drilling fluid (bentonite mud or water), remove 5 times the measured amount of total fluids lost while drilling <u>plus</u> 5 times the standing water volume as defined above. Use the same procedure (of adding more water) for cases of slow recharge, discolored water, or water that is not sediment free.

7. Note the final color, clarity, and odor of the water.

8. Measure and record the final pH, temperature, and specific conductance of the water according to SOP 2.2, Field Measurements on Ground and Surface Water Samples.

9. Complete the appropriate data entry requirements on the Well Completion Information form to document well development. A copy of the form and instructions for completing it are in SOP 4.3, Monitoring Well Installation.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to the presampling conditions as specified in the FSP or WP.

C. Make sure all monitoring well locations are properly staked and the location ID is readily visible on the protective casing.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. After the first round of analytical results have been received, determine and implement the appropriate water disposal method.

B. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

C. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

D. If samples have been collected for analysis, contact the laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCES

Barcelona, M. J., J. P. Gibb, J. A. Helfrich, and E. E. Garske. 1985. "Practical Guide to Groundwater Sampling." U.S. Environmental Protection Agency report EPA/600/2-85/104. Washington, D.C.: U.S. Government Printing Office.

Gass, Tyler E., "Monitor Well Development." 1986. Water Well Journal 40, no. 1: 52-55.

Schalla, Ronald, and Robert W. Landick. 1986. "A New Valved and Air-Vented Plunger for Developing Small Diameter Monitor Wells," Ground Water Monitoring Review 6, no. 2: 77-80.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Surge Block Schematics

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ pH Meter

_____ Electrical conductivity meter

_____ Distilled water

_____ Stopwatch

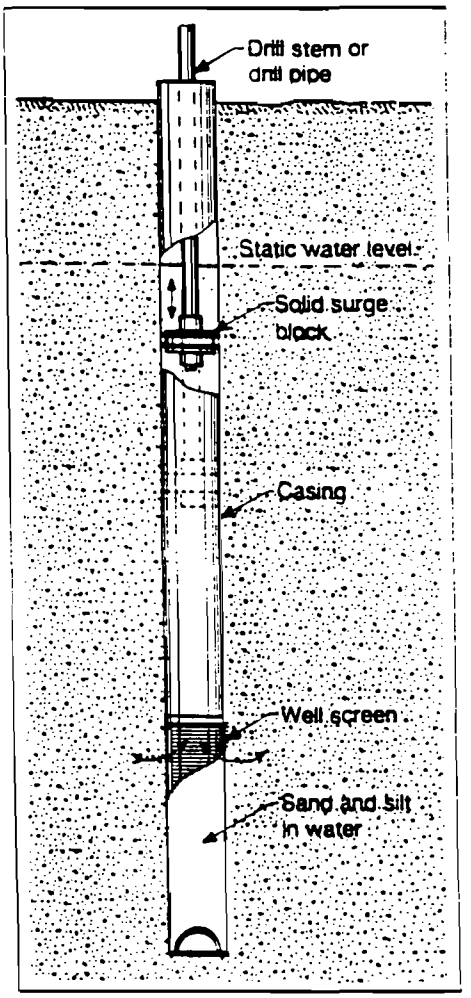
_____ Water level measurement probe

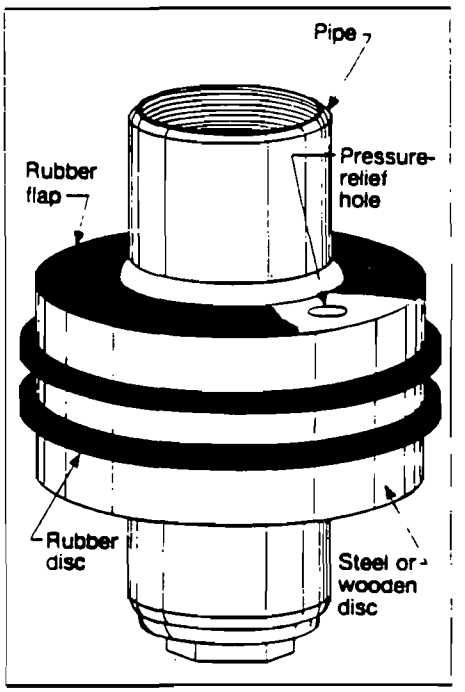
_____ 1000-ml Imhoff cone

_____ Plastic sheet

APPENDIX 5.2

SURGE BLOCK SCHEMATICS





STANDARD OPERATING PROCEDURE 4.7

PIEZOMETER INSTALLATION

1. PURPOSE

To ensure acceptable, consistent piezometer installation.

2. DISCUSSION

Piezometer installation creates a permanent access for measuring aquifer characteristics, primarily the static water table elevation. Ideally, the piezometer should not alter the medium that is being sampled.

The Field Sampling Plan (FSP) or Work Plan (WP) provides information about the scope and details of piezometer installation at a given site. A list of critical issues involved in piezometer installation are listed below.

- Soil/rock boring technique
- Casing and screen materials
- Casing and screen diameter, screen length and size, and screened interval
- Filter pack, annular seal, grout, protective cap, centralizers, and protective casing

Piezometers will be installed with a minimum borehole diameter of 6 inches using appropriate drilling techniques. All piezometer construction materials should be chemically inert and also of sufficient integrity during piezometer development and use. Therefore, it is recommended that two-inch-diameter, Schedule-40 PVC, 0.010-inch slot well screen be coupled with 2-inch-diameter, Schedule-40 PVC riser pipe (or as specified in the work plan). The location and completion depth of each piezometer will be outlined in the applicable work plan or field sampling plan. A 5-ft long well screen is recommended for most piezometer installations in order to monitor seasonal variations in the static water table. Well screens greater or less than 5 ft in length can be installed based on field conditions or as specified in the work plan. A quartz-sand filter pack, as specified in the work plan, will stem the annulus between the well string and the borehole wall from the bottom of the borehole to no more than 2 ft above the top of the well screen. Grain size of the geologic medium will be evaluated by the onsite geologist to confirm that the proper filter pack size is used. It is recommended that the filter pack be emplaced as a sand slurry (composed of silica sand and project-approved potable water) using a tremie pipe. This procedure will help the sand to settle and compact within the borehole annulus and prevent the sand from bridging along the well screen interval. Use only potable water to mix with the sand when a sand slurry is used. Either 5 times the volume of water used when making the sand slurry or 3 to 5 bore volumes of water should be removed during well development, whichever is greater. During emplacement, the depth to the top of the filter pack will be frequently tagged using a weighted measuring tape. A 2- to 4-ft interval of bentonite pellets or slurry will be emplaced on top of the filter pack using a side-discharge tremie pipe. The bentonite will adequately seal the zone of completion. The remaining borehole annulus will be stemmed to the ground surface using a cement/bentonite grout mixture. Centralizers will be placed above and below the screen and at 50-ft intervals above the top screen centralizer to ground surface.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Borehole drilling, development of the piezometers, collection and measurement of samples, and the documentation of data will be performed as described in the associated procedures. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
2.2	Field Measurements on Ground and Surface Water Samples
3.1	Water Level Measurement
4.1	Soil Boring
4.2	Rock Boring
4.6	Piezometer Development
5.1	Soil and Rock Borehole Logging and Sampling
6.1	Health and Safety Monitoring of Combustible Gas Levels
6.2	Health and Safety Monitoring of Organic Vapors with a Photoionization Detector
6.3	Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Research site hydrogeology to estimate key parameters (for example, anticipated aquifer depth and thickness, types of contaminants, and grain-size distribution).

E. If water/sand slurry or grout is required, the source(s) of any water used must be approved by the site manager before field operations.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

E. Record all pertinent information (date, site, ID #, and location) in the logbook or on the appropriate form. Include field conditions, unusual circumstances, and weather. Instructions for logbook entries are in SOP 1.3, Sample Control and Documentation.

3.2.3. Field

A. Decontaminate all equipment before piezometer installation, as specified in SOP 1.6, General Equipment Decontamination.

3.3. Operation

A. Piezometers must be installed in such a manner as to minimize disturbance and prevent introduction of contaminants to the subsurface environment. This is especially important if rotary drilling techniques using circulation fluid are employed. Any use of solvents, glues, soap, or cleaners is prohibited below grade unless otherwise stated in the specifications. When they are used, describe the material and include the manufacturer and type (specification). The use of pipe dope, grease, and oil is also prohibited. However, the use of Teflon pipe dope is acceptable.

B. Monitor downhole and the breathing zone according to SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels; SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector; and SOP 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector. Perform readings as often as necessary to ensure the safety of workers. Record all measurements on the data collection forms included with these SOPs.

C. Record all field measurements and comments on the Piezometer Information or the Borehole/Well Construction Field Data Log form. Complete all lines on the forms. Use the letter designation NA for not applicable, ND for not done, or UNK for unknown when applicable. If some steps or procedures were not performed as described, state the reason (as practicable) on the form or submit it as an attachment. Copies of these forms are in Appendix 5.1 and Appendix 5.2, respectively. Fill out the forms as described in Appendix 5.6. For a current list of codes used in the data form completion, consult the ER Program data administrator.

D. Record the diagram of the piezometer installation on the Piezometer Completion Information form and show the depth from surface grade, the bottom of the boring, sump, screen location, coupling design and location, granular backfill, seals, grout, cave-in, centralizers, and the height of the riser above the ground surface. Record the

actual composition of the grout, seals, and granular backfill on each Borehole/Piezometer Construction Field Data Log form. Include the screen slot size (in inches), slot configuration, and screen manufacturer.

E. If appropriate, include the protective casing detail on all piezometer sketches.

F. A quartz sand filter pack is required for all Mound ER piezometers. Instructions for proper filter pack installation are provided below.

1. Base the average grain size of the sand on the expected grain-size distributions (determined from previous drilling programs or expected lithology) in the screened formation and the size of predesigned well-screened openings. Use sand having a gradation that will allow no more than 10% of pack material to pass through the screen slots. If the required filter pack and well slot sizes are not available onsite, the proper materials will be obtained before piezometer installation proceeds.

2. Take at least one sample (1/2 to 1 pint in size) from each shipment of granular material, assign an identification number, and store it with the soil samples. Record the identification number on the sketch of each installation for which that material was used.

3. The specifications of the proposed sand-pack material should be submitted by the contractor for approval before use. Describe each sample in terms of lithology, grain-size distribution, and source (company from which it was purchased and the pit or quarry of origin). This material should be clean, inert, and siliceous. Use well-sorted (poorly graded) sand, like No. 8-12 or a similar material, with approximately 10% passing the design slot size.

G. It is desirable that all padlocks at a given site can be opened by the same key. The numbers on the locks should be noted and then rubbed off the back.

H. Safety equipment should be specified by the site health and safety officer. In all cases, the minimum physical protection should include a hard hat, safety glasses, gloves, steel-toed leather boots, hearing protection, and coveralls for splash protection and cold weather.

I. Typical well construction features are in Appendixes 5.3 and 5.4. However, specific contract requirements may alter some of the components or values. After piezometer development (SOP 4.6) is complete, indicate the water level on the piezometer construction diagram of the Piezometer Completion Information Form (Appendix 5.1).

J. Stainless steel centralizers will be used on all ER program well and piezometer installations to ensure the uniform and complete annular filling by granular backfill, seal, and grout materials. Fasten centralizers to the well casing by mechanical fasteners and radially space them around the casing at 120° or 90° intervals. On the Borehole/Piezometer Construction Field Data Log form (Appendix 5.2), provide a description of the fastening device and centralizer that includes their locations. Locations of centralizers are to include: 1) a centralizer located 1 ft above the screen, 2) a centralizer located approximately 1-ft below the screen, and 3) centralizers located in intervals of 50 ft above the top screen centralizer to ground surface.

K. Place a quartz sand filter pack in the annulus next to the well screen in all piezometers. The sand pack ensures continuous flow capability from the natural formation to the well bore.

1. Fill the annulus between the well screen and borehole wall with a sand slurry (composed of silica sand and project-approved potable water) using a tremie pipe. Frequently tag the depth to the top of the filter pack using a weighted measuring tape during this process to insure proper placement.

2. It is necessary to emplace sufficient sand slurry to stem the annular interval between the bottom of the borehole to no more than 2-ft above the top of the well screen after the sand pack has compacted and settled.

3. Ascertain the depth of the top of the sand with an acceptable measuring device or the tremie pipe and verify the thickness of the sand pack. If necessary, add more sand to bring the top of the sand pack to the proper elevation (no more than 2 ft above the top of the screen).

4. Under no circumstances should the sand pack extend into any aquifer other than the one to be monitored. In most cases, the well design can be modified to allow for a sufficient sand pack without the threat of cross flow between producing zones.

5. The site manager is the only individual authorized to modify an existing well design.

6. In materials that will not maintain an open hole, leave the hollow-stem augers in the hole during sand pack placement to the extent practical. Remove them as the level of the sand pack rises above the bottom of the augers. At a minimum, a 1- to 2-ft column of quartz sand will be maintained inside the auger string as the augers are removed from the borehole to keep the formation from collapsing in on the piezometer screen.

7. The approximate volume of filter pack material will be calculated before emplacement. The calculated volume of sand material will be compared to the volume used. If any discrepancy exists, a determination should be made as to the reason(s) why. Appendix 5.9 is a list of borehole volumes by material type.

8. Periodically, the depth of the filter pack will be determined to see if bridging has occurred. If bridging has occurred, investigate the problem and take the appropriate action to correct the problem.

L. Place a bentonite seal between the sand pack and grout to prevent infiltration of cement into the filter pack and the well screen. In special circumstances, an open borehole may be drilled to a depth below where the screen is set. If grout is used as backfill up to the proper level to seal off a lower aquifer, place a bentonite seal above the grout before the casing, screen, and sand pack are introduced. Place 2 ft of filter pack (quartz sand) between the bottom of the screen and the lower bentonite seal. Allow the grout to set up for a minimum of 12 to 24 hrs before placing the seal and 2 ft of filter pack material. Place the bentonite seal in the monitoring well as described below.

1. Fill the annulus between the well casing and borehole with a bentonite seal at least 2- to 4-ft thick (vertically) above the filter pack.

2. For piezometers less than approximately 35-ft in depth, use bentonite pellets. The pellets should have a minimum purity of 90 percent montmorillonite clay and a minimum dry bulk density of 75 lb/ft3 for 1/2-inch pellets (as provided by American Colloid) or the equivalent. Pour the bentonite pellets directly down the annulus. Pour the pellets from different points around the casing to ensure even application. Place a cap over the top of the well casing before pouring the bentonite pellets from the bucket. A tremie pipe may be used to redistribute and level out the top of the seal.

3. For the piezometers deeper than approximately 35 ft, or having an annulus less than 3 inches, the bentonite seal will be installed through a side discharge tremie pipe as a slurry.

4. Prepare the slurry by mixing powdered or granular bentonite with potable water. The slurry should be of sufficiently high specific gravity and viscosity to prevent its displacement by the grout that will be placed above. Regardless of depth and depending on fluid viscosity, a few handfuls of bentonite pellets may be dumped in to solidify the surface of the bentonite slurry as a precaution.

5. Before adding bentonite pellets or slurry, be sure the sand pack has ceased settling by measuring the depth of the top of the sand with the tremie pipe. The sand pack should provide an adequate cover over the screen.

6. If a bentonite slurry is used, visually check the condition of the slurry by pumping into a bucket or onto the ground. Retract the side discharge tremie pipe 3 ft from the top of the sand pack and begin pumping.

7. In materials that will not maintain an open hole, leave the hollow-stem augers in the hole during bentonite seal placement to the extent practical. Remove them as the level of the bentonite rises above the bottom of the augers.

8. In all situations, use a 2 to 4-ft bentonite seal. Tag the top of the seal by an acceptable measuring device or tremie pipe to verify that the proper thickness of seal has been placed in the annulus.

9. Until the specified quantity of bentonite has been placed in the well annulus, repeat the application and verification.

10. The approximate volume of bentonite seal material will be calculated before emplacement. The calculated volume of bentonite material will be compared to the volume used. If any discrepancy exists, a determination should be made as to the reason(s) why. Appendix 5.9 is a list of borehole volumes by material type.

11. Periodically, the depth of the bentonite seal will be determined to see if bridging has occurred. If bridging has occurred, investigate the problem and take appropriate action to correct the problem.

M. Place grout from the top of the bentonite seal to the surface and allow a minimum of 24 to 48 hrs after the bentonite seal has been placed to allow it to set up. Only Type I or Type II cement without accelerator additives may be used. Place grout in the monitoring wells as described below.

1. Fill the annulus between the well casing and borehole wall with grout.

2. Place the grout from a side discharge tremie pipe.

3. If any centralizers are used above the filter pack, a side discharge tremie pipe will be used to place a 2- to 4-ft bentonite slurry (seal) above the filter pack.

4. The side discharge tremie pipe should normally consist of 1.25-inch PVC or steel pipe. One-inch rolled, thin-walled polypipe has been used with success in some cases.

5. Pump the grout through this pipe to the bottom of the open annulus until undiluted grout flows from the annulus at the ground surface.

6. The grout should consist of a neat cement mix composed of 4 lbs of commercial bentonite and approximately 7.5 gallons of water added to each 94-lb bag of cement. Use only grout mixed with approved water.

7. In materials that will not maintain an open hole, leave the hollow-stem augers in the hole during grouting to the extent practical. Remove them as the level of the grout rises above the bottom of the augers.

8. While the grout is still green, add more grout to compensate for the removed casing or auger and tremie pipe and to ensure that the top of the grout is at or above the ground surface.

9. The approximate volume of grout material will be calculated before emplacement. The calculated volume of grout material will be compared to the volume used. If any discrepancy exists, a determination should be made as to the reason(s) why. Appendix 5.9 is a list of borehole volumes by material type.

10. The protective casing should now be installed.

11. After the grout has set (about 48 hrs), fill any depression in the grout caused by settlement with a grout mix similar to that described above.

N. Install protective casing around all piezometers. Modifications may be made on a case-by-case basis. The minimum elements in the protection design include those listed below. Modifications may include the use of flush-mount protective casing, so that nothing extends above ground level.

1. The protective steel cap should keep precipitation out of the protective casing and should be secured to the casing by padlocks.

2. Set a 5-ft (minimum) length of black iron pipe or galvanized pipe so that the top of the pipe is about 1.5 to 3 ft above the ground surface and grout it in place as shown in Appendixes 5.3 and 5.4.

3. Use the pipe diameter of 8 inches for 4-inch wells and 6 inches for 2—inch wells (depending on approved borehole size). A drain hole near ground level that is 0.5 inch in diameter is permitted.

4. Provide a protective steel cap and secure it to the top of each protective casing.

5. Mark the location ID on the inside and outside of the cover with indelible ink and on the protective casing with paint. Spray paint will not be used to mark the casing.

O. Install a concrete well apron or pad around each monitoring well as shown in Appendix 5.5. The apron will be constructed with minimum radius of 3 ft (6 by 6 ft) and 4 inches thick. The body of the apron should contain a 4- by 4-inch wire mesh to reinforce the structure. The concrete surface should be roughened for traction and bevelled at an angle of 2 degrees to drain runoff. A 10-inch diameter sona tube should surround the protective casing, with bentonite powder filling the annulus between the casing and the tube. This will prevent the apron from cracking during periods of frost heave. A surveyor's pin stamped with the well location ID should be installed on the well apron surface before the concrete hardens.

P. The installation of guard posts around the periphery of the well apron is required in areas where vehicle traffic might pose a hazard. Other areas will be investigated on a case-by-case basis and use or nonuse of guard posts will be determined by the FTL.

Guard posts shown in Appendix 5.5 consist of steel posts that are 3 inches in diameter or tee-bar driven steel posts. Three are radially located 4 ft around each well and driven 2 ft below the ground surface, having a minimum of 4 ft above the ground surface with flagging in areas of high vegetation. Each post should be cemented in place.

Q. Drilling through a suspected zone of contamination within the vadose zone could create a more permeable conduit for infiltrating groundwater to enter and leach potential contaminants to the static water table. Consult SOP 4.1.1., Methods to Control Communication of Subsurface Contaminants Within and Between Saturated Zones During Drilling and Well Installation, for procedures to follow. Borehole and well construction details are shown in Appendix 5.7.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to predrilling conditions as specified in the FSP or WP.

C. Make sure all monitoring wells are properly labeled and the location ID is readily visible on the protective casing.

D. The well/piezometer will be surveyed and referenced to mean sea level.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

4. SOURCES

Barcelona, M. J., J. P. Gibb, J. A. Helfrich, and E. E. Garske. 1985. "Practical Guide to Groundwater Sampling." U.S. Environmental Protection Agency report EPA/600/2-85/104. Washington, D.C.: U.S. Government Printing Office.

DOE. 1985. "Field Technical Representative Manual." 2d ed. U.S. Department of Energy, Uranium Mill Tailings Remedial Action Project Office, Albuquerque Operations Office document, June 1985. Albuquerque, New Mexico.

5. APPENDIXES

5.1. Piezometer Completion Information Form

5.2. Borehole/Piezometer Construction Field Data Log Form

5.3. Typical Construction of Overburden Piezometer

5.4. Typical Construction of Bedrock Piezometer

5.5. Typical Construction of Piezometer Apron

5.6. Post Placement Around Piezometer

5.7. Typical Construction of Telescoped Piezometer with Surface Casing

5.8. Data Form Completion

5.9. Borehole Volumes by Material Type

APPENDIX 5.1

PIEZOMETER COMPLETION INFORMATION FORM

PIEZOMETER COMPLETION INFORMATION

PAGE 1 OF 2

FACILITY CODE _____ FILTER PACK LENGTH (FT) _____

LOCATION ID _____ FORMATION OF COMPLETION (US/RC) _____

ACCEPTANCE CODE _____ WELL TYPE CLASSIFICATION _____

OWNER CODE _____ WELL COMPLETION METHOD _____

INSTALLER CODE _____ ZONE OF COMPLETION _____

INSTALLATION DATE _____

CASING ELEVATION (FT MSL) _____ OPEN/SCREEN DEPTH (FTFD) _____

CASING LENGTH (FT) _____ OPEN/SCREEN LENGTH (FT) _____

CASING DIAMETER (IN) _____ OPEN/SCREEN AREA (IN^2 /FT) _____

SEAL END DEPTH (FTFD) _____ FLOW RELATIONSHIP _____

SCREEN MATERIAL _____ CAP MATERIAL _____

RISER MATERIAL _____ CAP TYPE _____

WELL TYPE CLASSIFICATIONS:
- M – MONITOR WELL
- P – PRODUCTION WELL
- T – TEST WELL
- O – OTHER (SPECIFY)

CAP TYPES:
- LC – LOCKING
- SL – SLIP-ON
- TR – THREADED
- ND – NONE
- SC – SCREW ON
- OT – OTHER (SPECIFY)

CASING, CAP, RISER MATERIALS :
- BR – BRICK
- C1 – CONCRETE
- C2 – COPPER
- FI – FIBERGLASS
- GI – GALVANIZED IRON
- WI – WROUGHT IRON
- SS – STAINLESS STEEL
- OM – OTHER METAL
- TE – TEFLON
- PV – PVC
- RS – ROCK OR STONE
- ST – STEEL
- TI – TILE
- CS – COATED STEEL
- WO – WOOD
- ND – NONE
- OT – OTHER (SPECIFY)

FLOW RELATIONSHIPS:
- U – UPGRADIENT
- D – DOWNGRADIENT
- C – CROSS GRADIENT
- O – ON SITE
- N – NOT KNOWN
- B – BACKGROUND

ZONES OF COMPLETION:
- A – ARTESIAN
- B – ANISOTROPIC
- C – CONFINED
- H – AQUITARD
- G – AQUICLUDE
- I – ISOTROPIC
- M – MULTI-SYSTEM
- S – SEMI-CONFINED
- U – UNCONSOLIDATED

WELL COMPLETION METHODS:
- C – POROUS CONCRETE
- F – GRAVEL PACK
- H – HORIZONTAL GALLEY
- O – OPEN END
- P – PERFORATED/SLOTTED
- S – SCREEN
- T – SAND POINT
- W – WALLED OR SHORED
- X – OPEN
- O – OTHER (SPECIFY)

NOTE : FTFD = FEET FROM DATUM

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
WCD-006 (3/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.1, Continued

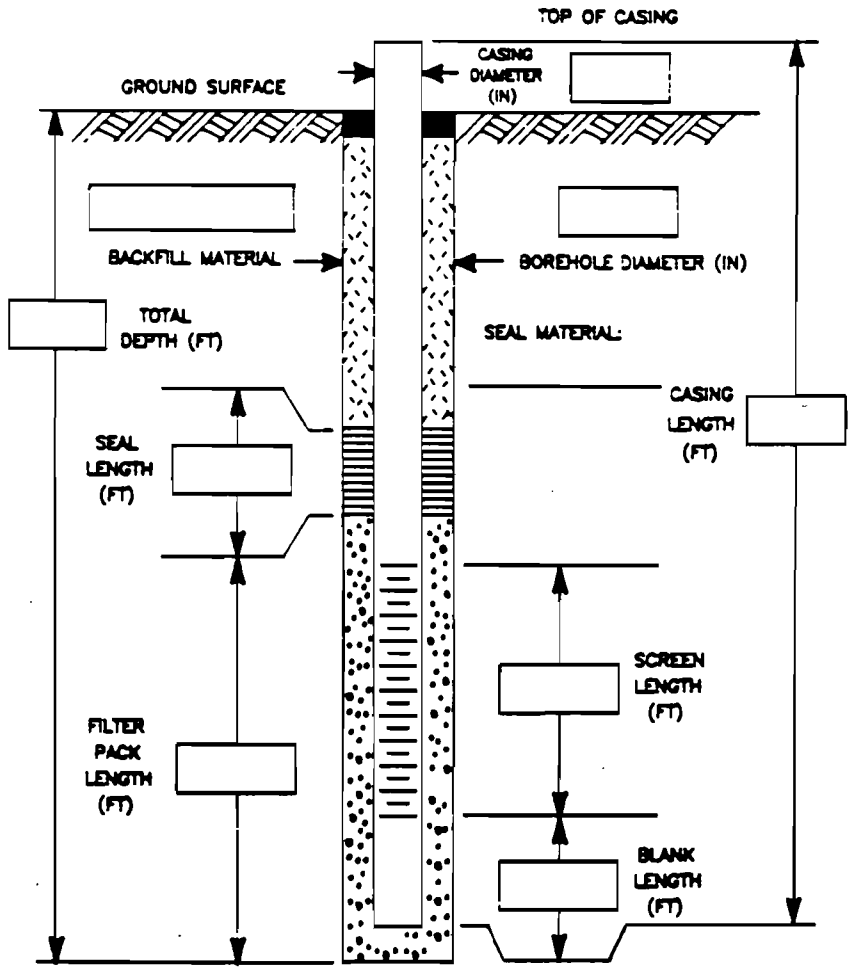
PIEZOMETER COMPLETION INFORMATION FORM

PIEZOMETER COMPLETION INFORMATION

PAGE 2 OF 2

FACILITY CODE _____

LOCATION ID _____ INSTALLATION DATE _____



FILTER PACK MATERIAL: _____

COMMENTS _____

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS

WCD-008 (1/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.2

BOREHOLE/PIEZOMETER CONSTRUCTION FIELD DATA LOG

BOREHOLE/PIEZOMETER CONSTRUCTION FIELD DATA LOG

FACILITY CODE _____ LOCATION ID _____ FIELD REP _____

LOGGER CODE _____ DRILLER CODE _____ RIG TYPE _____

INSTALLER CODE _____ COMPLETION DATE _____ ACCEPTANCE CODE _____

BOREHOLE SUMMARY

BIT TYPE	HOLE DIAM (in)	END ● DEPTH (ft)	FLUID TYPE

CASING SUMMARY

CASING* TYPE	DESCRIPTION	DIAM (in)	END ▲ DEPTH (ft)

* P – Protective S – Screen O – Open N – None

▲ Depth from Top of Casing

WELL CONSTRUCTION

TYPE* CODE	DESCRIPTION	END ● DEPTH (ft)

* B – Backfill S – Seal F – Filter Pack

● Depth From Ground Surface

CONSTRUCTION TIME LOG

ACTIVITY	START DATE	START TIME	END TIME
DRILLING			
CASING			
FILTER PACK			
SEAL			
BACKFILL			
DEVELOPMENT			
OTHER			

WELL DEVELOPMENT

COMMENTS _____

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TMS

BWO-044 (1/93)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.2, Continued

BOREHOLE/PIEZOMETER CONSTRUCTION FIELD DATA LOG

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Location ID. A four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

3. Field Rep. The name of the field representative.

4. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

5. Driller code. Three-character or four-character code identifying the company responsible for drilling the borehole.

6. Rig Type. Manufacturer and model of rig.

7. Installer Code. Three-character or four-character code identifying the company responsible for installing and completing a piezometer.

8. Completion Date. Date when well was completed in the format DD-MMM-YY (01-JAN-88).

9. Acceptance Code. One-character code assigned by the facility manager.

10. Borehole Summary

    a. Bit Type. The type of bit used.

    b. Hole Diam (In). Diameter of borehole in inches.

    c. End Depth (Ft). Depth from the ground surface to the bottom of the borehole (in feet and tenths of feet).

    d. Fluid Type. Type of fluid used during the drilling phase of piezometer installation.

11. Casing Summary

    a. Casing Type. One-character code describing the type of casing material used. The codes are listed below.

    b. Description. Describes the casing materials used (for example, Schedule 40 PVC) in well construction.

    c. Diameter (In). Diameter of casing in inches.

    d. End Depth (Ft). Depth (in feet and tenths of feet) from the top of the casing to the bottom of the casing.

12. Well Construction

    a. Type Code. One-character code describing the material used for filling the annulus space in borehole.

    b. Description. Describes the materials used in piezometer construction (bentonite pellets, for example) to fill the annulus space in borehole.

    c. End Depth (Ft). Depth (from the ground surface) where the materials for well construction are placed in the borehole in feet and tenths of feet.

13. Construction Time Log

    a. Start Date. The date construction started.

    b. Start Time. The time construction started.

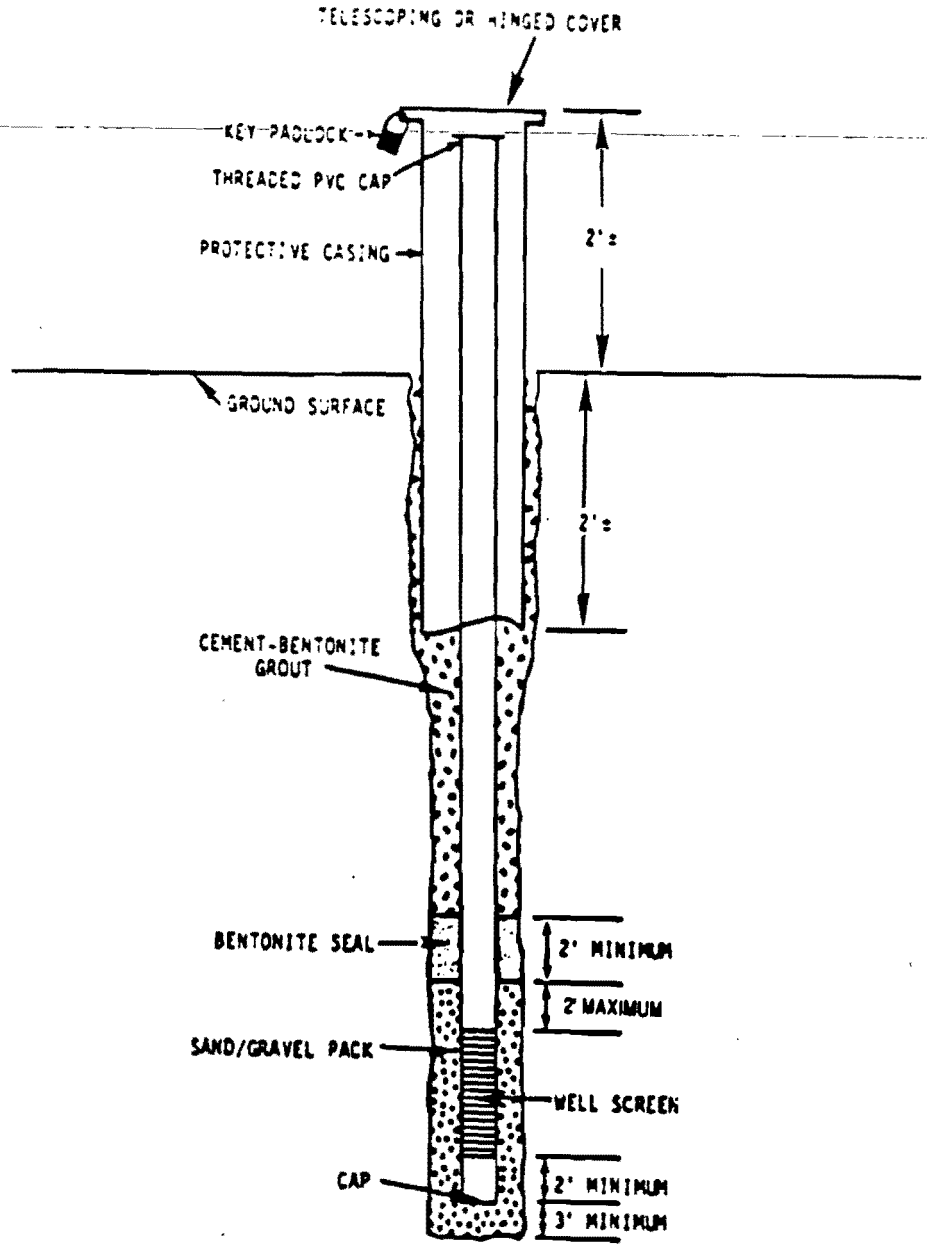
    c. End Time. The time when construction ended.

14. Well Development. Any further developments during piezometer construction.

15. Comments. Any additional information.

APPENDIX 5.3

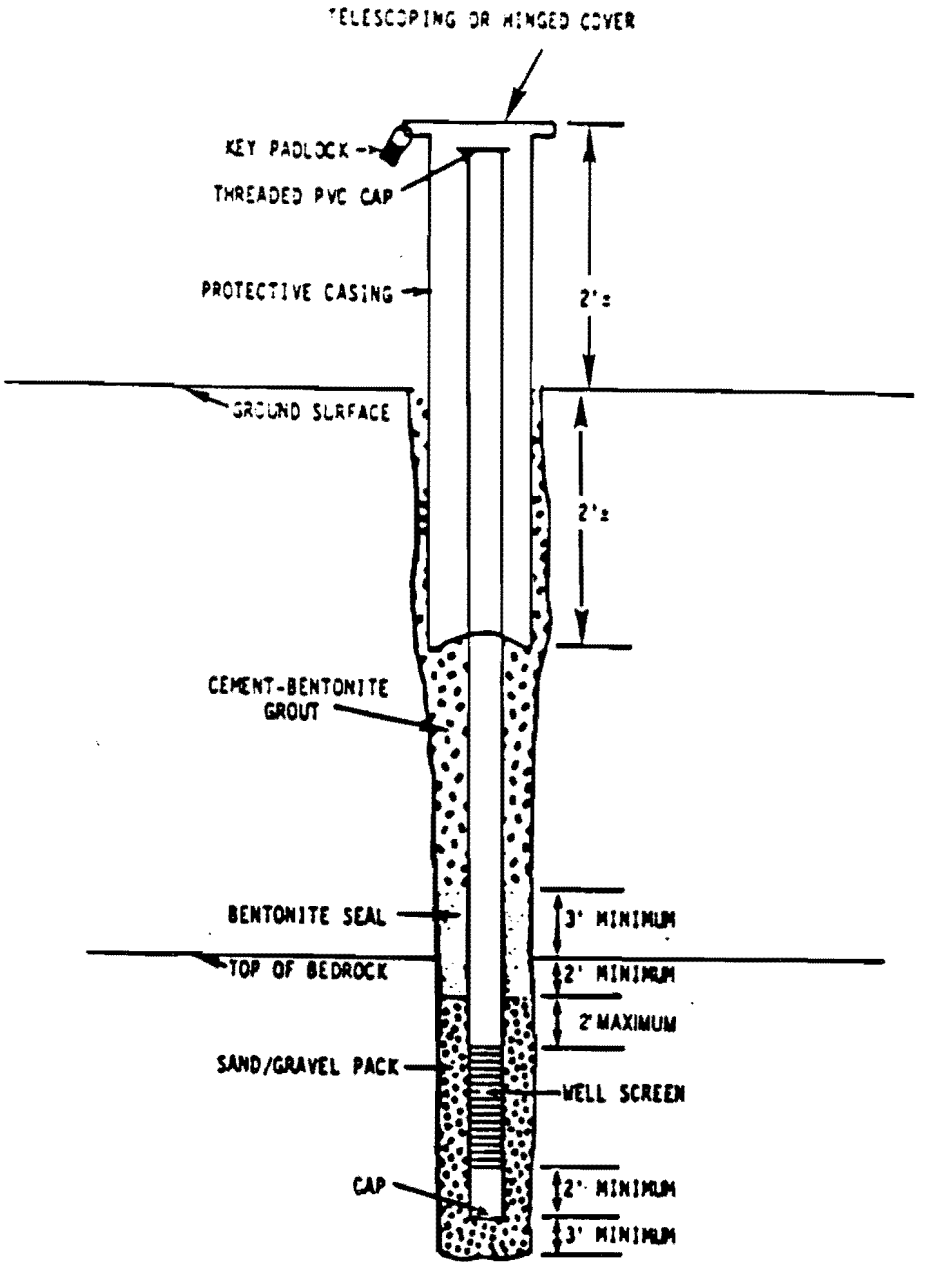
TYPICAL CONSTRUCTION OF OVERBURDEN PIEZOMETER



TYPICAL CONSTRUCTION OF OVERBURDEN WELL

APPENDIX 5.4

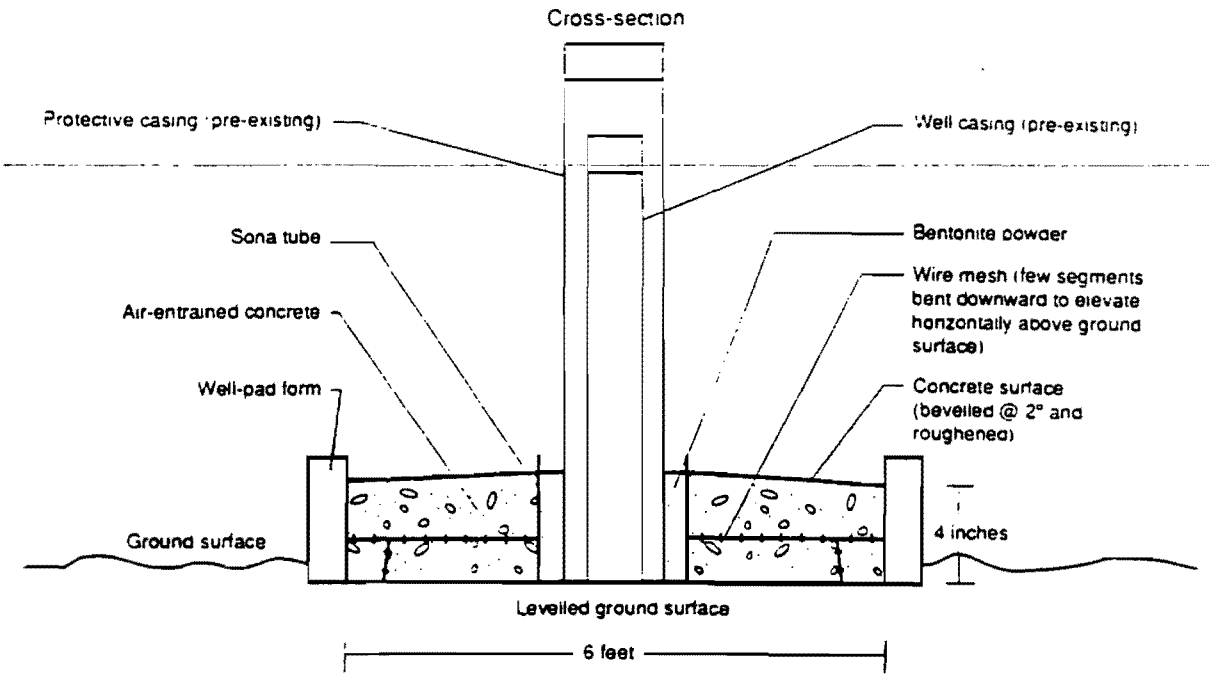
TYPICAL CONSTRUCTION OF BEDROCK PIEZOMETER

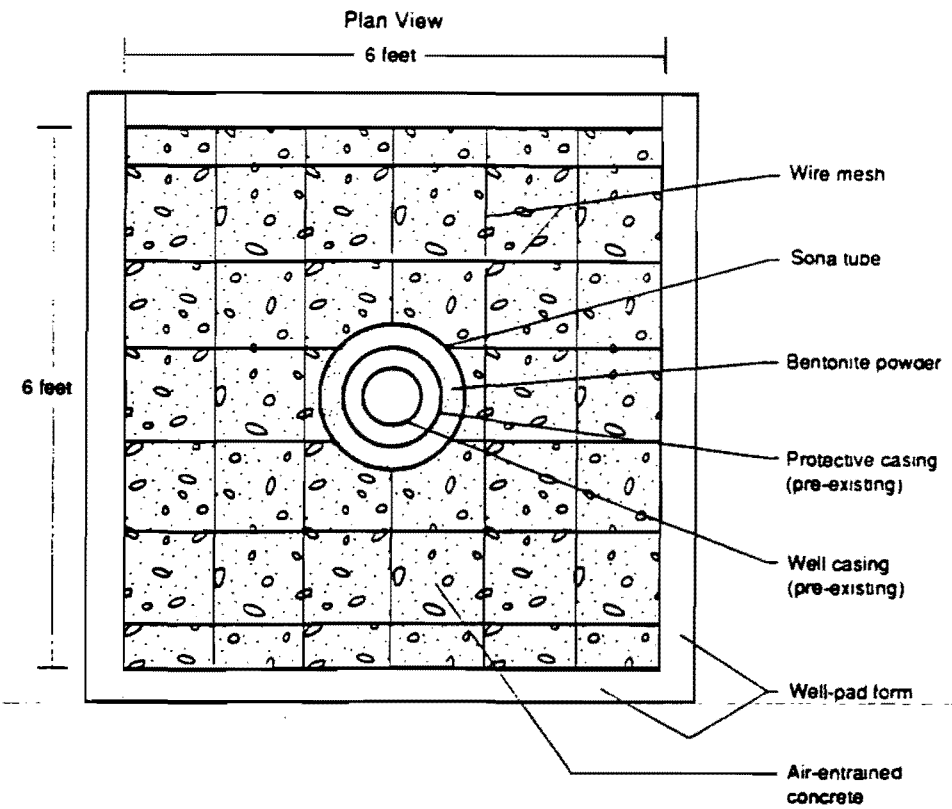


TYPICAL CONSTRUCTION OF BEDROCK WELL

APPENDIX 5.5

TYPICAL CONSTRUCTION OF PIEZOMETER APRON





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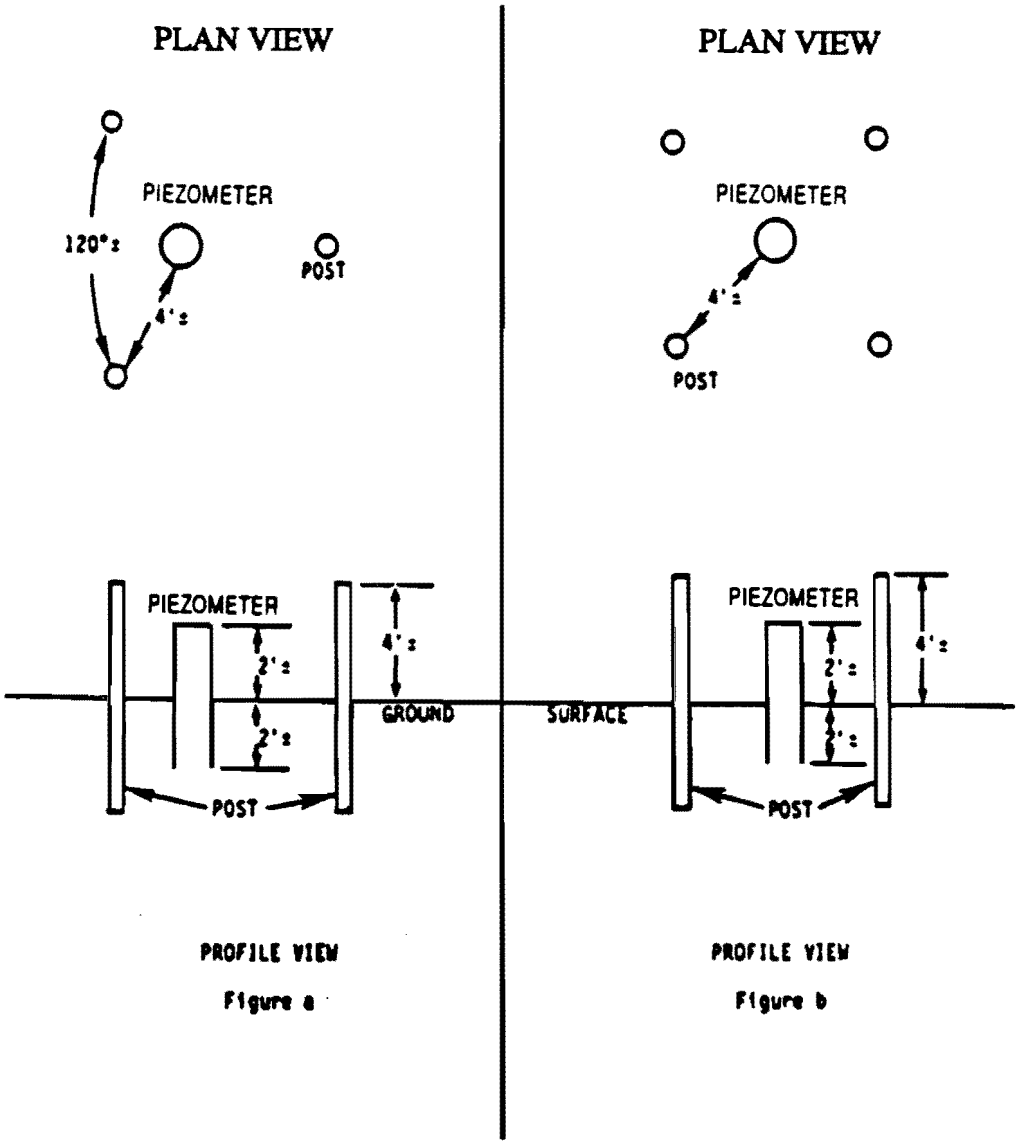
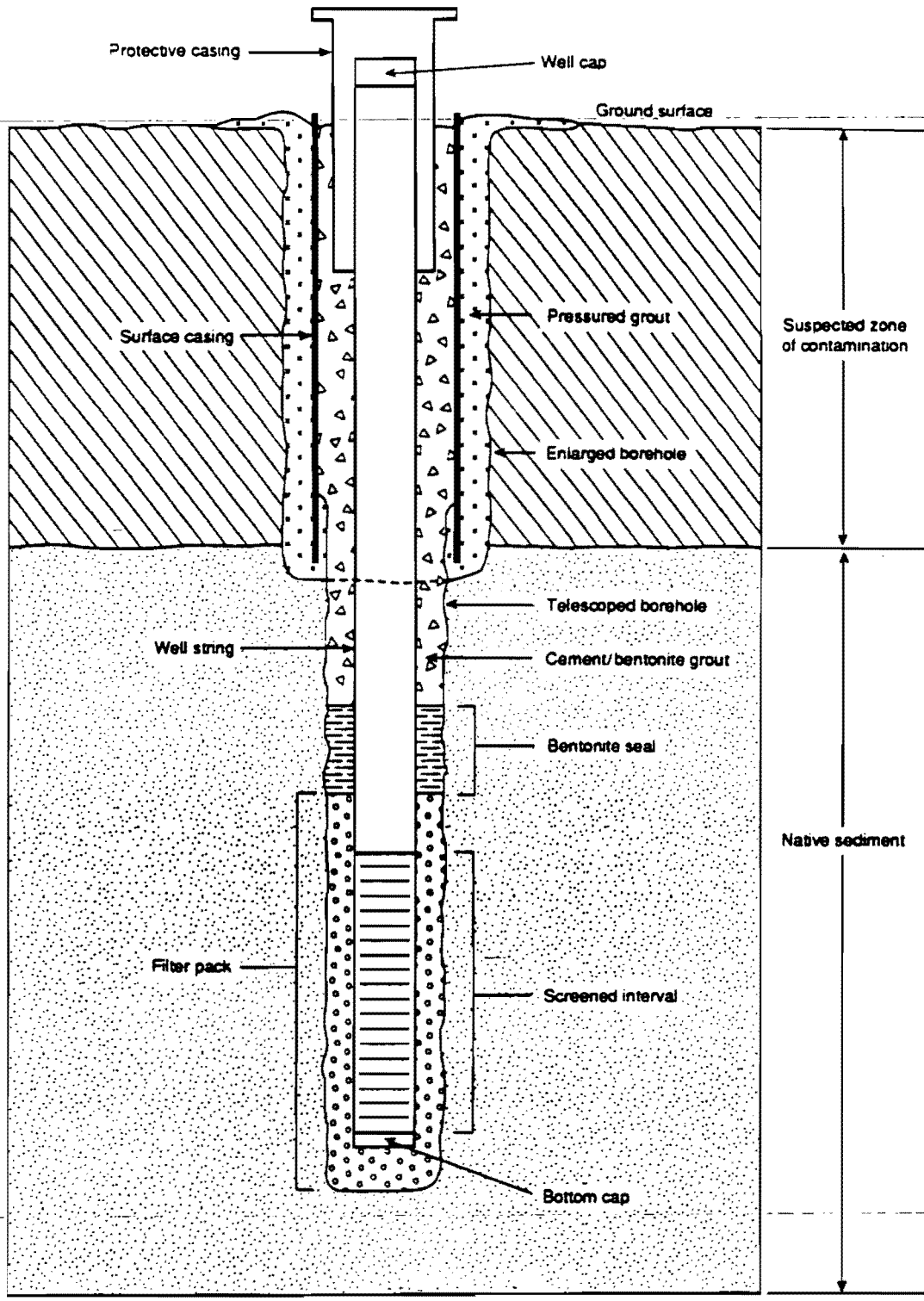
APPENDIX 5.6

POST PLACEMENT AROUND PIEZOMETER



APPENDIX 5.7

TYPICAL CONSTRUCTION OF TELESCOPED PIEZOMETER WITH SURFACE CASING



Append.7 2-24-92

APPENDIX 5.8

DATA FORM COMPLETION INSTRUCTIONS

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

PIEZOMETER COMPLETION INFORMATION FORM

1. Facility code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Location ID. A four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

3. Acceptance Code. One-character code assigned by the installation manager.

4. Owner Code. A three-character or four-character code identifying the owner of a piezometer that is being installed.

5. Installer Code. Three-character or four-character code identifying the company responsible for installing and completing a piezometer.

6. Installation Date. The date when the piezometer was installed in the format DD-MMM-YY (01-JAN-88).

7. Filter Pack Length (Ft). The length of the filter pack surrounding the screened portion of the casing.

8. Formation of Completion (US/RC). (US/RC) designation.

9. Well Type Classification. One-character code that designates the type of well being constructed. Valid codes are listed on page 1 of the Piezometer Completion Information form.

10. Well Completion Method. One-character code describing the method used to complete a well or the nature of the openings that allow water to enter a well. Valid codes are listed on page 1 of the Piezometer Completion Information form.

11. Zone of Completion. One-character code designating the basic water-bearing zones at which a piezometer is completed. Valid codes are listed on page 1 of the Piezometer Completion Information form.

12. Casing Elevation (Ft MSL). Top of casing elevation. Casing elevation will be filled out at completion of the field investigation.

13. Casing Length (Ft). Distance from the top of casing (in feet and tenths of feet) at which the bottom of the casing is placed.

14. Casing Diameter (In). Diameter of casing installed in inches.

15. Seal End Depth (FTFD). Depth below ground surface (in feet and tenths of feet) at which the bottom of the seal is placed.

16. Screen Material. A two-character code describing the type of screen material. Valid codes are listed on page 2 of the Piezometer Completion Information form.

17. Riser Material. A two-character code describing the riser material. Valid codes are listed on page 1 of the Piezometer Completion Information form.

18. Open/Screen Depth (FTFD). Depth in feet and tenths of feet from top of casing to top of screen.

19. Open/Screen Length (Ft). Total length of the screen in feet and tenths of feet.

20. Open/Screen Area (In2/Ft). Open area of screen in inches squared per foot.

21. Flow Relationship. One-character code designating the flow relationship. Valid codes are listed on page 1 of the Piezometer Completion Information form.

22. Cap Material. Two-character code describing the cap material. Valid codes are listed on page 1 of the Piezometer Completion Information form.

23. Cap Type. A two-character code describing the type of cap used in the installed well. Valid codes are listed on page 2 of the Piezometer Completion Information form.

24. Comments. Any additional information.

APPENDIX 5.9

BOREHOLE VOLUMES BY MATERIAL TYPE

ANNULAR SIZE (In.)	OUTSIDE DIAMETER	INSIDE DIAMETER	AREA (1) (Ft.)	LINEAR FEET OF BOREHOLE PER BAG						
				GRAVEL	SAND	C/B GROUT	VOLCLAY	PURE GOLD	BENT. CHIPS	PELLETS
3	3	0	0.049	20.4	20.4	30.6	71.3	44.8	14.3	3.97
3 x 1.25	3	1.75	0.032	30.9	30.9	46.3	108.1	68.0	21.6	2.62
4	4	0	0.087	11.5	11.5	17.2	40.1	25.2	8.0	7.07
4 x 2	4	2.38	0.056	17.7	17.7	26.6	62.1	39.0	12.4	4.56
HSA 4	8	0	0.349	2.9	2.9	4.3	10.0	6.3	2.0	28.26
HSA 4 x 2	8	2.38	0.318	3.1	3.1	4.7	11.0	6.9	2.2	25.76
6	6	0	0.196	5.1	5.1	7.6	17.8	11.2	3.6	15.90
6 x 2	6	2.38	0.165	6.0	6.0	9.1	21.2	13.3	4.2	13.40
6 x 3	6	3.5	0.129	7.7	7.7	11.6	27.0	17.0	5.4	10.49
6 x 4	6	4.5	0.086	11.6	11.6	17.5	40.8	25.6	8.2	6.95
HSA 6 x 2	10	2.38	0.514	1.9	1.9	2.9	6.8	4.3	1.4	41.66
HSA 6 x 3	10	3.5	0.478	2.1	2.1	3.1	7.3	4.6	1.5	38.75
HSA 6 x 4	10	4.5	0.435	2.3	2.3	3.5	8.1	5.1	1.6	35.21
8	8	0	0.349	2.9	2.9	4.3	10.0	6.3	2.0	28.26
8 x 2	8	2.38	0.318	3.1	3.1	4.7	11.0	6.9	2.2	25.76
8 x 4	8	4.5	0.238	0.2	0.2	6.3	14.7	9.2	2.9	19.32
HSA 8 x 2	12	2.38	0.754	1.4	1.4	2.0	4.6	2.9	0.9	61.08
HSA 8 x 3	12	3.5	0.718	1.4	1.4	2.1	4.9	3.1	1.0	58.18
HSA 8 x 4	12	4.5	0.625	1.5	1.5	2.2	5.2	3.3	1.0	54.64

ANNULAR SIZE (In.)	OUTSIDE DIAMETER	INSIDE DIAMETER	AREA (1) (Ft.)	LINEAR FEET OF BOREHOLE PER BAG						
				GRAVEL	SAND	C/B GROUT	VOLCLAY	PURE GOLD	BENT. CHIPS	PELLETS
HSA 8 x 5	12	5.5	0.620	1.6	1.6	2.4	5.6	3.5	1.1	50.23
HSA 8 x 6	12	6.6	0.548	1.8	1.8	2.7	6.4	4.0	1.3	44.35
10	10	0	0.545	1.8	1.8	2.8	6.4	4.0	1.3	44.16
10 x 4	10	4.5	0.435	2.3	2.3	3.5	8.1	5.1	1.6	35.21
10 x 6	10	6.625	0.306	3.3	3.3	4.9	11.4	7.2	2.3	24.78
12	12	0	0.785	1.3	1.3	1.9	4.5	2.8	0.9	63.59
12 x 6	12	6.625	0.546	1.8	1.8	2.7	6.4	4.0	1.3	44.20
12 x 8	12	8.625	0.379	2.6	2.6	4.0	9.2	5.8	1.8	30.74
14	13.5	0.5	0.994	1.0	1.0	1.5	3.5	2.2	0.7	80.47
14 x 8	13.5	8.625	0.588	1.7	1.7	2.6	6.0	3.7	1.2	47.63
14 x 10	13.5	10.625	0.378	2.6	2.6	4.0	9.3	5.8	1.9	30.63
18	18	0	1.766	0.6	0.6	0.8	2.0	1.2	0.4	143.07
18 x 10	18	10.625	1.151	0.9	0.9	1.4	3.0	1.9	0.6	93.22
18 x 12	18	12.75	0.880	1.1	1.1	1.7	4.0	2.5	0.8	71.28
24	24	0	3.140	0.3	0.3	0.5	1.1	0.7	0.2	254.34
24 x 10	24	10.625	2.525	0.4	0.4	0.6	1.4	0.9	0.3	204.49
24 x 12	24	12.75	2.254	0.4	0.4	0.7	1.6	1.0	0.3	182.56
24 x 18	24	18	1.374	0.7	0.7	1.1	2.5	1.6	0.5	111.27

(1) - Area of a circle is (3.1416)(radius squared)(height) or [(3.1416)(diameter squared)(height)]/4. Make sure units are consistent.

STANDARD OPERATING PROCEDURE 4.8

PIEZOMETER DEVELOPMENT

1. PURPOSE

To remove fine sediments or foreign materials that may have been introduced into the groundwater, well annulus, or well screen during well installation and to facilitate hydraulic communication between the screened formation and the piezometer.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the method and equipment to be used for developing the piezometer. Collection and measurement of samples and documentation of data will be performed as described in the associated procedures.

Piezometer development removes the fines from the well or aquifer formation near the screen and corrects damage that occurs during drilling. All piezometer installation procedures create a skin on the borehole wall. Two methods will be used, depending on the formation in which each piezometer has been completed, for developing piezometers: overpumping and rawhiding.

A. Overpumping involves pumping the piezometer down as low as possible and allowing it to refill. The increased velocities created by refilling remove fines. This method is not very effective, because the water flow is in one direction and at relatively low velocities. This method can be sufficiently effective and will be used when the piezometer has been completed in a coarse-grained formation.

B. Rawhiding is a modification of overpumping. After the water is pumped to the surface, it is either allowed to run back into the piezometer through a foot valveless pump or poured back down the well. This method generates two-directional flow and is superior to overpumping. This method will be used when the piezometer has been completed in a fine-grained formation or when the formation yields small amounts of water.

C. Surging involves raising and lowering a surge or swab block inside the piezometer. The resulting motion of the water removes the borehole skin and fines from the formation. The fines and water must occasionally be removed from the piezometer with a sand bailer to prevent sand locking of the surge block. The rubber or viton seals on the surge block are the same diameter as the inside of the piezometer or 1/2-inch smaller if surging is conducted inside the screened interval. A 3-ft stroke is typical.

D. Surging with a vented (pressure-relief) block (Appendix 5.2) and rawhiding are the preferred methods for piezometer development, although no one method is appropriate for all situations.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment

and supplies; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
2.2	Field Measurements on Ground and Surface Water Samples
3.1	Water Level Measurement
3.1	Water Level Measurement
4.5	Piezometer Installation
6.1	Health and Safety Monitoring of Combustible Gas Levels
6.2	Health and Safety Monitoring of Organic Vapors with a Photoionization Detector
6.3	Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all development equipment.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Decontaminate all equipment before developing each piezometer according to SOP 1.6, General Equipment Decontamination.

B. Assemble containers for the temporary storage of water produced during piezometer development. The containers must be structurally sound, compatible with anticipated contaminants, and field manageable.

NOTE: Truck-mounted tanks may be required for this operation.

3.3. Operation

Perform the development as soon as practical after well installation, but no sooner than 48 hrs after grouting is completed. Do not use any dispersing agents, acids, or disinfectants to enhance the development of the piezometer. Do not add water to aid development except under the special conditions defined below. If problems or unusual conditions are encountered, notify the site manager as soon as possible.

A. Assemble the necessary equipment on a plastic sheet outside of the splash range.

B. Record pertinent information in the logbook and on the Piezometer Completion Information form. A copy of this form and instructions for completing the form are provided in SOP 4.5, Piezometer Installation.

C. Open the piezometer and take the air monitoring reading at the top of the casing and in the breathing zone (see SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels; SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector; and SOP 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector).

D. Measure depth-to-water and the total depth of the piezometer according to SOP 3.1, Water Level Measurement.

E. Develop the piezometer until the piezometer is free of sediment. Development should continue until turbidity is less than 5 nephelometer turbidity units (NTUs) and three consecutive pH, specific conductance, and temperature readings are within ± 10% over three well volumes.

1. Note the initial color, clarity, and odor of the water.

2. Measure and record the initial pH, temperature, and specific conductance of the water according to SOP 2.2, Field Measurements on Ground and Surface Water Samples.

3. Containerize all water produced by development in contaminated areas or areas suspected of contamination. All development water will be containerized from each well location and taken to a central location at Mound Plant and placed into a 4,000-gallon holding tank. When this tank is full, no more development water will be accepted and a sample will be collected and analyzed for all suspected contaminants. Three 4,000-gallon tanks will be available onsite for containment of development water. Refer to SOP 1.15 for further details.

4. For those wells where the boring was installed without the use of drilling fluid (potable water), remove 5 times the standing water volume in the piezometer (well screen and casing plus saturated annulus). Should recharge be so slow that 5 volumes could not be removed in one day or the water is not sediment free after this 5-volume removal, the site manager will select an alternate procedure for verifying that the piezometer is properly developed.

5. For those piezometers that cannot be cleaned of formation fines (clays and silts) resulting in low yields of formation water, small amounts of project-approved potable

water should be added to the well bore. Once the majority of fines have been removed from the piezometer, continue development with formation water only. During this process, it is essential that at least 5 times the amount of water injected must be withdrawn from the piezometer to assure that all potable water has been removed from the formation. Do not add water to the piezometer to assist development without prior approval by the site manager.

6. For those piezometers where the boring was installed/enlarged with the use of drilling fluid (potable water), remove 5 times the measured amount of total fluids lost while drilling plus 5 times the standing water volume as defined above. Use the same procedure (of adding more water) for cases of slow recharge, discolored water, or water that is not sediment free.

7. If the turbidity has not decreased to 5 NTU or below and the following conditions have been met:

   - ten well volumes plus five times the amount of any water added has been removed,

   - proper well construction has been verified (i.e., no grout contamination, etc.),

   - several development techniques have been utilized, and

   - pH, specific conductance, and temperature have stabilized within $\pm$ 10% over at least three consecutive well volumes, then

   the site manager shall be notified and will recommend how to proceed.

8. Note the final color, clarity, and odor of the water.

9. Measure and record the final pH, temperature, and specific conductance of the water according to SOP 2.2, Field Measurements on Ground and Surface Water Samples.

10. Complete the appropriate data entry requirements on the Piezometer Completion Information form to document well development. A copy of the form and instructions for completing it are in SOP 4.5, Piezometer Installation.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to the presampling conditions as specified in the FSP or WP.

C. Make sure all piezometer locations are properly staked and the location ID is readily visible on the protective casing.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. After the first round of analytical results have been received, determine and implement the appropriate water disposal method. Refer to SOP 1.15 for comprehensive details for handling IDM.

B. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

C. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

4. SOURCES

Barcelona, M. J., J. P. Gibb, J. A. Helfrich, and E. E. Garske. 1985. "Practical Guide to Groundwater Sampling." U.S. Environmental Protection Agency report EPA/600/2-85/104. Washington, D.C.: U.S. Government Printing Office.

Gass, Tyler E., "Monitor Well Development." 1986. Water Well Journal 40, no. 1: 52-55.

Schalla, Ronald, and Robert W. Landick. 1986. "A New Valved and Air-Vented Plunger for Developing Small Diameter Monitor Wells," Ground Water Monitoring Review 6, no. 2: 77-80.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ pH Meter

_____ Electrical conductivity meter

_____ Distilled water

_____ Stopwatch

_____ Water level measurement probe

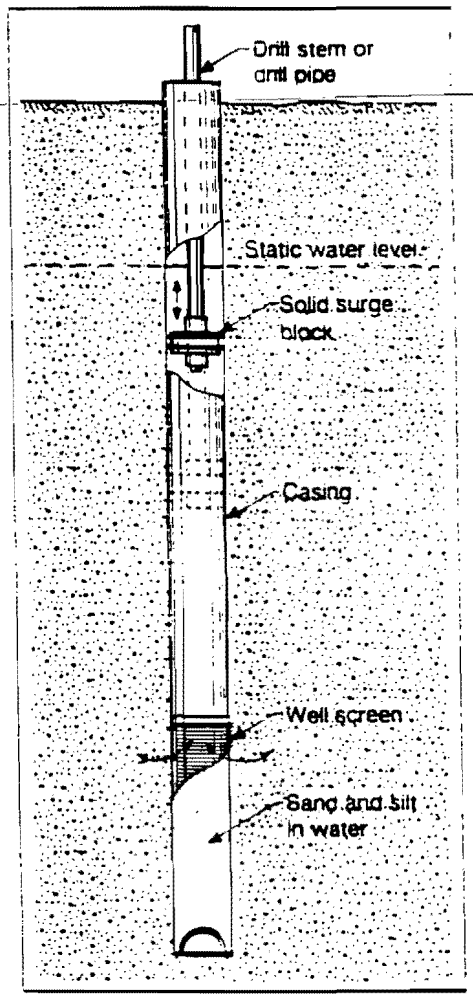
_____ 1000-mL Inhoff cone

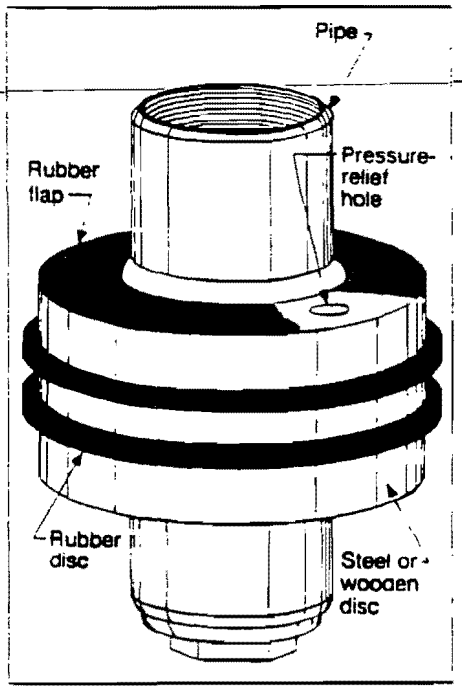
_____ Plastic sheet

_____ Thermometer

APPENDIX 5.2

SURGE BLOCK SCHEMATICS





STANDARD OPERATING PROCEDURE 5.1

SOIL AND ROCK BOREHOLE LOGGING AND SAMPLING

1. PURPOSE

To describe the physical nature of consolidated or unconsolidated subsurface earthen materials encountered during auger, rotary, or other drilling activities and collect samples of the earthen materials for further evaluation.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the type of samples to be collected. Collection and measurement of samples and the documentation of data will be performed as described in the associated procedures.

Before field drilling begins, all management personnel should obtain information about expected geologic and hydrogeologic conditions at the site. The FSP or WP includes directions for sampling methods, location, and details for the site where the field personnel will work.

Most sites where soil and rock borehole logging and sampling are conducted include unconsolidated deposits of varying thickness over consolidated bedrock at depth. Two forms are used for describing the soil and rock encountered during drilling and sampling. The Borehole Log (Soil) form (Appendix 5.2) is used when describing unconsolidated alluvium, colluvium, and regolith. The Borehole Log (Rock) form (Appendix 5.3) is used when drilling or coring rock to describe the lithology and other physical characteristics of sedimentary, igneous, and metamorphic rocks.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information on equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation

1.5	Guide to Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
4.1	Soil Boring
4.2	Rock Boring

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access. Have areas of subsurface sampling investigated for underground utilities.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

G. Contact the members of the survey crew and inform them of the approximate date that ground surveys will begin.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Decontaminate all sampling equipment before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and the FSP or WP).

B. Record all pertinent information (date, site, ID number, and location) in the logbook or the appropriate data form. Note field conditions, unusual circumstances, and weather conditions.

C. Permanently attach a soil sample identification label to each sample container.

3.3. Operation

3.3.1. Logging Samples

A. Whenever a sample is collected, complete a description of the sample using the Borehole Log (Soil) form (Appendix 5.2) or Borehole Log (Rock) form (Appendix 5.3). Fill out these forms according to the information described in Appendix 5.4. Include all scale drawings that further describe textural variations in the logbook. If cameras are permitted on the site, use photographs instead of drawings.

NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Soil Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains copies of the form and label and instructions for completing the form and label.

B. Gross physical properties of the sample can be described by unaided visual observation or inspection under a hand lens. Whenever feasible, prepare sample descriptions by observing fresh surfaces or cuttings.

C. Wash cuttings from mud rotary boring in clear water to remove drilling mud. Use a strainer with a large capacity during the washing process.

D. Split the core lengthwise, so that the interior can be inspected. Place core in cardboard box after inspection. Label top, bottom, and core interval on box. The core box will be lined with plastic to minimize cross-contamination. Mark unrecovered core intervals with blocks of wood. Use two permanent markers of different colors to draw parallel lines on the core so that its proper position in the core box can be maintained during and after future inspections.

E. Record all linear measurements in feet or tenths of feet, not inches.

F. Blow counts are to be counted for each 0.5-ft penetration of the Standard Penetration Test.

G. Use the standard Unified Soil Classification System (USCS) designations for identifying soil strata. Detailed descriptions of the different soil classifications are included in the U.S. Corps of Engineers Technical Memorandum, 1953.

H. Visual descriptions will be according to ASTM Designation D 2488-69 "Standard Recommended Practice for Description of Soils (Visual-Manual Procedure)."

I. Percent core recovery is a measure of coring efficiency and rock quality. If coring progresses gradually, a hard sandstone to a strongly fissile shale, the percent recovery will be affected. Once the core is shown to the field representative (preferably while still in the core barrel if it is a split-core barrel), measure the total length recovered. Sometimes it is possible to determine where core loss occurred in the run. The following clues are sometimes present: plugging off during drilling, intense fracturing in certain sections of core (possibly correlated with rough, high vibrations during drilling), and rolled and recut pieces of core.

J. The rock quality designation (RQD) is based on a modified core recovery procedure and indirectly on the number of fractures and the amount of softening or alteration in the rock mass. Obtain the measure by summing up the total length of core recovered and counting only those relatively hard, sound pieces of core that are four inches in length or longer. See Stags and Zienkiewitz, 1968 for an example of an RQD computation. It is necessary to distinguish between natural fractures and those caused by drilling or recovery operations. Depending on the engineering or hydrogeologic requirements of the project, breaks induced along high anisotropic planes (like foliation or bedding) may be counted as natural fractures. Lengths that contain strong and recemented fractures should be measured in total.

RQD	QUALITY OF ROCK MASS
90-100	Excellent
75-90	Good
50-75	Fair
25-50	Poor
0-25	Very Poor

K. Percent Drilling Fluid Recovery--the volume of fluid losses and the interval over which they occur. For example, no fluid loss means that no fluid was lost except through spillage and filling the hole. Partial fluid loss means that a return was achieved, but the amount of return was significantly less than the amount being pumped. Complete water loss means that no fluid returned to the surface during the pumping operation. A combination of opinions from the field personnel and the driller on this matter will result in the best estimate. Make a crude, relatively effective estimate by placing a calibrated stick in the recirculation pit. Estimate the return flow and volume of the pit at intervals of one-half ft to one ft on the stick. Obtain the pumping rate by measuring elapsed time to withdraw a specified volume from the pit without return. After estimating the return flow, a percentage can be obtained. The return flow can sometimes be crudely measured with a five-gallon bucket.

Record a change in the fluid recovery rates. If the recovery is essentially the same for an entire core run, only one call per change is necessary. Record the change in fluid recovery rate to the nearest 10%.

L. Spacing. Describe the spacing of discontinuities as close or wide according to the following tables.

SPACING	FOLIATION, BANDING, OR BEDDING	SYMBOL
(1) More than 6 ft	Very thickly (bedded or banded)	VT
(2) 2 to 6 ft	Thickly	T
(3) 8 to 24 inches	Medium	M
(4) 2 1/2 to 8 inches	Thinly	TN
(5) 3/4 to 2 1/2 inches	Very thinly	VTN

In describing structural features, describe the rock mass as thickly bedded or thinly bedded according to the above criteria. Depending on the project requirements, identify the form of joint (stepped, smooth, undulating, or planar), its dip (in degrees), its surface (rough, smooth, or slickensided), its opening (giving width), and its filling (none, sand, clay, or breccia).

M. Orientation. The orientation is the angle of bedding, joints, or fractures measured with a clear plastic protractor to the nearest 10°. Reference all measurements with 0° at horizontal. If fractures have a persistent orientation, record at the beginning and repeat every 5 ft in depth.

N. Condition. The texture of the fractures. Examples of condition are smooth, clean, rough, and stained.

O. Weathering. Describe the degree of weathering according to the following table.

GRADE	SYMBOL	DIAGNOSTIC FEATURES
Fresh	F	No visible sign of decomposition or discoloration. Rings under hammer impact present.
Slightly Weathered	SLW	Slight discoloration inward from open fractures; otherwise, similar to fresh.
Moderately Weathered	MW	Discoloration throughout. Weaker minerals (like feldspar) have decomposed. Strength somewhat less than fresh rock, but cores cannot be broken by hand or scraped by knife. Texture has been preserved.
Highly Weathered	HW	Most minerals are somewhat decomposed. Specimens can be broken by hand with effort or shaved with a knife. Core stones present in rock mass. Texture becoming indistinct, but fabric has been preserved.

Completely	CW	Minerals decomposed to soil, but fabric and structure have been preserved (saprolite). Easily crumbled or penetrated. Advanced state of decomposition resulting in plastic soils. Rock fabric and structure completely destroyed. Large volume change.

CAUTION: Soft rock is not necessarily weathered. Look for alteration minerals that indicate true weathering has occurred.

P. Hardness. Describes the degree of hardness according to the following table.

CLASS	HARDNESS	SYMBOL	FIELD TEST
I	Extremely hard	EH	Many blows with geologic hammer required to break intact specimen.
II	Very hard	VH	Hand-held specimen breaks with hammer end of pick under more than one blow.
III	Hard	H	Cannot be scraped or peeled with knife; hand-held specimen can be broken with single moderate blow with pick.
IV	Soft	SO	Can just be scraped or peeled with knife. Indentations 1 mm to 3 mm show in specimen with moderate blow with pick.
V	Very soft	VSO	Material crumbles under moderate blow with sharp end of pick and can be peeled with a knife, but specimen is too hard to hand trim to a size usable in a triaxial test apparatus.

Q. Lithologic. The type of strata encountered during various subsurface exploratory investigations. The geologic lithology codes that are to be used are listed in Appendix 5.7.

R. Visual Description. Other petrologic descriptors that aid in the classification of the rock or soil. Information that should be included is listed below.

1. Typical Name
   Sandstone, schist, granite, or any of the appropriate names/descriptions included in Appendix 5.6

2. Grain Size
   Fine, medium, or coarse

3. Structure
   Stratified, laminated (varved), fissured, slickensided, blocky, lensed, or homogeneous (nonstratified)

4. Color
   Use A.S.A. rock color chart for rocks; use Mansell color chart for soils. This should include grey colors for reduced soils.

5. Cementation
   Weak or strong

6. Local or Geologic Name

7. Group Symbol from Appendix 5.5 or 5.6

S. Place samples for analyses in appropriate containers (see SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples). Designate sample intervals removed from core by wooden blocks that have been properly labeled according to the interval sampled.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to presampling conditions and plug open sampling holes, as specified in the FSP or WP.

C. Make sure all borehole locations are properly staked and the location ID is readily visible on the location stake.

D. Prepare samples and transport according to SOP 1.3, Sample control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial and date all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are understood.

4. SOURCES

ASTM. 1986. "Standard Method for Penetration Test and Split-Barrel Sampling of Soils," 298-303, ASTM D: 1586-84. American Society of Testing Methods, Philadelphia, Pennsylvania.

ASTM. 1986. "Standard Practice for Thin-Walled Tube Sampling of Soils," 304-307, ASTM D: 1587-83. American Society of Testing Methods, Philadelphia, Pennsylvania.

ASTM. 1986. "Standard Practice for Diamond-Core-Drilling-For-Site-Investigation," 333-337, ASTM D: 2113-83. American Society of Testing Methods, Philadelphia, Pennsylvania.

ASTM. 1986. "Standard Test Method for Classification Of Soils For Engineering Purposes," 397-410, ASTM D: 2487-85. American Society of Testing Methods, Philadelphia, Pennsylvania.

ASTM. 1986. "Standard Recommended Practice for Description of Soils (Visual-Manual Procedure)," 411-25, ASTM D:2488-84. American Society of Testing Methods, Philadelphia, Pennsylvania.

ASTM. 1986. "Standard Practice for Ring-Lined Barrel Sampling of Soils," 560-563, ASTM D: 3550-84. American Society of Testing Methods, Philadelphia, Pennsylvania.

U.S. Corps of Engineers. 1953. "The Unified Soil Classification System." Technical Memorandum No. 3-357. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Borehole Log (Soil) Form

5.3. Borehole Log (Rock) Form

5.4. Data Form Completion

5.5. Checklist for Description of Fine-Grained Soils

5.6. Checklist for Description of Coarse-Grained Soils

5.7. Geologic Lithology Codes

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Plastic sheet

_____ Hand lens

_____ Tape measure (divided by feet and tenths of feet)

_____ Wooden blocks (for core)

_____ Core boxes

_____ Grain-size chart

_____ Color chart

_____ Dilute HCl

_____ Red and blue permanent markers

_____ Strainer

_____ Sample labels

_____ Sample containers

APPENDIX 5.2

BOREHOLE LOG (SOIL) FORM

BOREHOLE LOG (SOIL)

PAGE 1 OF ____

FACILITY CODE _____ DRILLER CODE _____
LOCATION ID _____ COMPLETION DATE _____
COORDINATES (FT): DIAMETER (IN) _____
NORTH _____ EAST _____ DEPTH (FTFD) _____
GROUND ELEVATION (FT MSL) _____ CONSTRUCTION METHOD _____
LOCATION TYPE BH ACCEPTANCE CODE _____
COMMENTS _____

GROUNDWATER LEVELS

DATE	TIME	DEPTH (FT)

LOCATION DESCRIPTION

LITHOLOGIC LOG

LOGGER CODE _____

DEPTH (FT)	SAMPLE INTERVAL	SAMPLE RECOVERY	SAMPLE RETAINED	SAMPLE METHOD	SAMPLE ID	BLOW COUNT (PER 6 IN)	N VALUE	USCS	VISUAL DESCRIPTION

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

CONSTRUCTION METHODS:

A – AIR ROTARY
B – BORED OR AUGERED
C – CABLE-TOOL
D – DUG
H – HYDRAULIC-ROTARY
J – JETTED
P – AIR-PERCUSSION
R – REVERSE ROTARY
T – TRENCHING
V – DRIVEN
W – DRIVE AND WASH
Z – OTHER (SPECIFY)

SAMPLE METHODS:

A – AUGER CUTTINGS
S – 2" O.D. 1.38" I.D. DRIVE SAMPLE
U – 3" O.D. 2.42" I.D. TUBE SAMPLE
T – 3" O.D. THIN-WALLED SHELBY TUBE
O – OTHER (SPECIFY)

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
BHD-002 (3/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

BOREHOLE LOG (SOIL)

PAGE ____ OF ____

FACILITY CODE _____

LOCATION ID _____ **COMPLETION DATE** _____

LITHOLOGIC LOG

DEPTH (FT)	SAMPLE INTERVAL	SAMPLE RECOVERY	SAMPLE RETAINED	SAMPLE METHOD	SAMPLE ID	BLOW COUNT (PER 6 IN)	N VALUE	USCS	VISUAL DESCRIPTION

COMPLETE BOLDED DATA FOR ENTRY INTO TMS
BND-002 (3/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.3

BOREHOLE LOG (ROCK) FORM

BOREHOLE LOG (ROCK)

PAGE 1 OF ____

FACILITY CODE _____ **DRILLER CODE** _____
LOCATION ID _____ **COMPLETION DATE** _____
COORDINATES (FT): **DIAMETER (IN)** _____
NORTH _____ **EAST** _____ **DEPTH (FTFD)** _____
GROUND ELEVATION (FT MSL) _____ CONSTRUCTION METHOD _____
LOCATION TYPE BH _____ **ACCEPTANCE CODE** _____

GROUNDWATER LEVELS

DATE	TIME	DEPTH (FT)

LOCATION DESCRIPTION

LITHOLOGIC LOG

LOGGER CODE _____

DEPTH (FT)	PACKER TEST INTERVAL	DRILLING METHOD	SAMPLE ID	% CORE RECOVERY	% ROCK QUALITY DESIGNATION (RQD)	% DRILLING FLUID RECOVERY	SPACING	ORIENTATION	CONDITION	WEATHERING	HARDNESS	LITHOLOGIC	VISUAL DESCRIPTION

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

CONSTRUCTION METHODS:

A – AIR ROTARY
B – BORED OR AUGERED
C – CABLE–TOOL
D – DUG
H – HYDRAULIC–ROTARY
J – JETTED
P – AIR–PERCUSSION
R – REVERSE ROTARY
T – TRENCHING
V – DRIVEN
W – DRIVE AND WASH
O – OTHER (SPECIFY)

DRILLING METHODS:

H – 8 1/2" HOLLOW STEM AUGER
C – 4 1/2" CONTINUOUS FLIGHT AUGER
GB – GEAR BIT
NX – NX ROCK CORING
NQ – NQ WIRELINE ROCK CORING

SPACING:

BEDDED, FOLIATION, ETC:
VT – VERY THICKLY
T – THICKLY
M – MEDIUM
TN – THINLY
VTN – VERY THINLY

JOINTS/FAULTS:
VW – VERY WIDELY
W – WIDELY
M – MEDIUM
C – CLOSELY
VC – VERY CLOSELY

CONDITION:

ND – NODULAR
MT – MOTTLED
V V – VARVED
BN – BANDED
ST – STINGERS
SM – SMOOTH
CL – CLEAN
RH – ROUGH
SL – SLIGHT

WEATHERING:

F – FRESH
SL – SLIGHTLY WEATHERED
MW – MODERATLY WEATHERED
HW – HIGHLY WEATHERED
CW – COMPLETELY WEATHERED
RS – RESIDUAL SOIL

HARDNESS:

EH – EXTREMELY HARD
VH – VERY HARD
H – HARD
S – SOFT
VS – VERY SOFT

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
BHD–003 (3/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

BOREHOLE LOG (ROCK)

PAGE ____ OF ____

FACILITY CODE _____

LOCATION ID _____ COMPLETION DATE _____

LITHOLOGIC LOG

DEPTH (FT)	PACKER TEST INTERVAL	DRILLING METHOD	SAMPLE ID	% CORE RECOVERY	% ROCK QUALITY DESIGNATION (RQD)	% DRILLING FLUID RECOVERY	SPACING	ORIENTATION	CONDITION	WEATHERING	HARDNESS	LITHOLOGIC	VISUAL DESCRIPTION

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS

BHD-003 (1/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.4

DATA FORM COMPLETION INSTRUCTIONS

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

BOREHOLE LOG (SOIL) FORM AND BOREHOLE LOG (ROCK) FORM

The following information explains the completion of the upper portion of both forms.

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, radiological, and other measurements are taken.

3. Coordinates (Ft): North/East. The horizontal location of the borehole. At the time of the field investigation, the exact coordinate position of the borehole will not be known. In this case, write NA in the two spaces on the form. This information will be provided on an addendum form when the survey data comes in after the drilling program has been completed.

4. Ground Elevation. At the time of the field investigation, the exact ground elevation of the borehole will not be known. In this case, write NA in the space on the form. This information will be provided on an addendum to the original data form when the survey data comes in after the drilling program has been completed.

5. Location Type BH is a standard location type for a borehole log or well.

6. Driller Code. A maximum of four characters noting the company responsible for drilling.

7. Completion Date. The date when the borehole reached total depth in the format DD-MMM-YY (01-JAN-88).

8. Diameter. Diameter of borehole in inches and tenths of inches.

9. Depth. Total depth of borehole in feet and tenths of feet.

10. Construction Method. The construction or drilling method used in the advancement of the borehole. A table of various construction methods is included at the bottom of each Borehole Log form.

11. Acceptance Code. A one-character code assigned by the facility manager.

12. Groundwater Levels. Record depth-to-water when encountered during the drilling. Take at least one water level measurement after the completion of drilling and the borehole has been left open or a piezometer or monitoring well has been installed. Before taking water level measurements, see SOP 3.1, Water Level Measurement.

13. Location Description. Description of the approximate borehole location in respect to some recognizable, permanent topographic or geographic location that is nearby.

14. Logger Code. Four-character code identifying the company responsible for collecting the information recorded on the form.

15. Depth in Feet That Depicts Lithologic or Soil Boundaries. Record depths on the Borehole Logs in feet and fractions (tenths of feet).

Conversion Table

Inches to Tenths of Feet

Inches	Tenths of Feet
1	.08
2	.17
3	.25
4	.33
5	.42
6	.50
7	.58
8	.67
9	.75
10	.83
11	.92
12	1.00

16. Sample ID. Four-digit number assigned to ensure that data collected retains uniqueness from other data collected at the same location ID.

A. The following describes the nonrepetitive information required for completing the Borehole Log (Soil) form.

1. Comments. Includes preservation method and any additional information.

2. Sample Interval. The designated starting and ending depth of the appropriate sampling technique. The following table summarizes common intervals for sample lengths.

APPENDIX 5.4, Continued

Sampling Device	Sample Interval (Feet)	Example Depth Internal
SPT	1.5 or 2.0	14.8 - 16.3
Large-diameter ring sample	1.0, 1.5, or 2.0	14.8 - 15.8
Shelby tube	2.0	14.8 - 16.8
Continuous sampler	5.0	14.8 - 19.8

If the designated sample is 1.5 ft standard penetration test (SPT), but in actuality the SPT only penetrates 0.5 ft (or some length less than the sample interval) in 50 blows per 6 inches or less (refusal blow count), the graphical representation for the sample interval remains at 1.5 ft.

3. Sample Recovery. The numerical representation of the actual sample recovered by the respective sampling method.

4. Sample Retained. The numerical representation of the actual sample retained for future laboratory testing. This number cannot be larger than the sample recovery number. If no sample is recovered, write NR for no recovery in the space provided.

5. Sample Method. One-character code to identify the sampling method used to retain a subsurface soil sample. Sample types are listed below. The box in the lower right-hand corner of the Borehole Log (Soil) form lists the types of samples.

   Sample Types:

   A Auger cuttings
   S 2-inch O.D., 1.38-inch I.D. drive sample
   U 3-inch O.D., 2.42-inch I.D. tube sample
   T 3-inch O.D., thin-walled Shelby tube
   O Other (specify)

6. Blow Count. The number of blows (blow counts) required for every 6 inches of the 18-inch or 24-inch SPT.

7. N Value. The sum of the number of blows in the last two 6-inch intervals of the SPT.

8. Unified Soil Classification System (USCS). Two-character code describing soil strata encountered during drilling. Use the standard Unified Soil Classification (USCS) designations except when a combination of two soils is encountered. In that case, use two different two-character codes (separated by a dash, like CL--ML). Codes may also be derived from the agricultural classifications of

soils. Agricultural classifications are not standard and vary from region to region for the same basic soil type.

For the purpose of classifications, the USCS system recognizes 15 soil groups, each having distinctive engineering properties. A listing of these 15 USCS classifications is shown below.

CH	Fat Clays
CL	Lean Clays, Sandy Clays, or Gravelly Clays
GC	Clayey Gravel or Clayey Sandy Gravel
GM	Silty Gravel or Silty Gravelly Sand
GP	Gravel or Sandy Gravel--Poorly Graded
GW	Gravel or Sandy Gravel--Well Graded
MH	Micaceous Silts or Diatomaceous Soils
OH	Fat Organic Clays
OL	Organic Silts or Lean Organic Clays
PT	Peat, Humus, and Other Organic Swamp Materials
SC	Clayey Sand or Clayey Gravelly Sand
SM	Silty Sand or Silty Gravelly Sand
SP	Sand or Gravelly Sand--Poorly Graded
SW	Sand or Gravelly Sand--Well Graded

9. Visual Description. The soil description will be according to the ASTM Designation, D 2488-69 Standard Recommended Practice for Description of Soils (Visual-Manual Procedure). Appendixes 5.5 and 5.6 include checklists outlining minimum descriptions of fine-grained and coarse-grained soils.

B. The following describes the nonrepetitive information required to complete the Borehole Log (Rock) form.

1. Packer Test Interval. A graphical representation that denotes the bottom of the top packer and the top of the bottom packer by a solid line drawn in the column.

2. Drilling Method. The drilling method could be, but is not limited to, gear bit, NX rock coring, or NQ wireline rock coring. The box in the lower right-hand corner of the Borehole Log (Rock) form lists the accepted abbreviations for drilling methods shown below.

<u>Drilling Methods</u>

GB	Gearbit (specify diameter)
NX	NX Rock Coring
NQ	NQ Wireline Rock Coring
AR	Air Rotary
MR	Mud Rotary
WR	Water Rotary
CT	Cable Tool

3. Percent Core Recovery. The total length of the recovered core multiplied by 100 and divided by the length of the core run results in the percentage of recovery. Record the recovery of core to the nearest 5%.

4. Rock Quality Designation (RQD). The Rock Quality Designation (RQD) is computed by summing the lengths of all pieces of core equal to or longer than 4 inches and dividing by the percent recovery. The result is multiplied by 10 to yield the RQD in a percentage form that can be recorded to the nearest 5%.

$$RQD = \frac{\text{Sum of Length} > 4 \text{ inches}}{\text{Total Length of Core}}$$

5. Percent Drilling Fluid Recovery. After estimating the return flow, a percentage can be obtained. Record a change in the fluid recovery rates. If the recovery is essentially the same for the entire core run, only one call per change is necessary. Record it to the nearest 10%.

6. Spacing. Describe the spacing of discontinuities with the symbols or verbiage described in section 3.3.1.M.

7. Orientation. Record this call to the nearest 10°.

8. Condition. Examples of conditions are smooth, clean, rough, or stained.

9. Weathering. Describes as fresh the degree of weathering (slight, moderate, or high), complete, or residual soil.

10. Hardness. Describes sample as extremely hard, very hard, hard, soft, or very soft.

11. Lithologic. Two-character code describing the lithology encountered during various subsurface exploratory investigations. Use the geologic lithology codes listed in Appendix 5.7.

12. Visual Description. Other petrologic descriptors to assist in the classification of the rock.

APPENDIX 5.5

CHECKLIST FOR DESCRIPTION OF FINE-GRAINED SOILS

1. Typical Name

   Sandy silt, silt, clayey silt, sandy clay, silty clay, clay, organic silt, organic clay, or fill

2. Size Distribution

   Approximate percent gravel, sand, and fines in fractions finer than three inches

3. Color

   Note presence of mottling and banding, as well as soil color

4. Moisture Content

   Dry, moist, wet, or saturated

5. Consistency

   Soft, firm (medium), stiff, very stiff, or hard

6. Structure

   Stratified, laminated (varved), fissured, blocky, lensed, or homogeneous (nonstratified)

7. Cementation

   Weak, strong, or absent

8. Local or Geologic Name

9. Group Symbol

   U.S.C.S. Soil Classification

Group Symbol	Group Name
CL	Lean clay (low to medium plasticity)
ML	Silt
OL	Organic clay or silt (lean)
CH	Fat clay (high plasticity)
MH	Elastic silt
OH	Organic clay or silt (fat)
PT	Peat

APPENDIX 5.6

CHECKLIST FOR DESCRIPTION OF COARSE-GRAINED SOILS

1. Typical Name

   Sand, clayey sand, silty sand, gravel, clayey gravel, silty gravel, cobbles, or boulders

2. Gradation

   Well graded (uniformly graded) or poorly graded (gap-graded)

3. Size Distribution

   Approximate percent gravel, sand, and fines in fractions finer than three inches.

4. Grain Shape

   Angular, subangular, subrounded, or rounded

5. Color

6. Moisture Content

   Dry, moist, wet, or saturated

7. Structure

   Stratified, lensed, or nonstratified

8. Cementation

   Weak or strong

9. Local or Geologic Name

10. Group Symbol

    U.S.C.S. Soil Classification

Group Symbol	Group Name
GW	Well-graded gravel
GP	Poorly graded gravel
GM	Silty gravel
GC	Clayey gravel
SW	Well-graded sands
SP	Poorly graded sands
SM	Silty sand
SC	Clayey sand

APPENDIX 5.7

GEOLOGIC LITHOLOGY CODES

LITHOLOGIC	NAME/DESCRIPTION
AL	Alluvium
BA	Basalt
BR	Undifferentiated Bedrock
BT	Bandelier Tuff
CG	Conglomerate
CH	Fat Clays
CL	Lean Clays, Sandy or Silty Clays, or Gravelly Clays
CA	Calcrete
CR	Chert
CS	Claystone
DI	Diorite
DO	Dolomite
FL	Fill Material
GC	Clayey Gravel or Clayey Sandy Gravel Soils
GM	Silty Gravel or Silty Soils
GN	Gneiss
GP	Gravel or Sandy Gravel, Poorly Graded
GR	Granite
GW	Gravel or Sandy Gravel, Well Graded
GY	Gypsum
LG	Lignite
LS	Limestone
MH	Micaceous Silts or Diatomaceous Soils
ML	Silts, Sands, or Clayey Fine Sands
NR	No Recovery of Data For Classifying
OH	Organic Clays of High Plasticity
OL	Organic Silts or Organic Clays of Low Plasticity
OT	Other General Materials
PT	Peat, Humus, and Other Organic Swamp Soils
QT	Quartzite
RY	Rhyolite
SA	Salt
SC	Clayey Sand or Sand-Clay Mixture
SH	Shale
SI	Silcrete, Poorly Graded
SM	Silty Sand or Sand-Silt Mixtures
SP	Sand or Gravelly Sand, Poorly Graded
SS	Sandstone
ST	Siltstone
SW	Sand or Gravelly Sand, Well Graded
TF	Tuff
TI	Till
TP	Unknown
TS	Topsoil, Undifferentiated
VO	Volcanics

STANDARD OPERATING PROCEDURE 5.2

SOIL SAMPLING WITH A SPADE AND SCOOP

1. PURPOSE

To describe a method for collecting a grab soil sample less than 4 ft below the land surface.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the type of samples to be collected. Collection and measurement of samples and documentation of data will be performed as described in the associated procedures.

Sampling of the soil horizons above the groundwater table can detect contaminants before they migrate into the water table. Soil sample analysis can assist in determining the extent of the contaminant source term and establish the amount of contamination absorbed into aquifer solids that have the potential to contaminate groundwater.

Accurate, representative samples can be collected with this procedure, if care and precision are demonstrated by the technician. The spade-and-scoop method can be used in most soil types, but is somewhat limited to sampling near the soil surface. Sample collection from depths greater than 4 ft can become extremely labor-intensive. Collection of samples from near the soil surface can be accomplished with tools like spades, shovels, and scoops. Spades and shovels will be used to remove surficial material to the required depth. Then a stainless steel or Teflon scoop is used to collect the sample. Devices plated with chrome or other materials are not acceptable for sample collection. The use of a flat, pointed mason trowel often aids in collecting undisturbed soil profile samples. To the extent possible, the sampling process should not alter the medium being investigated. In general, samples should be kept at $\underline{\underline{4}}$°$\underline{\underline{C}}$, protected from direct light, sealed tightly in glass bottles, and analyzed as soon as possible.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation

1.5	Guide to Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
5.1	Soil and Rock Borehole Logging and Sampling

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access. Have areas of subsurface sampling investigated for underground utilities.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

Decontaminate all sampling equipment before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and FSP or WP).

3.3. Operation

A. Whenever a sample is collected, complete a description of the sample using the Borehole Log (Soil) form. Copies of this form and instructions for completing the form are supplied in SOP 5.1, Soil and Rock Borehole Logging and Sampling.

B. Procedure for Soil Sampling

1. Carefully remove the top layer of soil to the desired sample depth with a spade which has been appropriately decontaminated.

2. Using an appropriate decontaminated stainless steel or Teflon scoop or trowel, remove and discard a thin layer of soil from the area that comes in contact with the shovel.

3. Transfer the sample into an appropriate sample bottle with a stainless steel or Teflon scoop, lab spoon, or equivalent.

4. If required, be sure the Teflon liner is present in the cap. Secure the cap tightly. Preservation with chemical additives is not necessary; it is achieved by cooling the sample with ice to 4°C. If feasible, minimize holding time and transport the sample to the laboratory no later than two days after collection.

5. Label the sample bottle with the appropriate sample tag. Be sure to label the tag carefully and clearly, addressing all the categories of parameters.

   NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Soil Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains copies of the form and label and instructions for completing the form and label.

6. Decontaminate equipment between sample locations according to SOP 1.6, General Equipment Decontamination.

7. Fill the hole and replace any grass turf.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to presampling conditions and fill open sampling holes as specified in the FSP or WP.

C. Make sure all sampling locations are properly staked and the location ID is readily visible on the location stake.

D. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record pertinent sample location information in the logbook.

B. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

C. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

D. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that the samples arrived safely and the instructions for sample analyses are clearly understood.

4. SOURCE

Ford, Patrick J., Paul J. Turina, and Douglas E. Seely. 1984. Available Sampling Methods, 2d ed. Vol. 2, Characterization of Hazardous Waste Sites - A Methods Manual. U.S. Environmental Protection Agency document EPA/600/4-84/076. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Stainless steel scoop or lab spoon (scoopulas)

_____ Stainless steel shovel or flat-pointed mason trowel

_____ Stainless steel spade

_____ Tape measure (tenths of feet)

_____ Teflon sheets or stainless steel sampling trays

_____ Plastic Sheet

_____ Alconox

_____ Brushes (long handle, scrub, and wire)

_____ Galvanized tub

_____ Trash bags

_____ Buckets (galvanized, stainless steel, and plastic)

_____ Garden pressure sprayer

_____ Cleaning wipes

_____ Kim wipes

_____ Storage containers for waste decontamination solutions

_____ Blue Ice or equivalent

_____ Disposable laboratory gloves

_____ Camera and film

_____ Sample containers and preservatives

_____ Any additional supplies listed in associated procedures, as needed

STANDARD OPERATING PROCEDURE 5.3

SUBSURFACE SOLID SAMPLING WITH HAND AUGER AND THIN-WALL SAMPLER

1. PURPOSE

To define a method of collecting grab subsurface solid samples with a hand auger and thin-wall tube sampler.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the type of samples to be collected. Collection and measurement of samples and the documentation of data will be performed as described in the associated procedures.

Solid samples can be recovered directly with a hand auger or with a thin-wall tube sampler. The thin-wall tube sampler provides a less disturbed sample than that obtained with a hand auger. However, it may not be possible to force the thin-wall tube sampler through some soil, and sampling with the hand auger may be the most viable alternative. It is usually not practical to use the hand auger or thin-wall sampler at depths beyond 20 ft.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation
1.5	Guide to Handling, Packaging, and Shipping of Samples
1.6	Equipment Decontamination

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a lobgook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

E. Document field conditions, unusual circumstances, and weather in the logbook.

3.2.3. Field

Decontaminate all sampling equipment before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and the FSP or WP).

3.3. Operation

This method uses an auger, a series of rods, a T handle, and a thin-wall tube or split-spoon sampler (Appendix 5.2). Bore a hole to a desired sampling depth (up to 20 ft) with the auger and then withdraw it. Replace the auger tip with a tube core (sampler), lower it down the borehole, and drive the auger into the soil at the completion depth. Withdraw the core and collect the sample.

Three types of augers are available for this method of sampling. They are bucket-type, continuous flight (screw), and posthole augers. The bucket-type auger is more appropriate for direct sample recovery. The bucket-type auger is fast and provides a large volume of sample. When a continuous flight auger is used, the sample can be collected directly off the flights that are usually in 5-ft intervals.

The continuous flight auger is satisfactory for use when a composite of the complete soil column is desired. Posthole augers have limited utility for sample collection because they are designed to cut through fibrous, rooted swampy areas. In soil where the borehole will not remain open when the tool is removed, use a temporary casing until the desired sampling depth is reached.

3.3.1 Collection of Samples

A. Clear any surface debris (twigs, rocks, and litter) from the area to be sampled. It may be advisable to remove the first three to six inches of surface soil for an area approximately six inches in radius around the drilling location.

B. Begin augering, periodically removing accumulated soils. This prevents accidentally brushing loose material back down the borehole when removing the auger or adding drill rods.

C. After reaching the desired depth, slowly and carefully remove the auger from boring.

NOTE: When sampling directly from the auger, collect the sample after the auger is removed from boring and proceed to step I.

D. Remove auger tip from drill rods and replace with a precleaned, thin-wall tube sampler. Install the proper cutting tip.

E. Lower the tube sampler down the borehole, being careful not to scrape soil from the sides of the borehole that will fall into the bottom of the borehole. Gradually force the tube sampler into the soil. Care should be taken to avoid scraping the borehole sides. Avoid hammering the drill rods to facilitate coring because the vibrations may cause the boring walls to collapse.

F. Remove the tube sampler and unscrew the drill rods.

G. Remove the cutting tip and remove the core from the device.

H. Discard all disturbed soil from the top of the core (usually at least the top one inch, which represents any material collected by the tube sampler before penetration of the layer in question).

I. Place sample into an appropriate container.

NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Soil Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains copies of the form and label and instructions for completing the form and label.

J. Be sure a Teflon liner is present in the cap. Secure the cap tightly onto the sample container. Preserve the sample container with ice or in a refrigerator. Freezing may be required (for instance, Hg or tritium determinations). Consult SOP 1.5, Guide To Handling,

Packaging, and Shipping of Samples, and SOP 1.4, Sample Containers and Preservation.

K. If another sample is to be collected at a greater depth in the same hole, reattach the auger bit to the drill and assembly and follow steps 3-11.

L. Refill the hole and restore the sampling area according to instructions provided in the FSP or WP.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to presampling conditions and fill open sampling holes as specified in the FSP or WP.

C. Make sure all sampling locations are properly staked and the location ID is readily visible on the location stake.

D. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCE

deVera, E. R., B. P. Simmons, R. D. Stephens, and D. L. Storm. 1980. "Samplers and Sampling Procedures for Hazardous Waste Streams." U.S. Environmental Protection Agency report EPA 600/2-80-018, January 1980. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Augers and Thin-Wall Tube Sampler

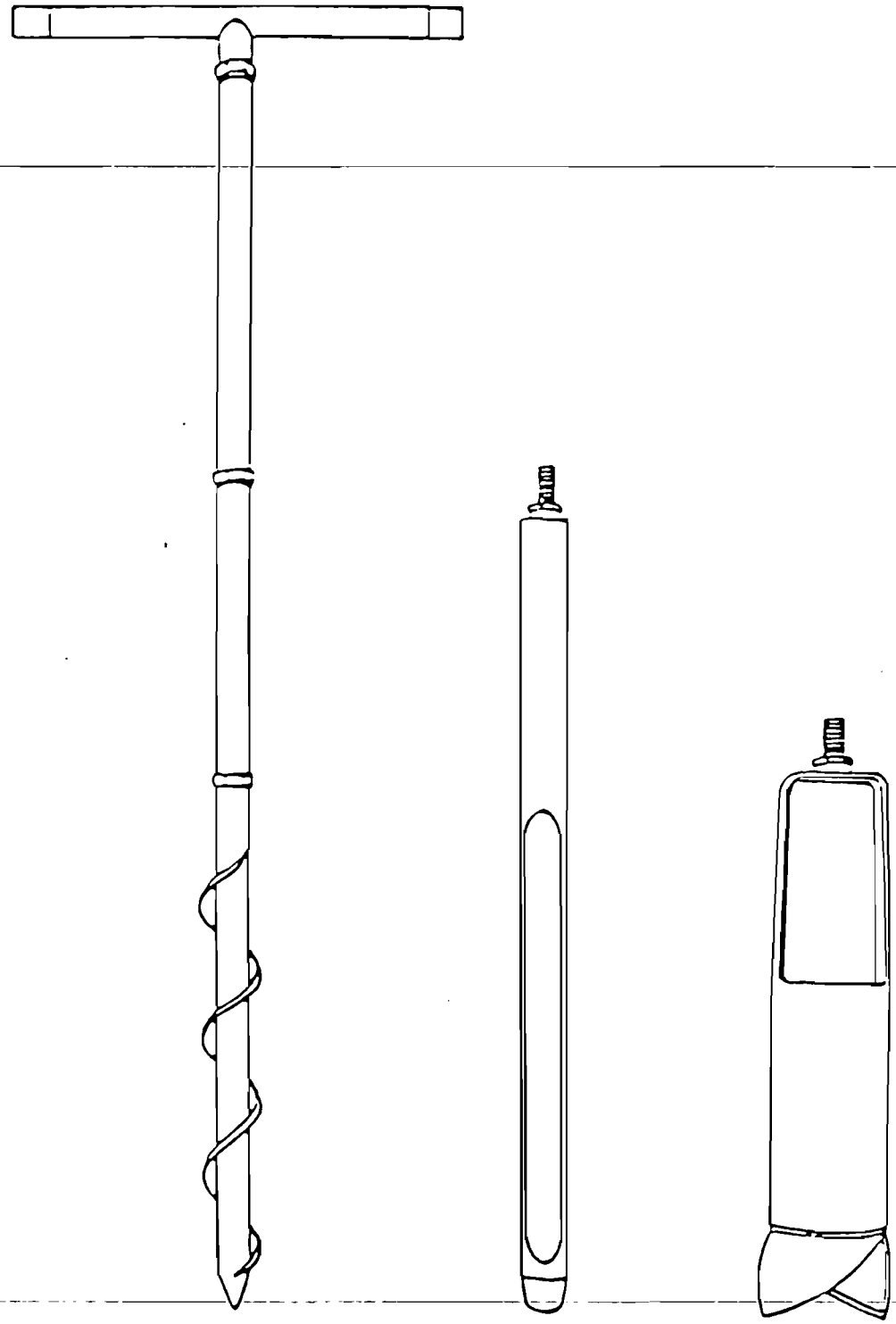
APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

- _____ Thin-wall tube sampler
- _____ Drill rods
- _____ T handle
- _____ Auger
  - _____ Bucket type
  - _____ Continuous flight
  - _____ Posthole
- _____ Sample container(s)
- _____ Decontamination equipment
  - _____ Alconox
  - _____ Sprayer
  - _____ Distilled water
  - _____ Scrub brush
  - _____ Methanol
  - _____ Disposable laboratory gloves
- _____ Combustible gas indicator
- _____ Portable photoionization detector (PID) or flame ionization detector (FID)
- _____ Blue Ice or equivalent
- _____ Plastic sheet
- _____ Any additional supplies listed in associated procedures, as needed

APPENDIX 5.2

AUGERS AND THIN-WALL TUBE SAMPLER



STANDARD OPERATING PROCEDURE 5.4

GENERAL SOIL GAS SAMPLING AND FIELD CHEMICAL ANALYSIS

1. PURPOSE

To present a general guidance for performing soil gas sampling and onsite analysis with a gas chromatograph for volatile organic contaminants.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the procedures for this SOP. This work generally will be conducted by a subcontractor who will provide specific sampling and equipment procedures. These procedures will be included in the FSP or WP when soil gas sampling is proposed. Issues that will be addressed in the procedure provided by the subcontractor will include calibration, temperatures, columns, sample containers, gas flow rate, number of dead volumes to be collected, etc. Refer to the FSP or WP for the number of samples to be collected. The documentation of data will be performed as described in the associated procedures.

Soil gas surveys may be used as a reconnaissance tool to delineate the areal extent of volatile organic contamination resulting from groundwater and vadose-zone contamination. Based on the distribution of volatile organic concentrations in soil vapors, a soil gas survey may support the placement of monitoring wells.

The method involves pumping a small amount of soil gas out of the soil matrix through a collection tube driven into the ground, collecting soil gases in a tube filled with adsorbents, and analyzing the desorbed gases for the presence of volatile organic contaminants through gas chromatography.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

E. Record field conditions, unusual circumstances, and weather conditions in the logbook. Whenever possible, use photographs to document activities.

3.2.3. Field

A. Stake the locations for the proposed sampling points.

B. Clear the working areas of all brush and minor obstruction.

C. Decontaminate all sampling equipment before the initiation of sampling and between sampling events as described in SOP 1.6, General Equipment Decontamination. Alternately, a quantity of sampling probes can be decontaminated at the same time and carried into the field. In this manner, a clean probe can be utilized between sampling events.

3.3. Operation

3.3.1. Collection of Soil Gas Sampling

A. Drive/push sample probe to desired depth or to refusal. The site manager or appointed representative will determine if soil gases will be collected from the point of refusal or another attempt will be made next to the first location.

B. Collect the sample following specifications provided in the procedures provided by the subcontractor.

C. Remove the sample probe.

D. Whenever a soil gas sample is collected, complete a description of sampling-related activities using the Soil Gas Data form (Appendix 5.1). Fill out the form as described in Appendix 5.2.

3.3.2. Sample Analysis

Samples should be analyzed in a mobile lab at the site; the criteria described below will apply (with more detailed specifics supplied by the subcontractor).

A. Use a gas chromatograph equipped with a detector that is sensitive to specified contaminants. The use of one or more of the following types of detectors may be necessary: electron capture, flame ionization, photoionization, or Hall.

B. When appropriate, use a chromatographic column based on the sensitivity required (for example, megabore or capillary).

C. Include lab blanks consisting of pure carrier gas in the analysis. Consult the FSP or WP or the approved subcontractor's Quality Assurance (QA) Plan for the number or percentage of lab blanks.

D. In the analysis, include external standards that are appropriate to the contaminants and field concentrations. Consult the FSP or WP or the approved subcontractor's QA Plan for the number of standard samples.

E. In the analysis, include a field blank collected by drawing ambient air through the sample collection equipment as if it were soil gas. Consult the FSP or WP for the number or percentage of field blanks.

F. Run replicate analyses on the number of samples specified in the FSP or WP.

G. Visually inspect chromatograms for errors that may affect the validity of the data. A sample or particular component may be eliminated from consideration on the basis of visual judgment. Examples of elimination criteria include badly skewed or tailing peaks, failure of the integrator to properly separate closely eluting or tailing peaks, and the presence of transient peaks that mask or interfere with the proper quantification of a peak of interest. A trained analytical chemist should make notes directly on the chromatogram recording the reason for the elimination of data points or runs.

H. Enter appropriate readings and field and analytical laboratory results on the Soil Gas Data form (Appendix 5.1). Associated documentation concerning lab blanks, standards, field blanks, and replicates will be delivered to the field manager.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to presampling conditions and fill open sampling holes as specified in the FSP or WP.

C. Make sure all survey or sampling locations are properly staked and the location ID is readily visible on the location stake.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms, logbooks, and laboratory calibration documentation to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

4. SOURCES

HydroGeoChem, Inc. 1987. "Soil Gas Sampling, Analysis and QA Procedures." Report dated January 15, 1987. Tucson, Arizona.

Marrin, D. L., H. Herfoot, and H. B. Lockheed. 1986. "Soil Gas Surveying for Subsurface Organic Contaminants." Report dated October 22, 1986. Las Vegas, Nevada.

Marrin, Donn L., and Glenn M. Thompson. 1980. "Gaseous Behavior of TCE Overlying a Contaminated Aquifer." Groundwater 25, 1: 21-27.

Tracer Research Corporation. 1985. Service Literature. Tucson, Arizona.

5. APPENDIXES

5.1. Soil Gas Data Form

5.2. Data Form Completion

APPENDIX 5.1

SOIL GAS DATA FORM

SOIL GAS DATA

PAGE 1 OF _____

FACILITY CODE _____ **LOG DATE** _____

LOCATION ID _____ TIME _____

SAMPLE ID _____ WEATHER _____

LOGGER CODE _____ AIR TEMP (C) _____

ACCEPTANCE CODE _____ **ANALYTICAL LAB CODE** _____

FIELD REP. _____

SURFACE CONDITIONS _____

_____

PROBE NO _____ **PROBE DEPTH (FT)** _____

CYLINDER NO _____ CARTRIDE NO _____

ADAPTER NO _____ PROBE VOLUME _____

VACUUM GAGE READING _____ PUMP FLOW RATE AND DURATION _____

COLUMN FLOW RATE AND DURATION _____

ADDITIONAL COMMENTS _____

LAB RECEIPT: _____

(NAME/SIGNATURE) _____ TIME/DATE _____

LAB SAMPLE CONTROL ID. _____

ANALYSIS CHECKED BY _____ DATE CHECKED _____

COMPOUND ANALYZED	MEASURED CONCENTRATION UNITS OF MEASURE		CHROMATOGRAM NO
	1st	2nd	

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
SGD–038 (1/88)

_____ FORM COMPLETED BY/DATE

_____ TECHNICAL REVIEWER/DATE

APPENDIX 5.2

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

SOIL GAS DATA FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, radiological, and other measurements are taken.

3. Sample ID. Four-digit number assigned to ensure that data collected retains uniqueness from other data collected at the same location ID.

4. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

5. Acceptance Code. One-character code assigned by the site manager.

6. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

7. Time. The hours or days during which work occurred.

8. Weather. State of the atmosphere with respect to heat or cold, wetness or dryness, calm or storm, and clearness or cloudiness.

9. Air Temp (C). Degrees as measured on the centigrade scale.

10. Analytical Lab Code. A maximum of four characters noting the laboratory responsible for analysis.

11. Field Rep. The name of the field representative.

12. Surface Conditions. A description of the ground surface in the area around the soil gas sampling location. It is important to note any stains, ponded water, soil type, and wetness of soil.

13. Probe No. The identification number of the probe.

14. Cylinder No. The model number of the cylinder.

15. Adapter No. The model number of the adapter.

16. Vacuum Gauge Reading. The gauge reading on the vacuum indicator at the time just before the sample is collected. This reading should be the same as the pump capacity for producing a vacuum, ensuring that a tight seal is present and leakage does not occur.

17. Probe Depth (Ft). The depth at which the soil gas sample is collected.

18. Cartridge No. The carbon adsorption cartridge, glass vessel, or syringe that is used to collect a soil gas sample.

19. Probe Volume. The volume of gas contained in the probe that must be evacuated before the sample is collected. For probes of the same lengths and inner diameters, compute this value only once.

20. Pump Flow Rate and Duration. The flow rate of the pump determined by a rotometer and the time in seconds that the pump operates in evacuating the probe.

21. Column Flow Rate and Duration. The flow rate through the cartridge that is determined by the reading and time in seconds that the pump operates while the sample is being collected.

22. Additional Comments. Any additional information.

23. Lab Receipt. The name of the laboratory that receives the sample for analysis.

24. Name/Signature. The name and signature of the laboratory representative who accepts the sample for analysis.

25. Time/Date. The time and date when the soil gas sample was collected in the format HHMM/DD-MMM-YY (1410/01-JAN-88).

26. Lab Sample Control ID. The identifying number assigned to the sample by the laboratory.

27. Analysis Checked By. The name of the laboratory representative who verified that the analysis has been performed according to applicable internal QA/QC procedures.

28. Date Checked. The date the analysis was verified by the laboratory respresentative in the format DD-MMM-YY (01-JAN-88).

29. Compound Analyzed. The names of the compounds identified in the soil gas.

30. Measured Concentration 1st. The value of the integrated area under the chromatogram peak for each compound identified.

Units of Measure. The units in which the measured concentrations were recorded ($\mu g/l$).

31. Measured Concentration 2nd. The second value obtained by reanalyzing the sample.

32. Chromatogram No. The number of the chromatogram run that was used to determine the measured concentrations in the soil gas sample.

STANDARD OPERATING PROCEDURE 5.8

SOIL SAMPLING WITH A STAINLESS STEEL SURFACE SOIL SAMPLER

1. PURPOSE

To define procedures for collecting surface soil samples to determine the chemical and physical soil properties.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the type of samples to be collected. Collection and measurement of samples and the documentation of data will be performed as described in the associated procedures.

Sampling of the soil horizons above the groundwater table can detect contaminants before they migrate into the water table. Soil-sample analysis can help determine the extent of the contamination and establish the amount of contamination sorbed on aquifer solids that have the potential to contaminate groundwater. However, the depth from which soils are collected and the properties of the sampling tool can result in a high variability of soil chemical/physical properties. To optimize accuracy and precision in measuring soil chemical/physical properties, collect surface soil samples at a uniform depth and volume.

To reduce error introduced by field techniques, collect soil samples in a consistent manner and use chemically inert sampling materials. The sampler must be constructed of machined stainless steel and include a beveled cutting edge at one end of the sample collection ring. The capacity of the ring may vary, depending on the laboratory test for the collected sample. Typically, the ring sampler is from 3 to 4 inches in diameter and 2 to 8 inches in length. The ring sampler can be constructed of thin walls, as long as it is capable of withstanding the force of being driven into the ground by a 10-lb drop-hammer extension without deforming.

Soil types can vary considerably at a hazardous waste site. These variations, along with vegetation, can affect the rate of contaminant migration through the soil. Therefore, it is important that a detailed record is maintained during sampling operations, particularly regarding location, depth, and other characteristics (grain size, color, odor, and readings obtained from field-monitoring equipment) specified in the FSP or WP. Changes in temperature, available oxygen, and light penetration can radically alter the rate of chemical reactions or the associated microbial activity in a sample. As a result, samples should be kept at their at-depth temperature or lower and protected from direct light. They should be sealed tightly in glass bottles and analyzed as soon as possible.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain general information on the performance of field activities. They should

be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation
1.5	Guide to Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
4.1	Soil Boring
5.1	Soil and Rock Borehole Logging and Sampling

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. When necessary, decontaminate or preclean all equipment before soil sampling as described in SOP 1.6, General Equipment Decontamination.

B. Decontaminate all sampling equipment before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and the FSP or WP).

3.3. Operation

A. Whenever a sample is collected, describe the location and sample using the Location Information and Borehole Log (Soil) forms. Copies of these forms are supplied in SOP 4.1, Soil Boring, and SOP 5.1, Soil and Rock Borehole Logging and Sampling, respectively. Complete the forms as described in these SOPs.

B. Procedure for Soil Sampling

NOTE: The component parts of a typical surface soil sampler are illustrated in Appendix 5.2.

1. Place the sampling cap inside the sampler ring and drive the assembly into the ground with a weighted drive hammer. Drive the sampler ring into the ground until the inside bottom of the cap touches the soil surface, but no further.

2. Use a stainless steel trowel with the same diameter as the sampler ring to move excess soil from the sides of the ring sampler. Push the trowel underneath the ring sampler, keeping the trowel in contact with the ring walls.

3. Raise and invert the sampler assembly, keeping the trowel in place.

4. If physical properties of the soil are to be determined, transport the sampler ring directly to the laboratory for *in situ* measurements of the undisturbed sample.

   If soil chemistry properties are to be determined, remove the soil from the ring sampler and transfer the sample into an appropriate sample bottle with a stainless steel or Teflon scoop, lab spoon, or the equivalent. Consult SOP 1.4, Sample Containers and Preservation, for guidance regarding the type of sample container, holding time, and preservation techniques to be used. If required, be sure the Teflon liner is present in the cap. Secure the cap tightly. Preservation with chemical additives is not necessary. Instead, preservation techniques are limited to cooling the sample with ice. When feasible, minimize the holding time. Transport the sample to the laboratory no later than two days after collection.

   NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Soil Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains

copies of the form and label and instructions for completing the form and label.

5. Clean the sampler assembly with a wire brush and decontaminate the equipment according to SOP 1.6, General Equipment Decontamination, between sample locations.

6. Fill the hole and replace any grass turf.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to presampling conditions and fill open sampling holes as specified in the FSP or WP.

C. Make sure all sampling locations are properly staked and the location ID is readily visible on the location stake.

D. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCE

Soiltest Environmental Division. 1986. "Test Instrumentation and Equipment." Soiltest Environmental Division report, Evanston, Illinois.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Component Parts of a Surface Soil Ring Sampler

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Stainless steel ring sampler

_____ Stainless steel trowel

_____ Stainless steel sampler top

_____ Stainless steel wire brush

_____ Drive hammer (3 lbs or 10 lbs)

_____ Plastic sheets or stainless steel sampling trays

_____ Decontamination solutions and distilled water

_____ Brushes (long-handled scrub or wire)

_____ Galvanized tub

_____ Trash bags

_____ Buckets (galvanized, stainless steel, and plastic)

_____ Garden pressure sprayer

_____ Cleaning wipes

_____ Kim wipes

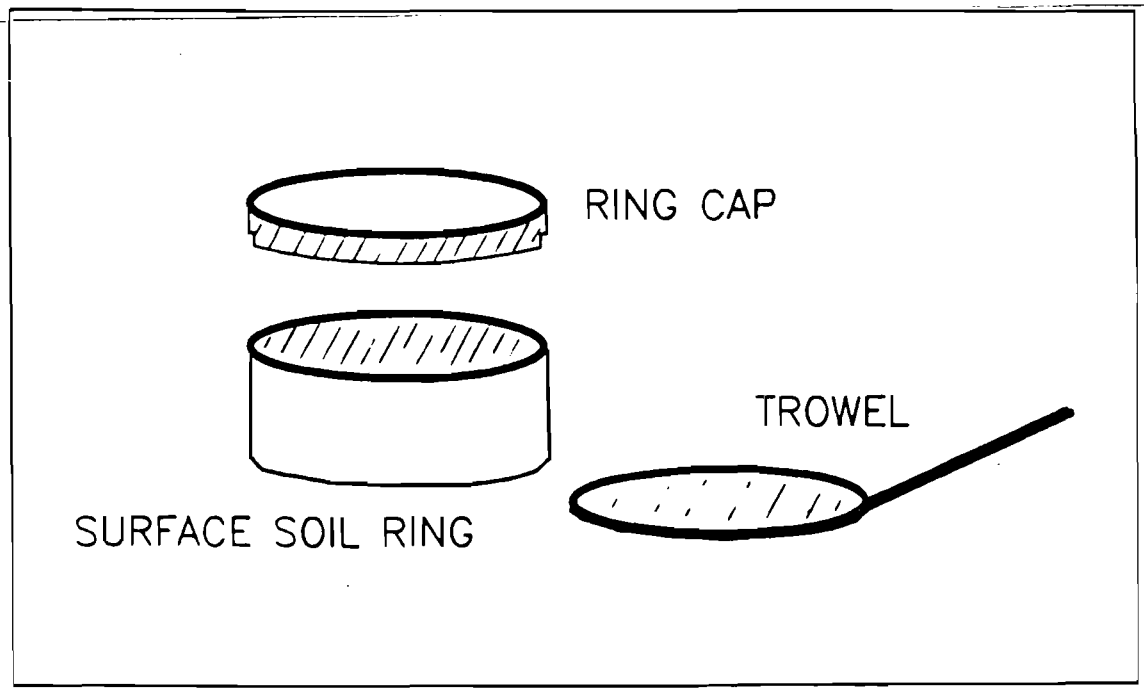
_____ 55-gallon drums

_____ Teflon or stainless steel scoop or spoon

_____ Any additional supplies listed in associated procedures

APPENDIX 5.2

COMPONENT PARTS OF A SURFACE SOIL RING SAMPLER



STANDARD OPERATING PROCEDURE 5.9

SEDIMENT SAMPLING PROCEDURES FOR STREAMS, RIVERS, AND PONDS

1. PURPOSE

To describe the methods for collecting deposited sediment samples in streams, rivers, and ponds.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the procedures and equipment for this Standard Operating Procedure (SOP). Refer to the FSP or WP for the type of samples to be collected. Collection and measurement of samples and documentation of data will be performed as described in the associated procedures.

Physical and chemical data collected from deposited sediment samples can help define the extent and nature of both airborne and surficially transported contamination. Potential future contaminant sources and migration pathways can also be determined from this data.

A relatively undisturbed vertical sample can be collected using either a tube (piston) corer or a gravity corer. Accurate and representative samples can be collected with these procedures if care and precision are demonstrated by the technician. If sediment type or excessive bottom vegetation precludes sample recovery by either of these methods, a bottom dredge can also be used. However, dredges tend to disturb the sediment more than the previously mentioned methods. Samples should be kept at 4°C, protected from direct light, sealed tightly in the appropriate container, and analyzed as soon as possible.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1 through 1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation
1.5	Guide to Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
5.1	Soil and Rock Borehole Logging and Sampling

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Decontaminate all sampling equipment before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and FSP or WP).

B. Record all pertinent information (date, site, sample ID number, and location) in the logbook and on the appropriate data form. Note field conditions, unusual circumstances, weather conditions, and all personnel on site.

3.3. Operation: Sediment & Sampling in Shallow (Wadeable) Waters

A. Locate sediment sampling locations in accordance with the WP. Place metal pin (steel rebar) flush with ground surface on left bank facing upstream to identify sample location. Also drive a 3-foot, wooden stake 1 foot into the ground at the same location and record sample identification on the stake. When possible, avoid stream banks with obvious indications of sloughing when selecting transects.

B. Record the location in the field logbook and, if possible, photograph the location. The location of the metal pin stake should be above the annual high water level to prevent washing away and to enable personnel to relocate the sample point during subsequent sampling.

C. Standing downstream of the sample stations, collect sediments by pushing a stainless steel tube (piston) corer or similar device into the sediment. When hard or coarse sediments are encountered, a gentle rotation of the tube corer while it is pushed will improve penetration and lessen core compaction.

D. Retrieve tube corer with a smooth, continuous, up-lifting motion. Do not bump corer as this may result in loss of sample materials.

E. Place the sediment sample into a stainless steel container. Repeat step C until an appropriate amount of material has been collected to complete the required sampling suite. Complete a description of the sediment using the Borehole Log (Soil) form (Appendix 5.2) and methods described in SOP 5.1. If applicable, collect a sample for volatile organic compounds first, then composite discrete sediment samples by mixing thoroughly to obtain a homogenous mixture. If necessary, samples can be sieved to remove larger materials such as leaves, sticks, gravel, rocks, etc.

F. Deposit each sediment sample into the appropriate widemouth sample container and seal tightly with a Teflon-lined cap. At the time of collection, the sample bottle will be filled to the top with the sediment sample.

NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Soil Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains copies of the form and label and instructions for completing the form and label.

G. Preserve the sample container with ice or in a refrigerator. Consult SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples, and SOP 1.4, Sample Containers and Preservation.

3.4. Sediment Sampling in Non-Wadeable Waters

Samples to be collected in water slightly deeper than wading depth or for sampling in shallow water from a boat, a tube (piston) coring device mentioned in Section 3.3 can be modified by adding extension lengths to the handle. If this method proves impractical, a gravity corer can be used.

3.4.1. Sampling Procedure Using a Stainless Steel Gravity Corer

A. Attach a precleaned gravity corer to the required length of sample line. Solid braided 5 mm (3/16-in.) nylon line is sufficient; however, 20 mm (3/4-in.) nylon is easier to grasp during hand hoisting. An additional weight can be attached to the outside of the corer if necessary.

B. Secure the free end of the line to a fixed support to prevent accidental loss of the corer.

C. Allow gravity corer to free fall through the liquid to the bottom.

D. Retrieve gravity corer with a smooth, continuous, up-lifting motion. Do not bump corer as this may result in some sample loss.

E. Remove nosepiece from gravity corer and slide sample out of corer into stainless steel container.

F. Follow steps E through G in Section 3.3.

3.4.2. Sampling Procedure Using Dredges

If sampling using a tube (piston) corer or gravity corer proves ineffective, a bottom dredge can be used. A Wildco-Eckman dredge is lightweight and is best suited for soft or sandy, non-vegetated sediments. A Wildco-Ponar dredge is better suited for all varieties of bottoms but is much heavier and more cumbersome to use and may actually require a winch and steel cable to operate safely.

3.4.2.1. Operation

A. Attach a precleaned dredge to the required length of sample line. Solid braided 20mm (3/4-inch) or thicker nylon line is recommended.

B. Secure the free end of the line to a fixed support to prevent accidental loss of the dredge.

C. Allow the dredge to free fall through the water to the bottom. The Wildco-Ponar dredge will close with contact with the bottom. The Wildco-Eckman dredge can be triggered closed by sending a weighted messenger down the sample line.

D. Retrieve dredge.

E. Follow steps E through G in Section 3.3.

3.5. Postoperation

3.5.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Make sure all sampling locations are properly staked and the location ID is readily visible on the location stake.

C. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.5.2. Documentation

A. Complete logbook entries, verify the accuracy of entries, and sign, initial, and date all pages.

B. Review data collection forms for completeness.

3.5.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCE

U.S. Environmental Protection Agency. 1983. *Characterization of Hazardous Waste Sites—A Method Manual: Volume II, Available Sampling Methods,* USEPA Environmental Monitoring Systems Laboratory, Las Vegas, Nevada. 89114-5027, EPA-600/4-83-040, September 1983.

U.S. Department of the Interior. 1977. National Handbook of Recommended Methods for Water-Data Acquisition. Revised July 1980.

Versar Inc. 1984. Field Draft Report, Sampling Guidance Manual for the National Dioxin Study for Arthur D. Little, Inc. and U.S. EPA, Office of Water Regulations and Standards Monitoring and Data Support Division. Springfield, Virginia.

APPENDIX 5.1
EQUIPMENT CHECKLIST FOR SEDIMENT SAMPLING

1. Health and Safety Items

___ Personal protective gear, including, but not limited to, the following (see Health and Safety Plan):

- Saranex/Tyvex
- Respirator, cartridges, wipes
- Latex booties
- Gloves (surgical, viton, and nitrile)
- Duct tape
- Hard hat
- Steel-toed boots
- Rain gear
- Ear plugs

___ Field first aid kit

___ Eye wash

___ FID/PID

2. Decontamination Items

___ Visqueen

___ Rinse bottles

___ Trash bags

___ Paper towels

___ Deionized water

___ Methanol, hexane and stainless steel pressurized tanks

___ Carboy for potable water

___ Decontamination tubs

___ Long handle brushes

___ Alconox

___ Deionized water for field blanks

___ Funnel

3. Paper Work

___ Health and Safety Plan

___ Field logbook and black ball point pens

___ Work plan

___ Daily report form

___ Site map

___ Chain-of-Custody form

4. Measuring Equipment

___ Folding ruler marked in tenths of an inch

___ 100-foot fiberglass tape measure

___ Grain size chart

___ Color chart

5. Sampling Equipment

___ Hip waders

___ Stainless steel trowels

___ Stainless steel tube (piston) corer, gravity corer, dredge, or similar device

___ Stainless steel, temperate glass or aluminum buckets/bowls

___ Boat

___ Braided nylon line

6. Shipping Supplies

___ Sample container, including bottles for QC samples

___ Airbills such as Federal Express

___ Hazardous materials declaration

___ Mailing labels

___ Bottle labels

___ Chain-of-custody tape

___ "This End Up" stickers

___ "Cargo Aircraft Only" stickers

___ "Arrow Up" stickers

___ Ziplock bags (1 quart and 1 gallon size)

___ 1-quart paint cans

___ Packing tape

___ Vermiculite

___ Coolers

7. Miscellaneous

___ Camera and film

___ Stakes

___ Flagging

___ Caution tape

___ Identification tags for staked locations

___ Mean Streak or other paint markers

___ Drum liners

___ Bung wrench/crescent wrench

STANDARD OPERATING PROCEDURE 6.1

HEALTH AND SAFETY MONITORING OF COMBUSTIBLE GAS LEVELS

1. PURPOSE

To describe the equipment and proper method for monitoring combustible gas levels in order to determine when an explosion hazard exists in the work environment.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information on the scope of specific operations, related health and safety requirements, and the applicability of this procedure. Combustible gas indicators (or explosimeters) are used to determine the potential for the combustion or explosion of unknown atmospheres. A typical combustible gas indicator (CGI) determines the level of organic vapors and gases present in an atmosphere as a percentage of the lower explosive limit (LEL) or lower flammability limit (LFL) by measuring the change in electrical resistance in a Wheatstone bridge circuit.

CGIs provide readouts in units of percent LEL, in parts per million (ppm) combustible gases by volume, or both. The types of combustible gases to be encountered are often unknown. In those instances, the more explosive the calibration gas (the lower the LEL), the more sensitive the indication of explosivity, and a greater margin of safety results. The operator should be familiar with the LEL concentrations for specific gases to effectively use instruments that provide data only in ppm combustible gas (by volume).

Although instruments can be purchased that are factory-calibrated for gases like butane, pentane, natural gas, or petroleum vapors, methane calibration is the most common. The LEL of methane is 5% by volume in air; therefore, an air mixture containing 5% methane will be read as 100% LEL and is explosive. When combustible gases other than methane are sampled, the relative response of the detector must be considered. Recalibration to other gases may be possible (see the manufacturer's recommendations), and National Bureau of Standards (NBS) traceable calibration gases should be used. The relative sensitivity of the detector and the differences in LEL for different gases will produce varying meter responses. Correlation equations that will convert the percent LEL (based on methane) indicated by the instrument to a percent LEL for another combustible gas can usually be found in the CGI operating manual. Many units have alarm systems that can be adjusted for various LELs, and several incorporate oxygen analyzers.

2.1. Definitions

A. Lower Explosive Limit (LEL)

The LEL (also LFL, lower flammability limit) is defined as the lowest concentration of gas or vapor in air by volume that can be ignited and cause an explosion or flame propagation.

B. Upper Explosive Limit (UEL)

The UEL (also UFL, upper flammability limit) is the concentration of gas in air above which there is insufficient oxygen available to support combustion and an explosion is unlikely. A flame, however, may burn at the gas/air interface. Should additional air enter the mixture, a very explosive atmosphere may develop.

2.2. Instrument Limitations

A. Of the many instruments commercially available for detecting combustible or explosive gas, some are not certified safe for operation in the atmospheres they can detect. It is important to use only those instruments that are certified safe for use in atmospheres greater than 25% of the LEL. The instrument manufacturer's operating manual should be consulted to determine safety certification in specific atmospheres.

B. Combustible gas measurement instruments do not indicate if a given atmosphere contains hazardous or toxic compounds.

C. The CGI cannot be used in atmospheres containing silanes, silicones, silicates, or other compounds containing silicon because these substances seriously impair the instrument response.

D. If the detector has a platinum filament, its sensitivity may be reduced by exposure to gases like leaded gasoline vapors (tetraethyl lead), sulfur compounds (mercaptans and hydrogen sulfide), and sulfide compounds. An inhibitor filament that will nullify the effect of leaded gasoline vapors is available on some commercial units (Mine Safety Appliances Company, Model 260 Portable Combustible Gas and Oxygen Alarm). The instrument manufacturer's operating manual should be consulted to determine the instrument's ability to function in leaded gasoline atmospheres.

E. An oxygen detector should be used in conjunction with a CGI. Select a unit with this feature and follow the operating manual when the oxygen detector is calibrated and used. This is especially important when atmospheres are monitored within enclosed spaces or where oxygen deficient atmospheres (<19.5%) may exist.

F. Unusually high concentrations of sulfur dioxide, fluorine, chlorine, bromine, iodine, and oxides of nitrogen cause measurement interference.

G. Combustible gas indicator instruments must be calibrated frequently. Using an NBS traceable calibration gas, consult the manufacturer's operating manual for calibration frequency. Also, frequent calibration

will be necessary if several known organic species are present. Maximum accuracy requires a recalibration for each gas.

3. PROCEDURE

3.1. Associated Procedures

Information that applies to most field activities is provided in SOPs 1.1-1.10. In addition to the FSP or WP, those SOPs provide guidance that may supplement the information in this procedure. They should be consulted as necessary to obtain specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Perform a minimal check of the CGI in the office to ensure that it is functioning properly. Obtain the CGI, its operating manual, and a supply of NBS traceable gas. Methane is the factory calibration gas, but other gases may be used for specific requirements. Perform the equipment checks described below.

1. Make sure the instrument is clean and serviceable, especially sample lines and detector surfaces.

2. Check the battery charge level. If in doubt, charge the battery as described in the operating manual. Some units have charge level meters, while others have only low charge alarms.

3. Turn the unit to the on position and allow the instrument sufficient warmup time.

4. Verify that the sample pump is operable when the analyzer is on. The pump can usually be heard when operating.

5. With the intake assembly in combustible-gas-free ambient air, zero the meter by rotating the zero control until the meter reads 0% LEL. For instruments with an additional oxygen meter, adjust the dial to 21% oxygen in nonhazardous locations.

6. Calibrate the unit against a known concentration of a calibration gas like hexane by rotating the calibration control (span or gain) until the meter reads the same concentration as the known standard.

7. Some instruments, like the Gas Tech Model 1314, require internal calibrating with a small screwdriver. Consult the operating manual before calibration. With this model, it is also necessary to maintain the proper flow rate during calibration. Connect a flow meter between the CGI and the calibration gas cylinder to monitor the flow rate.

8. The Gas Tech Model 1314 and others are equipped with three meters that read in percent O_2, percent LEL, and ppm. A correctly calibrated instrument for determining percent LEL is critical for monitoring many work environments. The percent oxygen is usually factory calibrated and should not be adjusted in the field. The ppm dial is often not used in the field unless a Photoionization Detector (PID) or Flame Ionization Detector (FID) is not available, as these instruments are considered to be more accurate.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes and location IDs used in the completion of data forms.

3.2.3. Field

A. Instrument Check

Before using the CGI in the field, follow the procedures in Section 3.2.1.D. Additional adjustments may be made. If necessary, adjust the alarm setting to the appropriate combustibility limit. The action level or the point at which activities are halted and personnel removed from the immediate vicinity is usually less than 25% of the LEL for the gases that are present.

B. Record necessary calibration data in the logbook and include the information listed below.

1. Date and time of arrival at the site

2. Site identification

3. Instrument, model number, and serial number

4. Date/time calibrated

5. Calibration gas used

6. Calibration location

7. Operator's signature

3.3. Operation

3.3.1. Field Measurements

A. Calibrate the CGI daily before use in the field. The calibration procedure for the Gas Tech Model 1314 is outlined in Appendix 5.4. Also, consult the manufacturer's manual.

B. Complete the Combustible Gas Indicator Monitoring Data form (Appendix 5.2) as described in Appendix 5.3, Data Form Completion.

C. Position the intake assembly close to the area in question to get an accurate reading. For readings taken downhole during drilling, there will be a slight delay between positioning the intake tubing downhole and registering accurate meter readings because of the time required for the sample to travel the length of the tube.

D. In general, combustible gas indicator instruments respond in the manner described below.

1. The meter indicates 0.5 LEL (50%). This means that 50% of the concentration of combustible gas needed to reach an unstable combustible situation is present. If the LEL of the gas is 5% in air, then the instrument indicates the presence of a 2.5% mixture.

2. The meter needle stays above 1.0 LEL (100%). This means that the concentration of combustible gas is greater than the LEL and less than the UEL. Therefore, the concentration is immediately combustible and explosive.

3. The meter needle rises above the 1.0 (100%) mark and then returns to zero. This response indicates that the ambient atmosphere has a combustible gas concentration greater than the UEL.

E. Personnel should evacuate the area if any of the events listed below occur.

1. Sounding of the alarm

2. Readings that reach the action levels designated in the Health and Safety Plan

3. Malfunctioning of the CGI

4. Condition encountered or suspected that indicates oxygen enrichment or depletion of the atmosphere (specially designed units are available for operation in those atmospheres)

F. Some important factors to keep in mind during use are listed below.

1. Slow, sweeping motions of intake or cell assembly will help ensure that problem atmospheres are not bypassed. Cover an area from floor (ground) to ceiling, the breathing zone, and areas where maximum concentrations may be expected (for example, downhole during drilling).

2. Operation of the unit in temperatures outside the recommended operating range may compromise the accuracy of readings or damage the instrument. Check the operating manual for the temperature limitations of a particular model.

3. Many combustible gas indicators are not designed for use in oxygen-enriched or depleted atmospheres. If this condition is encountered or suspected, personnel should evacuate the area. Specially designed units are available for operation in those atmospheres.

4. Use an oxygen detector in conjunction with a CGI. Select a unit and follow the operating manual for calibration and use of the oxygen detector.

5. Calibrate the equipment regularly and charge the battery after each field use. See the operating manual for details.

6. The operator should fully understand the operating principles and procedures for the specific CGI in use.

3.4 Postoperation

3.4.1 Field

A. When the activity is completed or at the end of the day, carefully clean the outside of the CGI with a damp disposable towel to remove any visible dirt. Return the CGI to a secure area and place on charge.

B. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

C. Make sure all survey or sampling locations are properly staked and the location ID is readily visible on the location stake.

3.4.2. Documentation

A. Record any uncompleted work (like additional monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the document control officer (with copies to the site manager and files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

4. SOURCE

EPA. 1984. "Characterization of Hazardous Waste Sites - A Methods Manual: Volume II, Available Sampling Methods, Second Edition," U.S. Environmental Protection Agency report EPA-600/4-84-076. Environmental Monitoring Systems Laboratory, Office of Research and Development, Las Vegas, Nevada.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Combustible Gas Indicator Monitoring Data Form

5.3. Data Form Completion

5.4. Calibration Procedure for Gas Tech Model 1314

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ CGI

_____ Battery charger for CGI

_____ Oxygen sensor

_____ Battery charger for oxygen sensor

_____ Spare gas detector filaments

_____ Spare batteries for CGI

_____ Jeweler's screwdrivers for internal adjustment

_____ Calibration kit

A) Spare gas cylinder (NBS traceable calibration gas)
B) Valve attachment
C) Flexible tubing (tygon)
D) Cylinder to encapsulate sensor probe

_____ Probe extensions

APPENDIX 5.2

COMBUSTIBLE GAS INDICATOR MONITORING DATA FORM

COMBUSTIBLE GAS INDICATOR (CGI) MONITORING DATA

FACILITY CODE _____ **LOG DATE** _____

LOGGER CODE _____ FIELD REP _____

CGI MANUFACTURER _____ CGI MODEL NO _____

SERIAL NO _____ CALIBRATION DATE/TIME _____

ACCEPTANCE CODE _____ BATTERY CONDITION _____

CALIBRATION GAS (%LEL):
TYPE _____ CONCENTRATION _____ % LEL CYLINDER SERIAL NO _____

CALIBRATION GAS (PPM):
TYPE _____ CONCENTRATION _____ PPM CYLINDER SERIAL NO _____

COMMENTS _____

LOCATION ID OR DESCRIPTION	COORDINATES (FT)		MONITORING TIME (HH:MM)	LOCATION TYPE	% LOWER EXPLOSIVE LIMIT	PPM	% OXYGEN
	NORTH	EAST					

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

LOCATION TYPES: BH – BOREHOLE SL – SURFACE LOCATION TP – TEST PIT WL – WELL

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS

CGI–101 (1/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.3

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

COMBUSTIBLE GAS INDICATOR MONITORING DATA FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date the information recorded on the form was obtained, in the format DD-MMM-YY (01-JAN-88).

3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

4. Field Rep. The name of the field representative.

5. CGI Manufacturer. The company that manufactured the CGI.

6. CGI Model No. The model number of the CGI.

7. CGI Serial No. The serial number of the CGI.

8. CGI Calibration Date/Time. The date and time when the CGI was last calibrated.

9. Acceptance Code. One-character code assigned by the site manager.

10. Battery Condition. The battery charge reading at the beginning of the measurement.

11. Calibration Gas (% LEL). This information consists of three data fields: the chemical name of the calibration gas (type), concentration of the calibration gas (% LEL), and the serial number of the gas cylinder.

12. Calibration Gas (ppm). This information consists of three data fields: the chemical name of the calibration gas (type), concentration of the calibration gas (ppm), and the serial number of the gas cylinder.

13. Comments. Any additional information.

14. Location ID or Description. Four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

15. Coordinates (Ft). The location of the measurement of the survey grid in units of feet. The two coordinate fields are in the format north, east.

16. Monitoring Time (HH:MM). The time when a field measurement was taken in the format hours:minutes using a 24-hr clock. Example: 08:37 for 8:37 a.m. and 19:12 for 7:12 p.m. (See conversion table below.)

Conversion Table

Conventional Time	24-Hr Time
1:00 a.m.	1:00
12:00 Noon	12:00
1:00 p.m.	13:00
2:00 p.m.	14:00
3:00 p.m.	15:00
4:00 p.m.	16:00
5:00 p.m.	17:00
6:00 p.m.	18:00
7:00 p.m.	19:00
8:00 p.m.	20:00
9:00 p.m.	21:00
10:00 p.m.	22:00
11:00 p.m.	23:00
12:00 Midnight	24:00

17. Location Type. Code describing the location of the CGI reading. The location type codes are: BH--borehole, TP--test pit, SL--surface location, and WL--well.

18. Percent Lower Explosive Limit. The reading obtained with the meter set to the LEL Scale.

19. PPM. The reading with the meter set to the PPM scale.

20. Percent Oxygen. Record the percent oxygen reading in this data field.

APPENDIX 5.4

CALIBRATION PROCEDURE FOR GAS TECH MODEL 1314

GASTECH MODEL 1314 CALIBRATION

CALIBRATION PROCEDURE

1. PPM RANGE
   - 1.01 Turn on instrument, allow to warm up and adjust zero in normal way.
   - 1.02 Add a few drops of water to glass wool packing inside humidifier. Glass wool should be moist but not dripping.
   - 1.03 Couple flowmeter to Cliplok fitting, and humidifier to flowmeter inlet, as shown.
   - 1.04 Couple Cliplok fitting to instrument inlet.
   - 1.05 Readjust zero as required after instrument stabilizes.
   - 1.06 Note flowmeter reading.
   - 1.07 Connect calibration valve to ppm-range cylinder. Open valve slightly to produce a small flow.
   - 1.08 Couple valve outlet to humidifier inlet.
   - 1.09 Adjust valve to give same flow on flowmeter as observed in 1.06.
   - 1.10 Watch meter as gas enters instrument. Observe highest reading.
   - 1.11 Compare reading with marked gas concentration on cylinder.
   - 1.12 If not correct, adjust calibration as shown in Section V of Instruction Manual.
   - 1.13 Turn off valve and disconnect calibration components.
2. LEL Range

   Use same procedure as above, but in LEL range. However, omit humidifier as it is not necessary in LEL range. Use LEL range cylinder.

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STANDARD OPERATING PROCEDURE 6.2

HEALTH AND SAFETY MONITORING OF ORGANIC VAPORS WITH A PHOTOIONIZATION DETECTOR

1. PURPOSE

To describe the equipment and proper method for environmental monitoring of toxic gases and vapors using a portable photoionization detector (PID).

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information on the scope of the given operation and the applicability of this procedure to the work activities.

The PID is useful as a general survey instrument at hazardous waste sites. A PID is capable of detecting and measuring real-time concentrations of many organic and inorganic vapors in the air. A PID is similar to a flame ionization detector (FID) in application. The PID has somewhat broader capabilities because it can detect certain inorganic vapors. Conversely, the PID is unable to respond to certain low molecular weight hydrocarbons (like methane and ethane) that are readily detected by FID instruments. Appendix 5.1 describes the application comparisons between an FID organic vapor analyzer and a PID.

A PID will respond to most vapors that have an ionization potential less than or equal to that supplied by the ionizing source in the detector, which is an ultraviolet (UV) lamp. Several probes are available for the PID, each having a different source and a different ionization potential. For this reason, the selection of the appropriate probe is essential in obtaining useful field results. Though it can be calibrated to a particular compound, the instrument cannot distinguish between detectable compounds in a mixture of gases. Therefore, it indicates an integrated response to the mixture.

2.1. PID Instrument Limitations

A. The PID is a nonspecific total vapor detector. It cannot be used to identify unknown substances; it can only quantify them.

B. The PID must be calibrated to a specific compound.

C. The PID does not respond to certain low molecular weight hydrocarbons like methane and ethane.

D. Certain toxic gases and vapors like carbon tetrachloride and hydrogen cyanide have high ionization potentials and cannot be detected with a PID.

E. Certain models of PID instruments are not intrinsically safe. Refer to the manufacturer's operating manual for use in potentially flammable or

combustible atmospheres. A PID should be used in conjunction with a combustible gas indicator (see SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels).

F. Electrical power lines or power transformers close to the PID instrument may cause measurement errors. Under this circumstance, refer to the operating manual for proper procedures.

G. High winds and high humidity will affect measurement readings. Certain models of PID instruments become unusable under foggy conditions. An indication of this is the needle dropping below 0.

H. The lamp window must be periodically cleaned to ensure ionization of the air contaminants.

I. One PID instrument, the HNu, measures concentrations from about 1 to 2000 ppm, although the response is not linear over this entire range. For example, the response to benzene is linear from about 0 to 600 ppm. This means the HNu reads a true concentration of benzene only between 0 and 600. Greater concentrations are read at a lower level than the true value. Consult the manufacturer's operating manual to determine the instrument's response to various chemicals.

2.2. Regulatory Limitations

A. Transport of calibration gas cylinders by passenger and cargo aircraft follow the U.S. Code of Federal Regulations, 49 CFR Parts 100-177. Benzene is a typical calibration gas included with a PID. Benzene is classified as a nonflammable gas, UN 1556, and the proper shipping name is compressed gas. It must be shipped in cargo aircraft only.

3. PROCEDURE

3.1. Associated Procedures

Information that applies to most field activities is provided in SOPs 1.1-1.10. In addition to the FSP or WP, those SOPs provide guidance that may supplement the information in this procedure. They should be consulted as necessary to obtain specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
6.1	Health and Safety Monitoring of Combustible Gas Levels

3.2. Preparation

3.2.1 Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.2. Perform the procedures described below.

1. Start-Up Procedure

   a. Before attaching the probe, check the function switch on the control panel to ensure that it is in the off position. Attach the probe by plugging it into the interface on the top of the readout module. Use care in aligning the prongs in the probe cord with the plug interface. Do not use excessive force.

   b. Turn the function switch to the battery check position. The needle on the meter should be within or above the green battery arc on the scale; if not, recharge the battery. If the red indicator light comes on, the battery needs recharging.

   c. Turn the function switch to any range setting. Look into the end of the probe to see if the lamp is on. If it is on, it will emit a purple glow. Do not stare into the probe any longer than 3 sec. Long-term exposure to UV light will damage the eyes. Also, listen for the hum of the fan motor.

   d. To zero the instrument, turn the function switch to the standby position and rotate the zero adjustment until the meter reads zero. A calibration gas is not needed because this is an electronic zero adjustment. If the span adjustment setting is changed after the zero is set, the zero should be rechecked and adjusted (if necessary). Wait 15 to 20 sec to ensure that the zero reading is stable. If necessary, readjust the zero.

2. Operational Check

   a. Follow the start-up procedure.

   b. With the instrument set on the 0 to 20 range, hold a solvent-based marker pen near the probe tip. If the meter deflects upscale, the instrument is working.

3. Calibration Procedure

   a. Follow the start-up procedure and the operational check.

   b. Set the function switch to the range setting for the concentration of the calibration gas.

c. Remove the detector from the outer casing by loosening the screw on the bottom of the casing.

d. Attach a regulator to a disposable cylinder of calibration gas. Connect the regulator to the probe of the PID with a piece of clean tygon tubing. Open the valve on the regulator.

e. After 15 sec, adjust the internal calibration screw until the meter reading equals the concentration of the calibration gas used. Consult the operating manual for the location of this screw.

f. If the PID does not start up, check out or calibrate properly and notify the equipment manager immediately. Under no circumstances should work requiring monitoring with a PID be performed without a properly functioning instrument.

g. Replace the detector in the outer casing.

h. Contact the carrier that will transport equipment and hazardous materials to obtain information on regulations and specifications.

3.2.2. **Documentation**

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of management codes, location IDs, and sample numbers used in the completion of data forms.

E. Record the calibration data on the Photoionization Detector Field Data form (Appendix 5.3). See Appendix 5.4 (Data Form Completion) for instructions.

3.2.3. **Field**

A. Follow the start-up procedure, operational check, and calibration check described in Section 3.2.1.D.

B. Set the function switch to the appropriate range. If the concentration of gases or vapors is unknown, set the function switch to the 0 to 20 ppm range; adjust the range if necessary.

C. With the exception of the probe's inlet and exhaust, wrap the PID in clear plastic to prevent it from becoming contaminated and to prevent water from getting inside the instrument in the event of precipitation.

3.3. Operation

3.3.1 Measuring organic vapor levels using the PID

A. As with any field instrument, accurate results depend on the operator's knowledge of the operator's manual. Follow the instructions in the operating manual explicitly in order to obtain accurate results.

B. Position the intake assembly close to the monitoring area because the low sampling rate allows for only very localized readings. Do not immerse the intake assembly in fluid under any circumstances.

C. While taking care not to permit the PID to be exposed to excessive moisture, dirt, or contamination, monitor the work activity as specified in the site Health and Safety Plan. Conduct the PID survey at a slow to moderate rate of speed and slowly sweep the intake assembly (the probe) from side to side.

D. During drilling activities, perform PID monitoring at every 5-ft interval downhole, at the headspace, and in the breathing zone. In addition, monitoring may be performed in the breathing zone during actual drilling when elevated organic vapor levels are encountered. When the activity being monitored does not involve drilling (like surface sampling), readings may only be recorded in the breathing zone. Refer to the site Health and Safety Plan for specific monitoring instructions.

E. Be prepared to evacuate the area if the preset alarm sounds. Operators using supplied air systems may not need to evacuate the work area, but they should frequently observe the levels indicated by the instrument.

F. Static voltage sources like power lines, radio transmissions, or transformers may interfere with measurements. See the operator's manual for a discussion of necessary considerations.

3.4. Postoperation

3.4.1. Field

A. When the activity is completed or at the end of the day, carefully clean the outside of the PID with a damp disposable towel to remove any visible dirt. Return the PID to a secure area and place on charge.

B. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

C. Make sure all survey or sampling locations are properly staked and the location ID is readily visible on the location stake.

3.4.2. Documentation

A. Record any uncompleted work (like additional monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. <u>Office</u>

A. Deliver original forms and logbooks to the document control officer (with copies to the site manager and files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment and charge the batteries. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

4. SOURCES

HNU Systems, Inc. 1986. "Instruction Manual for the Trace Gas Analyzer Model PI 101." Newton, Massachusetts.

CFR 49. 1985. Code of Federal Regulations, Title 49, U.S. Department of Transporatation, Parts 100-177. November 1, 1985. Washington, D.C.: U.S. Government Printing Office.

EPA. 1984. "Characterization of Hazardous Waste Sites--A Methods Manual: Volume II, Available Sampling Methods, Second Edition" U.S. Environmental Protection Agency report EPA-600/4-84-076. Environmental Monitoring Systems Laboratory, Office of Research and Development, Las Vegas, Nevada.

5. APPENDIXES

5.1. Comparison of the FID and PID

5.2. Equipment and Supplies Checklist

5.3. Photoionization Detector Field Data Form

5.4. Data Form Completion

APPENDIX 5.1

COMPARISON OF THE FID AND PID

	FID	PID
Response	Responds to many organic gases and vapors, especially low molecular weight hydrocarbons.	Responds to many organic and some inorganic gases and vapors, especially heavy hydrocarbons.
Application	In survey mode, detects total concentrations of gases and vapors. In GC mode, identifies and measures specific compounds.	In survey mode, detects total concentrations of gases and vapors. Some identification of compounds possible if GC column and standards are used.
Limitations	Does not respond to inorganic gases and vapors with a higher ionization potential than the flame detector. No temperature control.	Does not respond to methane or inorganic aliphatic chlorinated solvents. Does not respond properly in presence of water vapor (high humidity). Does not detect a compound if probe (lamp) has a lower energy than compound's ionization potential.
Calibration gas	Methane and others	Benzene (1,3-butadiene) and others
Ease of operation	Requires experience to interpret correctly, especially in GC mode.	Fairly easy to use and interpret. More difficult in the GC mode.
Detection limits	0.1 ppm (methane)	0.1 ppm (benzene), depends on lamp voltage.
Response time	2-3 sec (survey mode)	3 sec for 90% of total concentration

APPENDIX 5.1, Continued

	FID	PID
Maintenance	Periodically clean and inspect particle filters, valve rings, and burner chamber. Check calibration and pumping system for leaks. Recharge battery after each use.	Clean UV lamp frequently. Check calibration regularly. Recharge battery after each use.
Useful range	0-1000 ppm	0-2000 ppm
Service life	8 hrs; 3 hrs with strip chart recorder	10 hrs; 5 hrs with strip chart recorder

APPENDIX 5.2

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Photoionization detector (PID)

_____ Operating manual

_____ Probes: 9.5eV_____, 10.2eV_____, and 11.7eV_____

_____ Battery charger for PID

_____ Spare batteries

_____ Jeweler's screwdriver for adjustments

_____ Tygon tubing

_____ NBS traceable calibration gas (type)_____

_____ "T" valve for calibration

_____ Intake assembly extension

_____ Strap for carrying PID

_____ Teflon tubing for downhole measurements

_____ Plastic bags for protecting the PID from moisture and dirt

APPENDIX 5.3

PHOTOIONIZATION DETECTOR FIELD DATA FORM

PHOTOIONIZATION DETECTOR FIELD DATA

FACILITY CODE _____ **LOG DATE** _____

LOCATION ID _____ LOCATION TYPE _____

LOGGER CODE _____ FIELD REP _____

PHOTOIONZATION DETECTOR INSTRUMENT: MODEL _____

MANUFACTURER _____ DATE/TIME CALIBRATED _____

SERIAL NO _____ **ACCEPTANCE CODE** _____

CALIBRATION GASES:	
TYPE/CYLINDER ID NO	CONCENTRATION (PPM)/SPAN
1	1
2	2

COMMENTS _____

TIME (HH:MM)	SAMPLE ID	OBSERVED READING (ppm)					DRILLING DEPTH (FT)	COMMENTS
		DH	HS	BZ	D	OT		

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

LOCATION TYPES:
BH – BOREHOLE
SS – SOIL SAMPLE
SL – SURFACE LOCATION
SB – SAMPLE BOTTLE
TP – TEST PIT
WL – WELL
OT – OTHER

OBSERVED READING:
D – DURING DRILLING (BZ)
DH – DOWNHOLE
BZ – BREATHING ZONE
HS – HEADSPACE
OT – OTHER

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
PHO–040 (1/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.4

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

PHOTOIONIZATION DETECTOR FIELD DATA FORM

1. Facility Code. Five-character code abbreviating the facility name where the program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

3. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

4. Location Type. Two-character code identifying where the sample was taken. There is one location type for each location ID. Location types include those listed below.

   BH--Borehole

   TP--Test Pit

   SL--Surface Location

   WL--Well

   SB--Sample Bottle

   SS--Soil Sample

   OT--Other (explain)

5. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information on the form.

6. Field Rep. The name of the field representative.

7. PID Model. Model of photoionization detector (PID) instrument.

8. PID Manufacturer. Manufacturer's name on the PID instrument used.

9. Date/Time Calibrated. Last day and time when the PID instrument was calibrated. Calibration should be performed daily.

10. Serial No. Serial No. of PID instrument.

11. Acceptance Code. One-character code assigned by the site manager.

12. Calibration Gases

    a) Type/Cylinder ID No. Name of the calibration gas and the identification number of the cylinder.

    b) Concentration (ppm)/span. Concentration of calibration gas in parts per million (ppm) and the span setting for calibration.

13. Comments. Any additional information.

14. Time (HH:MM). The time when a field measurement was taken in the 24-hr clock format of hours:minutes (for example, 08:37 for 8:37 a.m. and 19:12 for 7:12 p.m.). See the conversion table below.

Conversion Table

Conventional Time	24-Hr Time
1:00 a.m.	1:00
12:00 Noon	12:00
1:00 p.m.	13:00
2:00 p.m.	14:00
3:00 p.m.	15:00
4:00 p.m.	16:00
5:00 p.m.	17:00
6:00 p.m.	18:00
7:00 p.m.	19:00
8:00 p.m.	20:00
9:00 p.m.	21:00
10:00 p.m.	22:00
11:00 p.m.	23:00
12:00 Midnight	24:00

15. Sample ID. When samples are being taken during a PID monitoring, the identification number or code assigned to a particular sample (like 01) is correlated with the observed readings and appropriate drilling depth (if drilling is being performed). This is useful in selecting samples for analyses and in the correlation of laboratory data with PID measurements.

16. Observed Reading (ppm). PID reading at the respective location ID in the units indicated on the meter. When the calibration gas and the gas being measured for the environment are the same, the meter reads in parts per million (ppm) during drilling. Readings may be taken downhole, at the headspace, and in the breathing zone, and data should be recorded in the appropriately marked column.

17. Drilling Depth (Ft). PID monitoring is performed every 5 ft during drilling. The depth of the drilling is listed in feet and can be given as the most recent interval (like 5-10) or as the ending depth (like 10).

18. Comments. Any additional information, including the type of gas being measured if this determination can be made (for example, by labels on drums).

STANDARD OPERATING PROCEDURE 6.3

HEALTH AND SAFETY MONITORING OF ORGANIC VAPORS WITH A FLAME IONIZATION DETECTOR

1. PURPOSE

To describe the equipment and proper method for environmental monitoring of toxic gases and vapors using a portable flame ionization detector (FID).

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information on the scope of the given operation and the applicability of this procedure to the work activities.

An FID is useful as a general screening tool to detect the presence of most organic vapors. It can be used to detect pockets of gaseous hydrocarbons in depressions or confined spaces, to screen drums or other containers for the presence of trapped vapors, or to screen an area for the presence of elevated levels of vapor-phase organics.

The FID is similar to a photoionization detector (PID) in application, but cannot detect certain inorganic vapors that are detected by the PID. However, the PID is unable to respond to certain low molecular weight hydrocarbons (like methane and ethane) that are readily detected by FID instruments. Appendix 5.1 describes the application comparisons between an FID organic vapor analyzer and a PID.

The FID will respond to most organic vapors as they form positively charged ions when burned in a hydrogen flame. The magnitude of the response is a function of the detector sensitivity and the ionization properties of the particular compound, as well as its concentration. As a result, the response must be compared with the response generated by a known concentration of a standard gas. The sample concentration is then reported as the parts-per-million (ppm) equivalent of the standard gas. Most units are calibrated with methane; however, almost any gaseous hydrocarbon that produces a response can be used. Many models also have built-in calibration circuits to ensure that the electronic response remains constant in all ranges.

2.1. FID Instrument Limitations

A. The FID does not respond to nongaseous organic compounds like some pesticides, polynuclear aromatic hydrocarbons (PNAs), and polychlorinated biphenyls (PCBs).

B. Most portable FIDs rely on the sample gas to supply the combustion air to the detector flame, so they are designed to operate in ambient atmospheres with oxygen concentrations of approximately 21%. This design precludes the sampling of process vents, poorly ventilated or sealed containers, or any sample gas hydrocarbon concentration sufficient to reduce the available oxygen or saturate the detector. Optional equipment is available that supplies oxygen from a compressed gas bottle or introduces sample gas through a dilution system with a known dilution factor.

C. Concentrations beyond the greatest scale factor of the instrument or in excess of 30% of the lower explosive limit (LEL) of the sample component require system modification. If system modifications are required, consult the manufacturer's operating manual.

D. Certain FID instruments have negligible response to carbon monoxide (CO) and carbon dioxide (CO_2). Their structure precludes the production of appreciable ions in the detector flame so other organic materials may be analyzed in the presence of CO and CO_2.

E. As with the PID, the FID responds differently to different compounds. Appendix 5.2 contains a list of the relative sensitivities of one FID model to some common organic compounds. Because the instrument is factory calibrated to methane, all relative responses are given in percentages with methane at 100. Therefore, the identity of the chemical of interest must be ascertained before its concentration can be determined. In addition, the unit requires a trained individual to maintain and operate the unit.

F. In general, the FID is more sensitive to hydrocarbons than to any other chemical class. Compounds containing oxygen, such as alcohols, ethers, aldehydes, carbolic acid and esters, give a lower response than that observed for hydrocarbons. This is particularly noticeable with compounds having a high ratio of oxygen to carbon, such as the lower members of each series which have one, two or three carbons. With compounds containing higher numbers of carbons, the effect is diminished to such an extent that the response is similar to that of the corresponding hydrocarbons.

   Nitrogen-containing compounds (e.g., amines, amides, and nitriles) respond in a manner similar to that observed for oxygenated materials. Halogenated compounds also show a lower relative response compared with hydrocarbons. Materials containing no hydrogen, such as carbon tetrachloride, give the lowest response; the presence of hydrogen in the compounds results in higher relative responses. Thus, $CHCl_3$ gives a much higher response than CCl_4. As in the other cases, when the carbon to halogen ratio is 5:1 or greater, the response will be similar to that observed for simple hydrocarbons.

2.2. Regulatory Limitations

A. International Air Transport Association (IATA) Dangerous Goods Regulations (2.9.2, Jan 1992) prohibit carrying compressed hydrogen gas on passenger aircraft. When the FID instrument is transported on a passenger aircraft, the hydrogen gas contained in the instrument must be emptied before loading.

B. Transport of an FID or extra cylinders of hydrogen gas or calibration gas by cargo aircraft must comply with the regulations stipulated in 49 CFR, Parts 100-177.

C. Appendix 5.6 describes the procedure for transporting an FID with a hydrogen tank. Consult the shipper for any recent changes in this procedure.

3. PROCEDURE

3.1. Associated Procedures

Information that applies to most field activities is provided in SOPs 1.1-1.10. In addition to the FSP or WP, those SOPs provide guidance that may supplement the information in this procedure. They should be consulted as necessary to obtain specific information about equipment and supplies; sample collection,

preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Contact the carrier that will transport samples to obtain information on regulations and specifications.

E. Assemble the equipment and supplies listed in Appendix 5.3. Perform the functional checks described below. The purpose of these checks is to verify that an instrument will function properly (for example, the batteries are serviceable and the instrument can be zeroed and calibrated) in the field. If problems develop, obtain a replacement unit and perform the same functional checks.

1. Turn the instrument on and allow adequate warmup time.

2. Check the battery charge level indicator. If it is not fully charged, recharge the battery as described in the manual.

3. Turn on the pump and check for leaks by covering the sample inlet and observing the rotameter. The indicator ball should drop to zero.

4. With the pump operating, open the hydrogen gas storage tank valve and the supply regulator to allow fuel gas to flow into the detector chamber.

5. Depress the igniter switch, observe the indicator needle for positive response, and listen for a pop. if the flame fails to light, depress the igniter switch again. Once the detector flame is lit, the unit is ready for use. Before lighting the detector flame, always be sure that the carrier gas flow (usually sample gas) is started.

6. If the instrument has internal calibration capability, perform the instrument calibration according to the procedures described in the operating manual.1

7. If the instrument has an alarm mode, set the alarm at the desired concentration.

3.2.2. Documentation

A. Obtain a logbook from the logbook coordinator.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

E. Record the calibration data on the Photoionization Detector Field Data form (Appendix 5.3). See Appendix 5.4 (Data Form Completion) for instructions.

3.2.3. Field

Before using the FID in the field, perform the following instrument checks to ensure that the equipment was not damaged during transport:

A. Follow the instrument checkout procedures described in Section 3.2.1.E.

B. If calibration to a specific hydrocarbon species is desired, complete this procedure according to the manufacturer's operating instructions.

C. Calibrate the FID daily before each use in the field.

3.3. Operation

3.3.1. Field Measurements of Organic Vapors

As with any field instrument, accurate results depend on the operator's knowledge of the operator's manual. The instructions in the manual should be followed explicitly in order to obtain accurate results.

A. Hold the sample probe in the area in question. The low sample rate allows for only very localized readings.

B. A slow sweeping motion should help prevent the bypassing of problem areas. Make sure the batteries are recharged within the time frame specified in the operator's manual. The usual length of the operating time between charges is 8 to 12 hours.

C. During drilling activities, perform FID monitoring at 5-ft intervals downhole, at the headspace, and in the breathing zone. In addition, where elevated organic vapor levels are encountered, monitoring may be performed in the breathing zone during actual drilling. When the activity does not require drilling (like surface sampling), readings may only be recorded in the breathing zone. Consult the Health and Safety Plan for the specific monitoring instructions.

D. In many areas in and adjacent to Mound Plant, organic vapors in subsurface are suspected to be from methane gas. All positive readings on OVA will be followed by installation of charcoal filters. Readings, both with and without the filter, will be recorded in logbooks. All organic vapors except methane will be absorbed by the filter.

After collecting the readings, STOP WORK and notify project manager of the measurements. The project manager will provide further instructions. Site geologic conditions may require use of double casings as described in SOP 4.1.1.

E. Some units have alarms that signal the operator if the detector flame goes out. If the alarm sounds, evacuate the work area, relight the flame in a known safe area, and reenter the site.

F. Monitor fuel and combustion air supply gauges regularly to ensure sufficient gas supplies.

G. High background readings after prolonged use may indicate that the sample probe or in-line filters (in front of detector) need to be cleaned. Use pipe cleaners to clean the probe and clean air blown backwards through the probe to clean the filters. Do not use organic solvents because the detector may be saturated by the solvent.

H. Perform the routine maintenance described in the operating manual. Because the unit contains pressurized gas supplies, also perform leak-check procedures regularly. Leaking hydrogen gas is explosive.

I. Concentrations beyond the maximum full-scale capability of the instrument or in excess of 30% LEL of the sample component require system modification. Similar modification may be necessary for sampling in oxygen-deficient atmospheres. This usually entails increasing the combustion air to the detector by sample dilution or by an independent air supply. A dilution system is the apparatus required to supply a filtered, controlled air supply for analyzers that use the sample gas stream as the source of combustion air. A dilution system can dilute a gas stream by ratios up to 100:1 through the selection of various critical orifices.

3.4. Postoperation

3.4.1. Field

A. When the activity is completed or at the end of the day, carefully clean the outside of the FID with a damp disposable towel to remove any visible dirt. Return the FID to a secure area and place on charge.

B. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

C. If necessary, make sure all survey or sampling locations are properly staked and that the location ID is readily visible on the location stake.

3.4.2. Documentation

A. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

B. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the document control officer (with copies to the site manager and files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Charge the instrument batteries.

D. If necessary, replenish supplies of the NBS traceable calibration gas.

4. SOURCES

Foxboro Analytical (A Division of The Foxboro Company). 1985. "Instruction and Service Manual, Century Systems Portable Organic Vapor Analyzer, Model OVA-128." New Haven, Connecticut.

CFR 49. 1985. Code of Federal Regulations, Title 49, U.S. Department of Transportation, Parts 100-177. November 1, 1985. Washington, D.C.: U.S. Government Printing Office.

EPA. 1984. "Characterization of Hazardous Waste Sites - A Methods Manual: Volume II, Available Sampling Methods, Second Edition," U.S. Environmental Protection Agency document EPA-600/4-84-076, December 1984. Environmental Monitoring Systems Laboratory, Office of Research and Development, Las Vegas, Nevada,.

5. APPENDIXES

5.1. Comparison of the FID and PID

5.2. Relative Sensitivities of the FID to Some Common Organic Compounds

5.3. Equipment and Supplies Checklist

5.4. Flame Ionization Detector Field Data Form

5.5. Data Form Completion

5.6. Shipment of OVA-128 and Hydrogen Tank

APPENDIX 5.1

COMPARISON OF THE FID AND PID

	FID	PID
Response	Responds to many organic gases and vapors, especially low molecular weight hydrocarbons	Responds to many organic and some inorganic gases and vapors, especially heavy hydrocarbons.
Application	In survey mode, detects total concentrations of gases and vapors. In GC mode, identifies and measures specific compounds.	In survey mode, detects total concentrations of gases and vapors. Some identification of compounds possible if GC column and standards are used.
Limitations	Does not respond to gases and vapors with a higher ionization potential than the flame detector. No temperature control.	Does not respond to methane or aliphatic chlorinated solvents. Does not respond properly in the presence of water vapor or high humidity. Does not detect a compound if the probe (lamp) has a lower energy than the compound's ionization potential.
Calibration gas	Methane and others	Benzene (1,3- butadiene) and others
Ease of operation	Requires experience to interpret correctly, especially in GC mode.	Fairly easy to use and interpret. More difficult in the GC mode.
Detection limits	0.1 ppm (methane)	0.1 ppm (benzene), depends on lamp voltage.
Response time	2-3 sec (survey mode)	3 sec for 90% of total concentration
Maintenance	Periodically clean and inspect particle filters, valve rings, and burner chamber. Check calibration and pumping system for leaks. Recharge battery after each use.	Clean UV lamp frequently. Check calibration regularly. Recharge battery after each use.
Useful range	0-1000 ppm	0-2000 ppm
Service life	8 hrs; 3 hrs with strip chart recorder	10 hrs; 5 hrs with strip chart recorder

APPENDIX 5.2

RELATIVE SENSITIVITIES OF THE FID TO SOME COMMON ORGANIC COMPOUNDS

Compound	Relative Response
Methane	100
Ethane	90
Propane	64
n-Butane	61
n-Pentane	100
Ethylene	85
Acetylene	200
Benzene	150
Toluene	120
Acetone	100
Methyl ethyl ketone	80
Methyl isobutyl ketone	100
Methanol	15
Ethanol	25
Isopropyl alcohol	65
Carbon tetrachloride	10
Chloroform	70
Trichloroethylene	72
Vinyl chloride	35

Source: Foxboro Analytical, 1985.

APPENDIX 5.3

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Flame ionization detector (FID)

_____ Probe extension

_____ Operating manual

_____ Battery charger

_____ Spare batteries

_____ Jeweler's screwdriver for adjustments and calibration

_____ Refueling hose for hydrogen cylinder

_____ NBS traceable calibration gas

APPENDIX 5.4

FLAME IONIZATION DETECTOR FIELD DATA FORM

FLAME IONIZATION DETECTOR FIELD DATA

FACILITY CODE _____ **LOG DATE** _____

LOCATION ID _____ LOCATION TYPE _____

LOGGER CODE _____ FIELD REP _____

FLAME IONIZATION DETECTOR INSTRUMENT :

MANUFACTURER _____ MODEL _____

SERIAL NO _____

DATE/TIME CALIBRATED _____ **ACCEPTANCE CODE** _____

CALIBRATION GASES :	
TYPE/CYLINDER ID NO	CONCENTRATION (PPM)
1	1
2	2

COMMENTS _____

TIME (HH:MM)	SAMPLE ID	OBSERVED READING (ppm)					DRILLING DEPTH (FT)	COMMENTS
		DH	HS	BZ	D	OT		

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

LOCATION TYPES:
BH – BOREHOLE
TP – TEST PIT
SS – SOIL SAMPLE
SB – SAMPLE BOTTLE
SL – SURFACE LOCATION
WL – WELL
OT – OTHER (EXPLAIN)

OBSERVED READING:
DH – DOWNHOLE
HS – HEADSPACE
BZ – BREATHING ZONE
D – DURING DRILLING (BZ)
OT – OTHER

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
FID–042 (1/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.5

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

FLAME IONIZATION DETECTOR FIELD DATA FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

3. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

4. Location Type. Two-character code identifying where the samples were taken. There is one location type for each location ID. Location types include those listed below.

   BH--Borehole

   TP--Test Pit

   SL--Surface Location

   WL--Well

   SB--Sample Bottle

   SS--Soil Sample

   OT--Other (explain)

5. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

6. Field Rep. The name of the field representative.

7. Manufacturer. Manufacturer's name on flame ionization detector (FID) instrument used.

8. Model. Model of FID instrument.

9. Serial No. Serial No. of FID instrument.

10. Date/Time Calibrated. The day and time when the FID instrument was calibrated. Calibration should be performed daily.

11. Acceptance Code. One- character code assigned by the site manager.

12. Calibration Gases

    a. Type/Cylinder ID No. The identification of the calibration gas and the lot number on the cylinder.

    b. Concentration (ppm). The concentration of the calibration gas in parts per million (ppm).

13. Comments. Any additional information.

14. Time (HH:MM). Time when a field measurement was taken in the 24-hr clock format of hours:minutes (for example, 0837 for 8:37 a.m. and 1912 for 7:12 p.m.)

Conversion Table

Conventional Time	24-Hr Time
1:00 a.m.	0100
12:00 Noon	1200
1:00 p.m.	1300
2:00 p.m.	1400
3:00 p.m.	1500
4:00 p.m.	1600
5:00 p.m.	1700
6:00 p.m.	1800
7:00 p.m.	1900
8:00 p.m.	2000
9:00 p.m.	2100
10:00 p.m.	2200
11:00 p.m.	2300
12:00 Midnight	2400

15. Sample ID. When samples are being taken while FID monitoring is being performed, the identification number or code assigned to a particular sample like 01 is correlated with the observed readings and appropriate drilling depth if drilling is being performed. This is useful in selecting samples for analyses and in the correlation of laboratory data with FID measurements.

16. Observed Reading (ppm). FID reading at the respective location ID in the units indicated on the meter. When the calibration gas and the gas being measured for the environment are the same, the meter reads in parts per million. Measurements can be made in the breathing zone, downhole, at the headspace, or other specified locations.

17. Drilling Depth (Ft). FID monitoring is performed every 5 ft during any type of drilling. The depth of the drilling is listed in feet and can be given as the most recent interval (like 5-10) or as the ending depth (like 10).

18. Comments. Any additional information, such as type of gas being measured, if this determination can be made (for example, by labels on drums).

APPENDIX 5.6

SHIPMENT OF OVA-128 AND HYDROGEN TANK

An organic vapor analyzer (OVA) is typically shipped with a charged cylinder and a supplementary hydrogen tank to a hazardous waste site as part of the safety monitoring requirements for site characterization. The OVA and the hydrogen tank must be shipped so as to protect their integrity and to protect against potential damage or injury that may be caused from leakage/breakage of the equipment. Regulations addressing the packaging, labeling, and shipping of an OVA and a hydrogen tank are described in 49 CFR Parts 171-178.
The packaging and labeling requirements for shipment of the OVA and the hydrogen tank are summarized in the following paragraphs.

A. Organic Vapor Analyzer

The OVA must be placed in its own case or in a box to minimize damage during handling and transportation. The following labels must be placed on the container before shipping.

1. A Flammable Gas label (red and white label)
2. A Danger label (orange and black label)
3. A label no smaller than 1 inch along each dimension with Hydrogen clearly written on it
4. A label stating Inside Packages Comply with Prescribed Specifications

Personnel engaged in shipping OVAs must note that a U.S. DOT exemption is applicable to the shipment of the OVA and must be attached to the shipping papers. In addition, personnel should note that it is preferable to transport all hazardous materials on cargo aircraft (for example, Emory or Federal Express).

B. Hydrogen Tank

The hydrogen tank must be secured with a safety cap. Because the tank needs to be shipped in a vertical position (safety cap on the up end), personnel may package the tank in a box for stability and further security. It should be noted that the hydrogen tank may be shipped without a box as long as the tank can remain in an upright position. If the hydrogen tank is packaged in a box, the shipper must ensure that the box has been securely taped. The following labels must be placed on the tank or container before shipping. Personnel involved in shipping hydrogen tanks must note that hydrogen tanks cannot be shipped by passenger aircraft or rail.

1. A Flammable Gas label (red and white label)
2. A Danger label (orange and black label)
3. A label no smaller than 1 inch with UN1049 clearly written on it
4. A label no smaller than 1 inch with Hydrogen clearly written on it
5. Labels with This End Up on the container or tank point pointing toward the safety cap
6. A Cargo Aircraft Only label
7. A label stating Inside Packages Comply with Prescribed Specifications

STANDARD OPERATING PROCEDURE 6.4

TOTAL ALPHA SURFACE CONTAMINATION MEASUREMENTS

1. PURPOSE

To provide guidance for determining levels of total surface alpha contamination on equipment, vehicles, and personnel that have been in contact with material that was potentially contaminated with alpha-emitting radionuclides.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information on the scope of a given operation, related health and safety requirements, and the applicability of this procedure to the activities.

Equipment and vehicles must be monitored for surface contamination before release for unrestricted use from a radiologically controlled area. Levels of surface alpha contamination on equipment will be determined and compared to release criteria presented in DOE Order 5480.11. These criteria are based on U.S. Nuclear Regulatory Commission Regulatory Guide 1.86 and presented as either total average, total maximum, or removable. Total average measurements are based on portable instrument surveys for alpha contamination over a 1 m^2 area. Total maximum measurements are based on portable instrument surveys for alpha contamination over a 100 cm^2 area. Removable contamination is defined as that amount of surface alpha activity that may be transferred to a soft, dry filter paper after wiping 100 cm^2 areas of the surface with moderate pressure. The swipe is then counted in a stationary radiation detector to determine removable alpha activity.

The primary alpha-emitting radionuclide of concern at the Mound Plant is plutonium-238. In some areas, isotopes of natural uranium and thorium are also of concern. In some instances, these plutonium, uranium, and thorium sources may contaminate some equipment surfaces concurrently. It is therefore necessary to select the surface contamination limits based on the most restrictive radionuclide, plutonium-238. For plutonium-238 and other transuranics, the surface contamination limits are as follow:

Nuclide	Average	Maximum	Removable
Plutonium-238	100 dpm/100 cm^2	300 dpm/100cm^2	20 dpm/100 cm^2

Activity per unit area is reported in units of disintegrations per minute (dpm) over a 100 cm^2 surface area. Natural uranium and thorium isotopes have significantly higher release limits than plutonium-238, thus are bounded by plutonium-238 limits. It is important to note that due to the characteristics of portable alpha detection instruments, it is generally not possible to statistically detect 20 dpm/100 cm^2 on a potentially contaminated surface. Therefore, removable alpha contamination measurements must be made on all equipment used in a radiologically controlled area of the Mound site. These measurements are addressed in SOP 1.7, Sampling for Removable Alpha Contamination.

All equipment must be decontaminated to levels that are as low as reasonably achievable and below the applicable release criterion in all cases. Personnel must be monitored for

contamination before leaving a controlled area and decontaminated to the lowest reasonably achievable levels.

High-voltage plateau curves and National Bureau of Standards (NBS) traceable source calibrations must be performed on the detector semiannually to ensure proper operation. Alpha detector counting efficiencies must be determined daily before using the instrument for contamination monitoring. The counting efficiency also must be determined following any adjustments or repairs on the instrument. The counting efficiency is used to convert instrument readings to a measure of activity in units of dpm per 100 cm^2.

3. PROCEDURE

3.1. Associated Procedures

Information that applies to most field activities is provided in SOPs 1.1-1.10. In addition to the FSP or WP, those SOPs provide guidance that may supplement the information in this procedure. They should be consulted as necessary to obtain specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
1.7	Sampling for Removable Alpha Contamination
6.11	Beta-Gamma Radiation Measurements Using a Geiger-Mueller Detector

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all field equipment. Ensure that the alpha scintillator and the ratemeter/scaler have current calibrations.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of codes used in the completion of data forms.

3.2.3. Field

A. Complete the Daily Alpha Efficiency Check form (Appendix 5.2) by following instructions in Appendix 5.4, Data Form Completion.

B. Perform a daily 10-min background count and a 1-min alpha source count during use and record the results on the Daily Alpha Efficiency Check form. To perform a background count, place the probe on a clean, uncontaminated surface and record the number of counts accumulated over a period of 10 min. To perform a check source count, place the alpha source in the detector tray or against the detector surface and record the number of counts accumulated per minute (cpm).

C. Calculate the counting efficiency (E) using the formula shown below.

$$E = \frac{(\text{source cpm}) - (\text{background cpm})}{(\text{source dpm})}$$

D. While counting samples or performing surveys, the alpha probe may be contaminated, causing the background count rate to increase. If this is suspected, repeat the 10-min background count. If the background count rate is more than 50% above the average value, the detector should be cleaned.

3.3 Operation

3.3.1 Total Alpha Survey

A. Complete the Total Alpha Contamination Survey Data form by following instructions in Appendix 5.4, Data Form Completion.

B. List the items to be surveyed in the first column on the form. Items must be identified as specifically as possible with serial numbers, model numbers, license numbers, or other forms of unique descriptions. If the items to be surveyed need to be labeled with the assigned identification number, use an indelible marker, spray paint, or some type of permanent marker. Use a separate line of the form to list each area surveyed on the items.

C. List the surveyor's name, date of survey, and identification number of the monitoring instrument/detector.

D. Switch the instrument on, check the batteries for adequate power, and check the instrument for damage. Record the instrument daily background, efficiency, and calibration factor in the appropriate spaces. The instrument background and efficiency should be determined at least once during each operational day.

E. Monitor potentially contaminated surfaces by passing the probe face along each surface at a rate of 5 cm/sec or less. Without touching it, hold the probe face as close as possible to the surface being monitored and not more than 0.5 cm away. Be careful not to damage the Mylar face of the probe. Hold the probe steady at any area that appears to indicate an elevated reading. Record the highest reading for each separate area of the item monitored, listing a description of each area in the space provided under the first column.

F. When monitoring potentially contaminated skin and clothing surfaces, hold the probe face as close as possible to the surface being monitored, no more than 0.5 cm away. Move the probe along the surface at a rate of 5 cm/sec or less. At a minimum, monitor the areas listed below.

1. Both sides of each hand

2. Tops, sides, and bottoms of shoes or boots

3. The torso of the body, both front and back

4. All loose equipment (for example, papers, clipboards, and hand-carried tools)

G. Instrument readings will fluctuate during monitoring. Investigate any significant elevation of the meter reading by holding the meter in the suspected area. A noticeable elevation in the meter reading identifies contamination that may need to be removed.

H. Multiply each instrument reading (cpm) by the calibration factor to obtain the contamination level in dpm/100 cm^2.

I. If the radiologically controlled area is known or suspected to contain plutonium-238, perform the swipe or smear survey procedure. See SOP 1.7, Sampling for Removable Alpha Contamination.

J. Wash contaminated skin and equipment with water and soap. Contaminated clothing may be removed and laundered at an appropriate facility.

K. Give the survey results to the personnel responsible for releasing equipment. Equipment that fails to meet the release limits must undergo additional decontamination according to SOP 1.6, General Equipment Decontamination, and must be resurveyed.

3.4. Postoperation

3.4.1. Field

A. Turn the power off.

B. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

3.4.2. Documentation

A. Record any uncompleted work (like additional monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the document control officer (with copies to the site manager and files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

4. SOURCE

NRC. 1974. Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors." U. S. Regulatory Commission, Washington, D.C.: U.S. Government Printing Office.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Daily Alpha Efficiency Check Form

5.3. Total Alpha Contamination Survey Data Form

5.4. Data Form Completion

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Alpha scintillation probe (Ludlum 43-5 or the equivalent)

_____ Ratemeter/scaler (Ludlum Model 3 or the equivalent)

_____ Alpha check source (Am-241 or the equivalent)

_____ Data forms

_____ Voltage meter

_____ Hand-held calculator

_____ Tape measure

APPENDIX 5.2

DAILY ALPHA EFFICIENCY CHECK FORM

DAILY ALPHA EFFICIENCY CHECK

FACILITY CODE _____ FIELD REP _____

LOGGER CODE _____ **ACCEPTANCE CODE** _____

RATEMETER/SCALER:

MODEL NO _____ SERIAL NO _____ CALIBRATION DATE _____

WINDOW OUT THRESHOLD _____ HIGH VOLTAGE _____ BATTERY _____

ALPHA SCINTILLATION PROBE:

MODEL NO _____ SERIAL NO _____ CALIBRATION DATE _____

SOURCE:

SERIAL NO _____ ISOTOPE _____ ACTIVITY _____ DPM

LOG DATE	TIME (HH:MM)	COUNTING TIME (MIN)	BACKGROUND CPM	GROSS COUNTS	GROSS CPM	NET CPM	EFFICIENCY (NET CPM/DPM)

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
DAE–103 (3/88)

_____ FORM COMPLETED BY/DATE

_____ TECHNICAL REVIEWER/DATE

APPENDIX 5.3

TOTAL ALPHA CONTAMINATION SURVEY DATA FORM

TOTAL ALPHA CONTAMINATION SURVEY DATA

FACILITY CODE _____ **LOG DATE** _____

LOGGER CODE _____ FIELD REP _____

RATEMETER/SCALER: **ACCEPTANCE CODE** _____

MODEL NO _____ SERIAL NO _____ CALIBRATION DATE _____

WINDOW OUT THRESHOLD _____ HIGH VOLTAGE _____ BATTERY _____

ALPHA PROBE:

MODEL NO _____ SERIAL NO _____ EFFICIENCY _____ CPM/DPM

PROBE FACE AREA [1] _____ CALIBRATION FACTOR [2] _____ $\frac{(DPM/100cm^2)}{CPM}$

ARE TRANSURANICS PRESENT OR SUSPECTED? (YES/NO) _____

IF YES – SWIPES ARE REQUIRED

ITEM SURVEYED (SPECIFY)	GROSS COUNTS	COUNT TIME	NET CPM	CONTAMINATION [3] LEVEL (IN DPM/100cm^2)	MEETS TOTAL SURFACE RELEASE LIMIT (100 dpm/cm^2) / (YES/NO)	SWIPE NECESSARY (YES/NO)

1 LUDLUM MODEL 43-1 PROBE FACE AREA = 83.0cm^2 LUDLUM MODEL 43-5 PROBE FACE AREA = 78.5 cm^2

2 CALIBRATION FACTOR = (100/PROBEFACE AREA (cm^2))/EFFECIENCY(CPM/DPM)

3 CONTAMINATION LEVEL = (NET CPM)(CALIBRATION FACTOR)

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
TAC-128 (6/92)

_____ FORM COMPLETED BY/DATE

_____ TECHNICAL REVIEWER/DATE

APPENDIX 5.4

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

DAILY ALPHA EFFICIENCY CHECK

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Field Rep. The name of the field representative.

3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

4. Acceptance Code. One-character code assigned by the site manager.

5. Ratemeter/Scaler Model No. The model number of the ratemeter/scaler.

6. Ratemeter/Scaler Serial No. The serial number of the ratemeter/scaler.

7. Ratemeter/Scaler Calibration Date. The date when the ratemeter/scaler was last calibrated.

8. Window. The window is in the out position unless otherwise specified.

9. Threshold. The adjustment for the lower energy level of the discriminator shown on the calibration sticker.

10. High Voltage. The voltage that is applied to the alpha scintillation probe shown on the calibration sticker. This voltage is determined semiannually using a voltage plateau.

11. Battery. The battery voltage reading at the beginning of the measurement.

12. Alpha Scintillation Probe Model No. The model number of the alpha detector probe.

13. Alpha Scintillation Probe Serial No. The serial number of the alpha probe.

14. Alpha Scintillation Probe Calibration Date. The date the probe was last calibrated.

15. Source Serial No. The serial number of the radiation source.

16. Source Isotope. The identity of the radioactive isotope contained in the source given as element and mass number, like Am-241.

17. Source Activity. The activity of the radioactive source in disintegrations per minute (dpm). If the check source activity is given in microcuries (μCi), it can be converted to dpm using 1 μCi = 2.22×10^{6}dpm.

18. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

19. Time (HH:MM). The time the efficiency was determined using the 24-hr clock in the format hours:minutes.

20. Counting Time (Min). The time in minutes over which the scaler counts. Enter N/A if using a ratemeter.

21. Background cpm. The count rate with no source present.

22. Gross Counts. The number of pulses recorded by the scaler during the counting time. Enter N/A if using a ratemeter.

23. Gross cpm. The count rate with the source present given in pulses per minute.

24. Net cpm. Net counts per minute (cpm) equals gross cpm minus background cpm.

25. Efficiency (Net cpm/dpm). The ratio of the observed count rate to the true disintegration rate.

$$\text{Efficiency} = \frac{\text{Net cpm}}{\text{Source dpm}}$$

APPENDIX 5.4, Continued

TOTAL ALPHA CONTAMINATION SURVEY DATA FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

4. Field Rep. The name of the field representative.

5. Acceptance Code. One-character code assigned by the site manager.

6. Ratemeter/Scaler Model No. The model number of the ratemeter/scaler.

7. Ratemeter/Scaler Serial No. The serial number of the ratemeter/scaler.

8. Ratemeter/Scaler Calibration Date. The date when the ratemeter/scaler was last calibrated.

9. Window. The window will be in the out position unless otherwise specified.

10. Threshold. The adjustment for the lower energy level of the discriminator shown on the calibration sticker.

11. High Voltage. The voltage applied to the alpha detector shown on the calibration sticker.

12. Battery. The battery voltage reading at the beginning of the measurement.

13. Alpha Probe Model No. The model number of the alpha detector probe.

14. Alpha Probe Serial No. The serial number of the alpha detector probe.

15. Alpha Probe Efficiency. The ratio of observed net count rate to the known disintegration rate of the check source from the Daily Alpha Efficiency Check form (Appendix 5.2).

16. Probe Face Area. The surface area of the Mylar window on the alpha scintillation detector in square cm. Values for Ludlum Models 43-1 and 43-5 are listed at the bottom of the form.

17. Calibration Factor. Factor that takes the detector efficiency and surface area into account to convert from cpm to dpm per 100 cm^2. The calibration factor in ($dpm/100cm^2$)/cpm equals (100/Probe Face Area in cm^2)/efficiency in cpm/dpm.

18. Are transuranics present or suspected (Yes/No). Answer based on historical data and Safety Plan review.

19. Item Surveyed (Specify). A description or identification number of the article surveyed. A separate line on the form is used to list and describe each area to be surveyed on the article.

20. Gross Counts. The total counts collected during the counting period.

21. Count Time. The time (in minutes) during which the counts were collected.

22. Net cpm. Gross count cpm minus background cpm.

23. Contamination Level (in $dpm/100cm^2$). This is calculated by multiplying the net cpm by the calibration factor.

    Contamination level = (Net cpm) (Calibration Factor)

24. Meets Release Limit (Yes/No). If the contamination level is greater than the applicable release limit, a no is written here. If the contamination level is less than the release limit, a yes is written here.

25. Swipe Necessary (Yes/No). If the total alpha contamination level exceeds the applicable removable contamination criteria, a swipe must be performed to determined the activity contribution of fixed and loose contamination. If item 18 is Yes, all locations will require a swipe.

STANDARD OPERATING PROCEDURE 6.7

NEAR SURFACE AND SOIL SAMPLE SCREENING FOR LOW-ENERGY GAMMA RADIATION USING THE FIDLER

1. PURPOSE

To describe the procedure in which a field instrument for the detection of low-energy radiation (FIDLER) is used to monitor surfaces and soil samples for the presence of low-energy gamma radiations that accompany some alpha emissions.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information on the scope of specific operations, related health and safety requirements, and the applicability of this procedure.

The FIDLER uses a thin, 5-inch-diameter sodium iodide (NaI) crystal to detect low-energy radiation. The NaI crystal is optically coupled to a quartz light pipe and installed in a standard 5-inch probe housing that has an entrance window of beryllium. The principal use of this detector is for photons with energies less than 75 kilo-electron volts (keV).

The FIDLER probe can be used to scan individual samples for low-energy photons that normally accompany alpha emissions. Uranium is principally an alpha emitter. However, the radiation from its daughter products includes low-energy photons, principally L-orbital x rays from thorium. In the case of U-238, for example, two low-energy photons from Th-234 can be detected by the FIDLER. During most investigations, the instrument will be adjusted for maximum response for the 63 keV photon from Th-234 or the 60 keV photon of Am-241 formed by the beta decay of Pu-241.

The detection limit for a FIDLER during field use is dependent on the source to detector geometry, the energy of gamma and x-rays associated with radionuclides present, and what radionuclide was used to calibrate the instrument to a calculated efficiency. A wide range in background soures can affect the estimated sensitivity as well.

Source to detector geometry can be influenced by the terrain roughness, amount and type of vegetation, and the physical configuration of the detector. These items should be noted during a field survey.

The thin NaI crystal in a FIDLER becomes less sensitive to increasing gamma and x-ray energies. It is necessary to note the energy and yield associated with potential radionuclides encountered. The energy and yield of the calibration source must also be known prior to field use. A FIDLER that has been calibrated to an americium-241 source (approximately 60 keV) may have a high voltage that is insufficient to amplify plutonium-238 (approximately 23 keV) pulses to a detector threshold.

Data from these measurements are presented as gross counts in the 60 keV energy range. The combination of this information with gross alpha counts of the same sample conducted according to SOP 6.5, Screening Soil Samples for Alpha Emitters, can be used to determine the presence or absence of radionuclides.

Included in this procedure are instructions for 1) initial instrument setup (voltage plateau), 2) daily response standardization using a sealed check source, 3) determination of the instrument's response to terrestrial background radiation, and 4) use of the instrument to scan ground surface areas and samples.

3. PROCEDURE

3.1. Associated Procedures

Information that applies to most field activities is provided in SOPs 1.1-1.10. In addition to the FSP or WP, those SOPs provide guidance that may supplement the information in this procedure. They should be consulted as necessary to obtain specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
6.5	Screening Soil Samples for Alpha Emitters

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all equipment.

D. Obtain appropriate permission for property access.

E. Before the FIDLER can be used in the field, it is necessary to determine the correct operating voltage. This is accomplished by determining the plateau for background radiation and for radiation from a source of Am-241 (60 keV) in which the intensity is several times greater than background radiation levels. Determine the operating voltage once each week.

1. Inspect the FIDLER, the ratemeter/scaler, and interconnecting cable for obvious damage.

2. If no damage is observed, adjust the high voltage to 0 volts before connecting the FIDLER and the ratemeter/scaler.

3. Connect the FIDLER to the ratemeter/scaler in an area that has exhibited background radiation in previous measurements.

4. Turn the ratemeter/scaler selector switch to the high voltage setting and slowly adjust the high voltage to 900 volts (V).

5. Place the FIDLER in a position so that a series of 0.5-min counts can be made at various high-voltage settings.

6. Make three 0.5-min readings and record the voltage, count time, counts, and counts per minute in the columns on the Plateau Curve Record. When these three readings have been completed, adjust the high voltage upward 40 to 50 V. Repeat the three readings. Continue this procedure until three recordings have been made at a high-voltage setting of 1400 V. Do not exceed 1400 V.

7. Place the Am-241 source approximately 1 inch from the beryllium entrance window near the center of the probe and repeat the series of 0.5-min readings for high-voltage settings between 900 and 1400 V.

8. On the Plateau Curve Record, plot the FIDLER response as a function of high voltage. Between 1100 and 1300 V, there is little change in the detector's response. This represents the operating plateau. Set the ratemeter/scaler high voltage at the midpoint of the plateau (typically 1200 V) for field operation. Minor fluctuations in the high voltage caused by environmental conditions or battery drain will have little effect on the count rate. Record this ratemeter/scaler voltage on the Plateau Curve Record form.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check and information concerning the initial setup of the FIDLER in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

E. Record information concerning the initial setup of the FIDLER on the Plateau Curve Record form (Appendix 5.2). Instructions for completing the form are in Appendix 5.5 (Data Form Completion).

3.2.3. Field

A. Daily Source Check

1. Establish a fixed geometry between the detector and the source so that their relative position is a matter of record and reproducible from one work period to the next.

2. Make five 1-min counts with the Am-241 source in its check position. Record each count in the logbook. Repeat this step twice daily when the instrument is in use or at any new locations.

3. Determine the average and standard deviation of the five 1-min counts. Record these values and three times the standard deviation in the logbook.

The average source count (X) = $\frac{x1+x2+x3+x4+x5}{5}$

The standard deviation of the average source count (SDX) = (X/5)1/2

B. Monitoring the performance of the FIDLER

1. Prepare a control chart at the beginning of the site characterization and use it each day to record the FIDLER's response to the Am-241 source.

2. On a piece of linear graph paper, place consecutive calendar dates on the x-axis. Define a range along the y-axis that includes the average FIDLER source count + 3 standard deviations. Draw three horizontal lines that intersect the y-axis at these three points.

3. Determine the average count rate and plot this value on the control chart for that day. If the average count rate falls within the +3 standard deviations as defined above, the FIDLER may be used for field measurements. If the average count rate is not within this range, corrective action must be taken (see Section 3.2.3.C).

C. Corrective Action

1. Check the ratemeter/scaler calibration due date.

2. Check to see that the ratemeter/scaler high voltage is set at the plateau midpoint.

3. Turn off the ratemeter/scaler and disconnect the cable to the FIDLER. Clean the cable and chassis connectors with ethyl alcohol and let dry.

4. Reconnect the cable, turn on the ratemeter/scaler, and check the voltage setting.

5. Check the source-to-detector distance and make any necessary corrections.

6. Repeat the daily source check procedure. If the FIDLER response is within the range of the average count rate + 3 standard deviations, the unit may be used. If the average count rate is still outside the control boundary, turn off the instrument and use a substitute instrument. Repeated failures will require attention by the manufacturer. The FIDLER is temperature sensitive and constant response will be ensured through the use of a battery-powered "warming jacket" in cold temperatures.

D. Determination of Background

1. In order to provide a statistical basis to determine if samples or locations are contaminated, calculate the mean background and standard deviation.

   a. In a location designated as background (not in the contaminated area) or using five soil samples collected from a background area, perform a series of five 1-minute counts with the FIDLER probe in the same position as it will be for screening samples in locations (see Sections 3.3.1 and 3.3.2).

   b. Determine the mean and standard deviation of the five background counts.

$$\text{Mean} = X = \frac{x1+x2+x3+x4+x5}{5}$$

where

x1, x2, x3, x4, x5 = the background counts

standard deviation = SDX = (X/5)1/2

2. The contamination criterion used for further samples is the mean background plus 3 standard deviations (X + 3SDX). Samples with 1-min counts greater than this criterion should be considered contaminated.

3. Record this number or criterion on the FIDLER Soil Sample Screening Log (Appendix 5.3) or the FIDLER Measurement Data form (Appendix 5.4), depending on the type of screening to be performed.

3.3. Operation

3.3.1 Screening Soil Samples

A. Record the soil sample screening data on the FIDLER Soil Sample Screening Log form (Appendix 5.3) following the instructions in Appendix 5.5, Data Form Completion.

B. Place the soil samples in the petri dishes (fill to the top).

C. The steps for screening samples are described below.

1. Place the soil sample container (petri dish) in the counting shield.

2. Place the FIDLER probe in a counting jig inside the lead shield so that it is positioned above the center of a sample container holder. Adjust the height so that the FIDLER is one inch above the sample container. Close the shield door.

3. Turn the ratemeter/scaler selector switch to preset time and set the time for one min. Push the reset button to start and count.

4. Record the counts and the counting time on the FIDLER Soil Sample Screening Log form.

6. Remove the sample container, store it in sample archive, and repeat with additional samples.

3.3.2. Near-Surface Screening

A. The FIDLER Measurement Data form (Appendix 5.4) is completed as described in Appendix 5.5, Data Form Completion.

B. Determine that the FIDLER system has been checked and is ready for field measurements.

C. Refer to the FSP or WP for the areas to be scanned, the number of people required, time requirements, and special instructions.

D. Subdivide the grid block squares into square (or regular) grid blocks, the total area of which can be scanned in 0.5 or 1-min intervals. Use a calibrated measurement tape.

E. Drainage paths can only be scanned with a FIDLER if the area is free of standing or flowing water. If the area is dry, place grid stakes at regular intervals between the preexisting stakes.

F. Record scan measurements as integral counts over the area to be scanned. Pulses from the FIDLER will be summed for 0.5 min or 1 min. Turn the main selector switch of the ratemeter/scaler to either 0.5 or 1 min (as specified in the FSP or WP).

G. Begin scans at one corner of a grid block and progress in a serpentine pattern over the entire block, ending at the diagonally opposite corner of the block. Push the ratemeter/scaler reset button as the scan begins. With practice, the timed count should end upon reaching the opposite corner. During the scan, the field representative must listen to the audible signal from the meter. Although scanning speed should not be slowed when increased audible signals are heard, note the presence of apparent hot spots when recording the integrated count for the scan.

H. After completing the scan for an individual grid block, record the integrated count in its respective position on the FIDLER Measurement Data form (Appendix 5.4). Place a check mark above the recorded count to signify that anomalous or hot spot areas may exist on the basis of audible signals for that grid block.

I. Compare the location count rate to the contamination criterion (average background and 3 standard deviations). If the count rate is greater, the location is marked Y for further study or characterization.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. If necessary, make sure all survey or sampling locations are properly staked and the location ID is readily visible on the location stake.

C. Ensure that all radiological sources and standards have been stored in a locked area.

3.4.2. Documentation

A. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

B. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the document control officer (with copies to the site manager and files) for eventual delivery to the Department of Energy.

B. Inventory Equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

4. SOURCE

Becron. 1985. "Technical Manual, Model: Labtech Scaler/Ratemeter/Analyzer with 2-Channel Option." Bicron Corporation, Newbury, Ohio.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Plateau Curve Record

5.3. FIDLER Soil Sample Screening Log Form

5.4. FIDLER Measurement Data Form

5.5. Data Form Completion

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ FIDLER probe

_____ Ratemeter/scaler with voltage indicator and optional headphones

_____ Connector cable

_____ Lead shield and counting jig (optional)

_____ Plan view (site map) of the area to be surveyed that includes grid system coordinates

_____ Calibrated measurement tape or chain

_____ Am-241 source or the equivalent

_____ Hand-held calculator

_____ FIDLER heat shield, if available

_____ Linear graph paper for the performance control chart

_____ Petri dishes for soil samples

APPENDIX 5.2

PLATEAU CURVE RECORD

PLATEAU CURVE RECORD

PAGE 1 OF ____

FACILITY CODE _____ LOG DATE _____

LOGGER CODE _____ FIELD REP _____

RATEMETER/SCALER: ACCEPTANCE CODE _____

MODEL NO _____ SERIAL NO _____ CALIBRATION DATE _____

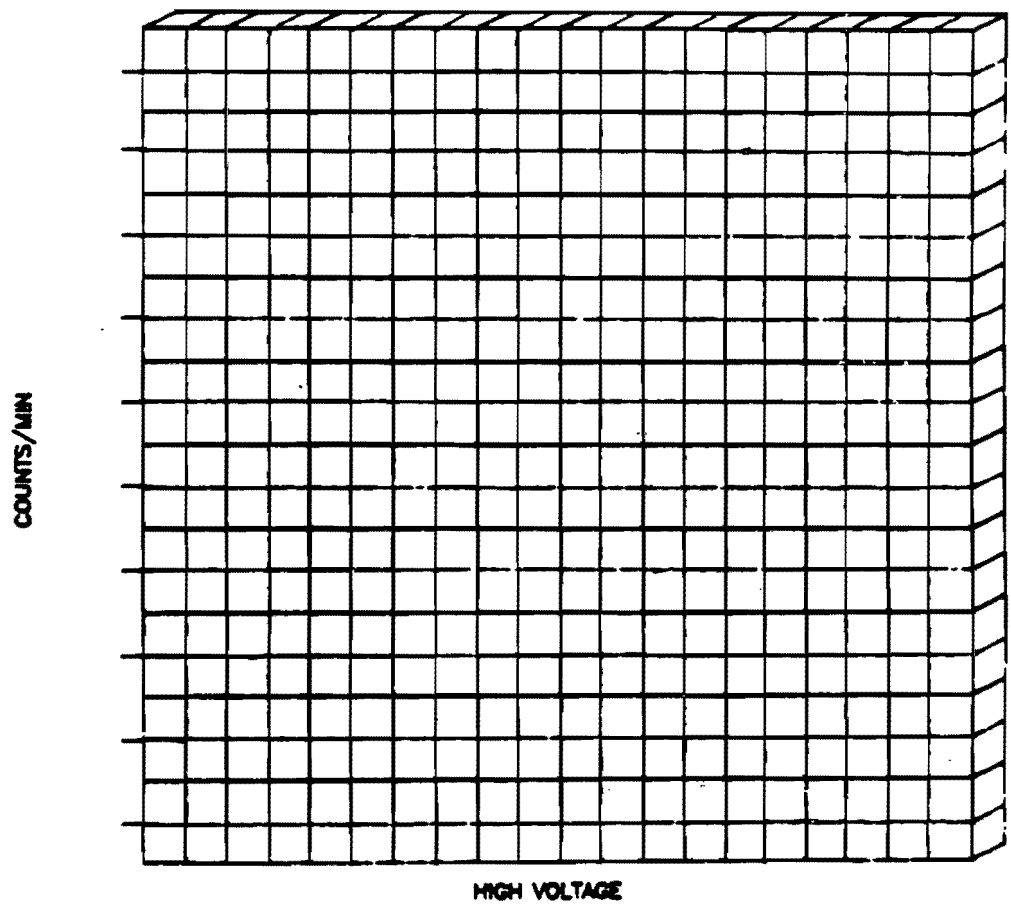
WINDOW _____ THRESHOLD _____ BATTERY _____

PROBE:

MODEL NO _____ SERIAL NO _____ HIGH VOLTAGE _____

CHECK SOURCE:

SERIAL NO _____ ISOTOPE _____ ACTIVITY _____



ACCEPTANCE CODES: A–ACCEPTABLE R–RECOMMENDANCE U–UNACCEPTABLE N–NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TMS

FOR–102 (3/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.3

FIDLER SOIL SAMPLE SCREENING LOG

FIDLER SOIL SAMPLE SCREENING LOG PAGE 1 OF ____

FACILITY CODE _____ LOG DATE _____

LOGGER CODE _____ FIELD REP _____

RATEMETER/SCALER: ACCEPTANCE CODE _____

MODEL NO _____ SERIAL NO _____ CALIBRATION DATE _____

WINDOW _____ THRESHOLD _____ HIGH VOLTAGE _____ BATTERY _____

NaI PROBE :

MODEL NO _____ SERIAL NO _____ CALIBRATION DATE _____

CHECK SOURCE:

ISOTOPE _____ ACTIVITY _____ DPM SERIAL NO _____

SOURCE CHECK

METER READING _____ COUNTS/_____ MIN = _____ CPM

(WITHIN ± 3 STANDARD DEVIATIONS?[1] _____ (Y/N))

AVERAGE BACKGROUND + 3 STANDARD DEVIATIONS = _____ CPM

COMMENTS _____

LOCATION ID	COORDINATES (FT)		SAMPLE ID	COUNTS (=CPM)	CONTAMINATED YES/NO	ESTIMATED[2] pCi/gram
	NORTH	EAST				

1 SOURCE CHECK WITHIN ± 3 STANDARD DEVIATIONS (YES/NO), FROM THE CONTROL CHART

2 THE pCi/gram RADIONUCLIDE CONCENTRATION CAN BE ESTIMATED ONLY IF FIELD CALIBRATION FACTORS ARE AVAILABLE

ACCEPTANCE CODES: A—ACCEPTABLE R—RECONNAISSANCE U—UNACCEPTABLE N—NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY IN TMS
FSS-128 (3/92)

_____ FORM COMPLETED BY/DATE

_____ TECHNICAL REVIEWER/DATE

APPENDIX 5.4

FIDLER MEASUREMENT DATA FORM

FIDLER MEASUREMENT DATA

PAGE 1 OF ___

FACILITY CODE _____ **LOG DATE** _____

LOGGER CODE _____ FIELD-REP _____

RATEMETER/SCALER: **ACCEPTANCE CODE** _____

MODEL NO _____ SERIAL NO _____ CALIBRATION DATE _____

WINDOW _____ THRESHOLD _____ VOLTAGE _____ BATTERY _____

NaI PROBE:

MODEL NO _____ SERIAL NO _____ CALIBRATION DATE _____

CHECK SOURCE:

ISOTOPE _____ ACTIVITY _____ DPM SERIAL NO _____

SOURCE CHECK

METER READING _____ COUNTS/_____ MIN = _____ CPM

(WITHIN ± 3 STANDARD DEVIATIONS?[1] _____ (Y/N)

AVERAGE BACKGROUND + 3 STANDARD DEVIATIONS = _____

COMMENTS _____

LOCATION ID	GRID BLOCK SCANNED (FROM N.E. CORNER)		INTEGRATED COUNT (CPM)	AUDIBLE (Y)es or (N)o	CONTAMINATED (Y)es or (N)o
	NORTH	EAST			

[1] SOURCE CHECK WITH ± 3 STANDARD DEVIATIONS. (YES/NO) FROM THE CONTROL CHART

ACCEPTANCE CODES: A—ACCEPTABLE R—RECONNAISSANCE U—UNACCEPTABLE N—NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIME
FMD-120 (3/88)

_____ FORM COMPLETED BY/DATE

_____ TECHNICAL REVIEWER/DATE

APPENDIX 5.5

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

PLATEAU CURVE RECORD

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

4. Field Rep. The name of the field representative.

5. Acceptance Code. One-character code assigned by the site manager.

6. Ratemeter/Scaler Model No. The model number of the ratemeter/scaler.

7. Ratemeter/Scaler Serial No. The serial number of the ratemeter/scaler.

8. Ratemeter/Scaler Calibration Date. The date when the ratemeter/scaler was last calibrated.

9. Window. The window will be in the out position unless otherwise specified.

10. Threshold. The adjustment for the lower energy level of the discriminator shown on the calibration sticker.

11. Battery. The battery voltage reading at the beginning of the measurement.

12. Probe Model Number. The model number of the FIDLER probe.

13. Probe Serial Number. The serial number of the FIDLER probe.

14. Probe High Voltage. The final voltage setting that will be applied to the detector, as determined by the Plateau Curve procedure. For the FIDLER, the operating voltage should be about 1200V.

15. Check Source Serial No. The serial number of the radiation check source.

16. Check Source Isotope. The radioactive isotope contained in the check source given as element and mass number, like Am-241.

17. Check Source Activity. The activity of the radioactive check source in disintegrations per minute (dpm). An activity given in microcuries (lCi) can be converted to dpm using 2.22 x 106 dpm = 1 lCi.

18. Counts/Min. The count rate given in counts per minute (cpm).

19. High Voltage. The voltage applied to the detector during the collection of the associated counts.

APPENDIX 5.5, Continued

FIDLER SOIL SAMPLE SCREENING LOG

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

4. Field Rep. The name of the field representative.

5. Acceptance Code. One-character code assigned by the site manager.

6. Ratemeter/Scaler Model No. The model number of the ratemeter/scaler.

7. Ratemeter/Scaler Serial No. The serial number of the ratemeter/scaler.

8. Ratemeter/Scaler Calibration Date. The date when the ratemeter/scaler was last calibrated.

9. Window. The window will be in the out position unless otherwise specified.

10. Threshold. The adjustment for the lower energy level of the discriminator shown on the calibration sticker.

11. High Voltage. The voltage setting that is applied to the probe as determined by the Plateau Curve procedure.

12. Battery. The battery voltage reading at the beginning of the measurement.

13. NaI Probe Model No. The model number of the FIDLER probe.

14. NaI Probe Serial No. The serial number of the FIDLER probe.

15. NaI Probe Calibration Date. The date when the FIDLER probe was last calibrated.

16. Check Source Isotope. The radioactive isotope that the source contains, given as element and mass number, like Am-241.

17. Check Source Activity. The activity of the check source, measured in disintegrations per minute (dpm). An activity given in microcuries can be converted to dpm using 2.22 x 106 dpm = 1 lCi.

18. Check Source Serial No. The serial number of the check source.

19. Source Check Meter Reading. The results of a count on a check source. The check source data consists of three fields: total counts, counting time in minutes, and count rate in counts per minute (cpm).

20. Within + 3 Standard Deviations (Y/N). This field describes the performance of the FIDLER, from the control chart in 3.2.3.B., Field Preparation.

21. Average Background + 3 Standard Deviations (cpm). This field gives the average background count rate + 3 standard deviations of the average count rate. It is used as a contamination criterion. Count rates greater than this are considered contaminated. Count time equals 1 min.

    X = Average or Mean Background = $\frac{x1+x2+x3...xn}{N}$

    where

    x1, x2, x3 etc = individual background counts

    N = the number of counts taken

    SDX = standard deviation of the average background = (X/N)1/2

22. Comments. Any additional information.

23. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

24. Coordinates (Ft). The location of the FIDLER measurement on the survey grid in units of feet. The two coordinate fields are in the format north and east.

25. Sample ID. The identifying code or number given to the sample.

26. Counts (=cpm). The number of counts registering on the FIDLER meter during the 1-min counting period.

27. Contaminated (Yes/No). If the counts per 1 min obtained are greater than the average background plus 3 standard deviations, the sample is considered contaminated. Enter Yes or Y if contaminated and No or N if not contaminated.

28. Estimated pCi/gram. If calibration factors are available for the specific site under investigation, the FIDLER cpm can be converted to a pCi/gram concentration. Enter N/A if these factors are not available.

APPENDIX 5.5, Continued

FIDLER MEASUREMENT DATA FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

4. Field Rep. The name of the field representative.

5. Acceptance Code. One-character code assigned by the site manager.

6. Ratemeter/Scaler Model No. The model number of the ratemeter/scaler.

7. Ratemeter/Scaler Serial No. The serial number of the ratemeter/scaler.

8. Ratemeter/Scaler Calibration Date. The date when the ratemeter/scaler was last calibrated.

9. Window. The window will be in the out position unless otherwise specified.

10. Threshold. The adjustment for the lower energy level of the discriminator shown on the calibration sticker.

11. Voltage. The voltage setting that is applied to the probe, as determined by the Plateau Curve procedure.

12. Battery. The battery voltage reading at the beginning of the measurement.

13. NaI Probe Model No. The model number of the FIDLER probe.

14. NaI Probe Serial No. The serial number of the FIDLER probe.

15. NaI Probe Calibration Date. The date when the FIDLER probe was last calibrated.

16. Check Source Isotope. The radioactive isotope that the source contains, given as element and mass number, like Am-241.

17. Check Source Activity. The activity of the check source, measured in disintegrations per minute (dpm). An activity given in microcuries (lCi) can be converted to dpm using 2.22 x 106 dpm = 1 lCi.

18. Check Source Serial No. The serial number of the check source.

19. Source Check Meter Reading. The results of a count on a check source. Check source data consists of three fields: total counts, count time in minutes, and count rate in cpm.

20. Within + 3 Standard Deviations. This field describes the performance of the FIDLER, from the control chart in Section 3.2.3.B, Field Preparation. Enter Y (yes) or N (no).

21. Average Background + 3 Standard Deviations. This field gives the average background count rate (cpm) + 3 standard deviations of the average. It is used as a contamination criterion; count rates greater than this number indicate contaminated areas.

$$X = \text{Average or Mean Background} = \frac{x1+x2+x3...xn}{N}$$

where

x1, x2, x3, etc. = individual background counts

N = the number of counts taken

SDX = standard deviation of the average background = (X/N)1/2

22. Comments. Any additional information.

23. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

24. Grid Block Scanned (From N.E. Corner). The location of the grid block that was scanned, identified by the survey coordinates of the northeast corner relative to the survey grid in units of feet. There are two fields in the coordinate description: north and east.

25. Integrated Count (cpm). The count rate in counts per minute obtained from the walkover scan of the grid.

26. Audible. If an audible anomaly was noted, enter YES; if no audible anomaly was detected, enter NO.

27. Contaminated. If the count rate recorded is greater than the average background plus 3 standard deviations, the location is considered contaminated (Y). If it is less, it is not considered contaminated (N).

STANDARD OPERATING PROCEDURE 6.15

MEASUREMENT OF GAMMA-RAY FIELDS USING A SODIUM IODIDE (NaI) DETECTOR

1. PURPOSE

To describe the procedure for making count-rate measurements of a gamma-ray field with a sodium iodide (NaI) detector.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information on the scope of a given operation, related health and safety requirements, and the applicability of this procedure to the activities.

Gamma radiation field strengths may be used to indicate contamination by gamma emitters. Elevated count-rate data must be carefully interpreted because uncontaminated areas can demonstrate high readings if they are next to an area contaminated with gamma emitters.

Using this procedure, it is possible to identify area or point sources of gamma-emitting radionuclides and determine whether an observed reading is due to shine from an adjacent source. These techniques are outlined in Sections 3.3.2 and 3.3.3. It should be noted that these are considered gross screening techniques only, rather than determinate measures.

Count-rate data from a sodium iodide (NaI) detector can be converted to exposure rate (μR/hr) measurements if the detector has been correlated with a calibrated, pressurized ionization chamber (PIC). See SOP 6.9, Correlation of a Sodium Iodide Detector to the Pressurized Ionization Chamber.

3. PROCEDURE

3.1. Associated Procedures

Information that applies to most field activities is provided in SOPs 1.1-1.10. In addition to the FSP or WP, those SOPs provide guidance that may supplement the information in this procedure. They should be consulted as necessary to obtain specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination

6.9	Exposure Rate Measurements Using a Pressurized Ionization Chamber
6.10	Correlation of a Sodium Iodide Detector to the Pressurized Ionization Chamber

3.2. **Preparation**

3.2.1. Office

A. Review the FSP or WP and SOPS listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all field equipment. Ensure current calibration of the probe and the ratemeter/scaler.

E. Obtain PIC correlation data if these have been determined for the surveyed area.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check and calibration in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of codes and location IDs used in the completion of data forms.

3.2.3. Field

A. Visually inspect the equipment, including the connector cable, for breakage.

B. Check the battery charge. If necessary, replace the batteries.

C. Set the threshold to the value given on the calibration sticker (usually 100 volts).

D. Set the detector voltage to the value given on the calibration sticker. The operating voltage for an NaI probe is usually 700 to 1000 volts.

E. Set the window to the out position (gross mode).

F. Note the response of the detector to the check source.

3.3. Operation

3.3.1. Count-Rate Measurements

A. Record the gamma count-rate measurements taken with the NaI detector on the Gamma Ray Count-Rate Data form (Appendix 5.2). Instructions to complete the form are in Appendix 5.4.

B. Turn on the instrument.

C. Hold the detector first at a height of 3 ft above the ground (waist height), then at the ground surface if an above-background level is noted. Allow the ratemeter/scaler to integrate the count rate for at least 10 sec.

D. Record the results on the Gamma Ray Count-Rate Data form.

3.3.2. Recognizing Area and Point Sources

A. Walk slowly in the area of interest, holding the NaI detector waist high and note the count rate. Determine the location of the highest observed gamma count rate (sometimes called the HOG).

B. At the HOG, compare the count rate obtained at waist height with the count rate obtained at ground level. If both count rates are above background and increase rapidly as the detector is held closer to the ground surface, the anomalous area may be an isolated hot spot with an area of only a few square feet. If the HOG is broad in extent and there is no difference in the count rate at ground level and waist height, the anomalous area probably is not highly localized.

3.3.3. Recognizing Gamma Shine from Nearby Anomalies

Walk slowly in the area of interest, holding the NaI detector at waist height. If the count rate increases while leaving the area of interest, some of the gamma count rate observed at the area of interest may be due to shine from an adjacent gamma source. If the count rate increases as the height of the detector above the ground increases, some of the gamma count rate at the area of interest may be due to shine.

3.4. Postoperation

3.4.1. Field

A. Turn all switches to the off position.

B. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

C. If necessary, make sure all survey or sampling locations are properly staked and the location ID is readily visible on the location stake.

3.4.2. Documentation

A. Record any uncompleted work (like additional monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the document control officer (with copies to the site manager and files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return all field equipment to the equipment manager and identify any operational problems from previous use.

C. Ensure that all radiological sources and standards have been stored in a locked area.

4. SOURCE

Ludlum. 1982. "Instruction Manual Model 2220 Portable Scaler Ratemeter." Ludlum Measurements, Inc. April 1982. Sweetwater, Texas.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Gamma Ray Count-Rate Data Form

5.3. Data Form Completion

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Portable ratemeter/scaler, Ludlum 2220 (or equivalent)

_____ Sodium iodide (NaI) gamma scintillometer, Ludlum 44-10 (or equivalent)

_____ D-cell batteries (4)

_____ Connector cable

_____ Hand-held calculator

_____ Gamma check source

APPENDIX 5.2

GAMMA RAY COUNT-RATE DATA FORM

GAMMA RAY COUNT–RATE DATA

(USING SCINTILLOMETER)

PAGE 1 OF ___

FACILITY CODE _____ FIELD REP _____

LOGGER CODE _____ **LOG DATE** _____

ACCEPTANCE CODE _____ SITE AREA CORRELATION NO _____

RATEMETER/SCALER MANUFACTURER _____ VOLTAGE _____

MODEL NO _____ SERIAL NO _____ CALIBRATION DATE _____

WINDOW OUT THRESHOLD _____ BATTERY _____

PROBE MANUFACTURER _____

MODEL NO _____ SERIAL NO _____ CALIBRATION DATE _____

SOURCE CHECK DATE/TIME _____

LOCATION	**COORDINATES (FT)**		METER READING (CPM)		EXPOSURE RATE (μ R/hr)	
ID	**NORTH**	**EAST**	SURFACE	3 FT	SURFACE	3 FT

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
SED–100 (2/88)

FORM COMPLETED BY/DATE

TECHNICAL REVIEWER/DATE

GAMMA RAY COUNT–RATE DATA

(USING SCINTILLOMETER)

PAGE ___ OF ___

FACILITY CODE _____ FIELD REP _____

LOGGER CODE _____ LOG DATE _____

LOCATION ID	COORDINATES (FT)		METER READING (CPM)		EXPOSURE RATE (μ R/hr)	
	NORTH	EAST	SURFACE	3 FT	SURFACE	3 FT

COMPLETE BOLDED DATA FOR ENTRY INTO TIME
SED-100 (3/88)

APPENDIX 5.3

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Field Rep. The name of the field representative.

3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

4. Log Date. The date that information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

5. Acceptance Code. One-character code assigned by the site manager.

6. Site Area Correlation No. The number assigned to the PIC scintillometer correlation data set by the site health and safety coordinator.

7. Ratemeter/Scaler Manufacturer. The manufacturer of the ratemeter/scaler in use.

8. Voltage. The voltage that is applied to the detector. The voltage value is set to the value given on the calibration sticker.

9. Ratemeter/Scaler Model No. The model number of the ratemeter/scaler.

10. Ratemeter/Scaler Serial No. The serial number of the ratemeter/scaler.

11. Ratemeter/Scaler Calibration Date. The date when the ratemeter/scaler was last calibrated.

12. Window. The window will be in the out position unless otherwise specified.

13. Threshold. The adjustment for the lower energy level of the discriminator. The threshold value is set to the value shown on the calibration sticker.

14. Battery. The battery charge reading at the beginning of the measurement.

15. Probe Manufacturer. The manufacturer of the sodium iodide (NaI) probe.

16. Probe Model No. The model number of the NaI probe.

17. Probe Serial No. The serial number of the NaI probe.

18. Probe Calibration Date. The date when the NaI probe was last calibrated.

19. Source Check Date/Time. The date and time that the detector response to a gamma source was last checked.

20. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

21. Coordinates (Ft). The coordinates of the measurement location in feet. The format is north and east.

22. Meter Reading (CPM). The count rate in counts per minute. There are two fields. One field is for readings at ground level, and the other is for readings at 3 ft above the ground.

23. Exposure Rate. The exposure rate in microR/hour (μR/hr). In order to make entries into these fields, it is necessary to determine the count rate to exposure rate conversion factor for the area of the site under investigation. A calibrated microR meter can also be used for entries in these fields. One field is for readings at ground level, and the other is for readings at 3 ft above the ground.

APPENDIX B

CONTRACT LABORATORY PROGRAM STATEMENT OF WORK MODIFICATIONS

MODIFICATION A:	Modification to CLP SOW ILM03.0 "Statement of Work for Inorganic Analysis, Multi-media, Multi-concentration"
MODIFICATION B:	Modification to CLP SOW ILM03.0 "Statement of Work for Inorganic Analysis (Residential Ground Water), Multi-media, Multi-concentration"
MODIFICATION C:	Modification to CLP SOW ILM3.0 "Statement of Work for Lanthanide Analysis, Multi-media, Multi-concentration"
MODIFICATION D:	Modification to CLP SOW OLM1.8 "Statement of Work for Organic Analysis, Multi-media, Multi-concentration"

MODIFICATION A

Modification to CLP SOW ILM03.0
"Statement of Work for Inorganic Analysis,
Multi-media, Multi-concentration"

The purpose of this addendum is to outline modifications to the Contract Laboratory Program (CLP) Statement of Work (SOW) ILM03.0, "Statement of Work for Inorganic Analysis, Multi-media, Multi-concentration", which are project-specific to the QAPP prepared by Roy F. Weston, Inc. for investigative activities at the Department of Energy/LANL Mound Plant, Miamisburg, Ohio.

This addendum extends the analysis to include lithium, molybdenum, bismuth, and tin and requires lower detection limits for aluminum, antimony, beryllium, and vanadium. Molybdenum, bismuth, and tin must be analyzed by ICP.

Exhibit A - Summary of Requirements

No modifications

Exhibit B - Reporting and Deliverables Requirements

Section I: Contract Reports/Deliverable Distribution
No Modifications

Section II: Report Descriptions and Order of Data Deliverables
No Modifications

Section III: Form Instruction Guide
No Modifications

Section IV: Data Reporting Forms

The following elements have been added to the CLP SOW by this addendum:

CAS No.	Analyte
7439-93-2	Lithium
7439-98-7	Molybdenum
7440-69-9	Bismuth
7440-31-5	Tin

These four elements and the lower CRDLs must be added to the following forms:

Form	Description
I	Data Sheet
II (A)	Initial and Continuing Calibration Verification
II (B)	CRDL Standard for AA and ICP
III	Blanks
IV	ICP Interference Check Sample
V (A)	Spike Sample Recovery
V (B)	Post Digest Spike Sample Recovery
VI	Duplicates
VII	Laboratory Control Sample
IX	ICP Serial Dilutions
X	Instrument Detection Limit (Quarterly)
XI (A)	ICP Interelement Correction Factors (Annually)
XI (B)	ICP Interelement Correction Factors (Annually)
XII	ICP Linear Ranges (Quarterly)
XIV	Analysis Run Log

Exhibit C - Inorganic Target Analyte List (TAL)

This table is modified to include the following additional elements with the estimated CRDL values:

Analyte	Water CRDL (ug/L)	Soil CRDL (mg/kg)
Lithium	100	10
Molybdenum	20	2
Bismuth	150	30
Tin	50	10

Lower CRDLs are required for the following elements:

Aluminum	20	4
Antimony	10	2
Beryllium	1	0.2
Vanadium	10	2

Exhibit D - Analytical Methods

Section I: Introduction
No Modifications

Section II: Sample Preservation and Holding Times
No Modifications

Section III: Sample Preparation

A. WATER SAMPLE PREPARATION

1. Acid Digestion Procedure for Furnace Atomic Absorption Analysis

No Modifications

2. Acid Digestion Procedure for ICP and Flame AA Analyses

A four-fold concentration of the sample or the use of 4 grams of sample instead of 1 gram is necessary to meet required detection limits for aluminum, antimony, beryllium, and vanadium. These metals are designated for analysis by ICP. This four-fold concentration preparation is detailed in Method 200.7 with revision 1.3 (1987) in the "Methods of Chemical Analysis of Water and Waste" (EPA-600/4-79-020). Briefly, one mL of (1 + 1) HNO_3 and five mL of (1 + 1) HCl is added to a 200 mL aliquot of the sample. The sample is digested until the volume is reduced to approximately 20 mL. When cool, the digestate is transferred to a 50-mL volumetric flask and brought up to volume with deionized distilled water. Analyte recovery data and sample preparation bias for these elements shall be evaluated prior to implementation of this technique.

B. SOIL/SEDIMENT PREPARATION

1. Acid Digestion Procedure for ICP, Flame AA, and Furnace AA Analyses

The laboratory is required to meet the required detection limits for aluminum, antimony, beryllium and vanadium. This may be accomplished through concentration of the sample (up to four-fold) or through digestion of up to 4 grams of soil instead of 1 gram. All analytes must be run within the linear range of the instrument.

C. TOTAL METALS SAMPLE PREPARATION USING MICROWAVE DIGESTION

Not Applicable

Section IV: Sample Analysis

Part A - Inductively Coupled Plasma - Atomic Emission Spectrometric Method

1.0 Scope and Application

1.1 No modification.

1.2 No modification.

1.3 Table I is modified to include:

Element	Wavelength (nm)	Est. Detection Limit (ug/L)
Molybdenum	202.030	20
Bismuth	223.061	150
Tin	189.989	50
Aluminum	--	20
Antimony	--	10
Beryllium	--	1
Vanadium	--	10

1.4 No modification.

2.0 Summary of Method

No modification.

3.0 Definitions

No modifications.

4.0 Safety

No modifications.

5.0 Interferences

Table 2 contains information regarding molybdenum. No information is available at this time for lithium, bismuth, and tin and will be evaluated before sample analysis is conducted.

6.0 Apparatus

No modifications.

7.0 Reagents and Standards

7.1 No modifications.

7.2 No modifications.

7.3 Stock standard solutions - Modified to include:

7.3.26 Bismuth solution, stock, 1 mL = 100 ug Bi:

Dissolve 0.1000 g of bismuth metal in a minimum amount of (1 + 1) HNO_3. Dilute to 1000 mL with deionized, distilled water.

7.3.27 Tin solution, stock, 1 mL = 100 ug Sn:

Dissolve 0.1000 g of tin metal in 100 mL of conc. HCl and dilute to 1000 mL with deionized, distilled water. This standard is prepared fresh weekly.

7.4 Mixed calibration standard solutions - Modify to include:

7.4.6 Mixed standard solution VI - Lithium, bismuth, and tin.

7.5 No modifications.

7.6 Instrumental and calibration check standards must include all analytes of interest in Table 1.

8.0 Procedure

No modifications.

9.0 Calculation

No modifications.

10.0 Quality Control (Instrumental)

No modifications.

Part B - Atomic Absorption Methods, Furnace Techniques

If tin is analyzed by GFAA, the peroxide used for digestion must be verified by the laboratory to be free of tin contamination.

Part C - Atomic Absorption Methods, Flame Techniques

Lithium will be analyzed by SW7430; "Test Methods for Evaluating Solid Wastes," U.S. EPA. Quality control must be implemented as required by CLP SOW for Flame AA analyses and outlined in QAPP Table III.2.

Part D - Cold Vapor Methods for Mercury Analysis

No Modifications

Part E - Methods for Cyanide Analysis

No Modifications

Part F - Percent Solids Determination Procedure

No Modifications

Part G - Alternate Methods (Catastrophic ICP Failure)

Bi method 3500-Bi; "Standard Methods for Analysis of Water and Waste Waters," 17th edition

Sn method 282.2; "Methods for Chemical Analysis of Water and Wastes," U.S. EPA EPA 600/4-79-020, March 1983.

Mo method 246.1; "Methods for Chemical Analysis of Water and Wastes," U.S. EPA EPA 600/4-79-020, March 1983.

Exhibit E - Quality Assurance/Quality Control Requirements

Section I - General QA/QC Procedures

No Modifications

Section II - Specific QA/QC Procedures

No Modifications

Section III - Quality Assurance Plan

No Modifications

Section IV - Data Management

No Modifications

Section V - Required QA/QC Operations

1.0 Instrument Calibration

All analytes from Table 1 must be included in calibration standards.

2.0 Initial Calibration Verification (ICV) and Continuing Calibration Verification (CCV)

All analytes from Table 1 must be included. If sample pre-concentration is to be utilized, analyte recovery data and sample preparation bias for these elements shall be evaluated and found to be acceptable prior to the implementation of this technique.

3.0 CRDL Standards for ICP (CRI) and AA (CRA)

All analytes from Table 1 must be included.

4.0 Initial Calibration Blank (ICB), Continuing Calibration Blank (CCB), and Preparation Blank (PB) Analyses

References to Exhibit C includes the modifications to Exhibit C presented in this addendum.

5.0 ICP Interference Check Sample (ICS) Analysis

Table 2 is modified to include the following analytes in solution AB:

Analyte	(mg/L)
Molybdenum	1.0
Bismuth	1.0
Tin	1.0

6.0 Spike Sample Analysis (S)

Table 3 is modified to include:

	For ICP/Flame AA		For Furnace AA	
Element	Water (µg/L)	Soil (mg/Kg)	Water (µg/L)	Soil (mg/kg)
Lithium	2000	500		
Molybdenum	300	200		
Bismuth	2000	500		
Tin	500	200	100	50

7.0 Duplicate Sample Analysis (D)

Reference to Exhibit C includes modifications to Exhibit C presented in this addendum.

8.0 Laboratory Control Sample (LCS) Analysis

All of the four new elements (Li, Mo, Sb, Sn) will be included in the LCS analysis.

9.0 ICP Serial Dilutions Analysis (L)

No modifications.

10.0 Instrument Detection Limit (IDL) Determination

Reference to Exhibit C includes the modifications to Exhibit C present in this addendum.

11.0 Interelement Corrections for ICP

ICS A and AB solutions for titanium must be monitored to insure adequate interelement correction factors between all elements.

12.0 Linear Range Analysis (LRA)

No modifications.

13.0 Furnace Atomic Absorption (AA) QC Analyses

No modifications.

Section VI - Laboratory Evaluation Process

No Modifications

Exhibit F - Chain-of-Custody, Document Control, and Standard Operating Procedures

No Modifications

Exhibit G - Glossary of Terms

No Modifications

Exhibit H - Data Dictionary and Format for Data Deliverables in Computer-Readable Format

The four additional elements addressed by this addendum must be included on all electronic deliverables.

MODIFICATION B

Modification to CLP SOW ILM03.0
"Statement of Work for Inorganic Analysis (Residential Ground Water),
Multi-media, Multi-concentration"

The purpose of this addendum is to outline modifications to the Contract Laboratory Program (CLP) Statement of Work (SOW) ILM03.0, "Statement of Work for Inorganic Analysis, Multi-media, Multi-concentration", which are project-specific to the QAPP prepared by Roy F. Weston, Inc. for investigative activities at the Department of Energy/LANL Mound Plant, Miamisburg, Ohio.

This addendum extends the analysis to include lithium, molybdenum, bismuth, and tin. It also specifies graphite furnace atomic absorption methodology for arsenic, antimony, cadmium, lead, selenium, and thallium. Lower detection limits are required for these six elements in addition to aluminum, beryllium, and vanadium. Molybdenum, bismuth, and tin must be analyzed by ICP.

Exhibit A - Summary of Requirements

No modifications

Exhibit B - Reporting and Deliverables Requirements

Section I: Contract Reports/Deliverable Distribution

No Modifications

Section II: Report Descriptions and Order of Data Deliverables

No Modifications

Section III: Form Instruction Guide

No Modifications

Section IV: Data Reporting Forms

The following elements have been added to the CLP SOW by this addendum:

CAS No.	Analyte
7439-93-2	Lithium
7439-98-7	Molybdenum
7440-69-9	Bismuth
7440-31-5	Tin

These four elements and the lower CRDLs must be added to the following forms:

Form	Description
I	Data Sheet
II (A)	Initial and Continuing Calibration Verification
II (B)	CRDL Standard for AA and ICP
III	Blanks
IV	ICP Interference Check Sample
V (A)	Spike Sample Recovery
V (B)	Post Digest Spike Sample Recovery
VI	Duplicates
VII	Laboratory Control Sample
IX	ICP Serial Dilutions
X	Instrument Detection Limit (Quarterly)
XI (A)	ICP Interelement Correction Factors (Annually)
XI (B)	ICP Interelement Correction Factors (Annually)
XII	ICP Linear Ranges (Quarterly)
XIV	Analysis Run Log

Exhibit C - Inorganic Target Analyte List (TAL)

This table is modified to include the following additional elements with the estimated CRDL values:

Analyte	CRDL (ug/L)
Lithium	100
Molybdenum	20
Bismuth	150
Tin	50

Lower CRDLs are required for the following elements:

Aluminum	20
Beryllium	1
Vanadium	10
Arsenic	2
Antimony	10
Cadmium	2
Lead	2
Selenium	2
Thallium	2

Exhibit D - Analytical Methods

Section I: Introduction

Arsenic, antimony, cadmium, lead, selenium, and thallium must be analyzed by graphite furnace atomic absorption methodology using Zeeman background correction. Lead and antimony have the option of using deuterium background correction.

Section III: Sample Preparation

A. WATER SAMPLE PREPARATION

1. Acid Digestion Procedure for Furnace Atomic Absorption Analysis

No Modifications

2. Acid Digestion Procedure for ICP and Flame AA Analyses

A four-fold concentration of the sample is necessary to meet required detection limits for aluminum, beryllium, and vanadium. These metals are designated for analysis by ICP. This four-fold concentration preparation is detailed in Method 200.7 with revision 1.3 (1987) in the "Methods of Chemical Analysis of Water and Waste" (EPA-600/4-79-020). Briefly, one mL of (1 + 1) HNO_3 and five mL of (1 + 1) HCl is added to a 200 mL aliquot of the sample. The sample is digested until the volume is reduced to approximately 20 mL. When cool, the digestate is transferred to a 50-mL volumetric flask and brought up to volume with deionized distilled water. Analyte recovery data and sample preparation bias for these elements shall be evaluated prior to implementation of this technique.

This digestate may be used for the analysis of other TAL elements. Dilutions may be performed in accordance with the CLP SOW to bring the response of each analyte into the appropriate calibration range.

B. SOIL/SEDIMENT PREPARATION

Not Applicable

C. TOTAL METALS SAMPLE PREPARATION USING MICROWAVE DIGESTION

No Modification

Section IV: Sample Analysis

Part A - Inductively Coupled Plasma - Atomic Emission Spectrometric Method

1.0 Scope and Application

1.1 No modification.

1.2 No modification.

1.3 Table I is modified to include:

Element	Wavelength (nm)	Est. Detection Limit (ug/L)
Molybdenum	202.030	20
Bismuth	223.061	150
Tin	189.989	50
Aluminum	--	20
Beryllium	--	1
Vanadium	--	10
Arsenic	--	2
Antimony	--	10
Cadmium	--	2
Lead	--	2
Selenium	--	2
Thallium	--	2

1.4 No modification.

2.0 Summary of Method

No modification.

3.0 Definitions

No modifications.

4.0 Safety

No modifications.

5.0 Interferences

Table 2 contains information regarding molybdenum. No information is available at this time for lithium, bismuth, and tin. The laboratory will evaluate interferences for these three elements before analysis is conducted.

6.0 Apparatus

No modifications.

7.0 Reagents and Standards

7.1 No modifications.

7.2 No modifications.

7.3 Stock standard solutions -
Modified to include:

7.3.26 Bismuth solution, stock, 1 mL = 100 ug Bi:

Dissolve 0.1000 g of bismuth metal in a minimum amount of (1 + 1) HNO_3. Dilute to 1000 mL with deionized, distilled water.

7.3.27 Tin solution, stock, 1 mL = 100 ug Sn:

Dissolve 0.1000 g of tin metal in 100 mL of conc. HCl and dilute to 1000 mL with deionized, distilled water. This standard is prepared fresh weekly.

7.4 Mixed calibration standard solutions -
Modify to include:

7.4.6 Mixed standard solution VI - Lithium, bismuth, and tin.

7.5 No modifications.

7.6 Instrument and calibration standards must include all analytes of interest in Table 1.

8.0 Procedure

No modifications.

9.0 Calculation

No modifications.

10.0 Quality Control (Instrumental)

No modifications.

Part B - Atomic Absorption Methods, Furnace Techniques

Graphite furnace analysis of arsenic, antimony, cadmium, lead, selenium, and thallium must be done using Zeeman background correction. Lead and antimony have the option of using deuterium background correction.

If tin is analyzed by GFAA, the peroxide used for digestion must be verified by the laboratory to be free of tin contamination.

Part C - Atomic Absorption Methods, Flame Techniques

Lithium will be analyzed by SW7430; "Test Methods for Evaluating Solid Wastes," U.S. EPA. Quality control must be implemented as required by CLP SOW for Flame AA analyses and outlined in QAPP Table III.2.

Part D - Cold Vapor Methods for Mercury Analysis

No Modifications

Part E - Methods for Cyanide Analysis

No Modifications

Part F - Percent Solids Determination Procedure

No Modifications

Part G - Alternate Methods (Catastrophic ICP Failure)

Bi method 3500-Bi; "Standard Methods for Analysis of Water and Waste Waters," 17th edition

Sn method 282.2; "Methods for Chemical Analysis of Water and Wastes," U.S. EPA EPA 600/4-79-020, March 1983.

Mo method 246.1; "Methods for Chemical Analysis of Water and Wastes," U.S. EPA EPA 600/4-79-020, March 1983.

Exhibit E - Quality Assurance/Quality Control Requirements

Section I - General QA/QC Procedures

No Modifications

Section II - Specific QA/QC Procedures

No Modifications

Section III - Quality Assurance Plan

No Modifications

Section IV - Data Management

No Modifications

Section V - Required QA/QC Operations

1.0 Instrument Calibration

No modifications.

2.0 Initial Calibration Verification (ICV) and Continuing Calibration Verification (CCV)

If sample pre-concentration is to be utilized, analyte recovery data and sample preparation bias for these elements shall be evaluated and found to be acceptable prior to the implementation of this technique.

3.0 CRDL Standards for ICP (CRI) and AA (CRA)

No modifications.

4.0 Initial Calibration Blank (ICB), Continuing Calibration Blank (CCB), and Preparation Blank (PB) Analyses

References to Exhibit C includes the modifications to Exhibit C presented in this addendum.

5.0 ICP Interference Check Sample (ICS) Analysis

Table 2 is modified to include the following analytes in solution AB:

Analyte	(mg/L)
Molybdenum	1.0
Bismuth	1.0
Tin	1.0

6.0 Spike Sample Analysis (S)

Table 3 is modified to include:

Element	Water (ug/L)
Lithium	2000
Molybdenum	300
Bismuth	2000
Tin	500

If GFAA is used due to ICP failure, the laboratory shall provide evidence that there is no tin present in the peroxide used for digestion.

7.0 Duplicate Sample Analysis (D)

Reference to Exhibit C includes modifications to Exhibit C presented in this addendum.

8.0 Laboratory Control Sample (LCS) Analysis

All of the four new elements (Li, Mo, Sb, Sn) will be included in the LCS analysis.

9.0 ICP Serial Dilutions Analysis (L)

No modifications.

10.0 Instrument Detection Limit (IDL) Determination

Reference to Exhibit C includes the modifications to Exhibit C present in this addendum.

11.0 Interelement Corrections for ICP

ICS A and AB solutions for titanium must be monitored to insure adequate interelement correction factors between all elements.

12.0 Linear Range Analysis (LRA)

No modifications.

13.0 Furnace Atomic Absorption (AA) QC Analyses

No modifications.

Section VI - Laboratory Evaluation Process

No Modifications

Exhibit F - Chain-of-Custody, Document Control, and Standard Operating Procedures

No Modifications

Exhibit G - Glossary of Terms

No Modifications

Exhibit H - Data Dictionary and Format for Data Deliverables in Computer-Readable Format

The four additional elements addressed by this addendum must be included on all electronic deliverables.

MODIFICATION C

Modification to CLP SOW ILM03.0
"Statement of Work for Lanthanide Analysis,
Multi-media, Multi-concentration"

The purpose of this addendum is to outline modifications to the Contract Laboratory Program (CLP) Statement of Work (SOW) ILM03.0, "Statement of Work for Inorganic Analysis, Multi-media, Multi-concentration", which are project-specific to the QAPP prepared by Roy F. Weston, Inc. for investigative activities at the Department of Energy/LANL Mound Plant, Miamisburg, Ohio.

This addendum extends the analysis to include the lanthanide series of rare earth elements, by ICP-AES.

Exhibit A - Summary of Requirements

No modifications

Exhibit B - Reporting and Deliverables Requirements

Section I: Contract Reports/Deliverable Distribution
No Modifications

Section II: Report Descriptions and Order of Data Deliverables
No Modifications

Section III: Form Instruction Guide
No Modifications

Section IV: Data Reporting Forms

The following elements have been added to the CLP SOW by this addendum:

CAS No.	Analyte
7440-65-5	Yttrium
7440-00-8	Neodymium
7440-64-4	Ytterbium
7440-60-0	Holmium
7439-91-0	Lanthanum
7440-27-9	Terbium
7440-52-0	Erbium
7429-91-6	Dysprosium
7440-45-1	Cerium
7440-19-9	Samarium
7440-54-2	Gadolinium
7440-10-0	Praseodymium
7440-53-1	Europium
7440-30-4	Thulium
7439-94-3	Lutetium

These 15 elements and must be added to the following forms:

Form	Description
I	Data Sheet
II (A)	Initial and Continuing Calibration Verification
II (B)	CRDL Standard for AA and ICP
III	Blanks
IV	ICP Interference Check Sample
V (A)	Spike Sample Recovery
V (B)	Post Digest Spike Sample Recovery
VI	Duplicates
VII	Laboratory Control Sample
IX	ICP Serial Dilutions
X	Instrument Detection Limit (Quarterly)
XI (A)	ICP Interelement Correction Factors (Annually)
XI (B)	ICP Interelement Correction Factors (Annually)
XII	ICP Linear Ranges (Quarterly)
XIV	Analysis Run Log

Exhibit C - Inorganic Target Analyte List (TAL)

This table is modified to include the following additional elements with the estimated CRDL values:

Analyte	Water CRDL (ug/L)	Soil CRDL (mg/kg)
Yttrium	200	40
Neodymium	200	40
Ytterbium	200	40
Holmium	200	40
Lanthanum	200	40
Terbium	200	40
Erbium	200	40
Dysprosium	200	40
Cerium	200	40
Samarium	200	40
Gadolinium	200	40
Praseodymium	200	40
Europium	200	40
Thulium	200	40
Lutetium	200	40

Exhibit D - Analytical Methods

Section I: Introduction
No Modifications

Section II: Sample Preservation and Holding Times
No Modifications

Section III: Sample Preparation

A. WATER SAMPLE PREPARATION

1. Acid Digestion Procedure for Furnace Atomic Absorption Analysis

No Modifications

2. Acid Digestion Procedure for ICP and Flame AA Analyses

No Modifications

B. SOIL/SEDIMENT PREPARATION

1. Acid Digestion Procedure for ICP, Flame AA, and Furnace AA Analyses

No Modifications

C. TOTAL METALS SAMPLE PREPARATION USING MICROWAVE DIGESTION

Add the lanthanide series of rare earth elements.

Section IV: Sample Analysis

Part A - Inductively Coupled Plasma - Atomic Emission Spectrometric Method

1.0 Scope and Application

1.1 No modification.

1.2 No modification.

1.3 Table I is modified to include:

CAS No.	Element	Wavelength (nm)	Est. Detection Limit (ug/L)
7440-65-5	Yttrium	371.030	200
7440-00-8	Neodymium	401.225	200
7440-64-4	Ytterbium	356.419	200
7440-60-0	Holmium	339.898	200
7439-91-0	Lanthanum	408.572	200
7440-27-9	Terbium	350.911	200
7440-52-0	Erbium	337.275	200
7429-91-6	Dysprosium	353.171	200
7440-45-1	Cerium	446.01	200
7440-19-9	Samarium	442.435	200
7440-54-2	Gadolinium	342.247	200
7440-10-0	Praseodymium	390.844	200
7440-53-1	Europium	420.505	200
7440-30-4	Thulium	376.133	200
7439-94-3	Lutetium	261.542	200

1.4 No modification.

2.0 Summary of Method

No modification.

3.0 Definitions

No modifications.

4.0 Safety

No modifications.

5.0 Interferences

Table 2 - No information is available at this time for the lanthanide rare earth elements except titanium may be an interference for some elements and will be evaluated before sample analysis is conducted.

6.0 Apparatus

No modifications.

7.0 Reagents and Standards

7.1 No modifications.

7.2 No modifications.

7.3 Stock standard solutions - Modified to include:

7.3.26 Prepare standard stock solutions at a concentration of 100 ug/mL (or equivalent) for Yttrium, Ytterbium, Holmium, Erbium, Dysprosium, Gadolinium, Europium, Thulium, and Lutetium.

7.3.27 Prepare standard stock solutions at a concentration of 500 ug/mL (or equivalent) for Neodynium, Lanthanum, Terbium, Cerium, Samarium, and Praseodymium.

7.4 Mixed calibration standard solutions - Modify to include:

7.4.6 Mixed standard solution VI - Lanthanide series solution containing 15 elements.

7.5 No modifications.

7.6 Instrumental and calibration check standards must include all analytes of interest in Table 1.

8.0 Procedure

No modifications.

9.0 Calculation

No modifications.

10.0 Quality Control (Instrumental)

No modifications.

Part B - Atomic Absorption Methods, Furnace Techniques

Not applicable

Part C - Atomic Absorption Methods, Flame Techniques

Not Applicable

Part D - Cold Vapor Methods for Mercury Analysis

Not Applicable

Part E - Methods for Cyanide Analysis

Not Applicable

Part F - Percent Solids Determination Procedure

No Modifications

Part G - Alternate Methods (Catastrophic ICP Failure)

Not Applicable, Lanthanides must be determined using ICP instrumentation.

Exhibit E - Quality Assurance/Quality Control Requirements

Section I - General QA/QC Procedures

No Modifications

Section II - Specific QA/QC Procedures

No Modifications

Section III - Quality Assurance Plan

No Modifications

Section IV - Data Management

No Modifications

Section V - Required QA/QC Operations

1.0 Instrument Calibration

All analytes from Table 1 must be included in calibration standards.

2.0 Initial Calibration Verification (ICV) and Continuing Calibration Verification (CCV)

All analytes from Table 1 must be included.

3.0 CRDL Standards for ICP (CRI) and AA (CRA)

All analytes from Table 1 must be included.

4.0 Initial Calibration Blank (ICB), Continuing Calibration Blank (CCB), and Preparation Blank (PB) Analyses

References to Exhibit C includes the modifications to Exhibit C presented in this addendum.

5.0 ICP Interference Check Sample (ICS) Analysis

Table 2 is modified to include the following analytes in solution AB:

Analyte	(mg/L)
Yttrium	1.0
Neodymium	1.0
Ytterbium	1.0
Holmium	1.0
Lanthanum	1.0
Terbium	1.0
Erbium	1.0
Dysprosium	1.0
Cerium	1.0
Samarium	1.0
Gadolinium	1.0
Praseodymium	1.0
Europium	1.0
Thulium	1.0
Lutetium	1.0

6.0 Spike Sample Analysis (S)

Table 3 is modified to include:

	For ICP/Flame AA	
Element	Water (µg/L)	Soil (mg/Kg)
Yttrium	500	100
Neodymium	2500	500
Ytterbium	500	100
Holmium	500	100
Lanthanum	2500	500
Terbium	2500	500
Erbium	500	100
Dysprosium	500	100
Cerium	2500	500
Samarium	2500	500
Gadolinium	500	100
Praseodymium	2500	500
Europium	500	100
Thulium	500	100
Lutetium	500	100

7.0 Duplicate Sample Analysis (D)

Reference to Exhibit C includes modifications to Exhibit C presented in this addendum.

8.0 Laboratory Control Sample (LCS) Analysis

It is recommended that the 15 new lanthanide rare earth elements be included in the LCS analysis.

9.0 ICP Serial Dilutions Analysis (L)

No modifications.

10.0 Instrument Detection Limit (IDL) Determination

Reference to Exhibit C includes the modifications to Exhibit C present in this addendum.

11.0 Interelement Corrections for ICP

No modifications.

12.0 Linear Range Analysis (LRA)

No modifications.

13.0 Furnace Atomic Absorption (AA) QC Analyses

No modifications.

Section VI - Laboratory Evaluation Process

No Modifications

Exhibit F - Chain-of-Custody, Document Control, and Standard Operating Procedures

No Modifications

Exhibit G - Glossary of Terms

No Modifications

Exhibit H - Data Dictionary and Format for Data Deliverables in Computer-Readable Format

The 15 additional lanthanide elements addressed by this addendum must be included on all electronic deliverables.

MODIFICATION D

Modification to CLP Organic SOW OLM01.8
"Statement of Work for Organic Analysis,
Multi-media, Multi-concentration"

The purpose of this addendum is to outline modifications to the Contract Laboratory Program (CLP) "Statement of Work for Organic Analysis, Multi-media, Multi-concentration" which are project specific to the QAPP prepared by Roy F. Weston, Inc. for investigative activities at the Department of Energy/LANL Mound Plant, Miamisburg, Ohio.

This addendum extends the analysis to include acetonitrile, acrylonitrile, 1,2-diethylbenzene, hexane, iodomethane, 1,1,2-trichloro-1,2,2-trifluoroethane, and vinyl acetate for volatiles and 4-chloro-2-(phenylmethyl)phenol, benzoic acid, and benzyl alcohol for semivolatiles. This addendum also provides methodology to achieve the lower required detection limits in residential well water samples for pesticide/PCB analyses.

Exhibit A - Summary of Requirements

No modifications to this section.

Exhibit B - Reporting and Deliverables Requirements

Section I: Contract Reports/Deliverables Distribution

No modifications to this section.

Section II: Report Descriptions and Order of Data Deliverables

No modifications to this section.

Section III: Form Instructions

No modifications to this section.

Section IV: Data Reporting Forms:

The following compounds must be added on Form I (Data Sheets).

CAS No.	Analyte
75-05-8	Acetonitrile
107-13-1	Acrylonitrile
76-13-1	1,1,2-Trichloro-1,2,2-Trifluoroethane
74-88-4	Iodomethane
110-54-3	Hexane
135-01-3	1,2-Diethylbenzene.
108-05-4	Vinyl Acetate

CAS NO.	Semivolatiles
120-32-1	4-Chloro-2-(phenylmethyl)phenol
100-51-6	Benzyl Alcohol
65-85-0	Benzoic Acid

Form VI VOA (Initial Calibration), and Form VII VOA (Continuing Calibration) must be modified to include these additional seven VOA compounds.

Form VI SV-2 (Initial Calibration) and Form VII SV-2 (Continuing Calibration) must be modified to include these additional compounds: 4-Chloro-2-(phenylmethyl)phenol, benzyl alcohol, and benzoic acid..

Exhibit C - Target Compound List (TCL) and Contract Required Quantitation Limits(CRQL)

The following should be added to the Target Compound List (TCL) and Contract required Quantitation Limits(CRQL, Page C-2 and Page C-4):

	CAS No.	CRQL Low Water ug/L	CRQL Low Soil ug/Kg	CRQL Med Soil ug/Kg	On Col. (ng)
Volatiles					
Acetonitrile	75-05-8	100	100	6000	(300)
Acrylonitrile	107-13-1	100	100	6000	(300)
1,1,2-Trichlorotrifluoroethane	76-13-1	5	10	1200	(50)
Iodomethane	74-88-4	NA	10	1200	(50)
Hexane	110-54-3	10	10	1200	(50)
1,2-Diethylbenzene	135-01-3	5	20	1200	(50)
Vinyl Acetate	108-05-4	10	10	1200	(50)
Semivolatiles					
4-Chloro-2-(phenylmethyl)phenol	120-32-1	10	330	10000	(20)
Benzyl Alcohol	100-51-6	10	330	10000	(20)
Benzoic Acid	65-85-0	50	1600	50000	(100)

The following are required CRQLs for residential well samples for TCL semivolatile organic compounds and pesticides/PCBs:

Compound	CRQL µg/L
Semivolatiles	
Phenol	5
bis-(2-Chloroethyl)ether	5
2-Chlorophenol	5
2-Methyphenol	5
2,2'-oxybis(1-Chloropropane)	5
4-Methylphenol	5
N-Nitroso-di-n-propylamine	5
Hexachloroethane	5
Nitrobenzene	5
Isophorone	5
2-Nitrophenol	5
2,4-Dimethylphenol	5
bis-(2-Chloroethoxy)methane	5
2,4-Dichlorophenol	5
1,2,4-Trichlorobenzene	5
Napthalene	5
4-Chloraniline	5
Hexachlorobutadiene	5
4-Chloro-3-methylphenol	5
2-Methylnaphthalene	5
Hexachlorocyclopentadiene	5
2,4,6-Trichlorophenol	5
2,4,5-Trichlorophenol	5
2-Chloronapthalene	5
2-Nitroaniline	20

Compound	CRQL µg/L
Semivolatiles (continued)	
Dimethylphthalate	5
Acenaphthylene	5
2,6-Dinitrotoluene	5
3-Nitroaniline	20
Acenaphthene	5
2,4-Dinitrophenol	20
4-Nitrophenol	20
Dibenzofuran	5
2,4-Dinitrotoluene	5
Diethylphthalate	5
4-Chlorophenyl-phenylether	5
Fluorene	5
4-Nitroaniline	20
4,6-Dinitro-2-methylphenol	20
N-Nitrosodiphenylamine	5
4-Bromophenyl-phenylether	5
Hexachlorobenzene	5
Pentachlorophenol	20
Phenanthrene	5
Anthracene	5
Di-n-butylphthalate	5
Fluoranthene	5
Pyrene	5
Butylbenzylphthalate	5
3,3'-Dichlorobenzidine	5
Benzo(a)anthracene	5
Chrysene	5
bis-2-Ethyl(hexyl)phthalate	5
Di-n-octylphthalate	5
Benzo(b)fluoranthene	5
Benzo(k)fluoranthene	5
Benzo(a)pyrene	5
Indeno(1,2,3-cd)pyrene	5
Dibenzo(a,h)anthracene	5
Benzo(g,h,i)perylene	5
Benzyl Alcohol	10
Benzoic Acid	50

Compound	CRQL µg/L
Pesticides/PCBs	
alpha-BHC	0.01
beta-BHC	0.01
delta-BHC	0.01
gamma-BHC (Lindane)	0.01
Heptachlor	0.01
Aldrin	0.01
Heptachlor epoxide	0.01
Endosulfan I	0.01
Dieldrin	0.02
4,4'-DDE	0.02
Endrin	0.01
Endosulfan II	0.02
4,4'-DDD	0.02
Endosulfan sulfate	0.02
4,4'-DDT	0.02
Methoxychlor	0.10
Endrin ketone	0.02
Endrin aldehyde	0.02
alpha-Chlordane	0.01
gamma-Chlordane	0.01
Toxaphene	1.0
Aroclor-1016	0.5
Aroclor-1221	0.5
Aroclor-1232	0.5
Aroclor-1242	0.5
Aroclor-1248	0.5
Aroclor-1254	0.5
Aroclor-1260	0.5

Form III

VOA-1 Water: Add: Acrylonitrile and acetonitrile QC Limits for Recovery 70-130% and RPD 15%.

VOA-2 Soil: Add: Acrylonitrile and acetonitrile QC Limits for Recovery 60-140% and RPD 25%.

Exhibit D - Analytical Methods for Volatiles:

Section I: Introduction:

1.1 Scope and Application: No modifications to this section

1.2 Problems: This section is modified to include:

- Acetonitrile may have poor purge efficiency
- Iodomethane can be easily degraded.

Section II: Sample Preparation and Storage

No modifications to this section.

Section III: Optional Screening

No modifications to this section.

Section IV: GC/MS Analysis of Volatiles:

1. Summary of Methods: No modifications to this section.

2. Interferences: No modifications to this section.

3. Apparatus and Materials: No modifications to this section.

4. Reagents: No modifications to this section.

5. Standards:

5.1 - 5.4 The above seven additional compounds must be added to the TCL of standards for preparation of stock standard solutions, secondary dilution standards, and working standards.

5.4.5 Add: Acrylonitrile is be added to the matrix spike solution at a concentration of 250 ug/L.

5.5 Aqueous Calibration Standard Solutions

5.5.1 Prepare five aqueous initial calibration standard solutions containing all purgeable TCL and additional compounds and system monitoring compounds at 10, 20, 50, 100, 200 ug/L levels except acetonitrile and acrylonitrile which will be prepared at 50, 100, 250, 500, 1000 ug/L.

5.5.2 No modifications to this section

5.5.3 The 50 ug/L aqueous calibration standard solution for all TCL except acetonitrile and acrylonitrile which will be at 250 ug/L is the continuing calibration solution.

5.6 No modifications to this section.

6. Instrument Operating Conditions:

6.1 No modifications to this section.

6.2.1 Final hold time is changed to "Until all target compounds elute."

6.3 and 6.4 No modifications to this section.

7. Calibration:

7.1 - 7.4.5 No modifications to this section.

7.4.6 The additional compounds acetonitrile, acrylonitrile, 1,2-diethylbenzene, hexane, iodomethane, vinyl acetate, and 1,1,2-trichlorotrifluoroethane must be added to the list of compounds. The maximum %RSD of 20.5 and maximum %Difference of 25 is acceptable for all the additional compounds, except acetonitrile and acrylonitrile. Acetonitrile may have a maximum %RSD of 35 and acrylonitrile may have a maximum %RSD of 30. The maximum %Difference for acetonitrile and acrylonitrile is 30. However, these compounds must meet the minimum RRF criteria of 0.01.

These are advisory limits and final limits will be established after method validation.

7.4.7 - 7.4.8 No modifications to this section.

7.5 - 7.9 No modifications to this section.

8. Sample Analysis:

8.1.1 -8.1.15 No modifications to this section.

8.1.16 Add: The concentration of acrylonitrile, the additional matrix spike compound is 250 ug/L.

8.1.17 - 8.1.18 No modifications to this section.

8.2.1.1 - 8.2.1.7 No modifications to this section.

8.2.1.8 Add: The concentration of the additional matrix spike compound acrylonitrile would be 250 ug/kg.

8.2.1.9 - 8.2.1.10 No modifications to this section.

8.2.2.1 - 8.2.2.8 No modifications to this section.

8.2.2.9 Add: The resulting concentration of the additional matrix spike compound in the soil is 31,250 ug/kg.

9. Qualitative Analysis: No modifications to this section.

10. Quantitative Analysis: No modifications to this section.

Table 3 No modifications to this section.

Table 4 The following is added to Table 4:

Analyte	Primary Ion	Secondary Ions
Acetonitrile	41	40
Acrylonitrile	53	52, 51
1,1,2-Trichlorotrifluoroethane	101	103, 151 153
Iodomethane	142	127
Hexane	57	86, 43, 41
1,2-Diethylbenzene	119	134, 115
Vinyl Acetate	43	86

Table 5 Add: The additional compounds acetonitrile, acrylonitrile, 1,2-diethylbenzene, hexane, iodomethane, vinyl acetate and 1,1,2-trichlorotrifluoroethane must be quantitated using the nearest eluting internal standard.

Table 6 No modifications to this section.

Table 7 Add:

Compound	%Recovery Water	RPD Water	%Recovery Soil	RPD Soil
Acrylonitrile	70-130	15	60-140	25
Acetonitrile	70-130	15	60-140	25

Exhibit D - Analytical Methods for Semivolatiles (SV)

Section I: Introduction

No modifications to this section.

Section II: Sample Preparation and Storage

No modifications to this section.

Section III: Screening of SV organic Extracts

No modifications to this section.

Section IV: GC/MS Analysis of SV

1. Summary of Method: No modifications to this section.

2. Apparatus and Materials: No modifications to this section.

3. Reagents:

3.1 Internal standards - No modifications to this section.

3.2 Calibration standards - 4-Chloro-2-(phenylmethyl)phenol must be added to the calibration standards prepared at 20, 50, 80, 120 and 160 total ng per 2 μL. Benzoic acid must be added to the calibration standard prepared at 50, 80, 120, 160 total ng per 2 μL.

3.3 DFTPP solution - No modifications to this section.

4. Instrument operating Conditions: No modifications to this section.

5. Calibration:

5.1 No modifications to this section.

5.2 and Table 2 Add: 4-Chloro-2-(phenylmethyl)phenol, benzoic acid, and benzyl alcohol must be calibrated using the closest eluting internal standard.

5.3 - 5.5 No modifications to this section.

Table 4 Add:

Parameter	Primary ion	Secondary ion(s)
4-Chloro-2-(phenylmethyl)phenol	218	183, 165, 140
Benzyl Alcohol	108	79,77
Benzoic Acid	122	105,77

5.6.1 No modifications to this section.

5.6.2 Add 4-Chloro-2-(phenylmethyl)phenol,benzoic acid, and benzyl alcohol to the list of compounds. The maximum %RSD must be $\leq$ 25 and maximum % Difference $\leq$30. However, this compound must meet the minimum RRF criteria of 0.01.

These are advisory limits and final limits will be established after method validation.

5.7 - 5.13 No modifications to this section.

6. Sample Analysis: No modifications to this section.

7. Qualitative Analysis: No modifications to this section.

8. Quantitation: No modifications to this section.

9. GC/MS Confirmation of Pesticides and Aroclors: No modifications to this section.

Exhibit D - Analytical Methods for Pesticides/PCBs

Section I: Introduction

No modifications to this section.

Section II: Sample Preparation and Storage

Part A: Sample Storage and Holding Times

No modifications to this section.

Part B: Sample Preparation for Extractable Pesticides and Aroclors

1. Summary of Sample Preparation Methods

No modifications to this section.

2. Interferences

No modifications to this section.

3. Apparatus and Materials

No modifications to this section.

4. Reagents

4.1 - 4.9.3 No modifications to these sections.

4.9.4 The surrogate spiking solution shall have a final concentration of 0.02 ug/ml of each surrogate, equivalent to a 1:10 dilution of the surrogate solution presented in the method.

4.9.5 The matrix spiking solutions presented in the method must be diluted 1:10 to obtain the following final concentrations:

gamma-BHC (Lindane)	0.05 ug/ml
4,4'-DDT	0.10 ug/ml
Endrin	0.10 ug/ml
Heptachlor	0.05 ug/ml
Aldrin	0.05 ug/ml
Dieldrin	0.10 ug/ml

4.9.6 - 4.9.7 No modifications to these sections.

5. Extraction of Water Samples

No modifications to this section.

6. Extraction of Soil/Sediment Samples

No modifications to this section.

7. Extract Cleanup

7.1 Extract Cleanup by GPC

No modifications to this section.

7.2 Solvent Exchange into Hexane

7.2.3 For samples which have not been subjected to GPC cleanup, concentrate the volume of the hexane extract to 1.0 ml. For samples which have been subjected to GPC cleanup, concentrate the extract to 0.5 ml.

7.3 Florisil Cartridge Procedure

7.3.1 - 7.3.3.5 No modifications to these sections.

7.3.3.6 The entire volume of sample extract obtained from section 7.2.3 shall be transferred to the Florisil cartridge.

7.3.3.7 To ensure quantitative transfer of the extract, use two additional 1 ml portions of hexane/acetone (90:10) to rinse the vial containing the extract. Add rinsates to the cartridge.

7.3.3.8 The pesticides/Aroclors in the extract concentrates are then eluted through the column with an additional 6 ml of hexane/acetone (90:10).

7.3.3.9 No modifications to this section.

7.3.3.10 Concentrate the extract to a final volume of 1 ml.

7.4 Sulfur Removal

No modifications to this section.

Section III: GC/EC Analysis of Pesticides and Aroclors

No modifications to this section.

Exhibit E - QA/QC Requirements

I. Overview:

No modifications to this section.

II. Quality Assurance Plan:

No modifications to this section.

III. Standard Operating Procedure:

No modifications to this section.

IV. QA/QC Requirements: Volatile QA/QC requirements

1. GC/MS Mass Calibration and Ion Abundance Patterns:

No modifications to this section.

2. GC/MS Initial Calibration:

Reference to Exhibit D includes the modifications to Exhibit D presented in this addendum.

3. Continuing Calibration:

Reference to Exhibit D includes the modifications to Exhibit D presented in this addendum.

4. Internal Standards Responses and Retention Times:

No modifications to this section.

5. Method Blank Analysis:

No modifications to this section.

6. System Monitoring Compound Recoveries:

No modifications to this section.

7. Matrix Spike and Matrix Spike Duplicate Analysis:

Reference to Exhibit D includes the modifications to Exhibit D presented in this addendum.

8. Dilution of Samples, MS and MSD

No modifications to this section.

IV. QA/QC Requirements: Semivolatile QA/QC requirements

1. GC/MS Mass Calibration and Ion Abundance Patterns:

   No modifications to this section.

2. GC/MS Initial Calibration:

   Reference to Exhibit D includes the modifications to Exhibit D presented in this addendum.

3. Continuing Calibration:

   Reference to Exhibit D includes the modifications to Exhibit D presented in this addendum.

4. Internal Standards Responses and Retention Times:

   No modifications to this section.

5. Method Blank Analysis:

   No modifications to this section.

6. System Monitoring Compound Recoveries:

   No modifications to this section.

7. Matrix Spike and Matrix Spike Duplicate Analysis:

   Reference to Exhibit D includes the modifications to Exhibit D presented in this addendum.

8. Dilution of Samples, MS and MSD

   No modifications to this section.

IV. QA/QC Requirements: Pesticides/Aroclor QA/QC requirements

Reference to Exhibit D includes the modifications to Exhibit D presented in this addendum.

V Analytical Standards Requirements

No modifications to this section.

VI Contract Compliance Screening

No modifications to this section.

VII Regional Data Review

No modifications to this section.

VIII Laboratory Evaluation Samples

No modifications to this section.

IX GC/MS Tape Audits

No modifications to this section.

X Data Package Audits

No modifications to this section.

XI On Site Laboratory Evaluations

No modifications to this section.

XII Quality Assurance and Data Management

No modifications to this section.

XIII Data Management

No modifications to this section.

Exhibit F - Chain of Custody, Document Control, and Standard Operating Procedures

No modifications to this section.

Exhibit G - Glossary of Terms

No modifications to this section.

Exhibit H - Data Dictionary and Format for Data Deliverables in Computer-Readable Format

No modifications to this section.

APPENDIX C

STATEMENTS OF WORK FOR SELECTED LABORATORY ANALYSES

SOW-001 . . . . . PETN Soil Extraction and Analysis

SOW-002 . . . . . PETN Water Extraction and Analysis

SOW-003 . . . . . Soil Preparation for Common Organic, Inorganic, and Selected Radiological Analyses

SOW-004 . . . . . Tritium Cryogenic Soil Preparation

SOW-005 . . . . . Total Organic Carbon Soil Preparation

SOW-006 . . . . . Soil Preparation for Anion Analysis

Statement of Work for PETN Soil Extraction and Analysis Using EPA Method 8330

1.0 Scope and Application

This procedure describes the required modification to extract and analyze pentaerythritol tetranitrate (PETN) from soil and other solid matrices by Method 8330 (EPA1990). This procedure also describes the surrogates required for the analysis of explosives.

2.0 Summary of Method

No change.

3.0 Interferences

No change.

4.0 Apparatus and Equipment

No change.

5.0 Reagents/Supplies

5.2.19 PETN - Reagent Grade

5.2.20 4-Nitrobutene - Reagent Grade

5.4.3 Surrogate Solution

Prepare a 2000 μg/mL solution of 4-nitrotoluene and 4-nitrobutene in acetonitrile 12.5 μL of solution will be added to each sample.

6.0 Sample Collection, Preservation, and Handling

No change.

7.0 Sample Analysis Procedure

7.1 Instrument Conditions

Primary HPLC Column

Column:	LC-18
Mobile Phase:	1:1 Methanol/Water
Flow:	1.5 ml/min.
Detector:	UV 220
Injection Size:	100 μl loop

Confirmation HPLC Column

Column:	LC-CN
Mobile Phase:	1:1 Methanol/Water
Flow:	1.5 ml/min.
Detector:	UV 220
Injection Size:	100 μl loop

8.0 Quality Control

8.7 Two surrogates, 4-nitrotoluene and 4-nitrobutene, are added to each sample.

8.8 A control spike (blank spike) is required for every 20 samples extracted or each batch of samples, whichever is more frequent.

9.0 References

No change.

Statement of Work for PETN Water Extraction and Analysis Using EPA Method 8330

1.0 Scope and Application

This procedure describes the required modification to extract and analyze pentaerythritol tetranitrate (PETN) from water by EPA Method 8330, (EPA 1990). This procedure also describes the surrogates required for the analysis of explosives.

2.0 Summary of Method

No change.

3.0 Interferences

No change.

4.0 Apparatus and Equipment

No change.

5.0 Reagents/Supplies

5.2.19 PETN - Reagent Grade

5.2.20 4-Nitrobutene - Reagent Grade

5.4.3 Surrogate Spiking Solution

Prepare a 200 μg/mL solution of 4-nitrotoluene and 4-nitrobutene in acetonitrile. 50 μL of solution will be added to each sample.

6.0 Sample Collection, Preservation, and Handling

No change.

7.0 Sample Analysis Procedure

7.1 Instrument Conditions

Primary HPLC Column

Column:	LC-18
Mobile Phase:	1:1 Methanol/Water
Flow:	1.5 ml/min.
Detector:	UV 220
Injection Size:	100 μL loop

Confirmation HPLC Column

Column:	LC-CN
Mobile Phase:	1:1 Methanol/Water
Flow:	1.5 ml/min.
Detector:	UV 220
Injection Size:	100 μL loop

8.0 Quality Control

8.7 Two surrogates, 4-nitrotoluene and nitrobutene, are required in every sample.

8.8 A control spike (blank spike) is required for every 20 samples extracted or each batch of samples, whichever is more frequent.

9.0 References

No change.

Statement of Work for Soil Preparation for Common Organic, Inorganic, and Selected Radiological Analyses

1.0 Scope and Application

This procedure describes how to aliquot Mound soil and soil-like samples for laboratory preparation and analysis. This procedure applies only to samples collected for analysis under the OU9 Site-Wide QAPP. This procedure applies to soil analysis for metals, semi-volatiles, pesticide/PCBs, cyanide, anions, explosives, and radiological analyses which do not have a prescribed soil preparation procedure. This procedure should not be used for volatile organic analysis. Soils for volatile organic analysis will be prepared and homogenized as described in the method of analysis.

2.0 Summary

A representative aliquot of a sample is taken in the laboratory by either visually examining and taking a representative portion from each layer in a sample or taking a core of the sample.

3.0 Interferences

Soil samples are heterogeneous by nature. Because of this nature, target analytes are often channeled and concentrated in the soil in specific layers or locations. This heterogeneity may affect both how representative the sample is of the field location and how representative the laboratory aliquot is of the sample.

Heterogeneous nature of soils can sometimes be eliminated in laboratory aliquoting by visually inspecting the sample for layering and selecting a representative aliquot or by taking a core of the sample.

4.0 Equipment

4.1 Spatula or Scoop

4.2 Glass tray, plastic tray, or other material for containing spilled soil

4.3 Large container, i.e. 1000 mL Pyrex beaker

5.0 Reagents/Supplies

5.1 Disposable gloves

6.0 Sample Collection/Holding Time/Preservation

6.1 Sample holding times are specified in the OU9 Site-Wide QAPP, Revision 1, Table IV.4.

7.0 Procedure

7.1 Place a glass tray, plastic tray, or disposable paper beneath the sample container. The tray or paper will be used to contain any soil which accidentally falls off the bottle lip when the cap is opened or falls out while the sample is taken.

7.2 Visually examine the contents of the sample container. If obvious layering is present, then representative portions of each layer must be taken for the aliquot.

If the sample is obviously a core sample (cylindrical soil mass), then use the spatula to core from the top of the sample to the bottom of the sample. This procedure should be representative of the entire core.

If the sample cannot be easily cored, it may be necessary to transfer the sample to a large container and thoroughly and carefully mix the sample with a spatula or scoop. Mixing will not be performed on soil samples for volatile and semi-volatile analyses.

If the sample is neither layered nor a core sample, then use a spatula to core through the middle of the sample. The core should be representative of the entire sample.

7.3 Process the sample as specified in the applicable method.

8.0 Quality Control

8.1 Each analytical method has specific types of quality control samples introduced to evaluate laboratory precision and reproducibility of sample results. Typically, these quality control samples are laboratory duplicates or matrix spike duplicates. These quality control samples permit the laboratory to calculate the relative percent difference and evaluate the soil aliquoting procedure and the precision of the method.

9.0 References and Associated Standard Operating Procedures

None

Statement of Work for Tritium Cryogenic Soil Preparation

1.0 Scope and Application

This procedure is used to determine amount of tritium present in soil or soil-like sample matrices.

2.0 Summary of the Method

Tritiated water is removed from the solid matrix through vacuum distillation and the distillate (water) is collected in a cryogenic trap. The distillate can then be mixed with a scintillation cocktail fluor and counted.

3.0 Interferences

Trace quantities of organic material present in the sample may co-distill with the tritiated water causing a quenching effect in the scintillant. The quenching can bias the reported result low. This interference can be eliminated by oxidizing trace organic with hydrogen peroxide, and then neutralizing the excess peroxide with manganese dioxide.

4.0 Apparatus and Materials

4.1 Distillation glassware

4.2 Vacuum pump

4.3 Trap

4.4 Dewar Flask

4.5 Heating Mantel

4.6 Electronic Balance (accurate to $\pm$ 0.1 g)

4.7 Plastic scintillation vial

5.0 Reagents/Supplies

5.1 "Dead" water *(used for method blank)*

5.2 30% Hydrogen Peroxide

5.3 Manganese Dioxide

5.4 Liquid Nitrogen

6.0 Sample Collection/Preservation/Holding

See OU9 Site-Wide QAPP, Revision 2, Table IV.4.

7.0 Procedure

7.1 Perform a % moisture determination on the soil per CLP SOW Document No. OLM01.

7.2 A representative soil aliquot must be taken as described in SOW-003. Weigh the aliquot of soil and add the soil to the distillation apparatus. Use 50 g of wet soil or if the soil is dry (not dried) use 100 g. (The amount of soil may also be determined based on the % moisture.)

7.3 Connect up the distillation apparatus to the vacuum and the trap.

7.4 Use liquid nitrogen to cool the trap. Heat the soil.

7.5 Distill the water from the soil. The distillation temperature can be increased incrementally to 105°C until at least 5 mL of water is collected.

7.6 When the distillation is complete transfer the distillate to a tared vial and determine the weight.

7.7 Prepare the sample for liquid scintillation by EPA Method 906.0. The detection limit of 500 pCi/L can be measured using this method assuming a minimum of 5 ml of water is recovered from the sample. If less than 5 mL of water is recovered, re-distill the sample using a larger sample aliquot.

7.8 If the water is highly colored, add 1.5 mL of 30% H_20_2 and allow the distillate to react overnight. Do not tightly seal the scintillation vial.

7.9 Destroy the excess H_20_2 with 1 g of manganese dioxide.

7.10 A 5.0 mL aliquot of the distillate will be used for the analysis and the result used to back calculate the pCi/g.

8.0 Quality Control

8.1 See OU9 Site-Wide QAPP for quality control requirements.

9.0 References

RESL Analytical Chemistry Branch, Procedures Manual, IDO-12096, edited by Louis Z. Bodnar and Donald R. Percival, 1982.

Radiochemical Analytical Procedures for Analysis of Environmental Samples, EMSL-LV-0539-17, edited by F.B. Johns, P.B. Hahn, D.J. Thomas, and E.W. Bretthauer, 1979.

Result and Error Evaluation System, (REES) User's Guide, United States Testing Company.

"Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements,:L.A. Currie, NUREG/CR-4007, U.S. Nuclear Regulatory Commission, September, 1984.

"Handbook for Analytical Quality Control in Radioanalytical Laboratories," L.G. Kanipe, EPA-600/7-77-088, August 1977.

"Establishing a Quality Assurance Program for Analytical Chemistry Laboratories within the Nuclear Industry," Annual Book of ASTM Standards, Volume 12, C1009-83.

OR-7121, "Tritium by Cryogenic Distillation," IT Analytical Services, Oak Ridge, TN, 1992.

Statement of Work
Total Organic Carbon Soil Preparation

1.0 Scope and Application

This procedure describes the process of preparing a soil for Total Organic Carbon (TOC) analysis.

The percent moisture will be determined prior to preparing the sample to allow the results to be reported on a dry-weight basis.

2.0 Summary of Method

The sample is prepared by reacting inorganic carbon with phosphoric acid. This reaction causes the inorganic carbon to be driven from the sample. The treated soil is then ready for analysis in a combustion tube by EPA 415.1 or EPA 415.2.

3.0 Interferences

This preparation procedure has a minor potential to drive off some organic carbon as well as the inorganic carbon causing the reported result to be biased low.

4.0 Apparatus and Equipment

4.1 Platinum Weigh Boat

4.2 Hot plate

4.3 Electronic Balance (accurate to $\pm$ 0.0001 g)

5.0 Reagents/Supplies

5.1 Spatula

5.2 Hotplate (75° C)

5.3 Combustion tube

5.4 Phosphoric Acid, 50%

6.0 Sample Collection, Preservation, and Handling

See OU9 Site-Wide QAPP, Revision 2, Table IV.4.

7.0 Sample Preparation Procedure

7.1 Determine the percent moisture in the sample per CLP SOW Document No. OLM018.

7.2 A representative sample aliquot will be taken as described in SOW-003. Weigh 1-2 mg of sample into a platinum boat and record the weight.

7.3 Add 0.05 mL (one drop) phosphoric acid to the soil and heat the boat to 75° C on a hot plate for about 30 minutes (near dryness). This procedure drives off inorganic carbon (carbonates) from the sample. Volatile organics will also be driven off during this procedure.

7.4 Place the treated soil into a combustion tube assembly for pyrolysis. The sample can now be analyzed as normal at 800° C. (EPA method 415.1 or 415.2).

7.5 The determined TOC result must be reported on a dry weight basis, as given by:

$$\frac{\text{TOC result (mg/Kg)}}{1 - (\%\ \text{moisture}/100)} = \text{TOC result (dry weight, mg/Kg)}$$

8.0 Quality Control

8.1 See OU9 Site-Wide QAPP, most recent version

9.0 References

None.

Statement of Work for Soil Preparation for Anion Analysis

1.0 Scope and Application

This procedure is used to prepare soil samples for anion analysis. Only water soluble anions can be analyzed from soils prepared by this method.

2.0 Summary of Method

Reagent water is added to the soil sample and used to leach the anions from the soil. The water leachate is then analyzed for analyte of interest.

3.0 Interferences

None

4.0 Apparatus and Equipment

4.1 Bottle, plastic

4.2 Spatula

4.3 Electronic Balance (minimum accuracy ± 0.01)

4.4 Stir Bar

4.5 Electronic Stirrer

4.6 Ultrasonic bath

5.0 Reagents/Supplies

5.1 Water, ASTM Type II

6.0 Sample Collection, Preservation, and Handling

See OU9 Site-Wide QAPP, Revision 1, Table IV.4.

7.0 Sample Preparation Procedure

7.1 Determine the percent moisture in the sample per CLP SOW Document No. OLM018.

7.2 Take a representative soil aliquot as described in SOW-003 and weigh 20 g of soil into a 250 mL plastic bottle. (If more than 200 mL of leachate is required for the tests, then use the ratio of 1:10 (soil to water) to generate the needed amount of leachate).

7.3 Add 200 mL of water to the bottle, a magnetic stir bar, and then mix the slurry for 10 minutes.

7.4 Sonicate the water/soil mixture for 10 minutes

7.5 Filter the slurry and the filtrate is ready for analysis. Results to be reported on dry weight basis.

8.0 Quality Control

8.1 See OU9 Site-Wide QAPP, most recent version.

9.0 References

"The Determination of Inorganic Ions by Ion Chromatography," USEPA Method 300.0.

APPENDIX D

LABORATORY SYSTEMS AUDIT CHECKLIST

LABORATORY AUDIT CHECKLIST

1.0 AUDIT INFORMATION

Laboratory: _____

Address: _____

Phone No.: _____

Date Audited: _____

Auditor(s): _____

_____

Personnel Contacted:

Name	Title	Subject	Phone Number

Analyses audited: _____

_____

_____

2.0 ORGANIZATION AND PERSONNEL

Laboratory or Project Manager (individual responsible for overall technical effort):

Name: _____
Yrs. experience: _____

Laboratory Director:

Name: _____
Yrs. experience: _____

QA/QC Manager:

Name: _____
Yrs. experience: _____

Does the laboratory QA officer report to senior management levels? Yes ___ No ___

Are training/certification records available for all personnel? Yes ___ No ___

Attach the most recent laboratory organization chart.

Does the laboratory intend to subcontract any analyses to other internal or external laboratories? Yes ___ No ___

If so, complete the following:

Which analyses may be subcontracted? _____

Which laboratories may be subcontracted? _____

Who are key personnel or contacts at subcontract labs? _____

Is it understood that the primary laboratory will be responsible for ensuring that all subcontract laboratories strictly follow and adhere to the QAPP? Yes ___ No ___

Describe the coordination and flow of samples between laboratories: _____

_____

_____

_____

_____

_____

Will the primary laboratory specify QC in terms of replicates and MS/MSD? Yes ___ No ___

_____

Will the primary laboratory perform a QA review of subcontract laboratory data and quality control results? Yes ___ No ___

Will the primary or subcontract laboratory produce the final deliverables (hard copy and EDT)? _____

_____

_____

Will the primary laboratory be responsible for the content of the final deliverable? Yes ___ No ___

Comments: _____

_____

_____

_____

_____

3.0 LABORATORY DOCUMENTATION

Is a copy of the Quality Assurance Manual available for inspection? Yes ___ No ___

Do all supervisors and analysts have access to controlled copies of the Quality Assurance Manual? Yes ___ No ___

Does the laboratory participate in external audit programs? Yes ___ No ___

If so, for which analytes groups and which programs?

_____
_____
_____
_____
_____
_____
_____

Are results available for review? Yes ___ No ___

Is there an internal audit program? Yes ___ No ___

If so, for which analyte groups and at what frequency?

_____
_____
_____

What topics are covered?

_____
_____
_____
_____
_____
_____

Is a copy of the latest internal audit report available? Yes ___ No ___

What external laboratory certifications do they have?

_____
_____
_____

Are copies of standard/reagent certificates kept on file? Yes ___ No ___

Are balance certifications kept on file? Yes ___ No ___

Do they have a current copy of the QAPP? Yes ___ No ___

Are copies available to the supervisor or analyst? Yes ___ No ___

How are analysts made aware of QAPP requirements?

_____
_____
_____

Is the laboratory certified to receive radioactive materials? Yes ___ No ___

Do they possess a current NRC license? Yes ___ No ___

What activity levels can they receive?

_____
_____

Is a chemical hygiene plan on file? Yes ___ No ___

Is a waste disposal plan on file? Yes ___ No ___

4.0 SAMPLE RECEIPT AND STORAGE AREA

Is a sample custodian designated? Yes ___ No ___
Name: _____

Are written SOPs developed for receipt and storage of samples? Yes ___ No ___

Are chain of custody forms checked with samples? Yes ___ No ___

Does the laboratory handle the forms properly? Yes ___ No ___

Are the samples and/or aliquots adequately tracked through the laboratory? Yes ___ No ___

How are samples transferred from storage areas to preparation areas? VOA: _____
Semi-VOA: _____
Pest/PCB: _____
Metals: _____
Radiological: _____
Other: _____

Are shipping containers and samples screened for radioactive levels upon arrival? Yes ___ No ___

Are the sample shipping containers opened in a manner which prevents possible laboratory contamination? Yes ___ No ___

Are samples with preservatives verified? Yes ___ No ___
If so, how? _____

Are samples stored in such a way as to maintain their preservation? Yes ___ No ___

Are sample temperatures verified upon arrival? Yes ___ No ___
If so, how? _____

Are volatile samples checked for air bubbles? Yes ___ No ___
What procedures are followed if bubbles are detected? _____

How and when is the client notified of a sample discrepancy? _____

_____

Are volatile samples stored separately from solvents and sample extracts? Yes ___ No ___

Are low level samples/standards stored separately from high level samples/standards? Yes ___ No ___

Are adequate facilities provided for storage of samples, including cold storage? Yes ___ No ___

Are previously analyzed samples kept until the date the report is finalized and accepted by the client? Yes ___ No ___

Is the temperature of the cold storage recorded daily in a logbook? Yes ___ No ___

Are temperature excursions noted and are appropriate actions taken when required? Yes ___ No ___

Are the thermometers used for storage areas referenced to a NBS or ASTM certified or traceable thermometer? Yes ___ No ___

Is the sample storage area secure? Yes ___ No ___

Is access to sample storage area restricted to authorized personnel? Yes ___ No ___

Are storage blanks used and monitored? Yes ___ No ___
Describe. _____

_____

5.0 INFORMATION MANAGEMENT

Is there a computerized sample tracking system in place? Yes ___ No ___

If not, describe methodology used: _____

Is sample status readily available? Yes ___ No ___

Is there a warning system for holding time expirations? Yes ___ No ___

How are special requests handled?

Data reports: _____
Quality control: _____
Instrumentation: _____
Additional analytes: _____

How are standard requests handled? _____

Is the run analysis time verified electronically or by independent QC inspection? Yes ___ No ___

How are files tracked once archived? _____

Comments: _____

6.0 LABORATORY QUALITY ASSURANCE PROGRAM

Is there a consistent understanding of the laboratory QA protocols at all levels:

- management Yes ___ No ___
- QA officers Yes ___ No ___
- supervisors Yes ___ No ___
- staff Yes ___ No ___
- technicians Yes ___ No ___

Is there an overall internal QA audit program? Yes ___ No ___
If so, what is the frequency and topics? _____

_____

_____

How are audits documented? _____

Is there a formal staff training program? Yes ___ No ___
For what topics? _____

_____

How are new analysts certified? _____

_____

Are training programs and certifications documented? Yes ___ No ___

7.0 CRITICAL OBSERVATION CHECKLIST

7.1 Capacity

How many shifts are normally run per day? _____

Does each shift have a senior supervisor? Yes ___ No ___

Does floor, lab bench, and storage space appear adequate? Yes ___ No ___

How does the lab handle overload?

- Turn away work? Yes ___ No ___
- Extra shifts? Yes ___ No ___
- Subcontract to outside lab? Yes ___ No ___

If outside subcontractors are used, identify which and for what analyses: _____

7.2 Responsiveness

Are senior technical personnel available for same-day consultation? Yes ___ No ___

Are specific individuals assigned for client contact? Yes ___ No ___

How long before a client request is typically answered? _____

How and when is a client notified of QC excursions? _____

How are QC excursions documented to the client? _____

7.3 Data Reporting

What is the calculated average turnaround time from sample receipt to report delivery? _____

Are report reviews documented, with the reviewer's signature? Yes ___ No ___

Is a case narrative provided with report? Yes ___ No ___

What types of QC reports are available? _____

_____

Are QC excursions reported in these reports? Yes ___ No ___

Are reports reviewed for completeness, method requirements, and contract requirements and documented? Yes ___ No ___

Is the reporting group aware of the project specific reporting requirements? Yes ___ No ___

Are EDTs reviewed for completeness and is review documented? Yes ___ No ___

Are EDTs checked against hardcopy data reports? Yes ___ No ___

8.0 SUMMARY CHECKLIST

Do responses to the evaluation indicate that project and supervisory personnel are aware of QA/QC and its application to the project?	Yes ___	No ___
Do project and supervisory personnel place positive emphasis on QA/QC?	Yes ___	No ___
Does the organization place the proper emphasis on QA/QC?	Yes ___	No ___
Have responses, with respect to QA/QC aspects of the project, been open and direct?	Yes ___	No ___
Has a cooperative attitude been displayed by all project and supervisory personnel?	Yes ___	No ___
Have any QA/QC deficiencies been discussed prior to leaving?	Yes ___	No ___
Is the overall QA adequate to accomplish the project objectives?	Yes ___	No ___

Comments: _____

9.0 EXIT INTERVIEW WORKSHEET

Part I

Laboratory Facility: _____

Date: _____

Prepared by: _____

	1	2	3	Comments
1.0 Basic Capabilities				
a - Facilities	____	____	____	
b - Organization and Personnel	____	____	____	
c - Analytical Instrumentation	____	____	____	
d - Calibration Materials	____	____	____	
e - Laboratory Documentation	____	____	____	
2.0 Laboratory Operations				
a - Sample Receipt and Handling	____	____	____	
b - Sample Tracking	____	____	____	
c - Sample Preparation	____	____	____	
d - Analytical Methods	____	____	____	
e - Data Reduction and Reporting	____	____	____	
f - Data Review and Documentation	____	____	____	
3.0 Critical Observations				
a - Capacity	____	____	____	
b - Responsiveness	____	____	____	
c - Reporting	____	____	____	
d - Effectiveness of QA Program	____	____	____	

1 - Satisfactory

2 - Not satisfactory - any item rated "not satisfactory" must be listed on the attached form with a full explanation of the deficiency. All such items should be discussed with laboratory management and corrective actions agreed upon and noted. The attached form must be signed and dated by the survey team and by laboratory management. A copy should be left with the laboratory for implementation of corrective actions.

3 - Not reviewed - items listed as "not reviewed" must also be accompanied by an explanation, although corrective action may not be required.

Exit Interview Worksheet

Part II

Areas of Deficiency

Item Number	Explanation of Deficiency	Corrective Action

Signatures:

_____ Date: _____ _____ Date: _____
Auditor Lab Director

_____ Date: _____ _____ Date: _____
Auditor Lab Director

VOLATILES

Laboratory _____

Date Surveyed _____

2.0 ORGANIZATION AND PERSONNEL

Volatiles Supervisor

Name: _____
Experience: (3 years minimum) _____

Support staff

Names: _____
_____

Experience: (1 year minimum) _____

Do personnel assigned to this project have the appropriate educational background to accomplish the objectives of the program? Yes ___ No ___

Does the staff have a copy of the facility's Quality Assurance Manual (QAM)? Yes ___ No ___

Do the analytical supervisors have their groups follow the QAM? Yes ___ No ___

Is the volatiles group adequately staffed to meet project commitments in a timely manner? Yes ___ No ___

Was the volatiles supervisor available during the audit? Yes ___ No ___

If not, was the substitute during the audit familiar with this specific project? Yes ___ No ___

How is the analyst trained/certified for volatile analysis? _____
_____
_____

Comments: _____
_____
_____
_____

3.0 LABORATORY DOCUMENTATION

Standard Operating Procedures (SOPs)

Are copies of the appropriate volatile SOPs available to the analyst? Yes ___ No ___

Are there SOPs for:

CLP SOW for VOAs OLM01.8 (3/90 __)	Yes ___	No ___
SW-846 Method 8010/8020	Yes ___	No ___
SW-846 Method 8240	Yes ___	No ___
Method 502.2	Yes ___	No ___
Sample preparation	Yes ___	No ___
Data Reporting	Yes ___	No ___
Staff training	Yes ___	No ___
Analyst certification	Yes ___	No ___
Reagents, standards handling	Yes ___	No ___
Records, logs (lab documentation)	Yes ___	No ___
Preventive maintenance	Yes ___	No ___
Glassware cleaning	Yes ___	No ___
Data report review	Yes ___	No ___
Data archives	Yes ___	No ___

Do the analytical SOPs include:

Equipment and materials	Yes ___	No ___
Step by step sequence of analysis	Yes ___	No ___
Calibration procedures	Yes ___	No ___
Data reduction procedures	Yes ___	No ___
Quality control procedures	Yes ___	No ___
Acceptance criteria for quality control	Yes ___	No ___
Corrective action to QC outliers	Yes ___	No ___
Sample handling	Yes ___	No ___
Proper recording of data	Yes ___	No ___
Instrument maintenance	Yes ___	No ___

Are deviations to the laboratory SOPs documented? Yes ___ No ___
If so, how? _____

Are hardbound logbooks in use? Yes ___ No ___

Did everyone who made entries in the logbook sign and initial the first page? Yes ___ No ___

Is all information in the logbooks up-to-date? Yes ___ No ___

Are logbooks available for:

standards & reagents -	Yes ___	No ___
sample preparation and extraction -	Yes ___	No ___
analysis run logs -	Yes ___	No ___
instrument maintenance -	Yes ___	No ___

Do the analysts record bench data in a neat and accurate manner? Yes ___ No ___

Has the VOA supervisor of the analyst maintaining the notebook/bench sheet personally reviewed the documentation periodically? Yes ___ No ___

Is this review documented and how? Yes ___ No ___

_____

_____

Comments: _____

_____

_____

_____

_____

4.0 SAMPLE RECEIPT AND STORAGE

Is an internal chain of custody used to document transfer of samples to VOA? Yes ___ No ___

Are samples properly stored until analysis? Yes ___ No ___

Is there an SOP for sample storage? Yes ___ No ___

How long do VOA samples remain at room temperature prior to analysis? _____

Are samples and standards kept separately? Yes ___ No ___

Is the temperature of the refrigerator/freezer recorded daily? Yes ___ No ___

Are thermometers used for monitoring refrigerated extracts traceable to NBS or certified? Yes ___ No ___

Are temperature excursions noted and appropriate actions taken when required? Yes ___ No ___

Is a system in place to ensure proper transmittal of QAPP-specific elements (analyte list, detection limits, QC, and deliverables) to the analysts? Yes ___ No ___
Describe.

_____
_____
_____

Does the analyst verify acid preservation of samples when indicated? How is it done? Yes ___ No ___

Are VOA samples checked for air bubbles prior to analysis? Yes ___ No ___

What determines if bubbles are analytically significant?

_____
_____

What corrective action is taken if bubbles are present? How is it documented?

_____
_____

Comments: _____

5.0 GENERAL VOA FACILITIES

Give special attention to the overall appearance of organization and neatness, the proper maintenance of facilities and instrumentation, and the general adequacy of the facilities to accomplish the work.

Is the VOA laboratory maintained in a clean and organized manner? Yes ___ No ___

Does the laboratory appear to have adequate space for the analysts and instruments? Yes ___ No ___

Does the VOA laboratory appear to have the capacity to handle the project samples? Yes ___ No ___
How many samples/day are processed? _____

Are voltage control devices used on the major instrumentation? Yes ___ No ___

Are contamination-free areas provided for trace level analytical work? Yes ___ No ___

Are exhaust hoods provided to allow contamination-free work with volatile materials? Yes ___ No ___

Is the air flow in the hoods checked and recorded? At what frequency? _____ Yes ___ No ___

Are chemical waste disposal policies and procedures well defined and followed by the VOA staff? Yes ___ No ___

Who is responsible for waste disposal? _____

What type of water is used for preparation of standards, method blanks, and dilutions? _____

How is VOA reagent water prepared? _____

Can the VOA supervisor document that the water used for standards, samples, and blanks is free of contaminants? _____

Is the analytical balance located away from drafts and rapid temperature changes? Yes ___ No ___

Is the balance checked routinely with an appropriate range of weights? Yes ___ No ___
At what frequency? _____
Are the results recorded in a logbook? Yes ___ No ___

Has the balance been calibrated within one year by a certified technician? Yes ___ No ___

Are pH meters operational and maintained? Yes ___ No ___

Are solvent and reagent storage cabinets separated from the sample handling area? Yes ___ No ___

Are the solvent storage cabinets properly vented to prevent possible contamination? Yes ___ No ___

Is the SOP for glassware washing posted at each cleaning station? Yes ___ No ___

Are the SOPs for glassware cleaning adequate for the particular analysis? Yes ___ No ___

Is the VOA lab in a separate room from semivolatiles or GC lab? Yes ___ No ___

Does the VOA lab have its own ventilation or exhaust system? Yes ___ No ___

Comments: _____

6.0 STANDARDS and REAGENTS

What grade of reagent is used for preparation of standards and samples? _____

Are primary standards certified and traceable to NBS (NIST,CRADA) standards? Yes ___ No ___

List sources of standards (vendor, traceability): _____

_____

_____

Are stock standards purchased or prepared from neat compounds?

_____

How often are fresh standards prepared? [Investigate] _____

Are logbooks maintained for the preparation of all standards (calibration, internal standards, spiking solutions, surrogates)? Yes ___ No ___

Do logbooks contain sufficient information to recreate the standard? Yes ___ No ___

Are working standards properly labeled with concentration, preparation date, and identity of person preparing the standard? Yes ___ No ___

Are standards stored properly (kept in proper containers, with correct preservatives and storage temperatures? Yes ___ No ___

Are standards stored separately from samples and sample extracts? Yes ___ No ___

Can each working standard be traced to the initial primary standard? Yes ___ No ___

Are all expired material removed from active use and disposed of properly? Yes ___ No ___
How is this documented? _____

_____

Is the calibration standard material prepared in methanol for VOA? Yes ___ No ___

Are all respective manufacturer's lot numbers recorded with the preparation information? Yes ___ No ___

Are certificates of traceability available for standards? Yes ___ No ___

Do these certificates indicate who made the standards and how they were verified, or is this information available? Yes ___ No ___

Are standards verified to ensure that they were correctly made prior to use? Is this documented? Yes ___ No ___

Are analytical reagents dated upon receipt? Yes ___ No ___

Are reagent inventories maintained on a first-in, first-out basis? Yes ___ No ___

Are analytical reagents analyzed before use? Yes ___ No ___

Are standards available for additional OU9 compounds? [See section 9.0] Yes ___ No ___

Will they be injected as separate mixture or with all other volatiles? Yes ___ No ___

Comments: _____

7.0 SAMPLE PREPARATION

Are the proper sample handling methods being used? Water: Yes ___ No ___
Soil: Yes ___ No ___

Does the lab use procedures for screening VOA samples? Yes ___ No ___
If so, what procedures? _____

Does the lab use low and medium level extraction and analysis procedures? Yes ___ No ___
If not, how does the lab handle detector saturation? _____
[blanks,vessel cleaned]

Are samples prepared in a contamination-free area? Yes ___ No ___

Are there bound record logs of the sample preparations and extractions? Yes ___ No ___

Is the format of the record log consistent and with sufficient information on each sample for the preparation? Yes ___ No ___

What surrogate compounds are used for 8010/8020?
[BrClmethane,Fbz,o-ClFbz]

Where are percent moisture determinations performed?

_____

How is % moisture data conveyed to VOA group?

_____

Are oven temperatures monitored and documented? Yes ___ No ___

Are thermometers calibrated and certified? Yes ___ No ___

Are thermometer calibration records maintained? Yes ___ No ___

Comments: _____

8.0 INSTRUMENTATION

GC/MS system

Manufacturer:
Model:
Age:
Data system:
Spectra Library/revision:
What analytical method is set up?
What columns are installed?

Purge and Trap Unit

Manufacturer:
Model:
Sample capacity:
Trap:

GC/MS system

Manufacturer:
Model:
Age:
Data system:
Spectra Library/revision:
What analytical method is set up?
What columns are installed?

Purge and Trap Unit

Manufacturer:
Model:
Sample capacity:
Trap:

Gas Chromatograph system

Manufacturer:
Model:
Age:
Data system:
What analytical method is set up?
What columns are installed?
What detectors are installed?

Purge and Trap Unit

Manufacturer:
Model:
Sample capacity:
Trap:

Gas Chromatograph system

Manufacturer:
Model:
Age:
Data system:
What analytical method is set up?
What columns are installed?
What detectors are installed?

Purge and Trap Unit

Manufacturer:
Model:
Sample capacity:
Trap:

[If VOCARB trap is used, inquire about degradation of 2-chloroethylvinyl ether]

Are manufacturer's operating manuals readily available to the operator? Yes ___ No ___

Is service maintenance by contract? Yes ___ No ___
If yes, how often is it performed? _____

Are extensive in-house replacement parts available? Yes ___ No ___

Is preventive maintenance scheduled? Yes ___ No ___
[Inspect against log book]

Are logbooks maintained documenting the preventive maintenance, changes, or repairs made to the instrument? Yes ___ No ___

Is maintenance performed by an outside service vendor documented in a permanent service record maintained in a logbook? Yes ___ No ___

Does information in the maintenance log include: who performed service, date, reason for service, service performed, documentation that corrective action fixed problem, and approximate duration of instrument downtime? Yes ___ No ___

Is the instrument properly vented or are the appropriate traps in place? Yes ___ No ___

Is raw data being archived and documented properly? Yes ___ No ___
What media is used for archiving?
How long is archived data maintained?

Are in-house quality control charts maintained and available for inspection? Yes ___ No ___

Is the GC/MS system hardware tuned against FC-43 or similar compound (specify)? _____ Yes ___ No ___
At what frequency? _____

What indicators are used to determine when this needs to be done? _____

_____

How and where is tune documented? _____

_____

Is the efficiency of the trap in the purge and trap system monitored? Yes ___ No ___
How and where is this documented? _____

_____

Are there bound instrument run logs using a consistent format? Yes ___ No ___

Are instrument run logs maintained? Yes ___ No ___

Comments: _____

_____

_____

_____

9.0 METHODOLOGY

What are the analytical methods based on? (give references)

_____

_____

What are the deviations to the referenced method and how are they documented? _____

_____

_____

How are anomalies in the analysis tracked and documented to the final reports? Who is notified? _____

_____

_____

Are QC criteria (blanks, RT windows, IS, cal. cks) met before samples are analyzed? Yes ___ No ___
How are QC outliers handled? _____

_____

What is the basis for evaluating the need for reanalysis (Chromatography, internal standard, saturation, surrogate)?

_____

_____

Are autosamplers used for unattended (overnight) analysis? Yes ___ No ___

If so, what actions are taken if QC criteria (blank, IS, calibration checks are not met? _____

_____

_____

Are purge volumes the same for standards and samples? Yes ___ No ___

Are retention windows established for all compounds? Yes ___ No ___
[CLP:+/- 0.06 RRT, 502.2:+/- 0.1 min, 846: +/- 3xSD]

How often are retention times recalculated? _____

_____

Can analysts verify proper instrument performance (calibration, continuing calibration, surrogate recovery, spike recovery, blanks, as appropriate) during analysis at the time of the audit? Yes ___ No ___

Is laboratory prepared to analyzed additional OU9 compounds? Yes ___ No ___

* Additional compounds by 8010/8020 (groundwater):
  - carbon disulfide
  - trichlorotrifluoroethane
  - acetone
  - 2-butanone (MEK)
  - 4-methyl-2-pentanone (MIBK)
  - acrylonitrile
  - acetonitrile
  - vinyl acetate
  - diethylbenzene

  GC/MS or second column required for detections at same RT as additional compounds.

  Can cis/trans DCE be separated? Yes ___ No ___

* Additional compounds by CLP SOW 3/90 (soil/sed,surface water):
  - acrylonitrile
  - acetonitrile
  - diethylbenzene
  - trichlorotrifluoroethane
  - hexane
  - iodomethane

* Additional compounds by 502.2 (residential well water):
  - acrylonitrile
  - acetonitrile
  - 2-chloroethylvinylether
  - acetone
  - trichlorotrifluoroethane
  - bis(2-chloroisopropyl)ether
  - 1-chlorohexane
  - diethylbenzene

* 8030 - acrylonitrile/acetonitrile

Can QAPP-required detection limits be met? Yes ___ No ___

Comments: _____

_____

_____

_____

10.0 CALIBRATION

Are criteria for GC/MS tuning with BFB met as specified in the SOP, or are exceptions permitted under special circumstances? Yes ___ No ___
How and where is this documented? _____

What are the calibration procedures? (Method/Procedure/Frequency)
[SW846:5 pt,<20%RSD]
[502.2:5 pt,<10%RSD]
[CLP:5 pt]

What is the frequency of continuing calibration standards? [SW846:1/10, 15%D]
[502.2:1/10, 20%D]
[CLP:1/12 hr]

Is a method blank analyzed following the calibration standard? Yes ___ No ___

What is frequency of method blank analyses? _____
[CLP:1/12 hr, 502.2:1/10 samples, SW846:1/20 samples]

What is acceptance criteria? _____
[CLP:<5x CRQL common, else ≤CRQL; 502.2/SW846: ≤PQL]

Are the calibration procedures required by the method being followed by the analyst? Yes ___ No ___

Is one of the calibration standards at or near the CRDL? Yes ___ No ___

Are limits of detection determined and reported properly? Frequency? _____ Yes ___ No ___

Does the calibration range reflect those concentrations in samples and the linear range of the instrument? Yes ___ No ___

When tune, calibration standards, or blanks do not meet criteria, what corrective actions are taken and how is it documented? _____

When are confirmations performed? [CLP:pos det] _____
[502.2:pos >PQL] _____
[SW846:pos @ same RT] _____

Are LCS sample analyzed? Yes ___ No ___
Frequency? _____
[SW846:1/20, 502.2:1/20]
What is acceptance criteria? _____
_____

Is an LFB sample, containing all target compounds at the CRQL, analyzed? Yes ___ No ___
What is frequency and acceptance criteria? _____
_____

Comments: _____
_____
_____
_____

11. DATA HANDLING

Are bench sheets accurate and well organized? Yes ___ No ___

Are calculations for sample results documented in the lab SOPs? Yes ___ No ___

What percentage of results and calculations are reviewed by:
- analyst - _____
- supervisor - _____
- QA officer - _____
- data reporting - _____

Are all data and records retained for the required amount of time? Yes ___ No ___

Are QC data (e.g., MS/MSD, duplicate, surrogate) accessible for all analytical results? Yes ___ No ___

Are control charts prepared and maintained? Yes ___ No ___

Are corrective actions taken and documented when analytical results fail to meet QC criteria? Yes ___ No ___

Do supervisory personnel review the data and QC results? Yes ___ No ___

Are the instrument runs recorded in a bound log book, with date, time, analysts initials, in sequence)? Yes ___ No ___

Are data calculations for sample results documented? Yes ___ No ___

Are calibrations maintained in a log book for each instrument? Yes ___ No ___

Comments: _____

12.0 DATA REDUCTION

Is data reduction covered in the method SOP? Yes ___ No ___

What software packages are used in data reduction? _____

_____

Has the software been validated? Yes ___ No ___

Is laboratory instrument or data processing software routinely updated? Yes ___ No ___

Comments: _____

_____

_____

_____

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13.0 REPORT GENERATION

Is report generating software included in data reduction software? Yes ___ No ___

If so, for what instruments and methods? _____

For all analysis which do not include computerized data reduction/reporting, how are data verified? _____

How is data transferred to report production group? _____

Have report generating software packages been independently verified? Yes ___ No ___

How are final reports proofed against input data? _____

Are reports signed by either the analyst or QC reviewer? Yes ___ No ___

Comments: _____

14.0 QUALITY ASSURANCE

Is there an internal audit program for the VOA group? Yes ___ No ___

If so, what is the frequency? _____

What topics are covered? _____

Are corrective actions implemented and documented? Yes ___ No ___

Does the VOA lab participate in external audit programs? Yes ___ No ___
Which ones? [CLP round robin]

Are results available for review? Yes ___ No ___

Are blind PE samples used to verify the methodology and analyst ability? Yes ___ No ___

Comments: _____

SEMIVOLATILES

Laboratory _____

Date Surveyed _____

2.0 ORGANIZATION AND PERSONNEL

Semivolatiles Supervisor

Name: _____
Experience: (3 years minimum) _____

Support staff

Names: _____
_____

Experience: (1 year minimum) _____

Do personnel assigned to this project have the appropriate educational background to accomplish the objectives of the program? Yes ___ No ___

Does the staff have a copy of the facility's Quality Assurance Manual (QAM)? Yes ___ No ___

Do the analytical supervisors have their groups follow the QAM? Yes ___ No ___

Is the semivolatiles group adequately staffed to meet project commitments in a timely manner? Yes ___ No ___

Was the semivolatiles supervisor available during the audit? Yes ___ No ___

If not, was the substitute during the audit familiar with this specific project? Yes ___ No ___

How is the analyst trained/certified for semivolatile analysis? _____
_____
_____

Comments: _____
_____
_____
_____

3.0 LABORATORY DOCUMENTATION

Standard Operating Procedures (SOPs)

Are copies of the appropriate semivolatile SOPs available to the analyst? Yes ___ No ___

Are there SOPs for:

CLP SOW for semivolatiles OLM01.8 (3/90 __)	Yes ___	No ___
Sample extraction/preparation	Yes ___	No ___
Data Reporting	Yes ___	No ___
Staff training	Yes ___	No ___
Analyst certification	Yes ___	No ___
Reagents, standards handling	Yes ___	No ___
Records, logs (lab documentation)	Yes ___	No ___
Preventive maintenance	Yes ___	No ___
Glassware cleaning	Yes ___	No ___
Data report review	Yes ___	No ___
Data archival	Yes ___	No ___

Do the analytical SOPs include:

Equipment and materials	Yes ___	No ___
Step by step sequence of analysis	Yes ___	No ___
Calibration procedures	Yes ___	No ___
Data reduction procedures	Yes ___	No ___
Quality control procedures	Yes ___	No ___
Acceptance criteria for quality control	Yes ___	No ___
Corrective action to QC outliers	Yes ___	No ___
Sample handling	Yes ___	No ___
Proper recording of data	Yes ___	No ___
Instrument maintenance	Yes ___	No ___

Are deviations to the laboratory SOPs documented? Yes ___ No ___
If so, how? _____

Are hardbound logbooks in use? Yes ___ No ___

Did everyone who made entries in the logbook sign and initial the first page? Yes ___ No ___

Is all information in the logbooks up-to-date? Yes ___ No ___

Are logbooks available for:

standards & reagents -	Yes ___	No ___
sample preparation and extraction -	Yes ___	No ___
analysis run logs -	Yes ___	No ___
instrument maintenance -	Yes ___	No ___
GPC cleanup -	Yes ___	No ___

Do the analysts record bench data in a neat and accurate manner? Yes ___ No ___

Has the semivolatiles supervisor of the analyst maintaining the notebook/bench sheet personally reviewed the documentation periodically? Yes ___ No ___

Is this reviewed documented and how? Yes ___ No ___

_____

_____

Comments: _____

_____

_____

_____

_____

4.0 SAMPLE RECEIPT AND STORAGE

Is an internal chain of custody used to document transfer of samples/extracts to the semivolatiles group? Yes ___ No ___

Are samples properly stored until analysis? Yes ___ No ___

Are samples and standards kept separately? Yes ___ No ___

Is adequate storage for semivolatile extracts provided, including cold storage? Yes ___ No ___

Is the temperature of the refrigerator/freezer recorded daily? Yes ___ No ___

Are thermometers used for monitoring refrigerated extracts traceable to NBS or certified? Yes ___ No ___

Are temperature excursions noted and appropriate actions taken when required? Yes ___ No ___

Is a system in place to ensure proper transmittal of QAPP-specific elements (analyte list, detection limits, QC, and deliverables) to the analysts? Yes ___ No ___
Describe.

_____
_____
_____

Does the analyst verify acid preservation of samples when indicated? How is it done? Yes ___ No ___

Comments: _____
_____
_____
_____
_____

5.0 GENERAL SEMIVOLATILES FACILITIES

Give special attention to the overall appearance of organization and neatness, the proper maintenance of facilities and instrumentation, and the general adequacy of the facilities to accomplish the work.

Is the GC/MS semivolatile laboratory maintained in a clean and organized manner? Yes ___ No ___

Does the laboratory appear to have adequate space for the analysts and instruments? Yes ___ No ___

Does the semivolatile laboratory appear to have the capacity to handle the project samples? Yes ___ No ___

How many samples/day are processed? _____

Are voltage control devices used on the major instrumentation? Yes ___ No ___

Are contamination-free areas provided for trace level analytical work? Yes ___ No ___

Are exhaust hoods provided to allow contamination-free work with volatile materials? Yes ___ No ___

Is the air flow in the hoods checked and recorded? At what frequency? _____ Yes ___ No ___

Are chemical waste disposal policies and procedures well defined and followed by the semivolatile staff? Yes ___ No ___

Who is responsible for waste disposal? _____

What type of water is used for preparation of standards and method blanks? _____

Can the semivolatile supervisor document that the water used for standards and blanks is free of contaminants? Yes ___ No ___

Is the analytical balance located away from drafts and rapid temperature changes? Yes ___ No ___

Is the balance checked routinely with an appropriate range of weights? Yes ___ No ___
At what frequency? _____
Are the results recorded in a logbook? Yes ___ No ___

Has the balance been calibrated within one year by a certified technician? Yes ___ No ___

Are pH meters operational and maintained? Yes ___ No ___

Are solvent and reagent storage cabinets separated from the sample handling area? Yes ___ No ___

Are the solvent storage cabinets properly vented to prevent possible contamination? Yes ___ No ___

Is the SOP for glassware washing posted at each cleaning station? Yes ___ No ___

Are the SOPs for glassware cleaning adequate for the particular analysis? Yes ___ No ___

Extraction/Sample Preparation Laboratory:

Does the lab have adequate space for extraction, concentration, and sample cleanup (GPC, column chromatography)? Yes ___ No ___

Does the lab have adequate equipment (separatory funnels, sonicators, concentrators, GPC) to handle the number of project samples? Yes ___ No ___

Is there adequate ventilation and hood space to handle the number of project samples? Yes ___ No ___

Comments: _____

6.0 STANDARDS and REAGENTS

What grade of reagent is used for preparation of standards and samples? _____

Are primary standards certified and traceable to NBS (NIST) standards? Yes ___ No ___

List sources of standards (vendor, traceability): _____

_____

_____

Are stock standards purchased or prepared from neat compounds?

_____

How often are fresh standards prepared? [Investigate] _____

Are logbooks maintained for the preparation of all standards (calibration, internal standards, spiking solutions, surrogates)? Yes ___ No ___

Do logbooks contain sufficient information to recreate the standard? Yes ___ No ___

Are working standards properly labeled with concentration, preparation date, and identity of person preparing the standard? Yes ___ No ___

Are standards stored properly (kept in proper containers, with correct preservatives and storage temperatures)? Yes ___ No ___

Are standards stored separately from samples and sample extracts? Yes ___ No ___

Can each working standard be traced to the initial primary standard? Yes ___ No ___

Are all expired material removed from active use and disposed of properly? Yes ___ No ___
How is this documented? _____

_____

Are all respective manufacturer's lot numbers recorded with the preparation information? Yes ___ No ___

Are certificates of traceability available for standards? Yes ___ No ___

Do these certificates indicate who made the standards and how they were verified, or is this information available? Yes ___ No ___

Are standards verified to ensure that they were correctly made prior to use? Is this documented? Yes ___ No ___

Are analytical reagents dated upon receipt? Yes ___ No ___

Are reagent inventories maintained on a first-in, first-out basis? Yes ___ No ___

Are analytical reagents analyzed before use? Yes ___ No ___

Are standard and surrogate concentrations verified before use? Yes ___ No ___

How are they verified? _____

_____

Are standards available for additional OU9 compound (2-benzyl-4-chlorophenol)? Yes ___ No ___

Will it be added to mixture or injected separately?

_____

Comments: _____

_____

_____

_____

7.0 SAMPLE PREPARATION

Are the proper extraction/sample handling methods being used? Water: Yes ___ No ___
Soil: Yes ___ No ___

Does the lab use low and medium level extraction and analysis procedures? Yes ___ No ___
If not, how does the lab handle detector saturation? _____

_____

Are samples prepared in a contamination-free area? Yes ___ No ___

What types of extraction equipment are used for:

1) Water:
   a) Separatory funnel? [Not CLP] _____
   b) Continuous extraction? _____

2) Solids:
   a) Sonicator? _____
   b) Soxhlet? _____

What types of concentration equipment are used (K-D)? _____

_____

What cleanup procedures are used? GPC? _____

_____

Is GPC used for soil samples?[Y] Yes ___ No ___

Are GPC recovery checks performed? Yes ___ No ___

Are control charts prepared and monitored? Yes ___ No ___

What type of GPC equipment is used? _____

Are there bound record logs of the sample preparations and extractions? Yes ___ No ___

Is the format of the record log consistent and with sufficient information on each sample for the preparation? Yes ___ No ___

Is there adequate ventilation and hood space in the extraction laboratory? Yes ___ No ___

Are surrogates added per CLP requirements? Yes ___ No ___

Where are percent moisture determinations performed?

_____

How is % moisture data transferred to group?

_____

Are oven temperatures monitored and documented? Yes ___ No ___

Are thermometers calibrated and certified? Yes ___ No ___

Are thermometer calibration records maintained? Yes ___ No ___

Comments: _____

_____

_____

_____

_____

8.0 INSTRUMENTATION

GC/MS system

Manufacturer:
Model:
Age:
Data system:
Spectra Library/revision:
What analytical method is set up?
What columns are installed?

GC/MS system

Manufacturer:
Model:
Age:
Data system:
Spectra Library/revision:
What analytical method is set up?
What columns are installed?

Gas Chromatograph system

Manufacturer:
Model:
Age:
Data system:
What analytical method is set up?
What columns are installed?
What detectors are installed?

Gas Chromatograph system

Manufacturer:
Model:
Age:
Data system:
What analytical method is set up?
What columns are installed?
What detectors are installed?

Are manufacturer's operating manuals readily available to the operator? Yes ___ No ___

Is service maintenance by contract? Yes ___ No ___
If yes, how often is it performed? _____

Are extensive in-house replacement parts available? Yes ___ No ___

Is preventive maintenance scheduled? Yes ___ No ___

[Inspect against logbook]

Are logbooks maintained documenting the preventive maintenance, changes, or repairs made to the instrument? Yes ___ No ___

Is maintenance performed by an outside service vendor documented in a permanent service record maintained in a logbook? Yes ___ No ___

Does information in the maintenance log include: who performed service, service date, reason for service, service performed, documentation that corrective action fixed problem, and approximate duration of instrument downtime? Yes ___ No ___

Is the instrument properly vented or are the appropriate traps in place? Yes ___ No ___

Is raw data being archived and documented properly? Yes ___ No ___
What media is used for archiving? _____
How long is archived data maintained? _____

Are in-house quality control charts maintained and available for inspection? Yes ___ No ___

Is the GC/MS system hardware tuned against FC-43 or similar compound (specify)? _____ Yes ___ No ___
At what frequency? _____

What indicators are used to determine when this needs to be done? _____
_____

How and where is tune documented? _____
_____

Are there bound instrument run logs using a consistent format? Yes ___ No ___
Are instrument run logs maintained? Yes ___ No ___

Comments: _____

_____

_____

_____

9.0 METHODOLOGY

What are the analytical methods based on? (give references)

_____

_____

What are the deviations to the referenced method and how are they documented? _____

_____

_____

How are anomalies in the analysis tracked and documented to the final reports? Who is notified? _____

_____

_____

Are QC criteria (blanks, IS, RT windows,cal. cks) met before samples are analyzed? Yes ___ No ___

How are QC outliers handled? _____

_____

What is the basis for evaluating the need for reanalysis (Chromatography, internal standard, saturation, surrogate)?

_____

_____

Are autosamplers used for unattended (overnight) analysis? Yes ___ No ___

If so, what actions are taken if QC criteria (blanks, IS, calibration checks) are not met? _____

_____

_____

Are injection amounts the same for standards and samples? Yes ___ No ___

Are retention windows established for all compounds?[+/-0.06 RRT] Yes ___ No ___

How often are retention times recalculated? _____

_____

Can analysts verify proper instrument performance (calibration, continuing calibration, surrogate recovery, spike recovery, blanks, as appropriate) during analysis at the time of the audit? Yes ___ No ___

Is laboratory prepared for additional compound of OU9 program? [2-benzyl-4-chlorophenol] Yes ___ No ___

Comments: _____

_____

_____

_____

10.0 CALIBRATION

Are criteria for GC/MS tuning with DFTPP met as specified in the SOP, or are exceptions permitted under special circumstances? Yes ___ No ___

How and where is this documented? _____

What are the calibration procedures? (Method/Procedure/Frequency)

_____

What is the frequency of continuing calibration standards? [1/12 hr]

Is a calibration blank analyzed following the calibration standard? Yes ___ No ___

What is frequency of method blanks? _____
[1/20 samples]

What is acceptance criteria? _____
[≤5x phthalates, else ≤CRQL]

Are the calibration procedures required by the method being followed by the analyst? Yes ___ No ___

Is one of the calibration standards at or near the CRDL? Yes ___ No ___

Are limits of detection determined and reported properly? Frequency? _____ Yes ___ No ___

Does the calibration range reflect those concentrations in samples and the linear range of the instrument? Yes ___ No ___

When tune, calibration standards, or blanks do not meet criteria, what corrective actions are taken and how is it documented? _____

Comments: _____

11. DATA HANDLING

Are bench sheets accurate and well organized? Yes ___ No ___

Are calculations for sample results documented in the lab SOPs? Yes ___ No ___

What percentage of results and calculations are reviewed by:
- analyst - _____
- supervisor - _____
- QA officer - _____
- data reporting - _____

Are all data and records retained for the required amount of time? Yes ___ No ___

Are QC data (e.g., MS/MSD, duplicate, surrogate) accessible for all analytical results? Yes ___ No ___

Are control charts prepared and maintained? Yes ___ No ___

Are corrective actions taken and documented when analytical results fail to meet QC criteria? Yes ___ No ___

Do supervisory personnel review all data and QC results? Yes ___ No ___

Are the instrument runs recorded in a bound log book, with date, time, analysts initials, in sequence)? Yes ___ No ___

Are data calculations for sample results documented? Yes ___ No ___

Are calibrations maintained in a log book for each instrument? Yes ___ No ___

Comments: _____

12.0 DATA REDUCTION

Is data reduction covered in the method SOP? Yes ___ No ___

What software packages are used in data reduction? _____

_____

Has the software been validated? Yes ___ No ___

Is laboratory instrument or data processing software routinely updated? Yes ___ No ___

Comments: _____

_____

_____

_____

13.0 REPORT GENERATION

Is report generating software included in data reduction software? Yes ___ No ___

If so, for what instruments and methods? _____

_____

For all analysis which do not include computerized data reduction/reporting, how are data verified? _____

_____

_____

How is data transferred to report production group?

_____

Have report generating software packages been independently verified? Yes ___ No ___

How are final reports proofed against input data? _____

_____

Who signs the final report? _____

Analyst? Yes ___ No ___
QC reviewer? Yes ___ No ___
Group supervisor? Yes ___ No ___

Comments: _____

_____

_____

_____

14.0 QUALITY ASSURANCE

Is there an internal audit program for the semivolatile group? Yes ___ No ___

If so, what is the frequency? _____

What topics are covered? _____

Are corrective actions implemented and documented? Yes ___ No ___

Does the semivolatile lab participate in external audit programs? Yes ___ No ___
Which ones? [CLP round robin]

Are results available for review? Yes ___ No ___

Are blind PE samples used to verify the methodology and laboratory ability? Yes ___ No ___

Comments: _____

PESTICIDE/PCBs

Laboratory _____

Date Surveyed _____

2.0 ORGANIZATION AND PERSONNEL

Pesticide/PCB Supervisor

Name: _____
Experience: (3 years minimum) _____

Support staff

Names: _____
_____

Experience: (1 year minimum) _____

Do personnel assigned to this project have the appropriate educational background to accomplish the objectives of the program? Yes ___ No ___

Does the staff have a copy of the facility's Quality Assurance Manual (QAM)? Yes ___ No ___

Do the analytical supervisors have their groups follow the QAM? Yes ___ No ___

Is the pesticide/PCB group adequately staffed to meet project commitments in a timely manner? Yes ___ No ___

Was the pesticide/PCB supervisor available during the audit? Yes ___ No ___

If not, was the substitute during the audit familiar with this specific project? Yes ___ No ___

How is the analyst trained/certified for pesticide/PCB analysis? _____
_____
_____

Comments: _____
_____
_____
_____

3.0 LABORATORY DOCUMENTATION

Standard Operating Procedures (SOPs)

Are copies of the appropriate pesticide/PCB SOPs available to the analyst? Yes ___ No ___

Are there SOPs for:

CLP SOW for pesticide/PCBs	Yes ___	No ___
OLM01.8 (3/90 ___)		
SW-846 Method 8080		
Sample extraction/preparation	Yes ___	No ___
Data Reporting	Yes ___	No ___
Staff training	Yes ___	No ___
Analyst certification	Yes ___	No ___
Reagents, standards handling	Yes ___	No ___
Records, logs (lab documentation)	Yes ___	No ___
Preventive maintenance	Yes ___	No ___
Glassware cleaning	Yes ___	No ___
Data report review	Yes ___	No ___
Data archives	Yes ___	No ___

Do the analytical SOPs include:

Equipment and materials	Yes ___	No ___
Step by step sequence of analysis	Yes ___	No ___
Calibration procedures	Yes ___	No ___
Data reduction procedures	Yes ___	No ___
Quality control procedures	Yes ___	No ___
Acceptance criteria for quality control	Yes ___	No ___
Corrective action to QC outliers	Yes ___	No ___
Sample handling	Yes ___	No ___
Proper recording of data	Yes ___	No ___
Instrument maintenance	Yes ___	No ___

Are deviations to the laboratory SOPs documented? Yes ___ No ___
If so, how? _____

Are hardbound logbooks in use? Yes ___ No ___

Did everyone who made entries in the logbook sign and initial the first page? Yes ___ No ___

Is all information in the logbooks up-to-date? Yes ___ No ___

Are logbooks available for:

standards & reagents -	Yes ___	No ___
sample preparation and extraction -	Yes ___	No ___
analysis run logs -	Yes ___	No ___
instrument maintenance -	Yes ___	No ___

Do the analysts record bench data in a neat and accurate manner? Yes ___ No ___

Has the pesticide/PCB supervisor of the analyst maintaining the notebook/bench sheet personally reviewed the documentation periodically? Yes ___ No ___

Is this reviewed documented and how? Yes ___ No ___

_____

_____

Comments: _____

_____

_____

_____

_____

4.0 SAMPLE RECEIPT AND STORAGE

Is an internal chain of custody used to document transfer of samples/extracts to the pesticide/PCB group? Yes ___ No ___

Are samples properly stored until analysis? Yes ___ No ___

Are samples and standards kept separately? Yes ___ No ___

Is adequate storage for pesticide/PCB extracts provided, including cold storage? Yes ___ No ___

Is the temperature of the refrigerator/freezer recorded daily? Yes ___ No ___

Are thermometers used for monitoring refrigerated extracts traceable to NBS or certified? Yes ___ No ___

Are temperature excursions noted and appropriate actions taken when required? Yes ___ No ___

Is a system in place to ensure proper transmittal of QAPP-specified elements (analyte list, detection limits, QC, deliverables) to the analysts? Yes ___ No ___
Describe.

_____
_____
_____

Does the analyst verify acid preservation of samples when indicated? How is it done? Yes ___ No ___

Comments: _____
_____
_____
_____
_____

5.0 GENERAL PESTICIDE/PCB FACILITIES

Give special attention to the overall appearance of organization and neatness, the proper maintenance of facilities and equipment, and the general adequacy of the facilities to accomplish the work.

Is the GC pesticide/PCB laboratory maintained in a clean and organized manner? Yes ___ No ___

Does the laboratory appear to have adequate space for the analysts and instruments? Yes ___ No ___

Does the pesticide/PCB laboratory appear to have the capacity to handle the project samples? Yes ___ No ___

How many samples/day are processed? _____

Are voltage control devices used on the major instrumentation? Yes ___ No ___

Are contamination-free areas provided for trace level analytical work? Yes ___ No ___

Are exhaust hoods provided to allow contamination-free work with volatile materials? Yes ___ No ___

Is the air flow in the hoods checked and recorded? At what frequency? _____ Yes ___ No ___

Are chemical waste disposal policies and procedures well defined and followed by the pesticide/PCB staff? Yes ___ No ___

Who is responsible for waste disposal? _____

What type of water is used for preparation of standards and method blanks? _____

Can the pesticide/PCB supervisor document that the water used for standards and blanks is free of contaminants? _____

Is the analytical balance located away from drafts and rapid temperature changes? Yes ___ No ___

Is the balance checked routinely with an appropriate range of weights? Yes ___ No ___
At what frequency? _____
Are the results recorded in a logbook? Yes ___ No ___

Has the balance been calibrated within one year by a certified technician? Yes ___ No ___

Are pH meters operational and maintained? Yes ___ No ___

Are solvent and reagent storage cabinets separated from the sample handling area? Yes ___ No ___

Are the solvent storage cabinets properly vented to prevent possible contamination? Yes ___ No ___

Is the SOP for glassware washing posted at each cleaning station? Yes ___ No ___

Are the SOPs for glassware cleaning adequate for the particular analysis? Yes ___ No ___

Extraction/Sample Preparation Laboratory:

Does the lab have adequate space for extraction, concentration, and sample cleanup (GPC, column chromatography)? Yes ___ No ___

Does the lab have adequate equipment (LLEs, sonicators, concentrators, GPC) to handle the number of project samples? Yes ___ No ___

Is there adequate ventilation and hood space to handle the number of project samples? Yes ___ No ___

Comments: _____

6.0 STANDARDS and REAGENTS

What grade of reagent is used for preparation of standards and samples? _____

Are primary standards certified and traceable to NBS (NIST) standards? Yes ___ No ___

List sources of standards (vendor, traceability): _____

_____

_____

Are stock standards purchased or prepared from neat compounds?

_____

How often are fresh standards prepared? [Investigate] _____

Are logbooks maintained for the preparation of all standards (calibration, internal standards, spiking solutions, surrogates)? Yes ___ No ___

Do logbooks contain sufficient information to recreate the standard? Yes ___ No ___

Are working standards properly labeled with concentration, preparation date, and identity of person preparing the standard? Yes ___ No ___

Are standards stored properly (kept in proper containers, with correct preservatives and storage temperatures? Yes ___ No ___

Are standards stored separately from samples and sample extracts? Yes ___ No ___

Can each working standard be traced to the initial primary standard? Yes ___ No ___

Are all expired material removed from active use and disposed of properly? Yes ___ No ___

How is this documented? _____

_____

Are all respective manufacturer's lot numbers recorded with the preparation information? Yes ___ No ___

Are certificates of traceability available for standards? Yes ___ No ___

Do these certificates indicate who made the standards and how they were verified, or is this information available? Yes ___ No ___

Are standards verified to ensure that they were correctly made prior to use? Is this documented? Yes ___ No ___

Are analytical reagents dated upon receipt? Yes ___ No ___

Are reagent inventories maintained on a first-in, first-out basis? Yes ___ No ___

Are analytical reagents analyzed before use? Yes ___ No ___

Are standard and surrogate concentrations verified before use? Yes ___ No ___

How are they verified? _____

_____

Comments: _____

_____

_____

_____

7.0 SAMPLE PREPARATION

Are the proper extraction/sample handling methods being used? Water: Yes ___ No ___
Soil: Yes ___ No ___

Does the lab use low and medium level extraction and analysis procedures? Yes ___ No ___
If not, how does the lab handle detector saturation? _____

Are samples prepared in a contamination-free area? Yes ___ No ___

What types of extraction equipment are used for:

1) Water:
   a) Separatory funnel? [Not CLP] _____
   b) Continuous extraction? _____

2) Solids:
   a) Sonicator? _____
   b) Soxhlet? _____

What types of concentration equipment are used (K-D)? _____

What cleanup procedures are used? GPC? Florisil? Sulfur cleanup?

Is GPC cleanup used for soil samples? Yes ___ No ___

Are GPC recovery checks performed? Yes ___ No ___

Are control charts prepared and monitored? Yes ___ No ___

What type of GPC equipment is used? _____

What material is used for sulfur cleanup? _____

What surrogates are used? [TCMX, DCB] _____

Are there bound record logs of the sample preparations, extractions, and cleanup? Yes ___ No ___

Is the format of the record log consistent and with sufficient information on each sample for the preparation? Yes ___ No ___

Is there adequate ventilation and hood space in the extraction laboratory? Yes ___ No ___

Where are percent moisture determinations performed? _____

How is percent moisture data conveyed to analytical group? _____

Are oven temperatures monitored and documented? Yes ___ No ___

Are thermometers calibrated and certified? Yes ___ No ___

Are thermometer calibration records maintained? Yes ___ No ___

Comments: _____

8.0 INSTRUMENTATION

GC/MS system

Manufacturer:
Model:
Age:
Data system:
Spectra Library/revision:
What analytical method is set up?
What columns are installed?

GC/MS system

Manufacturer:
Model:
Age:
Data system:
Spectra Library/revision:
What analytical method is set up?
What columns are installed?

Gas Chromatograph system

[With CLP 3/90 megabore column: inquire about shifting RT problems]

Manufacturer:
Model:
Age:
Data system:
What analytical method is set up?
What columns are installed?
What detectors are installed?

Gas Chromatograph system

[With CLP 3/90 megabore column: inquire about shifting RT problems]

Manufacturer:
Model:
Age:
Data system:
What analytical method is set up?
What columns are installed?
What detectors are installed?

Gas Chromatograph system

[With CLP 3/90 megabore column: inquire about shifting RT problems]

Manufacturer:
Model:
Age:
Data system:
What analytical method is set up?
What columns are installed?
What detectors are installed?

Are manufacturer's operating manuals readily available to the operator? Yes ___ No ___

Is service maintenance by contract? Yes ___ No ___
If yes, how often is it performed? _____

Are extensive in-house replacement parts available? Yes ___ No ___

Is preventive maintenance scheduled? Yes ___ No ___
[Inspect against log book]

Are logbooks maintained documenting the preventive maintenance, changes, or repairs made to the instrument? Yes ___ No ___

Is maintenance performed by an outside service vendor documented in a permanent service record maintained in a logbook? Yes ___ No ___

Does information in the maintenance log include: who performed service, service date, reason for service, service performed, documentation that corrective action fixed problem, and approximate duration of instrument downtime? Yes ___ No ___

Is the instrument properly vented or are the appropriate traps in place? Yes ___ No ___

Is raw data being archived and documented properly? Yes ___ No ___
What media is used for archiving? _____

How long is archived data maintained? _____

Are in-house quality control charts maintained and available for inspection? Yes ___ No ___

Is the GC/MS system hardware tuned against FC-43 or similar compound (specify)? _____ Yes ___ No ___
At what frequency? _____

What indicators are used to determine when this needs to be done? _____

_____

How and where is tune documented? _____

_____

Are there bound instrument run logs using a consistent format? Yes ___ No ___
Are instrument logs maintained? Yes ___ No ___

Comments: _____

_____

_____

_____

9.0 METHODOLOGY

What are the analytical methods based on? (give references)

_____

_____

What are the deviations to the referenced method and how are they documented? _____

_____

_____

How are anomalies in the analysis tracked and documented to the final reports? Who is notified? _____

_____

_____

Are QC criteria (blanks, RT windows, cal. cks) met before samples are analyzed? Yes ___ No ___

How are QC outliers handled? _____

_____

What is the basis for evaluating the need for reanalysis (Chromatography, RT, saturation, surrogate)?

_____

_____

Are autosamplers used for unattended (overnight) analysis? Yes ___ No ___

If so, what actions are taken if QC criteria (blanks, RT, calibration checks) are not met? _____

_____

_____

Are injection amounts the same for standards and samples? Yes ___ No ___

Are retention windows established for all compounds? Yes ___ No ___

How often are retention times recalculated? _____

_____

Can analysts verify proper instrument performance (calibration, continuing calibration, surrogate recovery, spike recovery, blanks, as appropriate) during analysis at the time of the audit? Yes ___ No ___

Are LCS samples analyzed? Yes ___ No ___

What are frequency and acceptance criteria? _____

_____

Comments: _____

_____

_____

_____

10.0 CALIBRATION

Are criteria for GC/MS tuning with DFTPP met as specified in the SOP, or are exceptions permitted under special circumstances? Yes ___ No ___
How and where is this documented? _____

_____

What are the calibration procedures? (Method/Procedure/Frequency)

_____

_____

What is the frequency of continuing calibration standards? _____

What is the frequency of method blanks? _____
[1/20 samples, ≤CRQL]

What is frequency of sulfur cleanup blank? _____
[as needed, ≤CRQL]

What is frequency of instrument run blank? _____

Is a calibration blank analyzed following the calibration standard? Yes ___ No ___

Are the calibration procedures required by the method being followed by the analyst? Yes ___ No ___

Is one of the calibration standards at or near the CRDL? Yes ___ No ___

Are limits of detection determined and reported properly? Frequency? _____ Yes ___ No ___

Does the calibration range reflect those concentrations in samples and the linear range of the instrument? Yes ___ No ___

When tune, calibration standards, or blanks do not meet criteria, what corrective actions are taken and how is it documented? _____

_____

_____

When are GC/MS confirmations performed? _____

Where are GC/MS confirmations performed? _____

_____

Are strict QC procedures followed? Yes ___ No ___

Describe: _____

_____

_____

Comments: _____

_____

11. DATA HANDLING

Are bench sheets accurate and well organized? Yes ___ No ___

Are calculations for sample results documented in the lab SOPs? Yes ___ No ___

What percentage of results and calculations are reviewed by:
- analyst - _____
- supervisor - _____
- QA officer - _____
- data reporting - _____

Are all data and records retained for the required amount of time? Yes ___ No ___

Are QC data (e.g., MS/MSD, duplicate, surrogate) accessible for all analytical results? Yes ___ No ___

Are control charts prepared and maintained? Yes ___ No ___

Are corrective actions taken and documented when analytical results fail to meet QC criteria? Yes ___ No ___

Do supervisory personnel review all data and QC results? Yes ___ No ___

Are the instrument runs recorded in a bound log book, with date, time, analysts initials, in sequence)? Yes ___ No ___

Are data calculations for sample results documented? Yes ___ No ___

Are calibrations maintained in a log book for each instrument? Yes ___ No ___

Comments: _____

12.0 DATA REDUCTION

Is data reduction covered in the method SOP? Yes ___ No ___

What software packages are used in data reduction? _____

_____

Has the software been validated? Yes ___ No ___

Is laboratory instrument and data processing software routinely updated? Yes ___ No ___

Comments: _____

_____

_____

_____

13.0 REPORT GENERATION

Is report generating software included in data reduction software? Yes ___ No ___

If so, for what instruments and methods? _____

For all analysis which do not include computerized data reduction/reporting, how are data verified? _____

How is data transferred to report production group? _____

Have report generating software packages been independently verified? Yes ___ No ___

How are final reports proofed against input data? _____

Who signs the final reports? _____

Analyst? Yes ___ No ___
QC reviewer? Yes ___ No ___
Group supervisor? Yes ___ No ___

Comments: _____

14.0 QUALITY ASSURANCE

Is there an internal audit program for the pesticide/PCB group? Yes ___ No ___

If so, what is the frequency? _____

What topics are covered? _____

Are corrective actions implemented and documented? Yes ___ No ___

Does the pesticide/PCB lab participate in external audit programs? Yes ___ No ___
Which ones? [CLP round robin]

Are results available for review? Yes ___ No ___

Are blind PE samples used to verify the methodology and laboratory ability? Yes ___ No ___

Comments: _____

INORGANICS

Laboratory _____

Date Surveyed _____

2.0 ORGANIZATION AND PERSONNEL

Inorganics Supervisor

Name: _____
Experience: (3 years minimum) _____

Support staff

ICP Spectroscopist
Name: _____
Experience: _____
Flameless AA Spectroscopist
Name: _____
Experience: _____
Flame and Cold Vapor Spectroscopist
Name: _____
Experience: _____
Metals/Cyanide Preparation Specialist
Name: _____
Experience: _____

Do personnel assigned to this project have the appropriate educational background to accomplish the objectives of the program? Yes ___ No ___

Does the staff have a copy of the facility's Quality Assurance Manual (QAM)? Yes ___ No ___

Do the analytical supervisors have their groups follow the QAM? Yes ___ No ___

Is the inorganics group adequately staffed to meet project commitments in a timely manner? Yes ___ No ___

Was the inorganics supervisor available during the audit? Yes ___ No ___

If not, was the substitute during the audit familiar with this specific project? Yes ___ No ___

How is the analyst trained/certified for inorganic analysis? _____

_____

_____

Comments: _____

3.0 LABORATORY DOCUMENTATION

Standard Operating Procedures (SOPs)

Are copies of the appropriate inorganic SOPs available to the analyst? Yes ___ No ___

Are there SOPs for:

CLP SOW for inorganics	Yes ___	No ___
Sample preparation	Yes ___	No ___
Data Reporting	Yes ___	No ___
Staff training	Yes ___	No ___
Analyst certification	Yes ___	No ___
Reagents, standards handling	Yes ___	No ___
Records, logs (lab documentation)	Yes ___	No ___
Preventive maintenance	Yes ___	No ___
Glassware cleaning	Yes ___	No ___
Data report review	Yes ___	No ___
Data archives	Yes ___	No ___

Do the analytical SOPs include:

Equipment and materials	Yes ___	No ___
Step by step sequence of analysis	Yes ___	No ___
Calibration procedures	Yes ___	No ___
Data reduction procedures	Yes ___	No ___
Quality control procedures	Yes ___	No ___
Acceptance criteria for quality control	Yes ___	No ___
Corrective action to QC outliers	Yes ___	No ___
Sample handling	Yes ___	No ___
Proper recording of data	Yes ___	No ___
Instrument maintenance	Yes ___	No ___

Are deviations to the laboratory SOPs documented? Yes ___ No ___
If so, how? _____

Are hardbound logbooks in use? Yes ___ No ___

Did everyone who made entries in the logbook sign and initial the first page? Yes ___ No ___

Is all information in the logbooks up-to-date? Yes ___ No ___

Are logbooks available for:

standards & reagents -	Yes ___	No ___
sample preparation -	Yes ___	No ___
analysis run logs -	Yes ___	No ___
instrument maintenance -	Yes ___	No ___
cyanide - distillation -	Yes ___	No ___

Do the analysts record bench data in a neat and accurate manner? Yes ___ No ___

Has the inorganics supervisor of the analyst maintaining the notebook/bench sheet personally reviewed the documentation periodically? Yes ___ No ___

Is this reviewed documented and how? Yes ___ No ___

_____

_____

Comments: _____

_____

_____

_____

_____

4.0 SAMPLE RECEIPT AND STORAGE

Is an internal chain of custody used to document transfer of samples/digestates/distillates to the inorganics group? Yes ___ No ___

Are samples properly stored until analysis? Yes ___ No ___

Are samples and standards kept separately? Yes ___ No ___

Is adequate storage for inorganic extracts/digestates/distillates provided, including cold storage? Yes ___ No ___

Is the temperature of the refrigerator/freezer recorded daily? Yes ___ No ___

Are thermometers used for monitoring refrigerated extracts traceable to NBS or certified? Yes ___ No ___

Are temperature excursions noted and appropriate actions taken when required? Yes ___ No ___

Is a system in place to ensure proper transmittal of QAPP-specified elements (analyte list, detection limits, QC, deliverables) to the analysts? Yes ___ No ___
Describe.

_____
_____
_____

Does the analyst verify acid/base preservation of samples when indicated? How is it done? Yes ___ No ___

Comments: _____
_____
_____
_____
_____

5.0 GENERAL INORGANICS FACILITIES

Give special attention to the overall appearance of organization and neatness, the proper maintenance of facilities and instrumentation, and the general adequacy of the facilities to accomplish the work.

Is the inorganic laboratory maintained in a clean and organized manner? Yes ___ No ___

Does the laboratory appear to have adequate space for the analysts and instruments? Yes ___ No ___

Does the inorganic laboratory appear to have the capacity to handle the project samples? Yes ___ No ___

How many samples/day are processed? _____

Are voltage control devices used on the major instrumentation? Yes ___ No ___

Are contamination-free areas provided for trace level analytical work? Yes ___ No ___

Are exhaust hoods provided to allow work with acid fumes? Yes ___ No ___

Is the air flow in the hoods checked and recorded? At what frequency? _____ Yes ___ No ___

Are chemical waste disposal policies and procedures well defined and followed by the inorganic staff? Yes ___ No ___

Who is responsible for waste disposal? _____

What type of water is used for preparation of standards and method blanks? _____

Can the inorganic supervisor document that the water used for standards and blanks is free of contaminants? _____

Is the analytical balance located away from drafts and rapid temperature changes? Yes ___ No ___

Is the balance checked routinely with an appropriate range of weights? Yes ___ No ___
At what frequency? _____
Are the results recorded in a logbook? Yes ___ No ___

Has the balance been calibrated within one year by a certified technician? Yes ___ No ___

Are pH meters operational and maintained? Yes ___ No ___

Are acid/base storage cabinets separated from the sample handling area? Yes ___ No ___

Is the SOP for glassware washing posted at each cleaning station? Yes ___ No ___

Are the SOPs for glassware cleaning adequate for the particular analysis? Yes ___ No ___

Extraction/Sample Preparation Laboratory

Does the laboratory have adequate space for distillation, digestion, and concentration? Yes ___ No ___

Is adequate equipment available? Yes ___ No ___

Is there adequate ventilation and hood space? Yes ___ No ___

Comments: _____

6.0 STANDARDS and REAGENTS

What grade of reagent is used for preparation of standards and samples? _____

Are primary standards certified and traceable to NBS (NIST) standards? Yes ___ No ___

List sources of standards and reagents(vendor, traceability):

_____

_____

Are stock standards and reagents purchased or prepared from neat compounds? _____

_____

How often are fresh standards prepared? [Investigate] _____

Are logbooks maintained for the preparation of all standards (calibration, verification, and laboratory control standards, spiking solutions, reagents)? Yes ___ No ___

Are working standards and reagents properly labeled with concentration, preparation date, and identity of person preparing them? Yes ___ No ___

Are standards stored properly (kept in proper containers, with correct preservatives and storage temperatures? Yes ___ No ___

Are standards stored separately from samples and sample extracts? Yes ___ No ___

Do logbooks contain sufficient information to recreate all standards (MS, ICV, CCV, etc.)? Yes ___ No ___

Can each working standard be traced to the initial primary standards and reagents? Yes ___ No ___

Are all expired material removed from active use and disposed of properly? Yes ___ No ___

How is this documented? _____

_____

Are all respective manufacturer's lot numbers recorded with the preparation information? Yes ___ No ___

Are certificates of traceability available for standards? Yes ___ No ___

Do these certificates indicate who made the standards and how they were verified, or is this information available? Yes ___ No ___

Are standards verified to ensure that they were correctly made prior to use? Is this documented? Yes ___ No ___

Are analytical reagents dated upon receipt? Yes ___ No ___

Are reagent inventories maintained on a first-in, first-out basis? Yes ___ No ___

Are analytical reagents analyzed before use? [Inquire about acids] Yes ___ No ___

Are standards on-hand for additional compounds required for OU9? [Mo,Sn,Bi,Li,lanthanides] Yes ___ No ___

Comments: _____

7.0 SAMPLE PREPARATION

Are the proper digestion/distillation/sample handling methods being used? Yes ___ No ___

Are digestion/distillation procedures based on the referenced method documents? Yes ___ No ___

Are samples prepared in a contamination-free area? Yes ___ No ___

Are preparation blanks prepared and at what frequency? _____ Yes ___ No ___

Are there bound record logs of the sample preparations, distillations, digestions? Yes ___ No ___

Is the format of the record log consistent and with sufficient information on each sample for the preparation? Yes ___ No ___

Where are percent moisture determinations performed?

_____

How is % moisture information transferred to the analyst?

_____

Are oven temperatures monitored and documented? Yes ___ No ___

Are thermometers calibrated and certified? Yes ___ No ___

Are thermometer calibration records maintained? Yes ___ No ___

Comments: _____

_____

_____

_____

_____

8.0 INSTRUMENTATION

ICP System

Manufacturer:
Model:
Sequential or simultaneous:
Age:
Data system:

ICP System

Manufacturer:
Model:
Sequential or simultaneous:
Age:
Data system:

Atomic Absorption System (Flame)

Manufacturer:
Model:
Age:
Data system:

Atomic Absorption System (Furnace)

Manufacturer:
Model:
Age:
Data system:

Flameless System (Cold Vapor)

Manufacturer:
Model:
Age:
Data system:

Spectrophotometer (Cyanide)

Manufacturer:
Model:
Age:
Data system:

Are manufacturer's operating manuals readily available to the operator? Yes ___ No ___

Is service maintenance by contract? Yes ___ No ___
If yes, how often is it performed? _____

Are extensive in-house replacement parts available? Yes ___ No ___

Is preventive maintenance scheduled? Yes ___ No ___

Are logbooks maintained documenting the preventive maintenance, changes, or repairs made to the instrument? Yes ___ No ___
[Inspect against logbook]

Is maintenance performed by an outside service vendor documented in a permanent service record maintained in a logbook? Yes ___ No ___

Does information in the maintenance log include: who performed service, date, reason for service, service performed, documentation that corrective action fixed problem, and approximate duration of instrument downtime? Yes ___ No ___

Is the instrument properly vented or are the appropriate collection bottles in place? Yes ___ No ___

Is raw data being archived and documented properly? Yes ___ No ___
What media is used for archiving? _____
How long is archived data maintained? _____

Are in-house quality control charts maintained and available for inspection? Yes ___ No ___

Is the argon supply reliable? Yes ___ No ___
What purity of argon is used? _____

Are there bound instrument run logs using a consistent format? Yes ___ No ___

Are instrument run logs maintained? Yes ___ No ___

Comments: _____

9.0 METHODOLOGY

What are the analytical methods based on? (give references)

_____

_____

Is the laboratory prepared to analyzed additional compounds required for OU9? [Mo,Sn,Bi,Li,lanthanides] Yes ___ No ___

What are the deviations to the referenced method and how are they documented? _____

_____

_____

How are anomalies in the analysis tracked and documented to the final reports? Who is notified? _____

_____

_____

Are QC criteria (blanks, cal. cks) met before samples are analyzed? Yes ___ No ___
How are QC outliers handled? _____

_____

What is the basis for evaluating the need for reanalysis (Saturation, outside calibration range, failed QC)?

_____

_____

Are injection/aspiration amounts the same for standards and samples? Yes ___ No ___

Can analysts verify proper instrument performance (calibration, continuing calibration, spike recovery, blanks, as appropriate) during analysis at the time of the audit? Yes ___ No ___

Are autosamplers used for unattended (overnight) analysis? Yes ___ No ___

If so, what actions are taken if QC criteria (blanks, calibration checks) are not met? _____

_____

_____

Comments: _____

_____

_____

_____

10.0 CALIBRATION

What are the calibration procedures? (Method/Procedure/Frequency)

_____

_____

What is the frequency of continuing calibration samples?
ICV: _____
CCV: _____
CCB: _____

Is a calibration blank analyzed following the calibration standard? Yes ___ No ___

What is the frequency of initial/continuing blanks?

_____

[after every ICV, CCV; ≤CRDL]

What is frequency of preparation blanks? _____
[1/20; ≤CRDL]

Are the calibration procedures required by the method being followed by the analyst? Yes ___ No ___

Is one of the calibration standards at or near the IDL? Yes ___ No ___

Are limits of detection determined and reported properly? Frequency? _____ Yes ___ No ___

Does the calibration range reflect those concentrations in samples and the linear range of the instrument? Yes ___ No ___

When calibration standards, or blanks do not meet criteria, what corrective actions are taken and how is it documented? _____

_____

_____

How often are LCS runs made? [1/10]

What is acceptance criteria? [85-115%]

For ICP:
Are interference check samples run regularly? Yes ___ No ___
At what frequency? _____

[beg/end of 8 hr shift]

How are the following interferences compensated?
Spectral overlap? _____
Spectral background? _____

Are interference corrections made automatically by the data system? Yes ___ No ___

For AA:
Is background correction automatically done? Yes ___ No ___

What is actions are taken if sample interference levels are higher than Interference check sample levels?

_____

For Cyanide:
Is background absorbance correction done automatically? Yes ___ No ___

Comments: _____

11. DATA HANDLING

Are bench sheets accurate and well organized? Yes ___ No ___

Are calculations for sample results documented in the lab SOPs? Yes ___ No ___

What percentage of results and calculations are reviewed by:

analyst - _____
supervisor - _____
QA officer - _____
data reporting - _____

Are all data and records retained for the required amount of time? Yes ___ No ___

Are QC data (e.g., MS, LCS, standard addition, replicate) accessible for all analytical results? Yes ___ No ___

Are control charts prepared and maintained? Yes ___ No ___

Are corrective actions taken and documented when analytical results fail to meet QC criteria? Yes ___ No ___

Do supervisory personnel review the data and QC results? Yes ___ No ___

Are the instrument runs recorded in a bound log book, with date, time, analysts initials, in sequence)? Yes ___ No ___

Are data calculations for sample results documented? Yes ___ No ___

Are calibrations maintained in a log book for each instrument? Yes ___ No ___

Comments: _____

12.0 DATA REDUCTION

Is data reduction covered in the method SOP? Yes ___ No ___

What software packages are used in data reduction? _____

_____

Has the software been validated? Yes ___ No ___

Comments: _____

_____

_____

_____

13.0 REPORT GENERATION

Is report generating software included in data reduction software? Yes ___ No ___

If so, for what instruments and methods? _____

For all analysis which do not include computerized data reduction/reporting, how are data verified? _____

How is data transferred to report production group? _____

Have report generating software packages been independently verified? Yes ___ No ___

How are final reports proofed against input data? _____

Are reports signed by either the analyst or QC reviewer? Yes ___ No ___

Comments: _____

14.0 QUALITY ASSURANCE

Is there an internal audit program for the inorganic group? Yes ___ No ___

If so, what is the frequency? _____

What topics are covered? _____

Are corrective actions implemented and documented? Yes ___ No ___

Does the inorganic lab participate in external audit programs? Yes ___ No ___
Which ones? [CLP round robin]

Are results available for review? Yes ___ No ___

Are blind PE samples used to verify the methodology and analyst ability? Yes ___ No ___

Comments: _____

EXPLOSIVES

Laboratory _____

Date Surveyed _____

2.0 ORGANIZATION AND PERSONNEL

Explosives Supervisor

Name: _____
Experience: (3 years minimum) _____

Support staff

Names: _____
_____

Experience: (1 year minimum) _____

Do personnel assigned to this project have the appropriate educational background to accomplish the objectives of the program? Yes ___ No ___

Does the staff have a copy of the facility's Quality Assurance Manual (QAM)? Yes ___ No ___

Do the analytical supervisors have their groups follow the QAM? Yes ___ No ___

Is the explosives group adequately staffed to meet project commitments in a timely manner? Yes ___ No ___

Was the explosives supervisor available during the audit? Yes ___ No ___

If not, was the substitute during the audit familiar with this specific project? Yes ___ No ___

How is the analyst trained/certified for explosives analysis? _____
_____
_____

Comments: _____
_____
_____
_____

3.0 LABORATORY DOCUMENTATION

Standard Operating Procedures (SOPs)

Are copies of the appropriate explosive SOPs available to the analyst? Yes ___ No ___

Are there SOPs for:

Explosives in soil (USATHAMA __ EPA __)	Yes ___	No ___
Explosives in water (USATHAMA __ EPA __)	Yes ___	No ___
Sample preparation	Yes ___	No ___
Data Reporting	Yes ___	No ___
Staff training	Yes ___	No ___
Analyst certification	Yes ___	No ___
Reagents, standards handling	Yes ___	No ___
Records, logs (lab documentation)	Yes ___	No ___
Preventive maintenance	Yes ___	No ___
Glassware cleaning	Yes ___	No ___
Data report review	Yes ___	No ___
Data archives	Yes ___	No ___

Do the analytical SOPs include:

Equipment and materials	Yes ___	No ___
Step by step sequence of analysis	Yes ___	No ___
Calibration procedures	Yes ___	No ___
Data reduction procedures	Yes ___	No ___
Quality control procedures	Yes ___	No ___
Acceptance criteria for quality control	Yes ___	No ___
Corrective action to QC outliers	Yes ___	No ___
Sample handling	Yes ___	No ___
Proper recording of data	Yes ___	No ___
Instrument maintenance	Yes ___	No ___

Are deviations to the laboratory SOPs documented? Yes ___ No ___
If so, how? _____

Are hardbound logbooks in use? Yes ___ No ___

Did everyone who made entries in the logbook sign and initial the first page? Yes ___ No ___

Is all information in the logbooks up-to-date? Yes ___ No ___

Are logbooks available for:

standards & reagents -	Yes ___	No ___
sample preparation and extraction -	Yes ___	No ___
analysis run logs -	Yes ___	No ___
instrument maintenance -	Yes ___	No ___

Do the analysts record bench data in a neat and accurate manner? Yes ___ No ___

Has the explosives supervisor of the analyst maintaining the notebook/bench sheet personally reviewed the documentation periodically? Yes ___ No ___

Is this reviewed documented and how? Yes ___ No ___

_____

_____

Comments: _____

_____

_____

_____

_____

4.0 SAMPLE RECEIPT AND STORAGE

Is an internal chain of custody used to document transfer of samples to explosives? Yes ___ No ___

Are samples properly stored until analysis? Yes ___ No ___

Are samples and standards kept separately? Yes ___ No ___

Is a system in place to ensure proper transmittal of QAPP-specific elements (analyte list, detection limits, QC, and deliverables) to the analysts? Yes ___ No ___
Describe.

_____
_____
_____

Comments: _____
_____
_____
_____
_____

5.0 GENERAL EXPLOSIVES FACILITIES

Give special attention to the overall appearance of organization and neatness, the proper maintenance of facilities and instrumentation, and the general adequacy of the facilities to accomplish the work.

Is the explosives laboratory maintained in a clean and organized manner? Yes ___ No ___

Does the laboratory appear to have adequate space for the analysts and instruments? Yes ___ No ___

Does the explosives laboratory appear to have the capacity to handle the project samples? Yes ___ No ___
How many samples/day are processed? _____

Are voltage control devices used on the major instrumentation? Yes ___ No ___

Are contamination-free areas provided for trace level analytical work? Yes ___ No ___

Are exhaust hoods provided to allow contamination-free work with volatile materials? Yes ___ No ___

Is the air flow in the hoods checked and recorded? At what frequency? _____ Yes ___ No ___

Are chemical waste disposal policies and procedures well defined and followed by the explosives staff? Yes ___ No ___

Who is responsible for waste disposal? _____

What type of water is used for preparation of standards, method blanks, and dilutions? _____

Can the explosives supervisor document that the water used for standards, samples, and blanks is free of contaminants? _____

Is the analytical balance located away from drafts and rapid temperature changes? Yes ___ No ___

Is the balance checked routinely with an appropriate range of weights? Yes ___ No ___

At what frequency? _____

Are the results recorded in a logbook? Yes ___ No ___

Has the balance been calibrated within one year by a certified technician? Yes ___ No ___

Are pH meters operational and maintained? Yes ___ No ___

Are solvent and reagent storage cabinets separated from the sample handling area? Yes ___ No ___

Are the solvent storage cabinets properly vented to prevent possible contamination? Yes ___ No ___

Is the SOP for glassware washing posted at each cleaning station? Yes ___ No ___

Are the SOPs for glassware cleaning adequate for the particular analysis? Yes ___ No ___

Comments: _____

6.0 STANDARDS and REAGENTS

What grade of reagent is used for preparation of standards and samples? _____

Are primary standards certified and traceable to NBS (NIST) standards? Yes ___ No ___

List sources of standards (vendor, traceability): _____

_____

_____

Are stock standards purchased or prepared from neat compounds?

_____

How often are fresh standards prepared? _____

Are logbooks maintained for the preparation of all standards (calibration, internal standards, spiking solutions, surrogates)? Yes ___ No ___

Do logbooks contain sufficient information to recreate the standard? Yes ___ No ___

Are working standards properly labeled with concentration, preparation date, and identity of person preparing the standard? Yes ___ No ___

Are standards stored properly (kept in proper containers, with correct preservatives and storage temperatures? Yes ___ No ___

Are standards stored separately from samples and sample extracts? Yes ___ No ___

Can each working standard be traced to the initial primary standard? Yes ___ No ___

Are all expired material removed from active use and disposed of properly? Yes ___ No ___

How is this documented? _____

_____

Are all respective manufacturer's lot numbers recorded with the preparation information? Yes ___ No ___

Are certificates of traceability available for standards? Yes ___ No ___

Do these certificates indicate who made the standards and how they were verified, or is this information available? Yes ___ No ___

Are standards verified to ensure that they were correctly made prior to use? Is this documented? Yes ___ No ___

Are analytical reagents dated upon receipt? Yes ___ No ___

Are reagent inventories maintained on a first-in, first-out basis? Yes ___ No ___

Are analytical reagents analyzed before use? Yes ___ No ___

Comments: _____

7.0 SAMPLE PREPARATION

Are the proper sample handling methods being used? Water: Yes ___ No ___
Soil: Yes ___ No ___

Does the lab use procedures for screening samples? Yes ___ No ___
If so, what procedures? _____

Does the lab use low and medium level extraction and analysis procedures? Yes ___ No ___
If not, how does the lab handle detector saturation? _____

Are samples prepared in a contamination-free area? Yes ___ No ___

Are surrogates added to samples? Yes ___ No ___

What surrogates are used? _____

Are there bound record logs of the sample preparations and extractions? Yes ___ No ___

Is the format of the record log consistent and with sufficient information on each sample for the preparation? Yes ___ No ___

Where are percent moisture determinations made for soil/sediment samples? _____

How is data transferred to analysis group? _____

Are oven temperatures monitored and documented? Yes ___ No ___

Are thermometers calibrated and certified? Yes ___ No ___

Are thermometer calibration records maintained? Yes ___ No ___

Comments: _____

8.0 INSTRUMENTATION

Liquid Chromatograph system

Manufacturer:
Model:
Age:
Data system:
What analytical method is set up?
What columns are installed?
What detectors are installed?

Liquid Chromatograph system

Manufacturer:
Model:
Age:
Data system:
What analytical method is set up?
What columns are installed?
What detectors are installed?

Are manufacturer's operating manuals readily available to the operator? Yes ___ No ___

Is service maintenance by contract? Yes ___ No ___
If yes, how often is it performed? _____

Are extensive in-house replacement parts available? Yes ___ No ___

Is preventive maintenance scheduled? Yes ___ No ___

Are logbooks maintained documenting the preventive maintenance, changes, or repairs made to the instrument? Yes ___ No ___

Is maintenance performed by an outside service vendor documented in a permanent service record maintained in a logbook? Yes ___ No ___

Does information in the maintenance log include: who performed service, date, reason for service, service performed, documentation that corrective action fixed problem, and approximate duration of instrument downtime? Yes ___ No ___

Is the instrument properly vented or are the appropriate traps in place? Yes ___ No ___

Is raw data being archived and documented properly? Yes ___ No ___
What media is used for archiving?
How long is archived data maintained?

Are in-house quality control charts maintained and available for inspection? Yes ___ No ___

Are there bound instrument run logs using a consistent format? Yes ___ No ___

Are instrument log maintained? Yes ___ No ___

Comments: _____

9.0 METHODOLOGY

[HMX,RDX,NB,13DNB,135TNB,24DNT,26DNT,TNT,2A46DNT,Tetryl,PETN]

What are the analytical methods based on? (give references)

_____

_____

Can all eleven required analytes be detected? Yes ___ No ___
Can detection limits be met? Yes ___ No ___

What are the deviations to the referenced method and how are they documented? _____

_____

_____

How are anomalies in the analysis tracked and documented to the final reports? Who is notified? _____

_____

_____

Are QC criteria met before samples are analyzed? Yes ___ No ___
How are QC outliers handled? _____

_____

What is the basis for evaluating the need for reanalysis (Chromatography, internal standard, saturation, surrogate)?

_____

_____

Are autosamplers used for unattended (overnight) analysis? Yes ___ No ___

If so, what actions are taken if QC criteria (blanks, calibration checks) are not met? _____

_____

_____

Are injection volumes the same for standards and samples? Yes ___ No ___

Are retention windows established for all compounds? [col,cmpd specific] Yes ___ No ___

How often are retention times recalculated? _____

_____

Can analysts verify proper instrument performance (calibration, continuing calibration, surrogate recovery, spike recovery, blanks, as appropriate) during analysis at the time of the audit? Yes ___ No ___

Comments: _____

10.0 CALIBRATION

What are the calibration procedures? (Method/Procedure/Frequency)
[5 pt, </=15% RSD] _____

_____

What is the frequency of continuing calibration standards? _____
[Prior to & 1/10; +/-25% pk. ht. of intial 10x TRL]

Is a method blank analyzed following the calibration standard? Yes ___ No ___

Are the calibration procedures required by the method being followed by the analyst? Yes ___ No ___

Is one of the calibration standards at or near the CRDL? Yes ___ No ___

Are limits of detection determined and reported properly? Frequency? _____ Yes ___ No ___

Does the calibration range reflect those concentrations in samples and the linear range of the instrument? Yes ___ No ___

When calibration standards or blanks do not meet criteria, what corrective actions are taken and how is it documented? _____

_____

_____

What is frequency of method blank? _____
[1/20]
What is acceptance criteria? [<PQL]

Comments: _____

_____

_____

_____

11. DATA HANDLING

Are bench sheets accurate and well organized? Yes ___ No ___

Are calculations for sample results documented in the lab SOPs? Yes ___ No ___

What percentage of results and calculations are reviewed by:
- analyst - _____
- supervisor - _____
- QA officer - _____
- data reporting - _____

Are all data and records retained for the required amount of time? Yes ___ No ___

Are QC data (e.g., MS/MSD, duplicate, surrogate) accessible for all analytical results? Yes ___ No ___

Are control charts prepared and maintained? Yes ___ No ___

Are corrective actions taken and documented when analytical results fail to meet QC criteria? Yes ___ No ___

Do supervisory personnel review the data and QC results? Yes ___ No ___

Are the instrument runs recorded in a bound log book, with date, time, analysts initials, in sequence)? Yes ___ No ___

Are data calculations for sample results documented? Yes ___ No ___

Are calibrations maintained in a log book for each instrument? Yes ___ No ___

Comments: _____

12.0 DATA REDUCTION

Is data reduction covered in the method SOP? Yes ___ No ___

What software packages are used in data reduction? _____

_____

Has the software been validated? Yes ___ No ___

Comments: _____

_____

_____

_____

13.0 REPORT GENERATION

Is report generating software included in data reduction software? Yes ___ No ___

If so, for what instruments and methods? _____

_____

For all analysis which do not include computerized data reduction/reporting, how are data verified? _____

_____

_____

How is data transferred to reporting group? _____

_____

Have report generating software packages been independently verified? Yes ___ No ___

How are final reports proofed against input data? _____

_____

Are reports signed by either the analyst or QC reviewer? Yes ___ No ___

Can EDTs be generated in accordance with QAPP requirements?

_____

Comments: _____

_____

_____

_____

14.0 QUALITY ASSURANCE

Is there an internal audit program for the explosives group? Yes ___ No ___

If so, what is the frequency? _____

What topics are covered? _____

Are corrective actions implemented and documented? Yes ___ No ___

Does the explosives lab participate in external audit programs? Yes ___ No ___
Which ones? _____

Are results available for review? Yes ___ No ___

Is laboratory approved by Army Corps of Engineers? Yes ___ No ___

Are blind PE samples used to verify the methodology and analyst ability? Yes ___ No ___

Comments: _____

MISCELLANEOUS

Laboratory _____

Date Surveyed _____

This survey checklist applies to the following analyses:

Anions (Cl, SO_4, F, NO_3/NO_2)
Total Organic Carbon (TOC)
Total Suspended Solids (TSS)
Total Dissolved Solids (TDS)
Nutrients (N,P)
Ammonia

Circle the appropriate analysis at the top of each page.

Anions/TOC/TSS/TDS/Nutrients/Ammonia

2.0 ORGANIZATION AND PERSONNEL

Group Supervisor

Name: _____
Experience: (3 years minimum) _____

Support staff

Name: _____
Experience: _____

Name: _____
Experience: _____

Do personnel assigned to this project have the appropriate educational background to accomplish the objectives of the program? Yes ___ No ___

Does the staff have a copy of the facility's Quality Assurance Manual (QAM)? Yes ___ No ___

Do the analytical supervisors have their groups follow the QAM? Yes ___ No ___

Is the group adequately staffed to meet project commitments in a timely manner? Yes ___ No ___

Was the supervisor available during the audit? Yes ___ No ___

If not, was the substitute during the audit familiar with this specific project? Yes ___ No ___

How is the analyst trained/certified for these analysis? _____

Comments: _____

Anions/TOC/TSS/TDS/Nutrients/Ammonia

3.0 LABORATORY DOCUMENTATION

Standard Operating Procedures (SOPs)

Are copies of the appropriate SOPs available to the analyst? Yes ___ No ___

Are there SOPs for:

Analytical Methods	Yes ___	No ___
Sample preparation	Yes ___	No ___
Data Reporting	Yes ___	No ___
Staff training	Yes ___	No ___
Analyst certification	Yes ___	No ___
Reagents, standards handling	Yes ___	No ___
Records, logs (lab documentation)	Yes ___	No ___
Preventive maintenance	Yes ___	No ___
Glassware cleaning	Yes ___	No ___
Data report review	Yes ___	No ___
Data archives	Yes ___	No ___

Do the analytical SOPs include:

Equipment and materials	Yes ___	No ___
Step by step sequence of analysis	Yes ___	No ___
Calibration procedures	Yes ___	No ___
Data reduction procedures	Yes ___	No ___
Quality control procedures	Yes ___	No ___
Acceptance criteria for quality control	Yes ___	No ___
Corrective action to QC outliers	Yes ___	No ___
Sample handling	Yes ___	No ___
Proper recording of data	Yes ___	No ___
Instrument maintenance	Yes ___	No ___

Are deviations to the laboratory SOPs documented? Yes ___ No ___
If so, how? _____

Are hardbound logbooks in use? Yes ___ No ___

Did everyone who made entries in the logbook sign and initial the first page? Yes ___ No ___

Is all information in the logbooks up-to-date? Yes ___ No ___

Are logbooks available for:

standards & reagents -	Yes ___	No ___
sample preparation and extraction -	Yes ___	No ___
analysis run logs -	Yes ___	No ___
instrument maintenance -	Yes ___	No ___

Do the analysts record bench data in a neat and accurate manner? Yes ___ No ___

Has the group supervisor of the analyst maintaining the notebook/bench sheet personally reviewed the documentation periodically? Yes ___ No ___

Is this reviewed documented and how? Yes ___ No ___

_____

_____

Comments: _____

_____

_____

_____

_____

Anions/TOC/TSS/TDS/Nutrients/Ammonia

4.0 SAMPLE RECEIPT AND STORAGE

Is an internal chain of custody used to document transfer of samples/extracts to the analytical group? Yes ___ No ___

Are samples properly stored until analysis? Yes ___ No ___

Are samples and standards kept separately? Yes ___ No ___

Is adequate storage for extracts provided, including cold storage? Yes ___ No ___

Is the temperature of the refrigerator/freezer recorded daily? Yes ___ No ___

Are thermometers used for monitoring refrigerated extracts traceable to NBS or certified? Yes ___ No ___

Are temperature excursions noted and appropriate actions taken when required? Yes ___ No ___

Is a system in place to ensure proper transmittal of QAPP-specific elements (analyte list, detection limits, QC, deliverables) to the analysts? Yes ___ No ___
Describe.

_____
_____
_____

Does the analyst verify acid/base preservation of samples when indicated? How is it done? Yes ___ No ___

Comments: _____
_____
_____
_____
_____

Anions/TOC/TSS/TDS/Nutrients/Ammonia

5.0 GENERAL WET CHEMISTRY FACILITIES

Give special attention to the overall appearance of organization and neatness, the proper maintenance of facilities and instrumentation, and the general adequacy of the facilities to accomplish the work.

Is the laboratory maintained in a clean and organized manner? Yes ___ No ___

Does the laboratory appear to have adequate space for the analysts and instruments? Yes ___ No ___

Does the laboratory appear to have the capacity to handle the project samples? Yes ___ No ___

How many samples/day are processed? _____

Are voltage control devices used on the major instrumentation? Yes ___ No ___

Are contamination-free areas provided for trace level analytical work? Yes ___ No ___

Are exhaust hoods provided to allow work with acid fumes and volatile solvents? Yes ___ No ___

Is the air flow in the hoods checked and recorded? At what frequency? _____ Yes ___ No ___

Are chemical waste disposal policies and procedures well defined and followed by the staff? Yes ___ No ___

Who is responsible for waste disposal? _____

What type of water is used for preparation of standards and method blanks? _____

Can the supervisor document that the water used for standards and blanks is free of contaminants? _____

Is the analytical balance located away from drafts and rapid temperature changes? Yes ___ No ___

Is the balance checked routinely with an appropriate range of weights? Yes ___ No ___
At what frequency? _____
Are the results recorded in a logbook? Yes ___ No ___

Has the balance been calibrated within one year by a certified technician? Yes ___ No ___

Are pH meters operational and maintained? Yes ___ No ___

Are acid/base storage cabinets separated from the sample handling area? Yes ___ No ___

Is the SOP for glassware washing posted at each cleaning station? Yes ___ No ___

Are the SOPs for glassware cleaning adequate for the particular analysis? Yes ___ No ___

Comments: _____

Anions/TOC/TSS/TDS/Nutrients/Ammonia

6.0 STANDARDS and REAGENTS

What grade of reagent is used for preparation of standards and samples? _____

Are primary standards certified and traceable to NBS (NIST) standards? Yes ___ No ___

List sources of standards and reagents(vendor, traceability):

_____

_____

Are stock standards and reagents purchased or prepared from neat compounds? _____

_____

How often are fresh standards prepared? _____

Are logbooks maintained for the preparation of all standards (calibration, verification, and laboratory control standards, spiking solutions, reagents)? Yes ___ No ___

Do logbooks contain sufficient information to recreate the standard? Yes ___ No ___

Are working standards and reagents properly labeled with concentration, preparation date, and identity of person preparing them? Yes ___ No ___

Are standards stored properly (kept in proper containers, with correct preservatives and storage temperatures? Yes ___ No ___

Are standards stored separately from samples and sample extracts? Yes ___ No ___

Can each working standard be traced to the initial primary standards and reagents? Yes ___ No ___

Are all expired material removed from active use and disposed of properly? Yes ___ No ___
How is this documented? _____

Are all respective manufacturer's lot numbers recorded with the preparation information? Yes ___ No ___

Are certificates of traceability available for standards? Yes ___ No ___

Do these certificates indicate who made the standards and how they were verified, or is this information available? Yes ___ No ___

Are standards verified to ensure that they were correctly made prior to use? Yes ___ No ___
Is this documented?

Are analytical reagents dated upon receipt? Yes ___ No ___

Are reagent inventories maintained on a first-in, first-out basis? Yes ___ No ___

Are analytical reagents analyzed before use? Yes ___ No ___

Comments: _____

Anions/TOC/TSS/TDS/Nutrients/Ammonia

7.0 SAMPLE PREPARATION

Are the proper sample handling methods being used? Water: Yes ___ No ___
Soil: Yes ___ No ___

Are preparation procedures based on the referenced method documents? Yes ___ No ___

Are samples prepared in a contamination-free area? Yes ___ No ___

Are preparation blanks prepared and at what frequency? _____ Yes ___ No ___

Are there bound record logs of the sample preparations and extractions? Yes ___ No ___

Is the format of the record log consistent and with sufficient information on each sample for the preparation? Yes ___ No ___

Where are percent moisture determinations made on soil/sediment samples? _____

Comments: _____

Anions/TOC/TSS/TDS/Nutrients/Ammonia

8.0 INSTRUMENTATION

TOC Analyzer

Manufacturer:
Model:
Age:
Data system:

Anion System

Manufacturer:
Model:
Age:
Data system:
Which anions are measured?

Other (specify)

Manufacturer:
Model:
Age:
Data system:
For which analytes:

Are manufacturer's operating manuals readily available to the operator? Yes ___ No ___

Is service maintenance by contract? Yes ___ No ___
If yes, how often is it performed? _____

Are extensive in-house replacement parts available? Yes ___ No ___

Is preventive maintenance scheduled? Yes ___ No ___

Are logbooks maintained documenting the preventive maintenance, changes, or repairs made to the instrument? Yes ___ No ___

Is maintenance performed by an outside service vendor documented in a permanent service record maintained in a logbook? Yes ___ No ___

Does information in the maintenance log include: who performed service, date, reason for service, service performed, documentation that corrective action fixed problem, and approximate duration of instrument downtime? Yes ___ No ___

Is the instrument properly vented or are the appropriate collection bottles in place? Yes ___ No ___

Is raw data being archived and documented properly? Yes ___ No ___
What media is used for archiving? _____
How long is archived data maintained? _____

Are in-house quality control charts maintained and available for inspection? Yes ___ No ___

Are there bound instrument run logs using a consistent format? Yes ___ No ___

Are instrument logs maintained? Yes ___ No ___

Comments: _____

Anions/TOC/TSS/TDS/Nutrients/Ammonia

9.0 METHODOLOGY

What are the analytical methods based on? (give references)

_____

_____

What are the deviations to the referenced method and how are they documented? _____

_____

_____

How are anomalies in the analysis tracked and documented to the final reports? Who is notified? _____

_____

_____

Are QC criteria met before samples are analyzed? Yes ___ No ___
How are QC outliers handled? _____

_____

What is the basis for evaluating the need for reanalysis (Saturation, outside calibration range, failed QC)?

_____

_____

Are injection amounts the same for standards and samples? Yes ___ No ___

Can analysts verify proper instrument performance (calibration, continuing calibration, spike recovery, blanks, as appropriate) during analysis at the time of the audit? Yes ___ No ___

What is frequency of replicate samples? _____
[TOC:4 analyses/sample]
[TSS/TDS:1/20]

What is acceptance criteria? _____
[TOC:</=20% RPD]
[TSS/TDS:</=20% RPD]

Comments: _____

_____

_____

_____

Anions/TOC/TSS/TDS/Nutrients/Ammonia

10.0 CALIBRATION

What are the calibration procedures? (Method/Procedure/Frequency)
[TOC:dup reading w/in 25%]
[Anions/nutrients/NH3: 3 pt + blank, >0.995]

What is the frequency of continuing calibration checks?
TOC: [1/20, +/-15%]
Anions/nutrients/NH3: [1/20, +/-15%]

Is a calibration blank analyzed following the calibration standard? Yes ___ No ___

Are the calibration procedures required by the method being followed by the analyst? Yes ___ No ___

Is one of the calibration standards at or near the IDL? Yes ___ No ___

Are limits of detection determined and reported properly? Frequency? _____ Yes ___ No ___

Does the calibration range reflect those concentrations in samples and the linear range of the instrument? Yes ___ No ___

When calibration standards, or blanks do not meet criteria, what corrective actions are taken and how is it documented? _____

Are LCS samples analyzed? Yes ___ No ___
At what frequency? [Anions,nutrients/NH3: 1/cal

What is acceptance criteria? [vendor spec]

What is frequency of method blanks? _____
[All: 1/20]
What is acceptance criteria? _____
[All: <PQL]

Comments: _____

_____

_____

_____

Anions/TOC/TSS/TDS/Nutrients/Ammonia

11. DATA HANDLING

Are bench sheets accurate and well organized? Yes ___ No ___

Are calculations for sample results documented in the lab SOPs? Yes ___ No ___

What percentage of results and calculations are reviewed by:
analyst - _____
supervisor - _____
QA officer - _____
data reporting - _____

Are all data and records retained for the required amount of time? Yes ___ No ___

Are QC data (e.g., MS, LCS, standard addition, replicate) accessible for all analytical results? Yes ___ No ___

Are control charts prepared and maintained? Yes ___ No ___

Are corrective actions taken and documented when analytical results fail to meet QC criteria? Yes ___ No ___

Are computer programs validated before use? Yes ___ No ___

Do supervisory personnel review the data and QC results? Yes ___ No ___

Are the instrument runs recorded in a bound log book, with date, time, analysts initials, in sequence)? Yes ___ No ___

Are data calculations for sample results documented? Yes ___ No ___

Are calibrations maintained in a log book for each instrument? Yes ___ No ___

Comments: _____

Anions/TOC/TSS/TDS/Nutrients/Ammonia

12.0 DATA REDUCTION

Is data reduction covered in the method SOP? Yes ___ No ___

What software packages are used in data reduction? _____

_____

Has the software been validated? Yes ___ No ___

Comments: _____

_____

_____

_____

Anions/TOC/TSS/TDS/Nutrients/Ammonia

13.0 REPORT GENERATION

Is report generating software included in data reduction software? Yes ___ No ___

If so, for what instruments and methods? _____

For all analysis which do not include computerized data reduction/reporting, how are data verified? _____

How is data transferred to reporting group? _____

Have report generating software packages been independently verified? Yes ___ No ___

How are final reports proofed against input data? _____

Are reports signed by either the analyst or QC reviewer? Yes ___ No ___

Comments: _____

Anions/TOC/TSS/TDS/Nutrients/Ammonia

14.0 QUALITY ASSURANCE

Is there an internal audit program for the analytical group? Yes ___ No ___

If so, what is the frequency? _____

What topics are covered? _____

_____

_____

Are corrective actions implemented and documented? Yes ___ No ___

Does the laboratory participate in external audit programs? Yes ___ No ___
Which ones? _____

_____

Are results available for review? Yes ___ No ___

Are blind PE samples used to verify the methodology and analyst ability? Yes ___ No ___

Comments: _____

_____

_____

_____

RADIOLOGICAL

Laboratory _____

Date Surveyed _____

2.0 ORGANIZATION AND PERSONNEL

Radiochemical Laboratory Supervisor:

Name: _____
Experience: (3 years minimum) _____

Sample Preparation Supervisor:

Name: _____
Experience: (1 year minimum) _____

Support staff (Analysts, technicians)

Names: _____
_____
_____

Experience: 1 year minimum

Do personnel assigned to this project have the appropriate educational background to accomplish the objectives of the program? Yes ___ No ___

Does the staff have a copy of the facility's Quality Assurance Manual (QAM)? Yes ___ No ___

Do the analytical supervisors have their groups follow the QAM? Yes ___ No ___

Is the radiochemical group adequately staffed to meet project commitments in a timely manner? Yes ___ No ___

Was the radiochemical supervisor available during the audit? Yes ___ No ___

If not, was the substitute during the audit familiar with this specific project? Yes ___ No ___

How is the analyst trained/certified for radiochemical analysis? _____
_____
_____

Comments: _____
_____
_____
_____

3.0 LABORATORY DOCUMENTATION

Standard Operating Procedures (SOPs)

Are copies of the appropriate radiochemical SOPs available to the analyst? Yes ___ No ___

Are there SOPs for:

Radiochemical methods of interest [Gamma,Pu,Th,U,tritium,Sr/Y; Am-241 & Ra-226 (water)]	Yes ___	No ___
Sample extraction/preparation	Yes ___	No ___
Data Reporting	Yes ___	No ___
Staff training	Yes ___	No ___
Analyst certification	Yes ___	No ___
Reagents, standards handling	Yes ___	No ___
Records, logs (lab documentation)	Yes ___	No ___
Preventive maintenance	Yes ___	No ___
Glassware cleaning	Yes ___	No ___
Data report review	Yes ___	No ___
Data archival	Yes ___	No ___

Do the analytical SOPs include:

Equipment and materials	Yes ___	No ___
Step by step sequence of analysis	Yes ___	No ___
Calibration procedures	Yes ___	No ___
Data reduction procedures	Yes ___	No ___
Quality control procedures	Yes ___	No ___
Acceptance criteria for quality control	Yes ___	No ___
Corrective action to QC outliers	Yes ___	No ___
Sample handling	Yes ___	No ___
Proper recording of data	Yes ___	No ___
Instrument maintenance	Yes ___	No ___

Are deviations to the laboratory SOPs documented? Yes ___ No ___
If so, how? _____

Are hardbound logbooks in use? Yes ___ No ___

Did everyone who made entries in the logbook sign and initial the first page? Yes ___ No ___

Is all information in the logbooks up-to-date? Yes ___ No ___

Are logbooks available for:

standards & reagents -	Yes ___	No ___
sample preparation and extraction -	Yes ___	No ___
analysis run logs -	Yes ___	No ___
instrument maintenance -	Yes ___	No ___

Do the analysts record bench data in a neat and accurate manner? Yes ___ No ___

Has the radiochemical supervisor of the analyst maintaining the notebook/bench sheet personally reviewed the documentation periodically? Yes ___ No ___

Is this reviewed documented and how? Yes ___ No ___

_____

_____

Comments: _____

_____

_____

_____

_____

4.0 SAMPLE RECEIPT AND STORAGE

Is an internal chain of custody used to document transfer of samples/extracts to the radiochemical group? Yes ___ No ___

Are samples properly stored until analysis? Yes ___ No ___

Are samples and standards kept separately? Yes ___ No ___

Is adequate storage for radiochemical extracts provided, including cold storage? Yes ___ No ___

Is the temperature of the refrigerator/freezer recorded daily? (if applicable) Yes ___ No ___

Are thermometers used for monitoring refrigerated extracts traceable to NBS or certified? Yes ___ No ___

Are temperature excursions noted and appropriate actions taken when required? Yes ___ No ___

Is a system in place to ensure proper transmittal of QAPP-specific elements (analyte list, detection limits, QC, and deliverables) to the analysts? Yes ___ No ___
Describe.

_____
_____
_____

Does the analyst verify acid preservation of samples when indicated? How is it done? Yes ___ No ___

Comments: _____
_____
_____
_____
_____

5.0 GENERAL RADIOCHEMICAL FACILITIES

Give special attention to the overall organization and neatness, the proper maintenance of facilities and instrumentation, and the general adequacy of the facilities to accomplish the work.

Is the radiochemical laboratory maintained in a clean and organized manner? Yes ___ No ___

Does the laboratory appear to have adequate space for the analysts and instruments? Yes ___ No ___

Does the radiochemical laboratory appear to have the capacity to handle the project samples? Yes ___ No ___

How many samples/day are processed, including prep time and QC samples) for:

Gamma spectrometry _____
Tritium _____
Sr-90/Y-90 _____
Isotopic Uranium _____
Isotopic Plutonium _____
Isotopic Thorium _____

Are voltage control devices used on the major instrumentation? Yes ___ No ___

Are there adequate warnings of radiation hazards, if necessary? Yes ___ No ___

Are the instruments shielded to decrease radiation background to a minimum? Yes ___ No ___

What types of shielding are in use?

_____

_____

Are contamination-free areas provided for trace level analytical work? Yes ___ No ___

Are exhaust hoods provided ventilated through filters to collect radioactive or toxic particles? [ck. drying/grinding] Yes ___ No ___

Is the air flow in the hoods checked and recorded? At what frequency? _____ Yes ___ No ___

Are chemical waste disposal policies and procedures well defined and followed by the radiochemical staff? Yes ___ No ___

Who is responsible for waste disposal? _____

What type of water is used for preparation of standards and method blanks? _____

Can the radiochemical supervisor document that the water used for standards and blanks is free of contaminants? Yes ___ No ___

Is the analytical balance located away from drafts and rapid temperature changes? Yes ___ No ___

Is the balance checked routinely with an appropriate range of weights? Yes ___ No ___
At what frequency? _____
Are the results recorded in a logbook? Yes ___ No ___

Has the balance been calibrated within one year by a certified technician? Yes ___ No ___

Are pH meters operational and maintained? Yes ___ No ___

Are solvent and reagent storage cabinets separated from the sample handling area? Yes ___ No ___

Are the solvent storage cabinets properly vented to prevent possible contamination? Yes ___ No ___

Is the SOP for glassware washing posted at each cleaning station? Yes ___ No ___

Are the SOPs for glassware cleaning adequate for the particular analysis? Yes ___ No ___

Is dedicated glassware used for high level radioactive samples? Yes ___ No ___

Is the radiochemical laboratory secure? Yes ___ No ___

Comments: _____

_____

_____

_____

_____

6.0 STANDARDS and REAGENTS

What grade of reagent is used for preparation of standards and samples? _____

Are primary standards certified and traceable to NBS (NIST) standards? Yes ___ No ___

List sources of standards (vendor, traceability): _____

_____

_____

How often are fresh standards prepared? _____

Are logbooks maintained for the preparation of all standards (calibration, internal standards, spiking solutions)? Yes ___ No ___

Do logbooks contain sufficient information to recreate the standard? Yes ___ No ___

Are working standards properly labeled with concentration, preparation date, and identity of person preparing the standard? Yes ___ No ___

Are standards stored properly (kept in proper containers, with correct preservatives and storage temperatures)? Yes ___ No ___

Are standards stored separately from samples and sample extracts? Yes ___ No ___

Can each working standard be traced to the initial primary standard? Yes ___ No ___

Are all expired material removed from active use and disposed of properly? Yes ___ No ___
How is this documented? _____

_____

Are all respective manufacturer's lot numbers recorded with the preparation information? Yes ___ No ___

Are certificates of traceability available for standards? Yes ___ No ___

Do these certificates indicate who made the standards and how they were verified, or is this information available?	Yes ___	No ___
Are standards verified to ensure that they were correctly made prior to use? Is this documented?	Yes ___	No ___
Are analytical reagents dated upon receipt?	Yes ___	No ___
Are reagent inventories maintained on a first-in, first-out basis?	Yes ___	No ___
Are analytical reagents analyzed before use?	Yes ___	No ___

Comments: _____

7.0 SAMPLE PREPARATION

Are the proper extraction/sample handling methods being used?	Water:	Yes ___	No ___
	Soil:	Yes ___	No ___
Are high level and low level samples prepared separately?		Yes ___	No ___
Are samples prepared in a contamination-free area?		Yes ___	No ___
Are there bound record logs of the sample preparations?		Yes ___	No ___
Is the format of the record log consistent and with sufficient information on each sample for preparation and extraction?		Yes ___	No ___
Are deviations to preparation methods adequately documented?		Yes ___	No ___
Are tracer compounds or recovery standards added during sample preparation to monitor extraction efficiency?		Yes ___	No ___

For which analyses: _____

Comments: _____

8.0 INSTRUMENTATION

A. Alpha Spectrometry: [Pu-238,239/240; U-234,235,238; Th-228,230,232; Th-227 (Ac-227), Ra-226(water); Am-241 (water)]

Instrumentation:

Make and model: _____

Age of instrument: _____

Which analyses performed: _____

Can required detection limits be met? [1 pCi/L, 1 pCi/g (0.6 Uranium) — Yes ___ No ___

Are manufacturer's operating manuals readily available to the operator? — Yes ___ No ___

Is service maintenance by contract? — Yes ___ No ___
If yes, how often is it performed? _____

Are extensive in-house replacement parts available? — Yes ___ No ___

Is preventive maintenance scheduled? — Yes ___ No ___

Are logbooks maintained documenting the preventive maintenance, changes, or repairs made to the instrument? — Yes ___ No ___

Is maintenance performed by an outside service vendor documented in a permanent service record maintained in a logbook? — Yes ___ No ___

Does information in the maintenance log include: who performed service, service date, reason for service, service performed, documentation that corrective action fixed problem, and approximate duration of instrument downtime? — Yes ___ No ___

Is the instrument location consistent with temperature and humidity requirements? — Yes ___ No ___

Is raw data being archived and documented properly? Yes ___ No ___
What media is used for archiving? _____
How long is archived data maintained? _____

What are the analytical methods based on? (give references)
_____
_____

Can Th-227 be done by alpha spec for the necessary detection limit of Ac-227? Yes ___ No ___

What are the deviations to the referenced method and how are they documented? _____
_____

How are anomalies in the analysis tracked and documented to the final reports? Who is notified? _____
_____

Are QC criteria met before samples are analyzed? Yes ___ No ___
How are QC outliers handled? _____
_____

What is the basis for evaluating the need for reanalysis (recovery)? _____
_____

Can analysts verify proper instrument performance (source check, spike recovery, blanks) during analysis at the time of the survey? Yes ___ No ___

Are there bound instrument run logs using consistent format (with date, times, sequence, analysts initials)? Yes ___ No ___

Are calibration maintained in log book for each instrument? Yes ___ No ___

Calibration
[Verify check source and background check frequency and duration]

Are check sources analyzed? Yes ___ No ___
How often? [daily,each detector] _____
What is the duration of check source analysis? _____

What is the laboratory acceptance criteria? _____
[+/-3xSD @ 5 MeV]
What corrective actions are taken if acceptance criteria are exceeded? _____

Are control charts prepared and monitored using source checks? Yes ___ No ___

Are background checks performed? Yes ___ No ___
How often? [1/week]
Duration of background check? [1000 min]
Is a long-term background check performed?[NR] Yes ___ No ___
If so, what is the duration? _____
Is the background subtracted from sample results?[Y] Yes ___ No ___
Are control charts prepared and monitored? Yes ___ No ___

How is the instrument calibrated? _____
How often is it calibrated? _____
Are standards traceable to NBS (NIST)? Yes ___ No ___

Are limits of detection determined and reported properly? Frequency? _____ Yes ___ No ___

Quality Control Parameters

Is a method blank prepared? Yes ___ No ___
At what frequency? [1/20]
What is the laboratory acceptance criteria? _____
[</=2xLLD]
What corrective actions are taken if criteria is exceeded? _____
[reanalyze]

Are method spikes prepared? Yes ___ No ___
At what frequency? [1/20]
What is the laboratory acceptance criteria? _____
[+/-3xSD (85-115%)]
What corrective actions are taken if criteria is exceeded? [evaluate]

What is concentration level of spike? _____
Are control charts prepared and monitored? Yes ___ No ___

Are sample replicates analyzed? Yes ___ No ___
At what frequency? [1/20]

What is the laboratory acceptance criteria? _____
[+4xSD (15%)]
What corrective actions are taken if criteria is exceeded? _____
[evaluate]
Are control charts prepared and monitored? Yes ___ No ___

Are matrix spikes prepared? Yes ___ No ___
At what frequency? [1/20]
What is the laboratory acceptance criteria? _____
[+/-3xSD (75-125%)]
What corrective actions are taken if criteria is exceeded? [evaluate]

Are tracer compounds (i.e., recovery standards) added to the extraction procedures to monitor extraction efficiency during sample preparation? Yes ___ No ___
If yes, what compounds for:

Iso-U _____
Iso-Pu [Pu-242]
Iso-Th _____
Ra-226 [Ba-133]
Am-241 _____

Are control charts prepared and monitored? Yes ___ No ___

Are LCS or PE samples analyzed? Yes ___ No ___
At what frequency? Yes ___ No ___

Comments: _____

B. Beta (gas discharge): [Sr-90/Y-90]

Instrumentation:

Make and model: _____

Age of instrument: _____

Which analyses performed: _____

Can detection limits be met? [5 pCi/L,1 pCi/g] Yes ___ No ___

Are manufacturer's operating manuals readily available to the operator? Yes ___ No ___

Is service maintenance by contract? Yes ___ No ___
If yes, how often is it performed? _____

Are extensive in-house replacement parts available? Yes ___ No ___

Is preventive maintenance scheduled and applied? Yes ___ No ___

Are logbooks maintained documenting the preventive maintenance, changes, or repairs made to the instrument? Yes ___ No ___

Is maintenance performed by an outside service vendor documented in a permanent service record maintained in a logbook? Yes ___ No ___

Does information in the maintenance log include: who performed service, service date, reason for service, service performed, documentation that corrective action fixed problem, and approximate duration of instrument downtime? Yes ___ No ___

Is the instrument location consistent with temperature and humidity requirements? Yes ___ No ___

Is raw data being archived and documented properly? Yes ___ No ___
What media is used for archiving? _____
How long is archived data maintained? _____

What are the analytical methods based on? (give references)

_____

_____

What are the deviations to the referenced method and how are they documented? _____

_____

How are anomalies in the analysis tracked and documented to the final reports? Who is notified? _____

_____

Are QC criteria met before samples are analyzed? Yes ___ No ___
How are QC outliers handled? _____

_____

What is the basis for evaluating the need for reanalysis (recovery)? _____

_____

Can analysts verify proper instrument performance (source check, spike recovery, blanks) during analysis at the time of the survey? Yes ___ No ___

Are there bound instrument run logs using consistent format (with date, times, sequence, analysts initials)? Yes ___ No ___

Are calibrations maintained in log book for each instrument? Yes ___ No ___

Calibration
[Verify check source, background check, and plateau frequency and duration]

Are check sources analyzed? Yes ___ No ___
How often? [daily]
What is the duration of check source analysis? _____
What is the laboratory acceptance criteria? _____
[+3xSD]
What corrective actions are taken if acceptance criteria are exceeded? _____
[correct,recheck]
Are control charts prepared and monitored using source checks? Yes ___ No ___

Are background checks performed? Yes ___ No ___
How often? [weekly]
Duration of background check? ___
Is a long-term background check performed? [NR] Yes ___ No ___
If so, what is the duration? ___
What is laboratory acceptance criteria? ___
[+3xSD]
Is the background subtracted from
sample results? [Y] Yes ___ No ___
Are control charts prepared and monitored? Yes ___ No ___

How is the instrument calibrated? ___
How often is it calibrated? ___
Are standards traceable to NBS (NIST)? Yes ___ No ___

How often is the detector plateau determined? [annual]
What acceptance criteria is used by the
laboratory? [NA]

Are limits of detection determined and
reported properly? Frequency? ___ Yes ___ No ___

How often is efficiency determination made? [annual]

Quality Control Parameters

Is a method blank prepared? Yes ___ No ___
At what frequency? [daily]
What is the laboratory acceptance criteria? ___
[</=2xLLD]
What corrective actions are taken if criteria
is exceeded? ___
[reanalyze]

Are method spikes prepared? Yes ___ No ___
At what frequency? [1/20]
What is the laboratory acceptance criteria? ___
[+/-3xSD (85-115%)]
What corrective actions are taken if criteria
is exceeded? ___
[evaluate]
What is concentration level of spike? ___
Are control charts prepared and monitored? Yes ___ No ___

Are sample replicates analyzed? Yes ___ No ___
At what frequency? [1/20]

What is the laboratory acceptance criteria? _____
[+4xSD (+/-15%)]
What corrective actions are taken if criteria is exceeded? _____
[evaluate]
Are control charts prepared and monitored? Yes ___ No ___

Are matrix spikes prepared? Yes ___ No ___
At what frequency? [1/20]
What is the laboratory acceptance criteria? _____
[+/-3xSD (75-125%)]
What corrective actions are taken if criteria is exceeded? _____
[evaluate]

Are tracer compounds (i.e., recovery standards) added to the extraction procedures to monitor extraction efficiency during sample preparation? Yes ___ No ___
If yes, what compounds for:

Sr-90 [carrier]

Are control charts prepared and monitored? Yes ___ No ___

Are LCS or PE samples analyzed? Yes ___ No ___
At what frequency? Yes ___ No ___

Comments: _____

C. Beta (scintillation): [Tritium]

Instrumentation:

Make and model: _____

Age of instrument: _____

Which analyses performed: _____

Can detection limits be met? [500 pCi/L,50 pCi/g] Yes ___ No ___

Are manufacturer's operating manuals readily available to the operator? Yes ___ No ___

Is service maintenance by contract? Yes ___ No ___
If yes, how often is it performed? _____

Are extensive in-house replacement parts available? Yes ___ No ___

Is preventive maintenance scheduled and applied? Yes ___ No ___

Are logbooks maintained documenting the preventive maintenance, changes, or repairs made to the instrument? Yes ___ No ___

Is maintenance performed by an outside service vendor documented in a permanent service record maintained in a logbook? Yes ___ No ___

Does information in the maintenance log include: who performed service, service date, reason for service, service performed, documentation that corrective action fixed problem, and approximate duration of instrument downtime? Yes ___ No ___

Is the instrument location consistent with temperature and humidity requirements? Yes ___ No ___

Is raw data being archived and documented properly? Yes ___ No ___
What media is used for archiving? _____
How long is archived data maintained? _____

What are the analytical methods based on? (give references)

_____

_____

What are the deviations to the referenced method and how are they documented? _____

_____

How are anomalies in the analysis tracked and documented to the final reports? Who is notified? _____

_____

Are QC criteria met before samples are analyzed? Yes ___ No ___
How are QC outliers handled? _____

_____

What is the basis for evaluating the need for reanalysis (recovery)? _____

_____

Can analysts verify proper instrument performance (source check, spike recovery, blanks) during analysis at the time of the survey? Yes ___ No ___

Are there bound instrument run logs using consistent format (with date, times, sequence, analysts initials)? Yes ___ No ___

Are calibrations maintained in log book for each instrument? Yes ___ No ___

Calibration
[Verify check source and background check frequency and duration]

Are check sources analyzed? Yes ___ No ___
How often? [daily] _____
What is the duration of check source analysis? _____
What is the laboratory acceptance criteria? _____
[+/-3xSD] _____
What corrective actions are taken if acceptance criteria are exceeded? _____
[reanalyze] _____
Are control charts prepared and monitored using source checks? Yes ___ No ___

Are background checks performed? Yes ___ No ___
How often? [daily]
Duration of background check? ___
Is a long-term background check performed? [NR] Yes ___ No ___
If so, what is the duration? ___
Is the background subtracted from sample results? Yes ___ No ___
Are control charts prepared and monitored? Yes ___ No ___

How is the instrument calibrated? ___
How often is it calibrated? ___
Are standards traceable to NBS (NIST)? Yes ___ No ___

Are limits of detection determined and reported properly? Frequency? ___ Yes ___ No ___

Quality Control Parameters

Is a method blank prepared? Yes ___ No ___
At what frequency? [1/20]
What is the laboratory acceptance criteria? ___
[</=2xLLD]
What corrective actions are taken if criteria is exceeded? ___
[reanalyze]

Are method spikes prepared? Yes ___ No ___
At what frequency? [1/20]
What is the laboratory acceptance criteria? ___
[+/-3xSD 985-115%)]
What corrective actions are taken if criteria is exceeded? ___
[evaluate]
What is concentration level of spike? ___
Are control charts prepared and monitored? Yes ___ No ___

Are sample replicates analyzed? Yes ___ No ___
At what frequency? [1/20]
What is the laboratory acceptance criteria? ___
[+4xSD (+/-15%)]
What corrective actions are taken if criteria is exceeded? ___
[evaluate]
Are control charts prepared and monitored? Yes ___ No ___

Are matrix spikes prepared? Yes ___ No ___
At what frequency? [1/20]
What is the laboratory acceptance criteria? _____
[+/-3xSD (75-125%)]
What corrective actions are taken if criteria is exceeded?
[evaluate]

Are tracer compounds (i.e., recovery standards) added to the extraction procedures to monitor extraction efficiency during sample preparation? **[NA]** Yes ___ No ___
If yes, what compounds for:

Tritium _____

Are control charts prepared and monitored? Yes ___ No ___

Are LCS or PE samples analyzed? Yes ___ No ___
At what frequency? Yes ___ No ___

Comments: _____

D. Gamma Spectroscopy: [Am-241 (soil); Co-60; Cs-137; Bi-207; Bi-210m; K-40; Ra-226 (soil); Po-210]

Instrumentation:

Make and model: _____

Age of instrument: _____

Which analyses performed: _____

Can detection limits be met? Yes ___ No ___
[Water:15 pCi/L (Bi), 20 pCi/L (K,Cs,Co)
Soil: 10 pCi/g (K), 0.3 pCi/g (Ra-226),
1 pCi/g all others]

Are manufacturer's operating manuals readily available to the operator? Yes ___ No ___

Is service maintenance by contract? Yes ___ No ___
If yes, how often is it performed? _____

Are extensive in-house replacement parts available? Yes ___ No ___

Is preventive maintenance scheduled and applied? Yes ___ No ___

Are logbooks maintained documenting the preventive maintenance, changes, or repairs made to the instrument? Yes ___ No ___

Is maintenance performed by an outside service vendor documented in a permanent service record maintained in a logbook? Yes ___ No ___

Does information in the maintenance log include: who performed service, service date, reason for service, service performed, documentation that corrective action fixed problem, and approximate duration of instrument downtime? Yes ___ No ___

Is the instrument location consistent with temperature and humidity requirements? Yes ___ No ___

Is raw data being archived and documented properly? Yes ___ No ___

What media is used for archiving? _____
How long is archived data maintained? _____

What are the analytical methods based on? (give references)
_____
_____

What are the deviations to the referenced method and how are they documented? _____
_____

How are anomalies in the analysis tracked and documented to the final reports? Who is notified? _____
_____

Are QC criteria met before samples are analyzed? Yes ___ No ___
How are QC outliers handled? _____
_____

What is the basis for evaluating the need for reanalysis (recovery)? _____
_____

Can analysts verify proper instrument performance (source check, spike recovery, blanks) during analysis at the time of the survey? Yes ___ No ___

Are there bound instrument run logs using consistent format (with date, times, sequence, analysts initials)? Yes ___ No ___

Are calibrations maintained in log books for each instrument? Yes ___ No ___

Calibration
[Verify check source and background check frequency and duration]

Are check sources analyzed? Yes ___ No ___
How often? [daily]
What is the duration of check source analysis? _____
What is the laboratory acceptance criteria? _____
[+/-3xSD]
What corrective actions are taken if acceptance criteria are exceeded? _____
[recount]

Are control charts prepared and monitored using source checks? Yes ___ No ___

Are background checks performed? Yes ___ No ___
How often? [daily]
Duration of background check? [10 min]
Is a long-term background check performed?[mth] Yes ___ No ___
If so, what is the duration? [1000 min]
Is the background subtracted from sample results?[monthly yes] Yes ___ No ___
Are control charts prepared and monitored? Yes ___ No ___

How is the instrument calibrated? _____
How often is it calibrated? _____
Are standards traceable to NBS (NIST)? Yes ___ No ___

Are mixed standards or energy calibration checks analyzed by the laboratory? Yes ___ No ___
At what frequency? [initial, as needed]
What is the laboratory acceptance criteria? _____
[+/- 5% known std]
What corrective actions are taken if acceptance criteria are exceeded? _____
[NA]
Are control charts prepared and monitored? Yes ___ No ___

Are energy efficiency curves prepared? Yes ___ No ___
At what frequency? _____

Are limits of detection determined and reported properly? Frequency? _____ Yes ___ No ___

Quality Control Parameters

Is a method blank prepared? [NR] Yes ___ No ___
At what frequency? [daily]
What is the laboratory acceptance criteria? _____
[w/in control limits]
What corrective actions are taken if criteria is exceeded? _____

Are method spikes prepared? **[NA]** Yes ___ No ___
At what frequency? _____
What is the laboratory acceptance criteria? _____

What corrective actions are taken if criteria is exceeded? _____

What is concentration level of spike? _____
Are control charts prepared and monitored? Yes ___ No ___

Are sample replicates analyzed? Yes ___ No ___
At what frequency? [1/20]
What is the laboratory acceptance criteria? _____
[+4xSD (+/-15%)]
What corrective actions are taken if criteria is exceeded? _____
[evaluate]
Are control charts prepared and monitored? Yes ___ No ___

Are matrix spikes prepared? **[NA]** Yes ___ No ___
At what frequency? _____
What is the laboratory acceptance criteria? _____

What corrective actions are taken if criteria is exceeded? _____

Are tracer compounds (i.e., recovery standards) added to the extraction procedures to monitor extraction efficiency during sample preparation? **[NA]** Yes ___ No ___
If yes, what compounds for:

_____

Are control charts prepared and monitored? Yes ___ No ___

Are LCS or PE samples analyzed? Yes ___ No ___
At what frequency? Yes ___ No ___

Comments: _____

9. DATA HANDLING

Are bench sheets accurate and raw data well organized? Yes ___ No ___

Are calculations for sample results documented in the lab SOPs? Yes ___ No ___

Are data calculations for sample results documented? Yes ___ No ___

What percentage of results and calculations are reviewed by:
- analyst - _____
- supervisor - _____
- QA officer - _____
- data reporting - _____

Are limits of detection determined and reported properly? Frequency? _____ Yes ___ No ___

Are all data and records retained for the required amount of time? Yes ___ No ___

Are QC data (e.g., MS/MSD, duplicate, surrogate) accessible for all analytical results? Yes ___ No ___

Are corrective actions taken and documented when analytical results fail to meet QC criteria? Yes ___ No ___

Are computer programs validated before use? Yes ___ No ___

Do supervisory personnel review all data and QC results? Yes ___ No ___

Is there a computerized sample tracking system in place? Yes ___ No ___

If not, describe current tracking methodology.

_____

_____

Is sample status readily available? Yes ___ No ___

How are files tracked once archived? _____

How are special analytical requests handled for data reporting, QC, and special analytes which deviate from routine laboratory operations? _____

Comments: _____

10.0 DATA REDUCTION

Is data reduction covered in the method SOP? Yes ___ No ___

What software packages are used in data reduction? _____

_____

Has the software been validated? Yes ___ No ___

Comments: _____

_____

_____

_____

11.0 REPORT GENERATION

Is report generating software included in data reduction software? Yes ___ No ___

If so, for what instruments and methods? _____

_____

For all analysis which do not include computerized data reduction/reporting, how are data verified? _____

_____

_____

Have report generating software packages been independently verified? Yes ___ No ___

How are final reports proofed against input data? _____

_____

Who signs the final report? _____

Analyst? Yes ___ No ___

QC reviewer? Yes ___ No ___

Group supervisor? Yes ___ No ___

What is average turnaround time from sample analysis to report delivery? _____

Are reports reviewed for completeness, method requirements, and contract requirements? Yes ___ No ___

Are EDTs reviewed against hardcopy? Yes ___ No ___

Comments: _____

_____

_____

_____

12.0 QUALITY ASSURANCE

Is there an internal audit program for the radiochemical group? Yes ___ No ___

If so, what is the frequency? _____

What topics are covered? _____

_____

_____

Are corrective actions implemented and documented? Yes ___ No ___

Does the radiochemical lab participate in external audit programs? Yes ___ No ___
Which ones? _____
[EPA RAD intercompanies, DOE]
Are results available for review? Yes ___ No ___

Are blind PE samples used to verify the methodology and laboratory ability? Yes ___ No ___

Is there a formal staff training program? Yes ___ No ___
For what topics? _____

_____

How are new analysts certified? _____

_____

_____

Are training programs and certifications documented? Yes ___ No ___

Comments: _____

_____

_____

_____

DIOXIN/FURAN

Laboratory _____

Date Surveyed _____

2.0 ORGANIZATION AND PERSONNEL

Dioxin/Furan Supervisor

Name: _____
Experience: (3 years minimum) _____

Support staff

Names: _____
_____

Experience: (1 year minimum) _____

Do personnel assigned to this project have the appropriate educational background to accomplish the objectives of the program? Yes ___ No ___

Does the staff have a copy of the facility's Quality Assurance Manual (QAM)? Yes ___ No ___

Do the analytical supervisors have their groups follow the QAM? Yes ___ No ___

Is the dioxin/furan group adequately staffed to meet project commitments in a timely manner? Yes ___ No ___

Was the dioxin/furan supervisor available during the audit? Yes ___ No ___

If not, was the substitute during the audit familiar with this specific project? Yes ___ No ___

How is the analyst trained/certified for dioxin/furan analysis? _____
_____
_____

Comments: _____
_____
_____
_____

3.0 LABORATORY DOCUMENTATION

Standard Operating Procedures (SOPs)

Are copies of the appropriate dioxin/furan SOPs available to the analyst? Yes ___ No ___

Are there SOPs for:

SW 8280 - low resolution	Yes ___	No ___
SW 8290 - high resolution	Yes ___	No ___
CLP SOW	Yes ___	No ___
Sample extraction/preparation	Yes ___	No ___
Data Reporting	Yes ___	No ___
Staff training	Yes ___	No ___
Analyst certification	Yes ___	No ___
Reagents, standards handling	Yes ___	No ___
Records, logs (lab documentation)	Yes ___	No ___
Preventive maintenance	Yes ___	No ___
Glassware cleaning	Yes ___	No ___
Data report review	Yes ___	No ___
Data archival	Yes ___	No ___

Do the analytical SOPs include:

Equipment and materials	Yes ___	No ___
Step by step sequence of analysis	Yes ___	No ___
Calibration procedures	Yes ___	No ___
Data reduction procedures	Yes ___	No ___
Quality control procedures	Yes ___	No ___
Acceptance criteria for quality control	Yes ___	No ___
Corrective action to QC outliers	Yes ___	No ___
Sample handling	Yes ___	No ___
Proper recording of data	Yes ___	No ___
Instrument maintenance	Yes ___	No ___

Are deviations to the laboratory SOPs documented? Yes ___ No ___
If so, how? _____

Are hardbound logbooks in use? Yes ___ No ___

Did everyone who made entries in the logbook sign and initial the first page? Yes ___ No ___

Is all information in the logbooks up-to-date? Yes ___ No ___

Are logbooks available for:

standards & reagents -	Yes ___	No ___
sample preparation and extraction -	Yes ___	No ___
analysis run logs -	Yes ___	No ___
instrument maintenance -	Yes ___	No ___
GPC cleanup -	Yes ___	No ___

Do the analysts record bench data in a neat and accurate manner? Yes ___ No ___

Has the supervisor of the analyst maintaining the notebook/bench sheet personally reviewed the documentation periodically? Yes ___ No ___

Is this reviewed documented and how? Yes ___ No ___

_____

_____

Comments: _____

_____

_____

_____

_____

4.0 SAMPLE RECEIPT AND STORAGE

Is an internal chain of custody used to document transfer of samples/extracts to the dioxin/furan group? Yes ___ No ___

Are samples properly stored until analysis? Yes ___ No ___

Are samples and standards kept separately? Yes ___ No ___

Is adequate storage for semivolatile extracts provided, including cold storage? Yes ___ No ___

Is the temperature of the refrigerator/freezer recorded daily? Yes ___ No ___

Are thermometers used for monitoring refrigerated extracts traceable to NBS or certified? Yes ___ No ___

Are temperature excursions noted and appropriate actions taken when required? Yes ___ No ___

Is a system in place to ensure proper transmittal of QAPP-specific elements (analyte list, detection limits, QC, and deliverables) to the analysts? Yes ___ No ___
Describe.

_____
_____
_____

Comments: _____
_____
_____
_____
_____

5.0 GENERAL DIOXIN/FURAN FACILITIES

Give special attention to the overall appearance of organization and neatness, the proper maintenance of facilities and instrumentation, and the general adequacy of the facilities to accomplish the work.

Is the GC/MS dioxin/furan laboratory maintained in a clean and organized manner? Yes ___ No ___

Does the laboratory appear to have adequate space for the analysts and instruments? Yes ___ No ___

Does the dioxin/furan laboratory appear to have the capacity to handle the project samples? Yes ___ No ___

How many samples/day are processed? _____

Are voltage control devices used on the major instrumentation? Yes ___ No ___

Are contamination-free areas provided for trace level analytical work? Yes ___ No ___

Are exhaust hoods provided to allow contamination-free work with volatile materials? Yes ___ No ___

Is the air flow in the hoods checked and recorded? At what frequency? _____ Yes ___ No ___

Are chemical waste disposal policies and procedures well defined and followed by the dioxin/furan staff? Yes ___ No ___

Who is responsible for waste disposal? _____

What type of water is used for preparation of standards and method blanks? _____

Can the dioxin/furan supervisor document that the water used for standards and blanks is free of contaminants? Yes ___ No ___

Is the analytical balance located away from drafts and rapid temperature changes? Yes ___ No ___

Is the balance checked routinely with an appropriate range of weights? Yes ___ No ___
At what frequency? _____
Are the results recorded in a logbook? Yes ___ No ___

Has the balance been calibrated within one year by a certified technician? Yes ___ No ___

Are pH meters operational and maintained? Yes ___ No ___

Are pipets calibrated? Yes ___ No ___

Are solvent and reagent storage cabinets separated from the sample handling area? Yes ___ No ___

Are the solvent storage cabinets properly vented to prevent possible contamination? Yes ___ No ___

Is the SOP for glassware washing posted at each cleaning station? Yes ___ No ___

Are the SOPs for glassware cleaning adequate for the particular analysis? Yes ___ No ___

Extraction/Sample Preparation Laboratory:

Does the lab have adequate space for extraction, concentration, and sample cleanup (column chromatography)? Yes ___ No ___

Does the lab have adequate equipment (separatory funnels, sonicators, concentrators) to handle the number of project samples? Yes ___ No ___

Is there adequate ventilation and hood space to handle the number of project samples? Yes ___ No ___

Comments: _____

6.0 STANDARDS and REAGENTS

What grade of reagent is used for preparation of standards and samples? _____

Are primary standards certified and traceable to NBS (NIST) standards? Yes ___ No ___

List sources of standards (vendor, traceability): _____

_____

_____

Are stock standards purchased or prepared from neat compounds?

_____

How often are fresh standards prepared? [Investigate] _____

Are logbooks maintained for the preparation of all standards (calibration, internal standards, spiking solutions, surrogates)? Yes ___ No ___

Do logbooks contain sufficient information to recreate the standard? Yes ___ No ___

Are working standards properly labeled with concentration, preparation date, and identity of person preparing the standard? Yes ___ No ___

Are standards stored properly (kept in proper containers, with correct preservatives and storage temperatures)? Yes ___ No ___

Are standards stored separately from samples and sample extracts? Yes ___ No ___

Can each working standard be traced to the initial primary standard? Yes ___ No ___

Are all expired material removed from active use and disposed of properly? Yes ___ No ___
How is this documented? _____

_____

Are all respective manufacturer's lot numbers recorded with the preparation information? Yes ___ No ___

Are certificates of traceability available for standards? Yes ___ No ___

Do these certificates indicate who made the standards and how they were verified, or is this information available? Yes ___ No ___

Are standards verified to ensure that they were correctly made prior to use? Is this documented? Yes ___ No ___

Are analytical reagents dated upon receipt? Yes ___ No ___

Are reagent inventories maintained on a first-in, first-out basis? Yes ___ No ___

Are analytical reagents analyzed before use? Yes ___ No ___

Are standard and surrogate concentrations verified before use? Yes ___ No ___

How are they verified? _____

Comments: _____

7.0 SAMPLE PREPARATION

Are the proper extraction/sample handling methods being used? Water: Yes ___ No ___
Soil: Yes ___ No ___

Does the lab use low and medium level extraction and analysis procedures? Yes ___ No ___
If not, how does the lab handle detector saturation? _____

_____

Are samples prepared in a contamination-free area? Yes ___ No ___

What types of extraction equipment are used for:

1) Water:
   a) Separatory funnel? _____
   b) Continuous extraction? _____

2) Solids:
   a) Sonicator? _____
   b) Soxhlet? _____

What types of concentration equipment are used (K-D)? _____

_____

What cleanup procedures are used? _____

_____

Are control charts prepared and monitored? Yes ___ No ___

Are there bound record logs of the sample preparations and extractions? Yes ___ No ___

Is the format of the record log consistent and with sufficient information on each sample for the preparation? Yes ___ No ___

Is there adequate ventilation and hood space in the extraction laboratory? Yes ___ No ___

Are internal standards added per method requirements? Yes ___ No ___

Where are percent moisture determinations performed?

_____

How is % moisture data transferred to group?

_____

Are oven temperatures monitored and documented? Yes ___ No ___

Are thermometers calibrated and certified? Yes ___ No ___

Are thermometer calibration records maintained? Yes ___ No ___

Comments: _____

8.0 INSTRUMENTATION

GC/MS system

Manufacturer:
Model:
Age:
Data system:
Spectra Library/revision:
What analytical method is set up?
What columns are installed?

GC/MS system

Manufacturer:
Model:
Age:
Data system:
Spectra Library/revision:
What analytical method is set up?
What columns are installed?

Gas Chromatograph system

Manufacturer:
Model:
Age:
Data system:
What analytical method is set up?
What columns are installed?
What detectors are installed?

Gas Chromatograph system

Manufacturer:
Model:
Age:
Data system:
What analytical method is set up?
What columns are installed?
What detectors are installed?

Are manufacturer's operating manuals readily available to the operator? Yes ___ No ___

Is service maintenance by contract? Yes ___ No ___
If yes, how often is it performed? _____

Are extensive in-house replacement parts available? Yes ___ No ___

Is preventive maintenance scheduled? Yes ___ No ___

[Inspect against logbook]

Are logbooks maintained documenting the preventive maintenance, changes, or repairs made to the instrument? Yes ___ No ___

Is maintenance performed by an outside service vendor documented in a permanent service record maintained in a logbook? Yes ___ No ___

Does information in the maintenance log include: who performed service, service date, reason for service, service performed, documentation that corrective action fixed problem, and approximate duration of instrument downtime? Yes ___ No ___

Is the instrument properly vented or are the appropriate traps in place? Yes ___ No ___

Is raw data being archived and documented properly? Yes ___ No ___
What media is used for archiving? _____
How long is archived data maintained? _____

Are in-house quality control charts maintained and available for inspection? Yes ___ No ___

Is the GC/MS system hardware tuned against PFK or similar compound (specify)? _____ Yes ___ No ___
At what frequency? _____

What indicators are used to determine when this needs to be done? _____
_____

How and where is tune documented? _____
_____

Are there bound instrument run logs using a consistent format? Yes ___ No ___
~~Are instrument run logs maintained?~~ ~~Yes ___ No ___~~

Comments: _____

9.0 METHODOLOGY

What are the analytical methods based on? (give references)

_____

_____

What are the deviations to the referenced method and how are they documented? _____

_____

_____

How are anomalies in the analysis tracked and documented to the final reports? Who is notified? _____

_____

_____

Are QC criteria (blanks, IS, RT windows,cal. cks) met before samples are analyzed? Yes ___ No ___

How are QC outliers handled? _____

_____

What is the basis for evaluating the need for reanalysis (Chromatography, internal standard, saturation, surrogate)?

_____

_____

Are autosamplers used for unattended (overnight) analysis? Yes ___ No ___

If so, what actions are taken if QC criteria (blanks, IS, calibration checks) are not met? _____

_____

_____

Are injection amounts the same for standards and samples? Yes ___ No ___

Are retention windows established for all compounds? Yes ___ No ___

How often are retention times recalculated? _____

_____

Can analysts verify proper instrument performance (calibration, continuing calibration, surrogate recovery, spike recovery, blanks, as appropriate) during analysis at the time of the audit? Yes ___ No ___

Is a GC column performance check sample analyzed? Yes ___ No ___
At what frequency? _____

How often is the mass resolution check analyzed?
_____

Is there a lock mass ion within each MS descriptor? Yes ___ No ___

Comments: _____
_____
_____
_____

10.0 CALIBRATION

Are criteria for GC/MS tuning with PFK met as specified in the SOP, or are exceptions permitted under special circumstances? Yes ___ No ___

How and where is this documented? _____

What are the calibration procedures? (Method/Procedure/Frequency)

_____

What is the frequency of continuing calibration standards? [1/12 hr]

Is the continuing calibration standard analyzed at the end of the shift? Yes ___ No ___

Is a calibration blank analyzed following the calibration standard? Yes ___ No ___

What is frequency of method blanks? _____
[1/20 samples]

What is acceptance criteria? _____

Are the calibration procedures required by the method being followed by the analyst? Yes ___ No ___

Is one of the calibration standards at or near the CRDL? Yes ___ No ___

Are limits of detection determined and reported properly? Frequency? _____ Yes ___ No ___

Does the calibration range reflect those concentrations in samples and the linear range of the instrument? Yes ___ No ___

When tune, calibration standards, or blanks do not meet criteria, what corrective actions are taken and how is it documented? _____

Comments: _____

11.0 DATA HANDLING

Are bench sheets accurate and well organized? Yes ___ No ___

Are calculations for sample results documented in the lab SOPs? Yes ___ No ___

What percentage of results and calculations are reviewed by:
- analyst - _____
- supervisor - _____
- QA officer - _____
- data reporting - _____

Are all data and records retained for the required amount of time? Yes ___ No ___

Are QC data (e.g., MS/MSD, duplicate, surrogate) accessible for all analytical results? Yes ___ No ___

Are control charts prepared and maintained? Yes ___ No ___

Are corrective actions taken and documented when analytical results fail to meet QC criteria? Yes ___ No ___

Do supervisory personnel review all data and QC results? Yes ___ No ___

Are the instrument runs recorded in a bound log book, with date, time, analysts initials, in sequence)? Yes ___ No ___

Are data calculations for sample results documented? Yes ___ No ___

Are calibrations maintained in a log book for each instrument? Yes ___ No ___

Comments: _____

12.0 DATA REDUCTION

Is data reduction covered in the method SOP? Yes ___ No ___

What software packages are used in data reduction? _____

_____

Has the software been validated? Yes ___ No ___

Is laboratory instrument or data processing software routinely updated? Yes ___ No ___

Comments: _____

_____

_____

_____

13.0 REPORT GENERATION

Is report generating software included in data reduction software? Yes ___ No ___

If so, for what instruments and methods? _____

_____

For all analysis which do not include computerized data reduction/reporting, how are data verified? _____

_____

_____

How is data transferred to report production group?

_____

Have report generating software packages been independently verified? Yes ___ No ___

How are final reports proofed against input data? _____

_____

Who signs the final report? _____

Analyst? Yes ___ No ___

QC reviewer? Yes ___ No ___

Group supervisor? Yes ___ No ___

Comments: _____

_____

_____

_____

14.0 QUALITY ASSURANCE

Is there an internal audit program for the dioxin/furan group? Yes ___ No ___

If so, what is the frequency? _____

What topics are covered? _____

_____

_____

Are corrective actions implemented and documented? Yes ___ No ___

Does the semivolatile lab participate in external audit programs? Yes ___ No ___
Which ones? _____

_____

Are results available for review? Yes ___ No ___

Are blind PE samples used to verify the methodology and laboratory ability? Yes ___ No ___

Comments: _____

_____

_____

_____

APPENDIX E

ELECTRONIC DATA DELIVERABLE (EDD) REPORTING FORMAT

EDD REPORTING FORMAT

The electronic data deliverables (EDDs) for the WESTON database management system are prepared by the laboratory on 3-1\2 or 5-1/4- inch floppy disks in a specified ASCII II format. The following sections describe the format for each data record (i.e., each analyte result), including the fields, field definitions and allowable codes for each field.

An example entry is provided for each field. Where the information for each field may be obtained is also described in the summary under the column heading identified as "source".

1.0 LABORATORY RECORD FORMAT

Field Name	Format	Source	Example
FACILITY ID	A5	CLIENT ID	MND01
LOCATION ID	A4	CLIENT ID	0601
SAMPLE DATE	A9	CHAIN OF CUSTODY	12-JUN-91
SAMPLE ID	A4	CLIENT ID	0001
*	A4		
PREP BATCH #	A8	LAB	911015
LOGGING COMPANY	A4	SET TO 'RFW/'	RFW/
*	A12		
SAMPLE TYPE	A2	CHAIN OF CUSTODY	F/
*	A3		
MATRIX CODE	A2	CHAIN OF CUSTODY	W
LAB ID	A14	LAB	9106-011-001
CLIENT ID	A20	CHAIN OF CUSTODY	MND01-0601-001
PARAMETER CODE	A10	VALID CODE LIST	94-75-7///
*	A2		
LAB CODE	A4	LAB	XYZA
BATCH NUMBER	A14	LAB	9104987
ANALYSIS DATE	A9	LAB	12-JUN-91
ANALYSIS TIME	A4	LAB	1204
ANALYSIS METHOD	A6	VALID CODE LIST	E908
EXTRACTION DATE	A9	LAB	12-JUN-91
EXTRACTION TIME	A4	LAB	1416
*	A8		
PARAMETER QUALIFIER.	A2	VALID CODE LIST	U

Field Name	Format	Source	Example
PARAMETER VALUE	A14	LAB	24.01/////1../
*	A1		
UNITS OF MEASURE	A10	VALID CODE LIST	UG/L
VALUE UNCERTAINTY	A12	LAB	25.01
*	A1		
DETECTION LIMIT	A9	LAB	0.5
*	A1		
DILUTION FACTOR	A9	LAB	1.0

Please be aware of the following conventions:

Client ID -- Client ID from the Chain of Custody will be in the form of:

AAAAA-BBBB-CCCC Where: AAAAA = Facility
BBBB = Location ID
CCCC = Sample ID

Note that the location ID may not be zero filled. The Chain of Custody may read: MND01-601-1. Please zero fill to read MND01-0601-0001.
• Set to the number of spaces indicated in the format.

2.0 LOCATION AND SAMPLE ID FIELDS

The following is the format for naming the sample ID for laboratory QC samples:

Field QC

Name	Sample Type	Location ID	Sample ID
Matrix spike	MS	Same as field sample	Same as field sample with a "A" preceding
Matrix spike duplicate	MD	Same as field sample	Same as field sample with a "B" preceding

Lab QC

Name	Sample type	Facility ID	Location ID	Sample ID
Method Blank	MB	QAD01	"9901"	"A001"
Blank Spike	BS	QAD01	"9901"	"B002"
Blank Spike Duplicate	BD	QAD01	"9903"	"C003"
Lab Duplicate	LD	Same as field sample	Same as field sample	Same as field with a "C" preceding

Note:
If there is more than one lab sample for a given batch, sample type, date, and location ID sequentially increment the sample ID.

Example:
The second blank spike duplicate would be labelled sample ID "C002"; the location ID remains "9903".

This convention provides for up to 999 QC samples per sample type, per date, per batch.

Chain of Custody -- indicates that the data are found on the Chain of Custody.

"/" - indicates a space

Lab - indicates the information is provided by the laboratory.

Valid Code List - indicates that only codes listed in the valid code list are to be used. In a case where a code definition does not meet the needs of the data to be recorded, the data administrator will be contacted so that concurrence can be obtained in establishing required coding conventions. ASCII data files that contain all valid code lists will be provided upon completion of contract negations with individual labs. See section 4.0 of this procedure for the valid code list.

Set - indicates that the entry person should set the field to the noted default value.

3.0 FIELD DEFINITIONS

The following defines the fields of information that will be provided in the EDD:

Facility ID - Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the site.

Location ID - Four-character code identifying the sample location.

Sample Date - The date the sample was collected.

Prep Batch No. - Designator assigned by the laboratory indicating the prep batch identifier.

Logging Company - Set to RFW.

Sample Type - The type of sample analyzed. Sample type will be noted on the Chain of Custody.

Matrix Code - Indicates the matrix of the sample. Matrix will be noted on the Chain of Custody.

Lab ID - Identifier assigned by the laboratory.

Batch Number - Identifier assigned by the laboratory.

Analysis Date - Date the sample was analyzed.

Analysis Time - Time the sample was analyzed.

Analysis Method - Sample analysis method.

Extraction Date - Date the sample was extracted.

Extraction Time - Time the sample was extracted.

Parameter Qualifier - Qualifier assigned by the laboratory to the reported parameter value.

Units of Measure - Parameter result units of measure.

Detection Limit - Detection limit associated with parameter results.

Dilution Factor - Dilution factor associated with the parameter results.

4.0 VALID CODE LIST

4.1 Sample Types

Code	Sample Name
AB	AMBIENT BLANK
AK	ANALYTICAL KNOWN
BS	BLANK SPIKE
D	DUPLICATE
EB	EQUIPMENT BLANK
F	FIELD SAMPLE
FB	FIELD BLANK
LD	LAB DUPLICATE
MB	METHOD BLANK
MD	MATRIX SPIKE DUPLICATE
MS	MATRIX SPIKE
PD	POST DIGESTION SPIKE
RB	REAGENT BLANK
S	SPIKE
TB	TRIP BLANK
TK	THEORETICAL KNOWN

4.2 Units of Measure (UOM)

Code	UOM Description
%	UNIT OF MEASURE %SOLIDS
% MOIST	PERCENT MOISTURE
% RECOVERY	PERCENT RECOVERY
% SOLIDS	% SOLIDS
% DIFFRENCE	PERCENT DIFFERENCE
ACI/M3	Actu Curies per cubic meter
CPMA	COUNTS PER MINUTE ALPHA
CPMB	COUNTS PER MINUTE BETA
D/UNITS	DELTA UNITS
DEG C	DEGREES CELSIUS
DEG F	DEGREES FAHRENHEIT
MG/KG	MILLIGRAMS PER KILOGRAM
MG/L	MILLIGRAMS PER LITER
NCI/L	NANOCURIES PER LITER
NG/G	NANOGRAM PER GRAM
NG/L	NANOGRAMS PER LITER
PCI/G	PICOCURIES PER GRAM
PCI/KG	PICOCORIES PER KILOGRAM
PCI/L	PICOCURIES PER LITER
PCI/ML	PICOCURIES PER MILLILITER
PPM	PARTS PER MILLION
STD DEV	STANDARD DEVIATION
SU	STANDARD UNITS
UG/G	MICROGRAMS PER GRAM
UG/KG	MICROGRAMS PER KILOGRAM
UG/L	MICROGRAMS PER LITER
UG/ML	MICROGRAMS PER MILLILITER
UMHOS/CM	MICROMHOS PER CENTIMETER

4.3 Parameter Codes

Code	Parameter Name	Parameter Group Code
1%SOL	% SOLIDS	C
630-20-6	1,1,1,2-TETRACHLOROETHANE	V
71-55-6	1,1,1-TRICHLOROETHANE	V
79-34-5	1,1,2,2-TETRACHLOROETHANE	V
79-00-5	1,1,2-TRICHLOROETHANE	V
75-34-3	1,1-DICHLOROETHANE	V
75-35-4	1,1-DICHLOROETHENE	V
156-59-4	1,2,-CIS-DICHLOROETHENE	V
35822-46-9	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-	D
67562-39-4	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFUR	D
55673-89-7	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFUR	D
39227-28-6	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIO	D
70648-26-9	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	D
57117-44-9	1,2,3,5,7,8-HEXACHLORODIBENZOFURAN	D
57653-85-7	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIO	D
19408-74-3	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIO	D
72918-21-9	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	D
40321-76-4	1,2,3,7,8-PENTACHLORODIBENO-P-DIOXI	D
57117-41-6	1,2,3,7,8-PENTACHLORODIBENZOFURAN	D
96-18-4	1,2,3-TRICHLOROPROPANE	V
120-82-1	1,2,4-TRICHLOROBENZENE	S
95-50-1	1,2-DICHLOROBENZENE	S
107-06-2	1,2-DICHLOROETHANE	V
1760-7-0	1,2-DICHLOROETHANE-d4	O
540-59-0	1,2-DICHLOROETHENE	V
2199-69-1	1,2-DICHLOROETHENE-d4	S
78-87-5	1,2-DICHLOROPROPANE	V
156-60-5	1,2-TRANS-DICHLOROETHENE	V
99-35-4	1,3,5-TRINITROBENZENE	E
10061-01-5	1,3-CIS-DICHLOROPROPENE	V
541-73-1	1,3-DICHLOROBENZENE	S
99-65-01	1,3-DNB	E
10061-02-6	1,3-TRANS-DICHLOROPROPENE	V
106-46-7	1,4-DICHLOROBENZENE	S
110-56-5	1,4-DICHLOROBUTANE	O
544-10-5	1-CHLOROHEXANE	V
60851-34-5	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	D
57117-31-4	2,3,4,7,8-PENTACHLORODIBENZOFURAN	D
1746-01-6	2,3,7,8-TCDD	D
51207-31-9	2,3,7,8-TCDF	D
95-95-4	2,4,5-TRICHLOROPHENOL	S
118-79-6	2,4,6-TRIBROMOPHENOL	O
88-06-2	2,4,6-TRICHLOROPHENOL	S
118-96-7	2,4,6-TRINITROTOLUENE	E
120-83-2	2,4-DICHLOROPHENOL	S

4.3 Parameter Codes (Cont.)

Code	Parameter Name	Parameter Group Code
105-67-9	2,4-DIMETHYLPHENOL	S
51-28-5	2,4-DINITROPHENOL	S
121-14-2	2,4-DINITROTOLUENE	E
606-20-2	2,6-DINITROTOLUENE	E
35572-78-2	2-AMINO-4,6-DINITROTOLUENE	E
78-93-3	2-BUTANONE	V
110-75-8	2-CHLOROETHYLVINYLETHER	V
91-58-7	2-CHLORONAPHTHALENE	S
95-57-8	2-CHLOROPHENOL	S
0000	2-CHLOROPHENOL-d4	O
95-49-8	2-CHLOROTOLUENE	V
321-60-8	2-FLUOROBIPHENYL	O
367-12-4	2-FLUOROPHENOL	O
591-78-6	2-HEXANONE	V
91-57-6	2-METHYLNAPHTHALENE	S
95-48-7	2-METHYLPHENOL	S
88-74-4	2-NITROANILINE	S
88-75-5	2-NITROPHENOL	S
91-94-1	3,3'-DICHLOROBENZIDINE	S
99-09-2	3-NITROANILINE	S
72-54-8	4,4'-DDD	P
72-55-9	4,4'-DDE	P
50-29-3	4,4'-DDT	P
534-52-1	4,6-DINITRO-O-CRESOL	S
101-55-3	4-BROMOPHENYL-PHENYL ETHER	S
59-50-7	4-CHLORO-3-METHYLPHENOL	S
106-47-8	4-CHLOROANILINE	S
7005-72-3	4-CHLOROPHENYL-PHENYLETHER	S
108-10-1	4-METHYL-2-PENTANONE	V
106-44-5	4-METHYLPHENOL	S
100-01-6	4-NITROANILINE	S
100-02-7	4-NITROPHENOL	S
83-32-9	ACENAPHTHENE	S
208-96-8	ACENAPHTHYLENE	S
67-64-1	ACETONE	V
75-05-8	ACETONITRILE	V
107-13-1	ACRYLONITRILE	V
AC-227	ACTINIUM-227	R
AC-228	ACTINIUM-228	R
309-00-2	ALDRIN	P
IALKL	ALKALINITY	F
5103-71-9	ALPHA CHLORDANE	P
319-84-6	ALPHA-BHC	P
MALTO	ALUMINUM, TOTAL	M
AM-241	AMERICIUM-241	R
INH3N	AMMONIA	C
INH4	AMMONIUM	C
120-12-7	ANTHRACENE	S
MSBTO	ANTIMONY, TOTAL	M

4.3 Parameter Codes (Cont.)

Code	Parameter Name	Parameter Group Code
SB-124	ANTIMONY-124	R
SB-125	ANTIMONY-125	R
12674-11-2	AROCLOR-1016	P
11104-28-2	AROCLOR-1221	P
11141-16-5	AROCLOR-1232	P
53469-21-9	AROCLOR-1242	P
12672-29-6	AROCLOR-1248	P
11097-69-1	AROCLOR-1254	P
11096-82-5	AROCLOR-1260	P
MASEP	ARSENIC, EP LEACHATE	M
MASTO	ARSENIC, TOTAL	M
MBAEP	BARIUM, EP LEACHATE	M
MBATO	BARIUM, TOTAL	M
BA-133	BARIUM-133	R
BA-140	BARIUM-140	R
71-43-2	BENZENE	V
56-55-3	BENZO(A)ANTHRACENE	S
50-32-8	BENZO(A)PYRENE	S
205-99-2	BENZO(B)FLUORANTHENE	S
191-24-2	BENZO(G,H,I)PERYLENE	S
207-08-9	BENZO(K)FLUORANTHENE	S
65-85-0	BENZOIC ACID	S
100-51-6	BENZYL ALCOHOL	S
BERA	BERYLLIUM	M
MBETO	BERYLLIUM, TOTAL	M
BE-7	BERYLLIUM-7	R
319-85-7	BETA-BHC	P
BI-211	BI-211	R
111-91-1	BIS(2-CHLOROETHOXY)METHANE	S
111-44-4	BIS(2-CHLOROETHYL)ETHER	S
39638-32-9	BIS(2-CHLOROISOPROPYL) ETHER	S
108-60-1	BIS(2-CHLOROISOPROPYL)ETHER	S
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	S
BI-210	BISMUTH-210	R
BI-212	BISMUTH-212	R
BI-214	BISMUTH-214	R
MB-SO	BORON, SOLUBLE	M
MB-TO	BORON, TOTAL	M
IBROM	BROMIDE	C
108-86-1	BROMOBENZENE	V
74-97-5	BROMOCHLOROMETHANE	O
75-27-4	BROMODICHLOROMETHANE	V
460-00-4	BROMOFLUOROBENZENE	O
75-25-2	BROMOFORM	V
74-83-9	BROMOMETHANE	V
85-68-7	BUTYL BENZYL PHTHALATE	S

4.3 Parameter Codes (Cont.)

Code	Parameter Name	Parameter Group Code
MCDEP	CADMIUM, EP LEACHATE	M
MCDTO	CADMIUM, TOTAL	M
MCASO	CALCIUM, SOLUBLE	M
MCATO	CALCIUM, TOTAL	M
86-74-8	CARBAZOLE	S
75-15-0	CARBON DISULFIDE	V
56-23-5	CARBON TETRACHLORIDE	V
CE-139	CERIUM-139	R
CE-141	CERIUM-141	R
CE-144	CERIUM-144	R
CS-134	CESIUM-134	R
CS-137	CESIUM-137	R
57-74-9	CHLORDANE	P
ICL	CHLORIDE	C
ICCL	CHLORIDE BY IC	C
108-90-7	CHLOROBENZENE	V
75-00-3	CHLOROETHANE	V
67-66-3	CHLOROFORM	V
74-87-3	CHLOROMETHANE	V
25168-05-2	CHLOROTOLUENE	V
MCREP	CHROMIUM, EP LEACHATE	M
MCRSO	CHROMIUM, SOLUBLE	M
MCRTO	CHROMIUM, TOTAL	M
CR-51	CHROMIUM-51	R
218-01-9	CHRYSENE	S
MCOTO	COBALT, TOTAL	M
CO-57	COBALT-57	R
CO-58	COBALT-58	R
CO-60	COBALT-60	R
MCUSO	COPPER, SOLUBLE	M
MCUTO	COPPER, TOTAL	M
57-12-5	CYANIDE	M
ICNTO	CYANIDE, TOTAL	M
2051-24-3	DECACHLOROBIPHENYL	O
319-86-8	DELTA-BHC	P
MD-SO	DEUTERIUM	R
84-74-2	DI-N-BUTYL PHTHALATE	S
117-84-0	DI-N-OCTYL PHTHALATE	S
53-70-3	DIBENZ(A,H)ANTHRACENE	S
132-64-9	DIBENZOFURAN	S
124-48-1	DIBROMOCHLOROMETHANE	V
74-95-3	DIBROMOMETHANE	V
1770-80-5	DIBUTYLCHLORENDATE	O
75-71-8	DICHLORODIFLUOROMETHANE	V
75-09-2	DICHLOROMETHANE-METHYLENE CHLORIDE	V
60-57-1	DIELDRIN	P
84-66-2	DIETHYL PHTHALATE	S
131-11-3	DIMETHYL PHTHALATE	S
959-98-8	ENDOSULFAN I(ALPHA)	P

4.3 Parameter Codes (Cont.)

Code	Parameter Name	Parameter Group Code
33213-65-9	ENDOSULFAN-II (BETA)	P
1031-07-8	ENDOSULFAN SULFATE	P
72-20-8	ENDRIN	P
7421934	ENDRIN ALDEHYDE	P
53494-70-5	ENDRIN KETONE	P
100-41-4	ETHYLBENZENE	V
EU-152	EUROPIUM-152	R
EU-154	EUROPIUM-154	R
EU-155	EUROPIUM-155	R
206-44-0	FLUORANTHENE	S
86-73-7	FLUORENE	S
IFLOR	FLUORIDE	C
462-06-6	FLUROBENZENE	O
GD-153	GADOLINIUM-153	R
5103-74-2	GAMMA CHLORDANE	P
58-89-9	GAMMA-BHC (LINDANE)	P
76-44-8	HEPTACHLOR	P
1024-57-3	HEPTACHLOR EPOXIDE	P
37871-00-4	HEPTACHLORODIBENZO-P-DIOXIN	D
38998-75-3	HEPTACHLORODIBENZOFURAN	D
118-74-1	HEXACHLOROBENZENE	S
87-68-3	HEXACHLOROBUTADIENE	S
77-47-4	HEXACHLOROCYCLOPENTADIENE	S
34465-46-8	HEXACHLORODIBENZO-P-DIOXIN	D
55684-94-1	HEXACHLORODIBENZOFURAN	D
67-72-1	HEXACHLOROETHANE	S
2691-41-0	HMX	E
193-39-5	INDENO(1,2,3-CD)PYRENE	S
IIOD	IODIDE	C
I-131	IODINE-131	R
IR-192	IRIDIUM-192	R
MFESO	IRON, SOLUBLE	M
MFETO	IRON, TOTAL	M
FE-59	IRON-59	R
78-59-1	ISOPHORONE	S
LA-140	LANTHANUM-140	R
MPBEP	LEAD, EP LEACHATE	M
MPBSO	LEAD, SOLUBLE	M
MPBTO	LEAD, TOTAL	M
PB-210	LEAD-210	R
PB-212	LEAD-212	R
PB-214	LEAD-214	R
MLISO	LITHIUM, SOLUBLE	M
MLITO	LITHIUM, TOTAL	M
MMGSO	MAGNESIUM, SOLUBLE	M
MMGTO	MAGNESIUM, TOTAL	M
MMNEP	MANGANESE, EP LEACHATE	M
MMNSO	MANGANESE, SOLUBLE	M
MMNTO	MANGANESE, TOTAL	M
MN-54	MANGANESE-54	R

4.3 Parameter Codes (Cont.)

Code	Parameter Name	Parameter Group Code
MHGEP	MERCURY, EP LEACHATE	M
MHGTO	MERCURY, TOTAL	M
HG-203	MERCURY-203	R
72-43-5	METHOXYCHLOR	P
MMOTO	MOLYBDENUM	M
544-85-4	N-DOTRIACONTANE	O
621-64-7	N-NITROSO-DI-N-PROPYLAMINE	S
86-30-6	N-NITROSODIPHENYLAMINE	S
91-20-3	NAPHTHALENE	S
MNISO	NICKEL, SOLUBLE	M
MNITO	NICKEL, TOTAL	M
NB-95	NIOBIUM-95	R
INO3N	NITRATE	C
ICNO3	NITRATE BY IC	C
IN3N2	NITRATE NITRITE	C
INO2	NITRITE AS NITROGEN	C
ICNO2	NITRITE BY IC	C
98-95-3	NITROBENZENE	E
4165-60-0	NITROBENZENE-D5	O
NP-237	NP-237	R
348-51-6	O-CHLOROFLUROBENZENE	O
3268-87-9	OCTACHLORODIBENZO-P-DIOXIN	D
39001-02-0	OCTACHLORODIBENZOFURAN	D
IPO4O	ORTHO PHOSPHATE	C
O-18	OXYGEN-18	R
1718-51-0	P-TERPHENYL-d14	O
36088-22-9	PENTACHLORODIBENZO-P-DIOXIN	D
30402-15-4	PENTACHLORODIBENZOFURAN	D
87-86-5	PENTACHLOROPHENOL	S
I%MST	PERCENT MOISTURE	C
IPETN	PETN	E
IPH	PH	F
85-01-8	PHENANTHRENE	S
108-95-2	PHENOL	S
OPHL	PHENOL-d5	O
4165-62-2	PHENOL-d5	O
PU-238	PLUTONIUM-238	R
PU-239	PLUTONIUM-239	R
PU-239/240	PLUTONIUM-239/240	R
MK-SO	POTASSIUM, SOLUBLE	M
MK-TO	POTASSIUM, TOTAL	M
K-40	POTASSIUM-40	R
PA-233	PROTACTINIUM-233	R
PA-234	PROTACTINIUM-234 METASTABLE	R
129-00-0	PYRENE	S
RA-223	RADIUM-223	
RA-224	RADIUM-224	R
RA-225	RADIUM-225	R
RA-226	RADIUM-226	R
RA-228	RADIUM-228	R

4.3 Parameter Codes (Cont.)

Code	Parameter Name	Parameter Group Code
121-82-4	RDX	E
RU-103	RUTHENIUM-103	R
RU-106	RUTHENIUM-106	R
SC-46	SCANDIUM-46	R
MSEEP	SELENIUM, EP LEACHATE	M
MSETO	SELENIUM, TOTAL	M
ISIO2	SILICA	C
MSISO	SILICON, SOLUBLE	M
MSITO	SILICON, TOTAL	M
MAGEP	SILVER, EP LEACHATE	M
MAGSO	SILVER, SOLUBLE	M
MAGTO	SILVER, TOTAL	M
AG-110	SILVER-110	R
MNASO	SODIUM, SOLUBLE	M
MNATO	SODIUM, TOTAL	M
NA-22	SODIUM-22	R
ISPCD	SPECIFIC CONDUCTANCE	F
SR-85	STRONTIUM-85	R
SR-89	STRONTIUM-89	R
SR-90	STRONTIUM-90	R
100-42-5	STYRENE	V
ISO4	SULFATE	C
ICSO4	SULFATE BY IC	C
ITEMP	TEMPERATURE	F
877-09-8	TETRACHLORO-M-XYLENE	P
41903-57-5	TETRACHLORODIBENZO-P-DIOXIN	D
30402-14-3	TETRACHLORODIBENZOFURAN	D
127-18-4	TETRACHLOROETHENE	V
479-45-8	TETRYL	E
MTLTO	THALLIUM, TOTAL	M
TL-208	THALLIUM-208	R
TH-227	THORIUM-227	R
TH-228	THORIUM-228	R
TH-230	THORIUM-230	R
TH-232	THORIUM-232	R
TH-234	THORIUM-234	R
TH-237	THORIUM-237	R
TI-208	TI-SOMETHING	R
SN-113	TIN-113	R
SN-126	TIN-126	R
108-88-3	TOLUENE	V
2037-26-5	TOLUENE-d8 (BY GC)	O
OPHCM	TOTAL HB HYDROCARBONS AS MOTOR OIL	H
TPG	TOTAL LOW BOILING HYD AS GASOLINE	H
TPD	TOTAL PETROLEUM HYD AS DIESEL FUEL	H
IPO4T	TOTAL PHOSPHATE	C
1330-20-7	TOTAL XYLENES	V
8001-35-2	TOXAPHENE	P
79-01-6	TRICHLOROETHENE	V
75-69-4	TRICHLOROFLUOROMETHANE	V

4.3 Parameter Codes (Cont.)

Code	Parameter Name	Parameter Group Code
638-67-5	TRICOSANE	O
98-08-8	TRIFLUOROTOLUENE	O
H-3	TRITIUM	R
U-233	URANIUM-233	R
U-234	URANIUM-234	R
U-235	URANIUM-235	R
U-235/236	URANIUM-235/236	R
U-238	URANIUM-238	R
MV-TO	VANADIUM, TOTAL	M
108-05-4	VINYL ACETATE	V
75-01-4	VINYL CHLORIDE	V
Y-88	YTTRIUM-88	R
MZNSO	ZINC, SOLUBLE	M
MZNTO	ZINC, TOTAL	M
ZN-65	ZINC-65	R
ZR-95	ZIRCONIUM-95	R

4.4 Analysis Methods

Code	Analysis Name
ABCRMO	TH
A303A	METALS (BY DIRECT ASPIRATION INTO AIR-ACTYLENE FLAME)
A412D	TOTAL CYANIDE
A429	COMMON ANIONS
A509A	PESTICIDES
A509B	CHLORINATED PHENOXY ACID HERBICIDES
C1.0AM	METALS - CLP SOW ILMO1.0, MOD A
C1.0BM	METALS - CLP SOW ILMO1.0, MOD B (RESIDENTIAL WELL SAMP)
C1.0CN	CN - CLP SOW ILMO1.0
C1.0ML	LANTHANIDES - CLP SOW ILMO1.0, MOD C
C1.8PP	PEST/PCBS - CLP SOW OLOMO1.8
C1.8DS	SEMIVOA - CLP SOW OLMO1.8, MOD D
C1.8DV	VOA - CLP SOW OLMO1.8, MOD D
E120.1	CONDUCTANCE
E150.1	PH
E160.1	FILTERABLE RESIDUE (ALSO KNOWN AS TOTAL DISOLVED SOLIDS)
E160.2	TOTAL SUSPENDED SOLIDS
E170.1	TEMPERATURE
E200.7	INDUCTIVELY COUPLED PLASMA (ICP) METALS SCREEN
E206.2	ARSENIC
E213.2	CADMIUM
E218.1	CHROMIUM
E220.1	COPPER
E239.2	LEAD
E239.2	LEAD
E245.1	MERCURY
E249.1	NICKEL
E270.2	SELENIUM
E272.2	SILVER
E289.1	ZINC
E310.1	ALKALINITY
E325.1	CHLORIDE
E335.2	TOTAL CYNIDE
E340.2	FLUORIDE
E350.1	AMMONIA
E350.3	AMMONIA (ISE)
E351.3	TOTAL NITROGEN
E353.2	NITRATE/NITRITE
E354.1	NITRITE
E365.1	TOTAL PHOSPHORUS
E375.2	SULFATE
E410.1	CHEMICAL OXYGEN DEMAND
E413.2	TOTAL RECOVERABLE OIL AND GREASE
E415.1	TOTAL ORGANIC CARBON (TOC)
E418.1	TOTAL RECOVERABLE PETROLEUM HYDROCARBONS
E420.1	TOTAL PHENOLICS
E502.1	ETHYLENE DIBROMIDE (1,2-DIBROMETHANE)
E601	PURGEABLE HALOCARBONS
E602	PURGEABLE AROMATICS
E608	ORGANOCHLORINE PESTICIDES AND PCB'S
E624	PURGEABLES

4.4 Analysis Methods (Cont.)

Code	Analysis Name
E624H	E624H METHOD
E625	EXTRACTABLE PRIORITY POLLUTANTS (BASE/NEUTRAL AND ACID)
E625H	E625H METHOD
E84006	PU
E901.1	GAMMA
E903.A	RA-226
E905	SR/Y
E906	TRITIUM
E908	U
FIELD	FIELD MEASUREMENT
GS	GAMMA SPECTROSCOPY
LGTERM	LONG-TERM (AVERAGING)
RC	RADIOCHEMISTRY
SW1310	EP TOXICITY - METALS
SW6010	INDUCTIVELY COUPLED PLASMA (ICP) METALS SCREEN
SW7060	ARSENIC
SW7420	LEAD
SW7471	MERCURY
SW7740	SELENIUM
SW8010	HALOGENATED VOLATILE ORGANICS
SW8015	NONHALOGENATED VOLATILE ORGANICS
SW8020	AROMATIC VOLATILE ORGANICS
SW8030	ACETONITRILE, ACRYLONITRILE
SW8080	ORGANOCHLORINE PESTICIDES AND PCB'S
SW8140	ORGANOPHOSPORUS PESTICIDES
SW8150	CHLORINATED HERBICIDES
SW8240	GC/MS METHOD FOR VOLATILE ORGANICS
SW8250	EXTRACTABLE PRIORITY POLLUTANTS (BASE/NEUTRAL AND ACID)
SW8270	EXTRACTABLE PRIORITY POLLUTANTS (BASE/NEUTRAL AND ACID)
SW8280	DIOXINS/FURANS
SW8290	DIOXINS/FURANS
SW8330	EXPLOSIVES
SW9010	TOTAL AND AMENABLE CYANIDE
SW9020	TOTAL ORGANIC HALIDES
SW9045	PH (SOIL - FIELD LABORATORY)
SW9081	CATION EXCHANGE CAPACITY
SW9100	TRAXIAL PERMEABILITY
SW9251	CHLORIDE
USATHAMA	EXPLOSIVES
UNK	UNKNOWN

4.4 Analysis Methods (Cont.)

Code	Analysis Name
11104-28-2	AROCLOR-1221
11141-16-5	AROCLOR-1232
53469-21-9	AROCLOR-1242
12672-29-6	AROCLOR-1248
11097-69-1	AROCLOR-1254
11096-82-5	AROCLOR-1260
MASEP	ARSENIC, EP LEACHATE
MASTO	ARSENIC, TOTAL
MBAEP	BARIUM, EP LEACHATE
MBATO	BARIUM, TOTAL
BA-133	BARIUM-133
BA-140	BARIUM-140
71-43-2	BENZENE
56-55-3	BENZO(A)ANTHRACENE
50-32-8	BENZO(A)PYRENE
205-99-2	BENZO(B)FLUORANTHENE
191-24-2	BENZO(G,H,I)PERYLENE
207-08-9	BENZO(K)FLUORANTHENE
65-85-0	BENZOIC ACID
100-51-6	BENZYL ALCOHOL
BERA	BERYLLIUM
MBETO	BERYLLIUM, TOTAL
BE-7	BERYLLIUM-7
319-85-7	BETA-BHC
BI-211	BI-211
111-91-1	BIS(2-CHLOROETHOXY)METHANE
111-44-4	BIS(2-CHLOROETHYL)ETHER
39638-32-9	BIS(2-CHLOROISOPROPYL)ETHER
108-60-1	BIS(2-CHLOROISOPROPYL)ETHER
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE
BI-210	BISMUTH-210
BI-212	BISMUTH-212
BI-214	BISMUTH-214
MB-SO	BORON, SOLUBLE
MB-TO	BORON, TOTAL
IBROM	BROMIDE
108-86-1	BROMOBENZENE
74-97-5	BROMOCHLOROMETHANE
75-27-4	BROMODICHLOROMETHANE
460-00-4	BROMOFLUOROBENZENE
75-25-2	BROMOFORM
74-83-9	BROMOMETHANE
85-68-7	BUTYL BENZYL PHTHALATE
MCDEP	CADMIUM, EP LEACHATE
MCDTO	CADMIUM, TOTAL
MCASO	CALCIUM, SOLUBLE
MCATO	CALCIUM, TOTAL

4.4 Analysis Methods (Cont.)

Code	Analysis Name
75-15-0	CARBON DISULFIDE
56-23-5	CARBON TETRACHLORIDE
CE-139	CERIUM-139
CE-141	CERIUM-141
CE-144	CERIUM-144
CS-134	CESIUM-134
CS-137	CESIUM-137
57-74-9	CHLORDANE
ICL	CHLORIDE
ICCL	CHLORIDE BY IC
108-90-7	CHLOROBENZENE
75-00-3	CHLOROETHANE
67-66-3	CHLOROFORM
74-87-3	CHLOROMETHANE
25168-05-2	CHLOROTOLUENE
MCREP	CHROMIUM, EP LEACHATE
MCRSO	CHROMIUM, SOLUBLE
MCRTO	CHROMIUM, TOTAL
CR-51	CHROMIUM-51
218-01-9	CHRYSENE
MCOTO	COBALT, TOTAL
CO-57	COBALT-57
CO-58	COBALT-58
CO-60	COBALT-60
MCUSO	COPPER, SOLUBLE
MCUTO	COPPER, TOTAL
57-12-5	CYANIDE
ICNTO	CYANIDE, TOTAL
319-86-8	DELTA-BHC
MD-SO	DEUTERIUM
84-74-2	DI-N-BUTYL PHTHALATE
117-84-0	DI-N-OCTYL PHTHALATE
53-70-3	DIBENZ(A,H)ANTHRACENE
132-64-9	DIBENZOFURAN
124-48-1	DIBROMOCHLOROMETHANE
74-95-3	DIBROMOMETHANE
1770-80-5	DIBUTYLCHLORENDATE
75-71-8	DICHLORODIFLUOROMETHANE
75-09-2	DICHLOROMETHANE-METHYLENE CHLORIDE
60-57-1	DIELDRIN
84-66-2	DIETHYL PHTHALATE
131-11-3	DIMETHYL PHTHALATE
959-98-8	ENDOSULFAN I(ALPHA)
33213-65-9	ENDOSULFAN II(BETA)
1031-07-8	ENDOSULFAN SULFATE
72-20-8	ENDRIN
7421934	ENDRIN ALDEHYDE

4.5 Parameter Value

Code	Parameter Value Qualifier Name
%	% RECOVERY
*	CONTROL LIMITS NOT APPLICABLE
*E	OUTSIDE CALIBRATION
B	PRESENT IN BLANK
D	DUPLICATE ANALYSIS OF A SAMPLE
E	DET BEYOND CALIBRATION RANGE
I	INTERFERENCE
J	PRESENT BELOW DETECTION LIMIT
JB	PRS BLW DET LMT(J)PRS IN BLANK
NA	NOT APPLICABLE
NC	NOT CALCULATED
NR	NOT REPORTED
NS	NOT SPIKED
R	NOT REQUESTED (NR)
S	NOT SPIKED (NS)
U	ANALYZED FOR BUT NOT DETECTED
UJ	NOT DETECTED/ESTIMATED

APPENDIX F

SUMMARY OF PROCEDURES FOR PERFORMANCE EVALUATION SAMPLES

Performance Evaluation Samples

Performance evaluation samples and project performance evaluation samples will be used to monitor laboratories providing services for a field investigation. A performance evaluation (PE) sample is defined to mean those samples provided by agencies such as USEPA or DOE, on a routine basis, as part of an approved cross-check program. Project performance evaluation (PPE) samples are defined as those samples submitted as blind/double blind samples to the laboratory by the subcontractor. The PE and PPE sample results will be used by the EG&G subcontractor to evaluate the laboratory's accuracy in identifying and quantitating analytes.

A PPE sample will be submitted for laboratory analysis at semi-annual intervals during a field effort for analytes applicable to that effort. PPE samples will not be submitted during periods of field inactivity of greater than six (6) consecutive months.

A PPE sample is created by spiking a known concentration of analyte into an artificial sample matrix, such as deionized water or sand. A PPE sample will be generated and verified by a independent vendor. The verified PPE sample will then be placed in pre-labelled Mound sample containers appropriate to the analysis and shipped to the sample document control administrator. The PPE sample will be assigned a sample ID and documented in the field logbook. The sample document control administrator will submit the sample as a normal sample for screening to Mound and shipment to the laboratory. Since the PPE sample will be shipped with other normal samples, every attempt will be made to ensure the laboratory is unaware a PPE sample has been included in the sample stream.

Laboratory results of routine cross-check PE samples will be monitored by the QAM or designee. The acceptance criteria for PPE samples will be 50-150% or vendor specifications, whichever are more stringent. The PPE samples will be validated in the same manner as Mound sample results. All PPE data will be reviewed by the QAM or designee. If results are outside of the specified criteria, the data will be evaluated for systematic errors, such as a missing surrogate compound in the spiking solution, incorrectly prepared standard(s), etc. If systematic errors are detected, the laboratory must take corrective action to alleviate the deficiency. If systematic errors detrimentally affect the integrity and usability of analytical data and corrective action cannot or has not been made by the laboratory within a QAM specified time frame, then

the laboratory will be removed from the program. If the errors are not systematic, a second PPE may be submitted for the same analyte group. In all cases, the QAM will determine the impact of PPE outliers on associated samples.

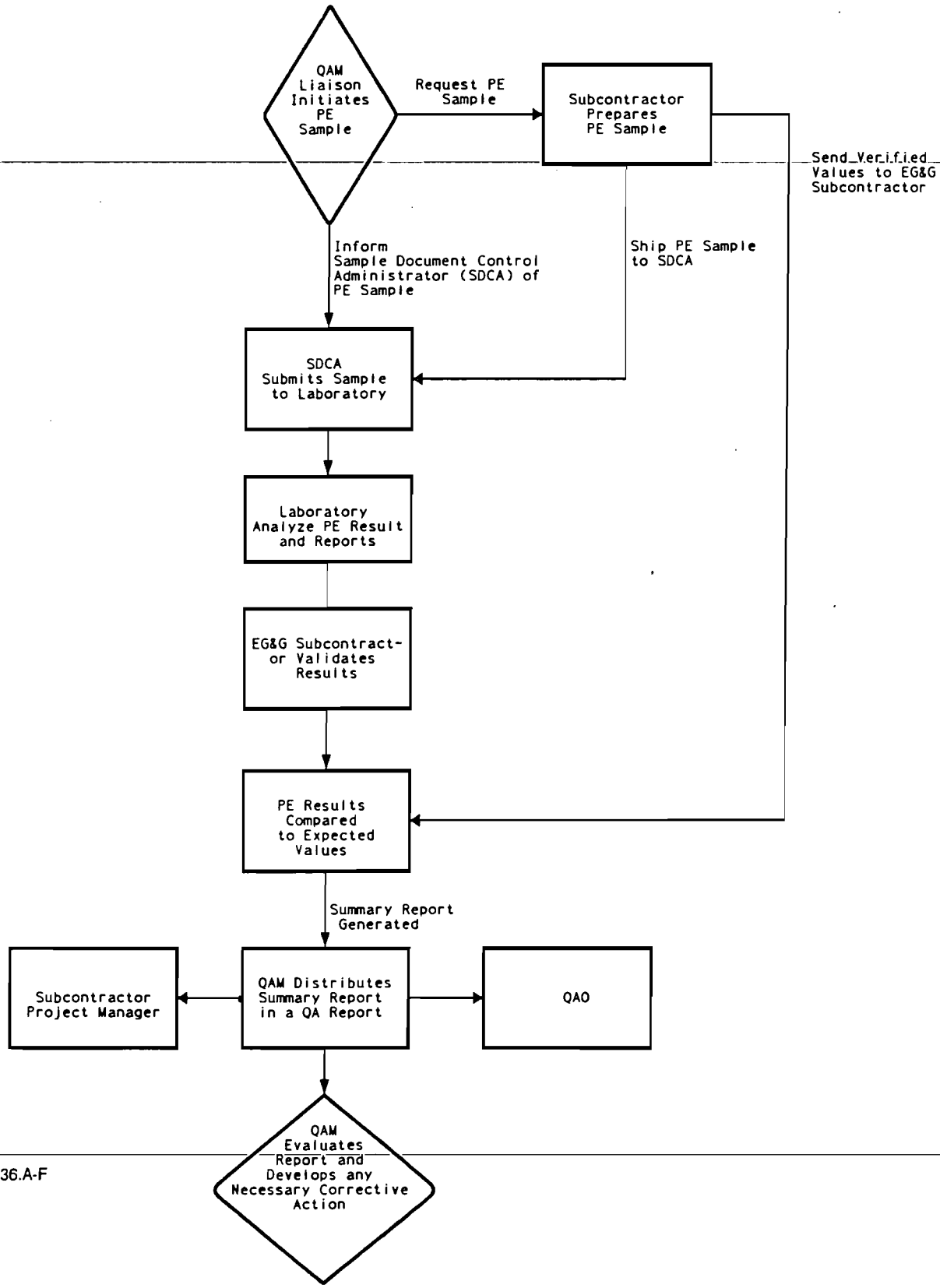
The QAM will review the validation summary report and determine whether the laboratory performance was acceptable, resolve problems as necessary with the laboratory, and send the laboratory a copy of their performance results. The QAM will distribute the summary to the Quality Assurance Officer and the EG&G subcontractor Project Manager. The process and responsibilities for submitting and evaluating a PPE sample is described in Figure F.1.

Table F.1 describes the anticipated type and number of analytes which to be included in the PPE sample. The actual analytes to be prepared in the PPE sample depend on the field investigation and the availability of materials from vendors.

Table F.1
Anticipated Analytes for PPE Samples

Analyte Group	Minimum Number of Analytes[1]	Frequency[2]
Organic Semivolatile Compounds	6	Semi-annual
Organic Volatile Compounds	3	Semi-annual
Pesticide/PCB Compounds	2 + one Aroclor	Semi-annual
Metals	2	Semi-annual
Cyanide	1	Semi-annual
Nitrate-N	1	
Fluoride	1	
Ammonia	1	
Nitrite	1	
Sulfate	1	
Chloride	1	
Total Nitrogen	1	
Total Phosphorus	1	
TOC	1	
TDS	1	
TSS	1	
Alkalinity	1	
Explosives	2	Semi-annual

1 Dependant on availability from vendors and the type of analyses performed for a given investigation.
2 PPE samples will be submitted semi-annually during the field effort. Samples will not be submitted during periods of field inactivity of greater than six (6) consecutive months.


QAM Liaison Initiates PE Sample
Request PE Sample
Subcontractor Prepares PE Sample
Send Verified Values to EG&G Subcontractor
Inform Sample Document Control Administrator (SDCA) of PE Sample
Ship PE Sample to SDCA
SDCA Submits Sample to Laboratory
Laboratory Analyze PE Result and Reports
EG&G Subcontract-or Validates Results
PE Results Compared to Expected Values
Summary Report Generated
Subcontractor Project Manager
QAM Distributes Summary Report in a QA Report
QAO
QAM Evaluates Report and Develops any Necessary Corrective Action

APPENDIX G

LABORATORY SPECIFICATION ATTACHMENTS

ATTACHMENT 1	Laboratory Specifications for IT Analytical Services - Mixed Waste and Radiological Sciences Laboratory, Oak Ridge, Tenessee
ATTACHMENT 2	Laboratory Specifications for IT Analytical Services - Middlebrook Pike, Knoxville, Tennessee
ATTACHMENT 3	Laboratory Specifications Analytical Services - Geotechnical Analysis Laboratory, Oak Ridge, Tennessee
ATTACHMENT 4	Laboratory Specifications for IT Analytical Services - St. Louis, Earth City, Missouri

REMEDIAL INVESTIGATION/FEASIBILITY STUDY

OPERABLE UNIT 9

QUALITY ASSURANCE PROJECT PLAN

Attachment 1

Laboratory Specifications for IT Analytical

Services - Mixed Waste and Radiological Sciences Laboratory

June 1992

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6. Laboratory Data Validation Procedures 6-1

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1. INTRODUCTION

The laboratory specifications attachment serves the purpose of providing elements of the Operable Unit 9 Quality Assurance Project Plan (QAPP) that are specific to a named laboratory. Providing the information in the form of an attachment allows for the use of more than one laboratory for an investigation. It is intended that scheduling conflicts and laboratory capacity issues are minimized with the provision of laboratory specifications attachments. This attachment, attachment 1, provides information on International Technologies Analytical Services (ITAS) Mixed Waste and Radiological Sciences Laboratory in Oak Ridge, Tennessee.

2. LABORATORY RESPONSIBILITIES

ITAS is required to meet the quality assurance requirements presented in the QAPP. ITAS Mixed Waste and Radiological Sciences Laboratory participates in the USEPA RAD Intercompanies Program Studies, DOE Environmental Measurements Laboratory Quality Assurance Programs, and the USEPA CLP round-robin program. The following are specific ITAS Mixed Waste and Radiological Sciences Laboratory quality-assurance related responsibilities:

- The regional director
    - reports directly to the Vice President of ITAS;
    - provides resources for implementation of the QAP at each laboratory;
    - periodically determines the effectiveness of the QAP at each laboratory; and
    - recommends changes in the QAP to the ITAS director of quality assurance and compliance.

- The laboratory director
    - reports directly to the Regional Director of Analytical Operations;
    - implements the QAP within the laboratory;
    - periodically determines the effectiveness of the QAP in the laboratory;
    - approves laboratory-specific attachments to the Quality Assurance Manual, project-specific manuals, SOPs, and revisions;
    - recommends changes in the QAP to the ITAS director of quality assurance and compliance;
    - issues laboratory reports;
    - maintains a current laboratory organization chart; and
    - supervises laboratory participation in inter-laboratory accreditation and proficiency programs.

- The laboratory manager
  - manages daily laboratory analytical operations and supervises quality control activities performed as part of routine analytical operations,
  - supervises the preparation and maintenance of laboratory records,
  - oversees the log-in of all samples received and supervises sample storage facilities, and
  - defines the instrument preventive maintenance schedule and oversees the preventive maintenance program.

- The technical director
  - provides technical overview of laboratory activities and serves as an "in-house" consultant for the applicability of general quality control practices to specific needs;
  - leads the training of analysts in laboratory operations and analytical procedures;
  - evaluates analytical techniques, procedures, instrumentation, and quality control procedures and provides recommendations to the laboratory manager;
  - supervises the verification of software for data processing;
  - recommends standards for purchasing instrumentation, equipment, reagents, gases, and chemicals; and;
  - defines the calibration program within the laboratory.

- The quality control coordinator
  - coordinates preparation of quality control standards, arranges insertion of quality control samples into the laboratory sample stream, and reviews the results;
  - performs statistical analyses, using results of quality control sample analyses to verify that the laboratory is meeting stated quality control goals;
  - informs the operations manager and group leaders of data which occur outside of acceptable limits;
  - serves as the "focal point" for the reporting and disposition of nonconformances within the laboratory and verifies corrective actions for all nonconformances;

- notifies the technical director and laboratory manager of out-of-control situations;
- reports unresolved nonconformances to the ITAS director of quality assurance and compliance;
- stops production of data in laboratory areas where the review of quality control data or procedures shows significant problems;
- assists in the performance of quality assurance audits and performs quality control audits and surveillances;
- closes findings and recommendations of quality assurance audits;
- establishes and supervises the laboratory quality assurance training program;
- maintains current distribution lists for laboratory-specific attachments, project-specific manuals, and SOPs; and
- reviews a minimum of 5% of all laboratory data after analyst cross-checks. If analyst cross-checks have not been performed, reviews a minimum of 20% of all laboratory data.

- Group supervisors
  - ensure calibration and preventive maintenance are performed as required,
  - perform data validation and final raw data reviews,
  - report out-of-control situations to the quality control coordinator,
  - review and create in-house data forms,
  - verify technical accuracy of internal procedures and forms, and
  - perform analytical procedures and data recording in accordance with accepted procedures.

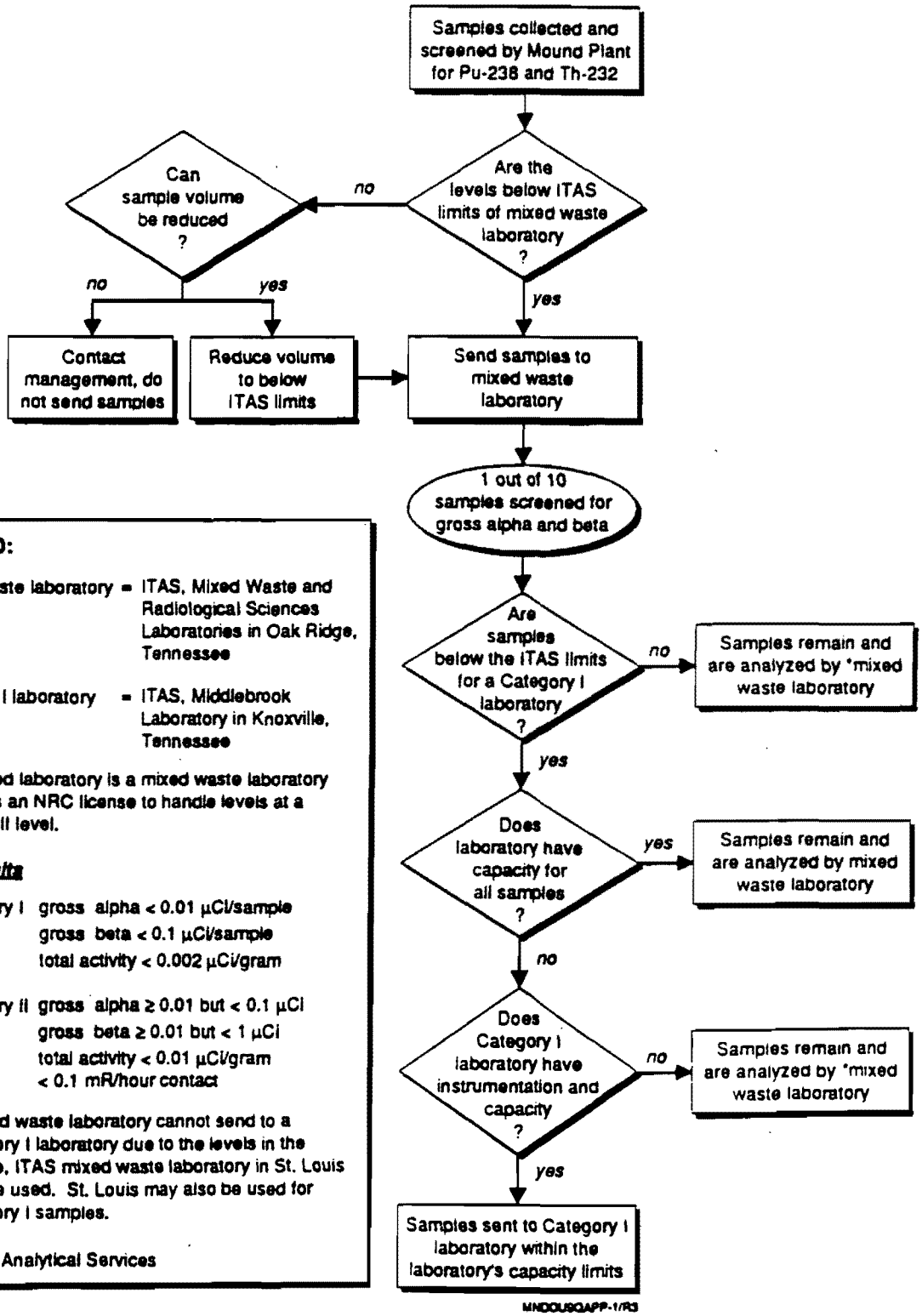
- Analysts
  - perform analytical procedures and data recording in accordance with accepted methods;
  - perform and document calibration and preventive maintenance of instrumentation, as appropriate;

- perform data processing and validation;
- immediately report out-of-control situations, instrument malfunctions, calibration failures, or other nonconformances to the group leader and quality control coordinator, as appropriate; and
- prepare data summaries for review by the laboratory manager.

These responsibilities meet the general responsibilities identified in section 2.3 of the QAPP.

In addition to the responsibilities listed above, the Mixed Waste/Radiological Science Laboratory may also send samples to either the ITAS Laboratory in St. Louis, Missouri or Knoxville, Tennessee if there is no capacity at the Oak Ridge Facility. The process for making this determination is presented in Figure 1 and primarily depends on level of activity in the samples. The use of another IT laboratory must be approved by the EG&G subcontractor Quality Assurance Manager (QAM) prior to shipment of samples.

ITAS Mixed Waste/Radiological Science Laboratory participates in the USEPA CLP round-robin program, USEPA RAD Intercompanies Program Study, and US DOE Environmental Measurement Laboratory cross-check program.



LEGEND:

Mixed waste laboratory = ITAS, Mixed Waste and Radiological Sciences Laboratories in Oak Ridge, Tennessee

Category I laboratory = ITAS, Middlebrook Laboratory in Knoxville, Tennessee

Designated laboratory is a mixed waste laboratory which has an NRC license to handle levels at a Category II level.

ITAS Limits

Category I gross alpha < 0.01 µCi/sample
gross beta < 0.1 µCi/sample
total activity < 0.002 µCi/gram

Category II gross alpha ≥ 0.01 but < 0.1 µCi
gross beta ≥ 0.01 but < 1 µCi
total activity < 0.01 µCi/gram
< 0.1 mR/hour contact

* If mixed waste laboratory cannot send to a Category I laboratory due to the levels in the sample, ITAS mixed waste laboratory in St. Louis may be used. St. Louis may also be used for Category I samples.

ITAS = IT Analytical Services

Figure 1. Use of Additional IT Laboratories, Operable Unit 9.

3. ANALYTICAL METHODS

ITAS Mixed Waste and Radiological Science Laboratory has been identified as the laboratory to perform the radiological and chemical analyses listed on Table 1. The analytical methodology to be followed is specified in section 6 of the QAPP. The laboratory quantitation limits and/or instrument detection limits for the parameters to be analyzed are also noted on Table 1. These limits are at or below the project required limits specified in section 6 of the QAPP.

Table 1. Analytical Methods, Parameters, and Instrument Detection Limits Surface Water/Groundwater and Soil/Sediment Samples

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Instrument Detection Limits[a] Water (µg/L)	Instrument Detection Limits[a] Soil/Sediment (µg/L)
1. Volatile Organic Compounds (VOCs), Soil/Sediments and Surface Water	CLP SOW[c] Modification D	CLP SOW[c] Modification D		Low Soil/ Sediment[d]
Chloromethane			3.1	3.1
Bromomethane			2.4	2.4
Vinyl Chloride			1.7	1.7
Chloroethane			1.5	1.5
Methylene chloride			1.3	1.3
Acetone			4.7	4.7
Carbon disulfide			0.8	0.8
1,1-Dichloroethene			4.5	4.5
1,1-Dichloroethane			1.9	1.9
1,2-Dichloroethene (total)			4.4	4.4
Chloroform			1.8	1.8
1,2-Dichloroethane			1.5	1.5
2-Butanone			4.3	4.3
1,1,1-Trichloroethane			1.2	1.2
Carbon Tetrachloride			0.8	0.8
Vinyl Acetate			4.6	4.6
Bromodichloromethane			1.5	1.5
1,2-Dichloropropane			2.2	2.2
cis-1,3-dichloropropene			2.4	2.4
Trichloroethene			1.9	1.9
Dibromochloromethane			1.3	1.3
1,1,2-Trichloroethane			1.0	1.0
Benzene			2.4	2.4
trans-1,3-dichloropropene			1.8	1.8
Tribromomethane			1.0	1.0
4-Methyl-2-pentanone (methyl isobutyl ketone)			3.1	3.1
2-Hexanone			2.3	2.3
Tetrachloroethene			1.9	1.9
Toluene			2.8	2.8
1,1,2,2-Tetrachloroethane			2.6	2.6
Chlorobenzene			1.9	1.9
Ethylbenzene			2.5	2.5
Styrene			1.9	1.9
Xylenes (total)			5.0	5.0

NA - Not Applicable

Please note that IT Oak Ridge is not currently set up for the version of CLP SOW specified in the QAP. Detection limits will be updated when the laboratory is set up for the analyses.

Table 1. (page 2 of 7)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Instrument Detection Limits[a] Water (µg/L)	Instrument Detection Limits[a] Soil/Sediment (µg/L)
2. Semivolatile Organic Compounds	CLP SOW[c] Modification-D	CLP SOW[c] Modification-D		Low Soil/ Sediment[d]
Phenol			0.3	9.9
bis(2-chloroethyl) ether			1	33
2-Chlorophenol			0.5	16
1,3-Dichlorobenzene			0.3	9.9
1,4-Dichlorobenzene			0.3	9.9
Benzyl alcohol			0.4	13
1,2-Dichlorobenzene			0.4	13
2-Methylphenol			0.7	23
bis(2-chloroisopropyl) ether			0.4	13
4-Methyphenol			0.5	16
N-nitroso-di-n-dipropylamine			0.8	26
Hexachloroethane			0.7	23
Nitrobenzene			0.5	16
Isophorone			0.5	16
2-Nitrophenol			2	66
2,4-Dimethylphenol			1	33
Benzoic acid			6	200
bis(2-chloroethoxy) methane			0.6	20
2,4-Dichlorophenol			1	33
1,2,4-Trichlorobenzene			0.6	20
Naphthalene			0.2	6.6
4-Chloroaniline			0.7	23
Hexachlorobutadiene			0.7	23
4-Chloro-3-methylphenol (para-chloro-meta-cresol)			1	33
2-Methylnaphthalene			1	33
Hexachlorocyclopentadiene			1	33
2,4,6-Trichlorophenol			0.8	26
2,4,5-Trichlorophenol			0.6	20
2-Chloronaphthalene			0.6	20
2-Nitroaniline			0.8	26
Dimethylphthalate			0.5	16
Acenaphthylene			1	33
2,6-Dinitrotoluene			0.3	9.9

NA - Not Applicable

Table 1. (page 3 of 7)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Instrument Detection Limits[a] Water (µg/L)	Instrument Detection Limits[a] Soil/Sediment (µg/L)
2. Semivolatile Organic Compounds (continued)	CLP SOW[c] Modification D	CLP SOW[c] Modification D		
3-Nitroaniline			3	99
Acenaphthene			0.5	16
2,4-Dinitrotoluene			2	66
4-Nitrophenol			2	66
Dibenzofuran			0.4	13
2,4-Dinitrotoluene			0.7	23
Diethylphthalate			0.5	16
4-Chlorophenyl-phenyl ether			0.5	16
Fluorene			0.6	20
4-Nitroaniline			3	99
4,6-Dinitro-2-methylphenol			3	99
N-nitrosodiphenylamine			1	33
4-bromophenyl-phenylether			1	33
Hexachlorobenzene			1	33
Pentachlorophenol			3	99
Phenanthrene			0.3	9.9
Anthracene			0.6	20
Di-n-butylphathalate			1	33
Fluoranthene			0.7	23
Pyrene			2	66
Butylbenzylphthalate			4	130
3,3'-Dichlorobenzidine			4	130
Benzo(a)anthracene			1	33
Chrysene			1	33
bis(2-Ethylhexyl)phthalate			4	130
Di-n-octylphthalate			1	33
Benzo(b)fluoranthene			2	66
Benzo(k)fluoranthene			2	66
Benzo(a)pyrene			0.8	26
Indeno(1,2,3-cd)pyrene			0.6	20
Dibenz(a,h)anthracene			0.5	16
Benzo(g,h,i)perylene			1	33
Additional Compounds:				
2-benzyl-4-chlorophenol			TBD	TBD
3. Pesticides and PCBs	CLP SOW[c]	CLP SOW[c]		
alpha-BHC			0.01	0.7
beta-BHC			0.01	0.7
delta-BHC			0.01	0.7
gamma-BHC (Lindane)			0.02	1.3

NA - Not Applicable
TBD - To Be Determined

Table 1. (page 4 of 7)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Instrument Detection Limits[a] Water (µg/L)	Instrument Detection Limits[a] Soil/Sediment (µg/L)
3. Pesticides and PCBs (continued)	CLP SOW[c] Modification D	CLP SOW[c] Modification D		
Heptachlor			0.02	1.3
Aldrin			0.03	2.0
Heptachlor epoxide			0.03	2.0
Endosulfan I			0.03	2.0
Dieldrin			0.01	0.7
4,4'-DDE			0.02	1.3
Endrin			0.03	2.0
Endosulfan II			0.03	2.0
4,4'-DDD			0.01	0.7
Endosulfan sulfate			0.01	0.7
4,4'-DDT			0.03	2.0
Methoxychlor			0.01	0.7
Endrin ketone			0.02	1.3
Endrin aldehyde			0.03	2.0
alpha-Chlordane			0.01	0.7
gamma-Chlordane			0.01	0.7
Toxaphene			0.25	16.7
Aroclor-1016			0.04	2.7
Aroclor-1221			0.06	4.0
Aroclor-1232			0.20	13.3
Aroclor-1242			0.10	6.7
Aroclor-1248			0.20	13.3
Aroclor-1254			0.08	5.3
Aroclor-1260			0.03	2.0
4. Metals (Target Analyte List)	CLP SOW[e] Modification A	CLP SOW[e] Modification A		(mg/kg)
Aluminum			60	12
Antimony			30	6
Arsenic			2.0	0.4
Barium			2.0	0.4
Beryllium			2.0	0.4
Cadmium			2	0.4
Calcium			20	4
Chromium			10.	2
Cobalt			10	2
Copper			10	2
Iron			10	2

NA - Not Applicable

Table 1. (page 5 of 7)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Instrument Detection Limits[a] Water (µg/L)	Instrument Detection Limits[a] Soil/Sediment (µg/L)
4. Metals (Target Analyte List) (continued)	CLP SOW[e] Modification A	CLP SOW[e] Modification A		(mg/kg)
Lead			2.0	0.4
Magnesium			50	10
Manganese			2.0	0.4
Mercury			0.2	0.04
Nickel			20	4
Potassium			1000	200
Selenium			2.0	0.4
Silver			10	2
Sodium			100	20
Thallium			2.0	0.4
Vanadium			10	2
Zinc			5	1
Additional Elements:				
Molybdenum			TBD	TBD
Tin			TBD	TBD
Bismuth			TBD	TBD
Lithium			TBD	TBD
				(mg/kg)
5. Cyanide	CLP SOW[e]	CLP SOW[e]	2.0	2
6. Common Anions			Quantitation Limits[a] (mg/L)	(mg/kg)
Nitrate-Nitrite	E353.2[g]	E353.2[g]	0.10	1[f]
Chloride	E325.1[g]/ SW9250[b]	SW9250[b]	0.50	5[f]
Sulfate	375.2[g]	NA	5	NA
Ammonia	E350.1[g]	NA	0.1	NA
Fluoride	E340.2[g]	E340.2[g]	0.1	0.025
7. Total Nitrogen	E351.3[g]	NA	0.10	NA
8. Total Phosphorus	E365.1[g]	NA	0.10	NA
9. Total Organic Carbon (TOC)	E415.1/ E415.2[g]	NA	1	25
10. Total Dissolved Solids (TDS)	E160.1[g]	NA	4	NA
11. Total Suspended Solids (TSS)	E160.2[g]	NA	10	NA
12. Alkalinity	E310.1[g]	NA	5	NA

NA - Not Applicable
TBD - To Be Determined
Arsenic, lead, selenium, and thallium are analyzed using graphite furnace atomic absorption (AA) with Zeeman background correction. Rest of the metals are analyzed using ICP decept for potassium (flame AA) and mercury (cold vapor AA).

Table 1. (page 6 of 7)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Instrument Detection Limits[a] Water (μg/L)	Instrument Detection Limits[a] Soil/Sediment (μg/L)
18. Radionuclides			(pCi/L)	(pCi/g dry)
Gamma Spectrometry	Nuclear Data Inc., 1986[n]	Nuclear Data Inc., 1986[n]		
Americium-241			NA	1[m]
Cobalt-60			20[i]	1[m]
Cesium-137			20[i]	1[m]
Bismuth-210 metastable			15[i]	1[m]
Bismuth-207			15[i]	1[m]
Potassium-40			20	10[m]
Radium-226 (soils)			NA	0.3[m]
Tritium	E906.0[o]	E906.0[o]	500[p]	50 pCi/g
Plutonium Isotopes	NAS, 1965[r]	NAS, 1965[r]	1[i]	1.0[s]
Thorium Isotopes	NAS, 1960[t]	NAS, 1960[t]	1[i]	1.0[s]
Radium-226	ASTM D2460-70[i]	NA	1[v]	NA
Uranium Isotopes	NAS, 1962[j]	NAS, 1962[j]	1	0.6
Strontium-90	NAS, 1960	NAS, 1960	5	1
Americium-241	EML Am-01	NA	1	NA

[a] For non-CLP analyses, these are expected method detection limits based on reagent grade water or a purified solid matrix. Actual quantitation limits may be higher depending upon the nature of the sample matrix. The limit reported on final laboratory reports will take into account the actual sample volume or weight, percent moisture (where applicable), and the dilution factor, if any.

[b] "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd edition, U.S. EPA, November 1986.

Table 1. (page 7 of 7)

[c] "U.S. EPA Contract Laboratory Program, Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration." SOW No. 2/88 including revisions 9/88 and 6/89 or most recent version. Pesticides/PCBs will be analyzed according to CLP SOW Document No. OLM01.0, including revisions 0.1 (December 1990) and 0.2 (January 1991).

[d] Medium Soil/Sediment CRQLs are 125 times the low soil/sediment CRQLs for volatile organic compounds and 60 times the low soil/sediment CRQLs for semivolatile organic compounds. Estimated detection limits for metals in soil are based on a 1-gram sample diluted to 200 mL.

[e] "U.S. EPA Contract Laboratory Program, Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration." SOW No. 7/88 including revisions 2/89 and 6/89 or most recent version.

[f] Based on a 10-gram soil sample and 100 mL volume of extractant and a soil moisture content between 0 and 10 percent (rounded). Actual quantitation limit will vary with the sample and extractant amounts and will depend upon the nature of the soil matrix.

[g] "Methods for Chemical Analysis of Water and Wastes," U.S. EPA, EPA-600/4-79-020 revised March 1983

[h] If soils are acidic, CEC will be analyzed by "Method of Soil Analysis, Part 2 Chemical and Microbiological Properties," by H. D. Chapman, American Society of Agronomists. 1965.

[i] "Annual Book of American Society of Testing Materials Standards," Section 4, Construction, Volume 04.08, Soil and Rock, Building Stones, Geotextiles," ASTM 1990.

[j] "Radiochemistry of Uranium," NAS-NS-3050, National Academy of Sciences, March 1962.

[l] Based on 900-mL sample size.

[m] Based on 650-gram dry sample.

[n] ND 9900 VAX/VMS Spectroscopy Application Package User's Manual (09-0196), Nuclear Data, Inc. Schaumberg, IL. August 1986.

[o] "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," U.S. EPA, EPA-600/4-80-032, latest version.

[p] Based on 100-mL sample size.

[q] Dependent upon percent moisture in sample, based on 10 grams.

[r] "The Radiochemistry of Plutonium," G.H. Coleman, NAS-NS-3058, National Academy of Sciences, September 1965.

[s] Based on 2-gram dry sample.

[t] "The Radiochemistry of Thorium," E.K. Hyde. NAS-NS-3004, National Academy of Sciences, January 1960.

[u] "Standard Test Methods for Radium in Water," ASTM, latest version.

[v] Based on 1,000-mL sample size.

TBD - To Be Determined. Information will be supplied in next version.

4. LABORATORY SAMPLE CUSTODY PROCEDURES

4.1. Sample Receipt

- Upon receipt, the sample custodian will inspect sample containers for integrity and will note the temperature inside the sample coolers. The presence of leaking or broken containers will be noted on the chain-of-custody record (see Figure 4.1). The IT project manager for the Mound Plant ER Program will notify either the WESTON field manager or the sample bank manager within 24 hours of the receipt of broken or leaking samples. The sample custodian will sign the chain-of-custody record (with date and time of receipt), thus assuming custody of the samples. The pressure gauge on air canister samples will be recorded on the chain-of-custody form.

- The information on the chain-of-custody record will be compared by the sample custodian with that on sample tags and labels to verify sample identity. Any inconsistencies will be resolved with the field sampling representative before sample analysis proceeds. The samples will be checked for the required sample containers, preservation, and volumes.

- Samples will be moved to one of the locked sample storage refrigerators for storage prior to analysis by the sample custodian. The storage location will be recorded on the chain-of-custody record.

- The sample custodian will retain the original chain-of-custody record; carbon copies will be provided to each laboratory section manager, and one carbon copy will be placed in the main sample log, which is kept in the laboratory. An internal chain of custody is generated for tracking samples during storage and analysis and is kept with the samples/extracts at all times.

- The sample custodian will alert the appropriate section managers and analysts of any analyses requiring immediate attention because of short holding times.

4.2. Sample Storage

Samples will be maintained in storage in one of the locked storage refrigerators prior to sample preparation and analysis. Samples designated for analysis for volatile organic compounds will be stored in a separate refrigerator. The storage refrigerators are maintained at 4 % 2oC. Analytical laboratory personnel will retrieve samples for analysis from the storage refrigerators and will sign the chain-of-custody record. The sample custodian and analyst will sign and date the chain-of-custody record to acknowledge transfer of custody to the analyst.

PAGE NO.:

Project Code _____
EPA Case # _____
Sample Nos. _____

INTERNAL CHAIN-OF-CUSTODY FORM
IT Analytical Services - Oak Ridge Laboratory

WORKORDER NO.: _____

Sample No.	Date	Time	Extr/ Digt/ Smpl	Moved From	Moved To	Reason	Signature

O = Original sample
D = Distillate (specify)
A = Acid extract
P = Pest./PCB extract
E = BN/AE extract
V = VOAs sample

WH = Water, HCl finish
WN = Water, HNO_3 finish
DH = Soil/sediment, HCl finish
DN = Soil/sediment, HNO_3 finish
B = Base Neutral extract

Figure 4.1. Internal Chain-of-Custody Form

4.3 Sample Tracking - Organic Analysis

For samples that require extraction prior to analysis, a sample extraction form is completed during the time of extraction. When samples are extracted for analysis by gas chromatography/mass spectroscopy (GC/MS) or liquid chromatography, all pertinent data are entered on the sample extraction form and are recorded in a bound laboratory notebook. Extraction data are entered into the laboratory information management system by the person performing the extraction. A hard copy of the form is printed out and is used as the vehicle for custody transfer to the analyst. Copies are provided to the analysts to inform them that extracts are ready for analysis. The bound laboratory notebook is kept in the extraction laboratory.

Extracts are maintained in secured refrigerated storage by the sample preparation section until transferred to the analysts.

4.4. Sample Tracking - Metals Analysis

Samples are received by the sample preparation section for digestion prior to analysis for metals by atomic absorption/inductively coupled plasma spectroscopy. Sample digests are stored at room temperature in a secured area before analysis and for a minimum of six weeks after analysis. When samples are prepared for digestion, the preparation technician fills out a sample digestion record.

All information regarding sample digestion is entered onto the sample digestion record as the sample preparation proceeds and is recorded in a bound laboratory notebook. The digestion record is maintained to acknowledge custody transfer of digestates to the metals analysis section. Upon completion of sample digestion, a carbon copy of the sample digestion record is provided to the metals analysis section to alert them that digestates are ready for analysis. The bound laboratory notebook containing the digestion record is retained by the metals digestion laboratory.

4.5. Recordkeeping

Information related to sample tracking at the IT Laboratories is recorded in laboratory log-in books and in the Laboratory Information Management System (LIMS). This information includes

- project identification number;
- sample number;
- type of samples;
- date received;
- date put into storage after analysis was completed; and
- date of disposal.

Laboratory notebook pages are signed and dated daily by laboratory analysts. Corrections to notebook entries are made by drawing a single line through the erroneous entry and by writing the correct entry next to the one crossed out. All corrections are initialed and dated by the analyst.

5. LABORATORY DATA REDUCTION PROCEDURES

All raw analytical data are recorded in numbered and bound laboratory notebooks issued by the quality assurance officer. Data are recorded and are associated with the unique laboratory sample identification number and the field sample identifier. For inorganic (nonmetal) analyses, the bound notebook pages are preformatted for each analytical method. Those pages contain the following:

- analytical method,
- analyst,
- date,
- reagent concentrations,
- instrument settings (as applicable), and
- raw data.

The laboratory analysts sign and date all notebook entries daily. The notebook pages are reviewed periodically by the section manager before final data assembly. Copies of strip-chart outputs (for example, chromatograms) are maintained on file.

At the completion of a set of analyses, all calculations are completed and are checked by the analyst. Calculations using raw data to obtain final concentrations are performed according to the procedures described in the specified analytical method. Laboratory data reduction procedures are provided in the respective IT Laboratory SOPs and in the CLP SOW. The associated quality control data (laboratory duplicates, surrogates, matrix spikes, and MSDs) are entered onto quality control charts and are verified as being within control limits. If all data are acceptable, the data are entered into the laboratory computer system, and the data summaries (including raw data) are submitted to the section manager for review. After approval, data are subsequently entered into the project database format. Data outside control limits will be reported with a qualifier on the CLP reporting forms for CLP data packages. Case narratives will note any out-of-control situations for non-CLP analyses. After the laboratory section manager approves, the laboratory data manager is notified that the data are ready to be reported, and the completed analyses are removed from the laboratory backlog. A hard-copy

data summary is then generated that is reviewed and is signed by the laboratory section manager and/or laboratory manager.

6. LABORATORY DATA VALIDATION PROCEDURES

Prior to the final production of analytical reports, laboratory data are reviewed and verified according to ITAS procedures described in the ITAS Quality Assurance Manual in section 10.2, Data Validation. The ITAS data review procedures are based on two activities:

- processing quality control sample results; and
- data validation of reporting analytical results.

Precision and accuracy of the analyses are evaluated with the quality control sample results. Control charts prepared from statistical evaluation of quality control sample results (e.g., matrix spikes and matrix spike duplicates) are used to compare results to established control limits.
Data validation consists of review of data processing and data reporting. Twenty percent of all data processed will be checked by an independent analyst using one of two procedures.
One procedure involves the check of a copy of the data for the appropriateness of the equations used, correctness of numerical input, corrections of calculations, and correct interpretation of raw data. Any changes are agreed upon by both the reviewer and originator of the data. If any errors are found, a 100 percent check of the data is performed.

The other procedure entails marking original data in black ink for review. Changes are backchecked and conformances and corrective actions are documented. The frequency of checks using this procedure is the same.

Data reports are reviewed against the processed data by the analyst or group leader. The operations manager then reviews the data report to ensure that it meets project requirements. The laboratory manager gives final approval of issuance of the laboratory report.

7. PREVENTIVE MAINTENANCE

IT Laboratories maintain full service contracts or have an equivalent maintenance program on all major instruments. These service contracts not only provide routine preventive maintenance, but also emergency repair service. Each analytical instrument is assigned an instrument logbook. All maintenance activities are recorded in the instrument log. The information entered in the instrument log includes

- date of service,
- person performing service,
- type of service performed and reason for service,
- replacement parts installed (if appropriate), and
- miscellaneous information.

Table 2 summarizes the type and frequency of maintenance of major instruments for IT Laboratories that will be used for the analytical program. Those parts commonly replaced, as specified in Table 2, are the spare parts kept in the laboratory. A listing of spare parts is also routinely maintained in files for each instrument.

TABLE 2.

PREVENTIVE MAINTENANCE REQUIREMENTS FOR MAJOR INSTRUMENTS

ITAS MIXED WASTE AND RADIOLOGICAL SCIENCES, OAK RIDGE, TENNESSEE

APPLICABLE ANALYTICAL METHOD	INSTRUMENT	ITEMS CHECKED/SERVICED	MINIMUM FREQUENCY
Metals	Inductively Coupled Argon Plasma (ICAP)	Replace Pump Tubing	As Needed
		Inspect and Clean Sample Introduction System	As Needed
		Drain Air Filters	Semi-weekly
		Check Drain Receptacle Level	Weekly
		Clean Torch	Monthly
Metals	Atomic Absorption Spectrometer for Mercury Analysis	Replace Check Valves	As Needed
		Check Pump Delivery	As Needed
		Check Tubing Integrity	As Needed
		Clean Burner/Adsorption Cell Mount	Monthly
		Clean Adsoption Cell	Monthly
		Replace System Tubing	Semi-annually
Metals	Atomic Absorption Spectro-photometer Flame Units	Inspect Backflash Diaphram	As Needed
		Check Drain Receptacle Level	As Needed
		Replace Nebulizer Chamber O-rings	As Needed
		Replace Beam Splitter	As Needed
		Clean Nebulizer	Weekly
		Clean Burner Head	Weekly
		Clean Spray Chamber	Weekly
		Remove and Clean Burner Mount	Monthly

TABLE 2. (continued)

APPLICABLE ANALYTICAL METHOD	INSTRUMENT	ITEMS CHECKED/SERVICED	MINIMUM FREQUENCY
Metals	Graphite Furnace Atomic Absorption Spectrometer (Model 951/655)	Replace Graphite Cuvetter	As needed
		Replace Fry-Rite and Glass Wool	As needed
		Check Drain Receptacle	As needed
		Replace Temperature Sensor	As needed
		Clean Electrodes	As needed
		Replace Graphite Inserts	As needed
		Replace Electrodes and Sensor Posts	As needed
		Check Graphite Insert	Weekly
		Check Recirculator Water Level	Weekly
		Replace Set Screw	Weekly
		Check Electrode Appearance	Weekly
		Clean Nebulizer and Spray Chamber	Monthly
		Clean Furnace Chamber and Windows	Monthly
		Clean Furnace Head with Actic Acid	Semi-Annually
		Replace Recirculator Water	Semi-Annually
Metals	Graphite Furnace Atomic Absorption	Check Drain Receptacle	As needed
		Clean Sapphire Window	As needed
		Replace Graphite Cuvette	As needed
		Clean Cell Body and Windows	Weekly
		Replace Marble Chips	Weekly
		Check Recirculator Water Level	Weekly
		Clean Temperature Sensor Filter	Semi-Montly
		Clean FASTAC Pump	Monthly
		Clean Nebulizer and Spray Chamber	Monthly
		Clean Air Filter	Monthly
		Flush Furnace Head with Acetic Acid	Semi-Annually
		Replace recirculator Water	Semi-Annually

TABLE 2. (continued)

APPLICABLE ANALYTICAL METHOD	INSTRUMENT	ITEMS CHECKED/SERVICED	MINIMUM FREQUENCY
	Organic Prep: Sonicator	Inspect Prope Tips for Etching/Pitting	Daily when used
		Replace Probe Tip	As needed
		Disassemble and Clean Sonicator Probe Tips	Semi-Annually
		Tune Sonicator	Semi-Annually
	pH Meters	Gel Filled	Maintenance Free
		Electronics Checked	As needed
Chloride, nitrate-nitrite	Spectrophotometer	Replace Lamp	As needed
		Check tubing	Daily
	Millipore Water System	Conductivity Check	Daily
		Pressure Check	Daily
		Change Ion Exchange Bed and Filters	As needed
	Analytical Balance	Internal Weight Train, Gears, Electronics	Annually by Service Contract
N/A	Refrigerators	Temperature Checked and Logged	Daily
N/A	Walk-In Coolers	Temperature Checked and Logged	Daily
N/A	Ovens	Temperature Checked and Logged	Daily

TABLE 2. (continued)

APPLICABLE ANALYTICAL METHOD	INSTRUMENT	ITEMS CHECKED/SERVICED	MINIMUM FREQUENCY
SW8010,SW8020 Pesticides/PCBs	Gas Chromatograph	Inlet, Detector and Column Temperatures	Daily when instrument in use
		Gas pressures	Daily
		Column and Detector Flow Rates	Daily when instrument in use
		Check Zero and Noise Level	Daily when instrument in use
		Check Responses, Retention Times using a Check Standard	Daily when instrument in use
		Gas Purity check	As needed
		Check Autosampler for Bubbles, Flush Volume	Daily when instrument in use
		Reactor Tube Temperature (HALL only)	Daily when instrument in use
		Check Pressure in Gas Tanks, Replace in < 500 PSI	Weekly
		Clean Outside Surfaces of Instruments	Weekly
		Replace Septa	As needed
		Replace Column or Part of Column Packing	As needed
		Clean/Replace Detector	As needed
		Replace Glass Wool/Glass insert	As needed
		Clean Injection Port	As needed
		Replace Reaction Tube (HALL only)	As needed
E415.1/415.2	Total Organic Carbon Analyzer	Gas Tank Pressure	Daily when in use
		N^2 and O^2 Regulator Pressure	Daily when in use
		Zone Temperature	Daily when in use
		Purge and Detector Flow Rates	Daily when in use
		Clean Prot Valves	After 72 hours of operation
		Purge Gas and Detector Leak Test	After 72 hours of operation

TABLE 2. (continued)

APPLICABLE ANALYTICAL METHOD	INSTRUMENT	ITEMS CHECKED/SERVICED	MINIMUM FREQUENCY
Volatile and Semivolatile Organic Compounds	GC/MS	Diffusion Pump Oil	Bi-Weekly
		Mechanical Pump Oil	Quarterly
		Power Con. Air Filter	Bi-Weekly
		QEM Filter	Bi-Weekly
		Water Bay Filter	Bi-Weekly
		Interface Box	Bi-Weekly
		Vacuum Chaff Filter	Monthly
		Turbo Pump Oil	Quarterly
		Water Filter (if applicable)	Observe and change as needed
		Computer Air Filter	Monthly
		Card Cage Air Filter	Monthly
		Source-Clean Ceramics, Polish Lenses	As needed
		Clean Poles and Ceramics on the Poles	As needed
		Clean Contacts on the Component Boards	As needed
		Vacuum the Component Boards	As needed
		Clean all Fan Screens	Weekly
		Vacuum Outside of Instrument	Weekly
		Clean Grob and Replace Quartz Insert	As needed
		Replace Septum	Daily (each shift)
		Injection Port Liner Checked	Daily
		Column maintenance	As needed

TABLE 2. (continued)

APPLICABLE ANALYTICAL METHOD	INSTRUMENT	ITEMS CHECKED/SERVICED	MINIMUM FREQUENCY
Volatile and Semivolatile Organic Compounds (continued)	GC/MS (continued)	Disk Drive (CMD only)	Semi-Annual(ServiceEngineer) or as needed
		Printer	Quarterly
	Manual Alpha/Beta Counter	Clean fan filter	Monthly
	Gamma Spec System		
	MCA	Clean fan filter	Monthly
	Equipment Rack	Check for operation	Monthly
	Vacuum pump	Change fan filter	Monthly
		Change pump oil	Annually
	Germanium detectors	Fill LN_2 Dowers	Weekly
	Alpha Scintillation Counters	Electronic Check	Quarterly

Note: As needed, minimum frequency refers to the fact that the item is routinely checked during analysis, and the item is replaced/repaired when needed.

8. SPECIFIC PROCEDURES TO ASSESS PROCEDURES TO ASSESS PRECISION AND ACCURACY

The ITAS procedures for assessing analytical accuracy and precision are those specified in section 12 of the QAPP.

The precision of radiological analyses are assessed by replicate results. An expected mean range is calculated using several replicate results. A control limit equaling the mean range plus three standard deviations (SD) is established.

The accuracy of radiological analyses are assessed by analyses of spiked samples or reference standard samples. The expected precision of the recovered sample result, based on the activity of the known value is the mean +/- 3 SD. The control limit for the spiked or reference standard sample is >3SD or <3SD.

Normalized scaling is used by ITAS for evaluating these radiological quality control samples. These procedures are described in "Environmental Radioactivity Laboratory Intercomparison Studies Program," EPA document number EPA-600/4-81-004. Control charts are prepared with a minimum of 20 results with upper and lower warning limits and control limits.

REMEDIAL INVESTIGATION/FEASIBILITY STUDY

OPERABLE UNIT 9

QUALITY ASSURANCE PROJECT PLAN

Attachment 2

Laboratory Specifications

Analytical Services - Middlebrook Pike, Knoxville, Tennessee

June 1992

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1. INTRODUCTION

The laboratory specifications attachment serves the purpose of providing elements of the Operable Unit 9 Quality Assurance Project Plan (QAPP) which are specific to a named laboratory. Providing the information in the form of an attachment allows for the use of more than one laboratory for an investigation. It is the hope that scheduling conflicts and laboratory capacity issues are minimized with the provisions of laboratory specifications attachments. This attachment, attachment 2, provides the information on International Technologies Analytical Services (ITAS), Middlebrook Laboratory in Knoxville, Tennessee.

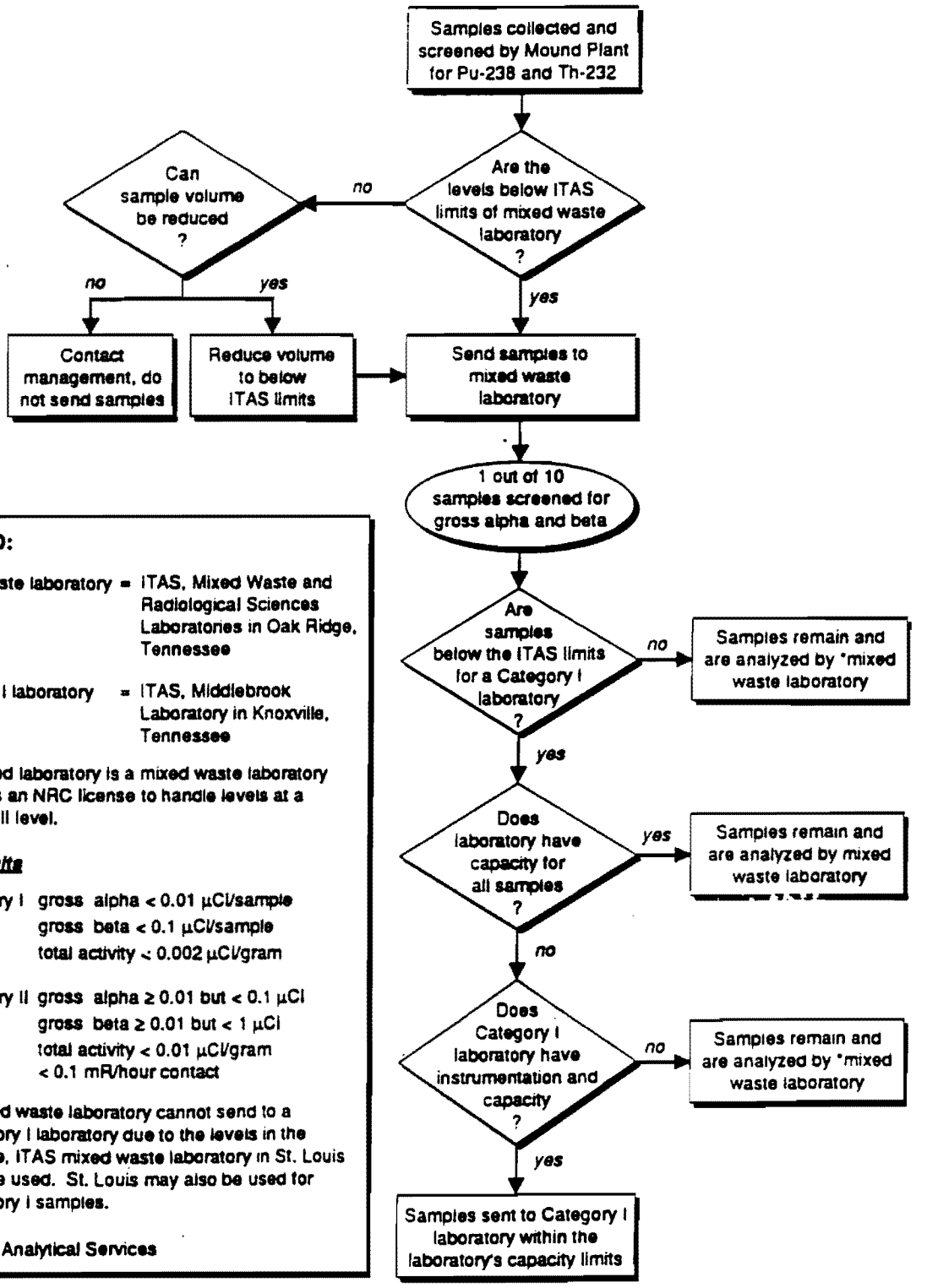

Figure 1. Use of Additional IT Laboratories, Operable Unit 9.

2. LABORATORY RESPONSIBILITIES

ITAS is required to meet the quality assurance requirements presented in the QAPP. ITAS Middlebrook Laboratory participates in the USEPA CLP round-robin program. The following are the specific ITAS Middlebrook Laboratory quality assurance related responsibilities:

- The laboratory director shall
  - report directly to the Vice President of ITAS;
  - periodically determine the effectiveness of the QAP in the laboratory; and
  - approve the laboratory-specific attachment to the Quality Assurance Manual, project-specific manuals, Standard Operating Procedures (SOPs), and revisions.
- The laboratory manager shall
  - approve the laboratory-specific attachment to the Quality Assurance Manual, project-specific manuals, SOPs, and all revisions;
  - implement the QAP within the laboratory;
  - supervise routine quality control activities within the laboratory;
  - recommend changes in the QAP to the ITAS quality assurance/quality control director;
  - approve all reports issued by the laboratory;
  - maintain a current laboratory organization chart;
  - manage laboratory daily analytical operations; and
  - supervise sample storage facilities.
- The technical director shall
  - provide technical overview of laboratory activities;
  - define and oversee the training program;
  - serve as an "in-house" consultant for the applicability of general quality control practices to specific needs;
  - evaluate new analytical techniques, procedures, instrumentation, and quality control procedures and provide recommendations to the laboratory manager;
  - define the calibration program for instrumentation within the laboratory;
  - define and oversee the instrument preventive maintenance program and schedule;
  - supervise the verification of software for data processing; and

- recommend standards for purchasing instruments, equipment, reagents, gases, and chemicals.

- The quality assurance coordinator shall
  - prepare quality control standards, insert quality control samples into the laboratory sample stream, and review results;
  - perform statistical analyses using results of quality control sample analyses;
  - notify the laboratory manager of out-of-control or biased situations;
  - report nonconformances to the ITAS quality assurance/quality control director if the situation is not corrected within the laboratory;
  - assist in the performance of quality assurance audits and perform quality control audits;
  - establish and supervise the laboratory quality assurance training program;
  - supervise the maintenance of laboratory records;
  - monitor implementation of the QAP;
  - perform an annual review of the quality assurance manual and procedures; and
  - serve as focal point for the reporting and disposition of nonconformances.
- Group leaders shall
  - serve as lead analysts within the laboratory group to which they are assigned (group meaning a division of people in the lab who perform work of a similar nature or in a specific area);
  - organize and schedule the analytical testing program with consideration for sample-holding times;
  - review all analytical data and submit to the laboratory manager for approval;
  - implement data verification procedures;
  - assign analysts for data processing and validation activities;
  - evaluate instrument performance and supervise instrument calibration and preventive maintenance programs;
  - report out-of-control or nonconforming situations to the laboratory manager and quality control coordinator;
  - stop production of data in laboratory areas where review of quality control data or procedures reveals significant problems;

- resolve ongoing and recurring nonconformances within the laboratory;
- recommend corrective actions for resolutions of nonconformances;
- review statistical data to verify that the laboratory is meeting stated quality control goals;
- maintain current distribution lists for laboratory-specific attachments, project-specific manuals, and SOPs; and
- verify that corrective actions in response to findings and recommendations of quality assurance audits have been performed where appropriate.

- Technicians shall
  - perform analytical procedures and data recording in accordance with accepted methods;
  - perform and document calibration and preventive maintenance of instrumentation, as required in associated procedures;
  - perform data processing and validation; and
  - immediately report out-of-control situations, instrument malfunctions, calibration failures, or other nonconformances to the group leader and quality control coordinator, as appropriate.

These responsibilities meet the general responsibilities identified in section 2.3 of the QAPP.

The ITAS Middlebrook Laboratory receives samples from the Mixed Waste Laboratory after the Mound Plant screening test results have been reviewed by the laboratory's health physicist and 1 in 10 samples are screened for gross alpha and beta. The process for determining which samples are delivered to the Middlebrook Laboratory is presented in Figure 1.

ITAS Middlebrook Laboratory participates in the US EPA CLP round-robin program.

3. ANALYTICAL METHODS

ITAS Middlebrook laboratory has been identified to perform the USATHAMA explosives and volatile organic compounds for groundwater analysis. This laboratory may also perform the other CLP methods identified for Operable Unit 9, depending upon the sample capacity at the ITAS Oak Ridge Laboratory. Table 1 lists all possible analyses to be performed by the ITAS Middlebrook Laboratory. This table also lists either the laboratory quantitation limits or instrument detection limits, which are at or below the project required limits specified in section 6 of the QAPP.

Table 1. Analytical Methods, Parameters, and Quantitation Limits Surface Water/Groundwater and Soil/Sediment Samples

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Instrument Detection Limits[a,j] Water (µg/L)	Instrument Detection Limits[a,j] Soil/Sediment (µg,L)
1. Volatile Organic Compounds (VOCs), Groundwater				
1.1. Purgeable Halocarbons	SW5030/ SW8010[b]	NA		
Vinyl chloride			0.6	NA
Trichlorofluoromethane			0.6	NA
1,1-dichloroethene			0.5	NA
Methylene chloride (dichloromethane)			2.0	NA
~~1,2 trans dichloroethene~~			~~1.0~~ 0.5	~~NA~~
1,1-dichloroethane			0.5	NA
Trichloromethane (chloroform)			0.5	NA
1,1,1-trichloroethane			0.5	NA
Carbon tetrachloride			0.5	NA
1,2-dichloroethane			0.5	NA
Trans-1,2-dichloroethene			0.5	NA
Cis-1,2-dichloroethene			TBD	NA
Trichloroethene			0.5	NA
1,2-dichloropropane			0.5	NA
Bromodichloromethane			0.5	NA
Dibromomethane			0.2	NA
2-chloroethyl vinyl ether			0.5	NA
1,3-cis-dichloropropene			0.5	NA
1,3-trans-dichloropropene			0.5	NA
1,1,2-trichloroethane			0.5	NA
Tetrachloroethene			0.5	NA
Dibromochloromethane			0.5	NA
1-chlorohexane			0.5	NA
Chlorobenzene			0.5	NA
1,1,1,2-tetrachloroethane			0.5	NA
Bromoform			0.5	NA
1,1,2,2-tetrachloroethane			0.5	NA
1,2,3-trichloropropane			0.5	NA
Phenyl bromide (bromobenzene)			0.5	NA
Chlorotoluenetca			0.5	NA
1,3-dichlorobenzene			0.5	NA
1,4-dichlorobenzene			0.5	NA
1,2-dichlorobenzene			0.5	NA
Bis(2-chloroisopropyl)ether			20	NA

NA - Not Applicable
TBD - To Be Determined

Table 1. (2 of 8)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Instrument Detection Limits[a,j] Water (µg/L)	Instrument Detection Limits[a,j] Soil/Sediment (µg/kg)
Additional Compounds:				
Methylethyl ketone (2-butanone)			TBD	NA
Methylisobutyl ketone (4-methyl-2-pentanone)			TBD	NA
Vinyl acetate			TBD	NA
1.2 Purgeable Aromatic Compounds, Groundwater	SW5030/ SW8020[b]	NA		
Benzene			0.5	NA
Chlorobenzene			0.5	NA
1,2-Dichlorobenzene			0.5	NA
1,3-Dichlorobenzene			0.5	NA
1,4-Dichlorobenzene			0.5	NA
Ethylbenzene			0.5	NA
Toluene			0.5	NA
Xylenes			0.5	NA
Additional Compounds:				
Diethylbenzene			TBD	NA
2. Volatile Organic Compounds (VOCs), Soil/Sediment and Surface Water	CLP SOW-Modification D	CLP SOW-Modification D		Low Soil/Sediment[d]
Chloromethane			0.6	0.6
Bromomethane			1.5	1.5
Vinyl Chloride			0.7	0.7
Chloroethane			1.4	1.4
Methylene chloride			1.1	1.1
Acetone			5.1	5.1
Carbon disulfide			0.6	0.6
1,1-Dichloroethene			0.4	0.4
1,1-Dichloroethane			0.2	0.2
1,2-Dichloroethene (total)			0.4	0.4
Chloroform			0.2	0.2
1,2-Dichloroethane			0.3	0.3
2-Butanone			0.3	0.3

NA - Not Applicable
TBD - To Be Determined

Table 1. (3 of 8)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Instrument Detection Limits[a] Water (µg/L)	Instrument Detection Limits[a] Sol/Sediment (µg/kg)
2. Volatile Organic Compounds (continued)	CLP SOW-Modification D	CLP SOW-Modification D		
1,1,1-Trichloroethane			0.5	0.5
Carbon Tetrachloride			0.8	0.8
Vinyl Acetate			0.1	0.1
Bromodichloromethane			0.6	0.6
1,2-Dichloropropane			0.5	0.5
cis-1,3-dichloropropene			0.4	0.4
Trichloroethene			0.9	0.9
Dibromochloromethane			0.8	0.8
1,1,2-Trichloroethane			0.8	0.8
Benzene			0.6	0.6
trans-1,3-dichloropropene			0.4	0.4
Tribromomethane			0.5	0.5
4-Methyl-2-pentanone			0.4	0.4
2-Hexanone			0.7	0.7
Tetrachloroethene			0.6	0.6
Toluene			0.6	0.6
1,1,2,2-Tetrachloroethane			0.3	0.3
Chlorobenzene			0.3	0.3
Ethylbenzene			0.7	0.7
Styrene			0.3	0.3
Xylenes (total)			0.3	0.3
Additional Compounds:				
Acrylonitrile			TBD	TBD
Acetontrile			TBD	TBD
Diethylbenzene			TBD	TBD
Trichlorotrifluoroethane			TBD	TBD
Hexane			TBD	TBD
Iodomethane			TBD	TBD

NA - Not Applicable
TBD - To Be Determined

Table 1. (4 of 8)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Instrument Detection Limits[a,] Water (µg/L)	Instrument Detection Limits[a,] Soil/Sediment (µg/kg)
3. Semivolatile Organic Compounds	CLP SOW-Modification D	CLP SOW-Modification D		Low Soil/Sediment[d]
Phenol			3.8	110
bis(2-chloroethyl) ether			4.1	120
2-Chlorophenol			3.7	110
1,3-Dichlorobenzene			0.6	18
1,4-Dichlorobenzene			3.3	99
Benzyl alcohol			7.1	210
1,2-Dichlorobenzene			2.6	78
2-Methylphenol			4.9	150
bis(2-chloroisopropyl) ether			5.0	150
4-Methyphenol			2.5	75
N-nitroso-di-n-dipropylamine			3.8	110
Hexachloroethane			1.6	48
Nitrobenzene			1.1	33
Isophorone			1.3	39
2-Nitrophenol			3.4	100
2,4-Dimethylphenol			0.9	27
Benzoic acid			11.0	330
bis(2-chloroethoxy) methane			1.2	36
2,4-Dichlorophenol			3.4	100
1,2,4-Trichlorobenzene			1.9	57
Naphthalene			1.7	51
4-Chloroaniline			5.0	150
Hexachlorobutadiene			3.1	93
4-chloro-3-methylphenol (para-chloro-meta-cresol)			1.9	57
2-Methylnaphthalene			1.1	33
Hexachlorocyclopentadiene			2.9	87
2,4,6-Trichlorophenol			3.3	99
2,4,5-Trichlorophenol			2.2	66
2-Chloronaphthalene			3.0	90
2-Nitroaniline			2.2	66

NA - Not Applicable

Table 1. (5 of 8)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Instrument Detection Limits[a,j] Water (µg/L)	Instrument Detection Limits[a,j] Sol/Sediment (µg/kg)
3. Semivolatile Organic Compounds (continued)	CLP SOW-Modification D	CLP SOW-Modification D		
Dimethylphthalate			4.1	120
Acenaphthylene			6.0	180
2,6-Dinitrotoluene			8.0	240
3-Nitroaniline			9.3	280
Acenaphthene			3.0	90
2,4-Dinitrophenol			3.1	93
4-Nitrophenol			6.7	200
Dibenzofuran			3.0	90
2,4-Dinitrotoluene			3.0	90
Diethylphthalate			2.6	78
4-Chlorophenyl-phenyl ether			2.4	72
Fluorene			3.1	93
4-Nitroaniline			8.3	250
4,6-Dinitro-2-methylphenol			2.7	81
N-nitrosodiphenylamine			10	300
4-bromophenyl-phenylether			5.3	160
Hexachlorobenzene			6.8	200
Pentachlorophenol			3.7	110
Phenanthrene			5.0	150
Anthracene			2.2	66
Di-n-butylphthalate			8.8	260
Fluoranthene			6.0	180
Pyrene			4.6	140
Butylbenzylphthalate			6.4	190
3,3'-Dichlorobenzidine			11	330
Benzo(a)anthracene			1.6	48
Chrysene			4.8	140
bis(2-Ethylhexyl)phthalate			5.6	170
Di-n-octylphthalate			5.6	170
Benzo(b)fluoranthene			7.7	230
Benzo(k)fluoranthene			2.9	87
Benzo(a)pyrene			7.0	210
Indeno(1,2,3-cd)pyrene			5.9	180
Dibenz(a,h)anthracene			8.8	260
Benzo(g,h,i)perylene			4.6	140

NA - Not Applicable
TBD - To Be Determined

Table 1. (6 of 8)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Instrument Detection Limits[a,j] Water (µg/L)	Instrument Detection Limits[a,j] Sol/Sediment (µg/kg)
Additional Compounds:				
2-benzyl-4-chlorophenol			TBD	TBD
4. Pesticides and PCBs	CLP SOW-	CLP SOW-	Quantitation Limits[a]	
alpha-BHC			0.05	1.7
beta-BHC			0.05	1.7
delta-BHC			0.05	1.7
gamma-BHC (Lindane)			0.05	1.7
Heptachlor			0.05	1.7
Aldrin			0.05	1.7
Heptachlor epoxide			0.05	1.7
Endosulfan I			0.05	1.7
Dieldrin			0.10	3.3
4,4'-DDE			0.10	3.3
Endrin			0.10	3.3
Endosulfan II			0.10	3.3
4,4'-DDD			0.10	3.3
Endosulfan sulfate			0.10	3.3
4,4'-DDT			0.10	3.3
Methoxychlor			0.5	17.0
Endrin ketone			0.10	3.3
Endrin aldehyde			0.10	3.3
alpha-Chlordane			0.05	1.7
gamma-Chlordane			0.05	1.7
Toxaphene			5.0	170.0
Aroclor-1016			1.0	33.0
Aroclor-1221			2.0	67.0
Aroclor-1232			1.0	33.0
Aroclor-1242			1.0	33.0
Aroclor-1248			1.0	33.0
Aroclor-1254			1.0	33.0
Aroclor-1260			1.0	33.0
5. Metals (Target Analyte List)	CLP SOW- Modification A	CLP SOW- Modification A	Instrument Detection Limits[i]	(mg/kg)
Aluminum			40	4.0
Antimony			30	3.0
Arsenic			2	0.2
Barium			2	0.2

NA - Not Applicable
TBD - To Be Determined

Table 1. (7 of 8)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Water (µg/L)	Sol/Sediment (µg/kg)
5. Metals (Target Analyte List) (continued)	CLP SOW-Modification A	CLP SOW-Modification A	Instrument Detection Limits[1]	(mg/kg)
Beryllium			1	0.1
Cadmium			5	0.5
Calcium			30	3.0
Chromium			10	1.0
Cobalt			20	2.0
Copper			10	1.0
Iron			10	1.0
Lead			2	0.2
Magnesium			30	3.0
Manganese			2	0.2
Mercury			0.2	0.02
Nickel			20	0.2
Potassium			1000	100
Selenium			2	0.2
Silver			5	0.5
Sodium			200	20
Thallium			2	0.2
Vanadium			10	1.0
Zinc			5	0.5
Additional Compounds:				
Molybdenum			TBD	TBD
Tin			TBD	TBD
Bismuth			TBD	TBD
Lithium			TBD	TBD
				(mg/kg)
6. Cyanide	CLP SOW-	CLP SOW-	10	2

NA - Not Applicable

Table 1. (8 of 8)

Parameters	Analytical Methods Water	Analytical Methods Soil/Sediment	Instrument Detection Limits[a,j] Water (µg/L)	Instrument Detection Limits[a,j] Soil/Sediment (µg/kg)
7. ~~9.~~ Explosives	USATHAMA[i] UW-11	USATHAMA[i] LW-06	(mg/L) Instrument Detection Limit[j] (µg/L)	(mg/kg) Practical Quantitation Limit (mg/kg)
HMX			1.9	2.9
RDX			1.9	2.2
NB			0.9	1.3
1,3-DNB			0.9	1.2
1,3,5-TNB			0.9	1.3
2,4-DNT			0.9	0.3
2,6-DNT			0.9	1.3
TNT			0.9	1.3
2A,4,6-DNT			0.2	1.3
Tetryl			0.9	2.2\
PETN			TBD	TBD

TBD - To Be Determined

[a] For non-CLP analyses, these are expected method detection limits based on reagent grade water or a purified solid matrix. Actual quantitation limits may be higher depending upon the nature of the sample matrix. The limit reported on final laboratory reports will take into account the actual sample volume or weight, percent moisture (where applicable), and the dilution factor, if any.

[b] "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd edition, U.S. EPA, November 1986.

[c] "U.S. EPA Contract Laboratory Program, Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration." SOW No. 2/88 including revisions 9/88 and 6/89 or most recent version. Pesticides/PCBs will be analyzed according to CLP SOW Document No. OLM01.0, including revisions 0.1 (December 1990) and 0.2 (January 1991). Quantitation limits are contract-required quantitation limits (CRQLs).

[d] Medium Soil/Sediment CRQLs are 125 times the low soil/sediment CRQLs for volatile organic compounds and 60 times the low soil/sediment CRQLs for semivolatile organic compounds. Estimated detection limits for metals in soil are based on a 1-gram sample diluted to 200 mL.

[e] "U.S. EPA Contract Laboratory Program, Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration." SOW No. 7/88 including revisions 2/89 and 6/89 or most recent version. Quantitation limits are CRDLs.

[f] Based on a 10-gram soil sample and 100 mL volume of extractant and a soil moisture content between 0 and 10 percent (rounded). Actual quantitation limit will vary with the sample and extractant amounts and will depend upon the nature of the soil matrix.

[g] "Methods for Chemical Analysis of Water and Wastes," U.S. EPA, EPA-600/4-79-020 revised March 1983

[h] If soils are acidic, CEC will be analyzed by "Method of Soil Analysis, Part 2 Chemical and Microbiological Properties," by H. D. Chapman, American Society of Agronomists. 1965.

[i] USATHAMA Method UW-11, "Ion Nitroexplosives in Water by HPLC," and USATHAMA Method LW-06, "Nitroexplosives in Soil by HPLC," IT Laboratories, Knoxville, TN.

4. LABORATORY SAMPLE CUSTODY PROCEDURES

In addition to the custody procedures specified in section 5.1.2 of the QAPP, the following procedures are carried out in the Middlebrook Laboratory.

4.1. SAMPLE RECEIPT

The following checks are performed upon sample receipt:

- Seals and tapes on the cooler,
- Sample containers,
- Ice in cooler,
- Sample IDs on Chain of Custody and on bottles,
- Sufficient sample volume,
- Number samples in cooler and noted on chain of custody,
- label sample bottles with client specific ID - a three- or four-letter code followed by five digits; and
- non-conformance entered on non-conformance forms.

4.2 RECORD KEEPING

Sample information from the chain of custody is entered into the laboratory computerized management system. A coding package is produced which contains a chain of custody, a completed Request for Analysis form, and a printout of the entered sample information. This package is sent to the group leaders. An internal tracking form is used to track the samples in the laboratory, shown as Figure 2.

PAGE NO.:

Project Code
EPA Case #
Sample Nos

INTERNAL CHAIN-OF-CUSTODY FORM
IT Analytical Services - Oak Ridge Laboratory

WORKORDER NO.:

Sample No.	Date	Time	Extr/ Digt/ Smpl	Moved From	Moved To	Reason	Signature

O = Original sample
D = Distillate (specify)
A = Acid extract
P = Pest./PCB extract
E = BN/AE extract
V = VOAs sample

WH = Water, HCl finish
WN = Water, HNO_3 finish
DH = Soil/sediment, HCl finish
DN = Soil/sediment, HNO_3 finish
B = Base Neutral extract

Figure 4.1. Internal Chain-of-Custody Form

5. LABORATORY DATA REDUCTION PROCEDURES

All raw analytical data are recorded in numbered and bound laboratory notebooks issued by the quality assurance officer. Data are recorded and are associated with the unique laboratory sample identification number and the field sample identifier. For inorganic (nonmetal) analyses, the bound notebook pages are preformatted for each analytical method. Those pages contain the following:

- analytical method,
- analyst,
- date,
- reagent concentrations,
- instrument settings (as applicable), and
- raw data.

The laboratory analysts sign and date all notebook entries daily. The notebook pages are reviewed periodically by the section manager before final data assembly. Copies of strip-chart outputs (for example, chromatograms) are maintained on file.

At the completion of a set of analyses, all calculations are completed and are checked by the analyst. Calculations using raw data to obtain final concentrations are performed according to the procedures described in the specified analytical method. Laboratory data reduction procedures are provided in the respective IT Laboratory SOPs and in the CLP SOW. The associated quality control data (laboratory duplicates, surrogates, matrix spikes, and MSDs) are entered onto quality control charts and are verified as being within control limits. If all data are acceptable, the data are entered into the laboratory computer system, and the data summaries (including raw data) are submitted to the section manager for review. After approval, data are subsequently entered into the project database format. Data outside control limits will be reported with a qualifier on the CLP reporting forms for CLP data packages. Case narratives will note any out-of-control situations for non-CLP analyses. After the laboratory section manager approves, the laboratory data manager is notified that the data are ready to be reported, and the completed analyses are removed from the laboratory backlog. A hard-copy data summary is then generated that is reviewed and is signed by the laboratory section manager and/or laboratory manager.

6. LABORATORY DATA VALIDATION PROCEDURES

Prior to the final production of analytical reports, laboratory data are reviewed and verified according to ITAS procedures described in the ITAS Quality Assurance Manual in section 10.2, Data Validation. The ITAS data review procedures are based on two activities:

- processing quality control sample results; and
- data validation of reporting analytical results.

Precision and accuracy of the analyses are evaluated with the quality control sample results. Control charts prepared from statistical evaluation of quality control sample results (e.g., matrix spikes and matrix spike duplicates) are used to compare results to established control limits.

Data validation consists of review of data processing and data reporting. Twenty percent of all data processed will be checked by an independent analyst using one of two procedures.

One procedure involves the check of a copy of the data for the appropriateness of the equations used, correctness of numerical input, corrections of calculations, and correct interpretation of raw data. Any changes are agreed upon by both the reviewer and originator of the data. If any errors are found, a 100 percent check of the data is performed.

The other procedure entails marking original data in black ink for review. Changes are backchecked and conformances and corrective actions are documented. The frequency of checks using this procedure is the same.

Data reports are reviewed against the processed data by the analyst or group leader. The operations manager then reviews the data report to ensure that it meets project requirements. The laboratory manager gives final approval of issuance of the laboratory report.

7. PREVENTIVE MAINTENANCE

The preventive maintenance program is the responsibility of the group leaders, however, an instrument maintenance department performs in house corrective maintenance and the difficult preventive maintenance procedures. Table 2 summarizes the relevant equipment, items checked on the equipment, and the frequency of each check. Preventive maintenance records are maintained in a central file or in individual instrument log books. The schedule of maintenance is posted in front of each respective log book. The maintenance procedures performed are documented in the log book.

Table 2. Preventive Maintenance Requirements
ITAS Middlebrook Laboratories
Knoxville, Tennessee

APPLICABLE ANALYTICAL METHOD	INSTRUMENT	ITEMS CHECKED/SERVICED	MINIMUM FREQUENCY
Metals	Inductively Coupled Argon Plasma (ICAP)	Replace Pump Tubing	As Needed
		Inspect and Clean Sample Introduction System	As Needed
		Drain Air Filters	Semi-weekly
		Check Drain Receptacle Level	Weekly
		Clean Torch	Monthly
Metals	Atomic Absorption Spectrometer for Mercury Analysis	Replace Check Valves	As Needed
		Check Pump Delivery	As Needed
		Check Tubing Integrity	As Needed
		Clean Burner/Adsorption Cell Mount	Monthly
		Clean Adsoption Cell	Monthly
		Replace System Tubing	Semi-annually
Metals	Atomic Absorption Spectro-photometer Flame Units	Inspect Backflash Diaphram	As Needed
		Check Drain Receptacle Level	As Needed
		Replace Nebulizer Chamber O-rings	As Needed
		Replace Beam Splitter	As Needed
		Clean Nebulizer	Weekly
		Clean Burner Head	Weekly
		Clean Spray Chamber	Weekly
		Remove and Clean Burner Mount	Monthly

TABLE 2. (2 of 6)

APPLICABLE ANALYTICAL METHOD	INSTRUMENT	ITEMS CHECKED/SERVICED	MINIMUM FREQUENCY
Metals	Graphite Furnace 951/655	Replace Graphite Cuvetter	As needed
		Replace Fry-Rite and Glass Wool	As needed
		Check Drain Receptacle	As needed
		Replace Temperature Sensor	As needed
		Clean Electrodes	As needed
		Replace Graphite Inserts	As needed
		Replace Electrodes and Sensor Posts	As needed
		Check Graphite Insert	Weekly
		Check Recirculator Water Level	Weekly
		Replace Set Screw	Weekly
		Check Electrode Appearance	Weekly
		Clean Nebulizer and Spray Chamber	Monthly
		Clean Furnace Chamber and Windows	Monthly
		Clean Furnace Head with Actic Acid	Semi-Annually
		Replace Recirculator Water	Semi-Annually
Metals	Graphite Furnace 12 E/188	Check Drain Receptacle	As needed
		Clean Sapphire Window	As needed
		Replace Graphite Cuvette	As needed
		Clean Cell Body and Windows	Weekly
		Replace Marble Chips	Weekly
		Check Recirculator Water Level	Weekly
		Clean Temperature Sensor Filter	Semi-Montly
		Clean FASTAC Pump	Monthly
		Clean Nebulizer and Spray Chamber	Monthly
		Clean Air Filter	Monthly
		Flush Furnace Head with Acetic Acid	Semi-Annually
		Replace Recirculator Water	Semi-Annually

TABLE 2. (3 of 6)

APPLICABLE ANALYTICAL METHOD	INSTRUMENT	ITEMS CHECKED/SERVICED	MINIMUM FREQUENCY
USATHAMA Explosives	High Performance Liquid Chromatography (HPLC)	Degas Solvents	Daily when used
		Check for Leaks	Daily when instrument used
		Flush Column	Daily when instrument used
		Check Injector for Blockage/Pressure Drop	Daily when instrument used
		Check Column Pressure	Daily when instrument used
		Replace Lamp	As needed
		Replace Guard Column	As needed
	Organic Prep: Sonicator	Inspect Prope Tips for Etching/Pitting	Daily when used
		Replace Probe Tip	As needed
		Disassemble and Clean Sonicator Probe Tips	Semi-Annually
		Tune Sonicator	Semi-Annually
	pH Meters	Gel Filled	Maintenance Free
		Electronics Checked	As needed
	UV/VIS Spectrophotometer	Replace Lamp	As needed
		Check tubing	Daily
	Millipore Water System	Conductivity Check	Daily
		Pressure Check	Daily
		Change Ion Exchange Bed and Filters	As needed
	Analytical Balance	Internal Weight Train, Gears, Electronics	Annually by Service Contract

TABLE 2. (4 of 6)

APPLICABLE ANALYTICAL METHOD	INSTRUMENT	ITEMS CHECKED/SERVICED	MINIMUM FREQUENCY
SW8010, SW8020, Pesticides/PCBs	Gas Chromatograph	Inlet, Detector and Column Temperatures	Daily when instrument in use
		Gas pressures	Daily
		Column and Detector Flow Rates	Daily when instrument in use
		Check Zero and Noise Level	Daily when instrument in use
		Check Responses, Retention Times using a Check Standard	Daily when instrument in use
		Gas Purity check	As needed
		Check Autosampler for Bubbles, Flush Volume	Daily when instrument in use
		Reactor Tube Temperature (HALL only)	Daily when instrument in use
		Check Pressure in Gas Tanks, Replace in <500 PSI	Weekly
		Clean Outside Surfaces of Instruments	Weekly
		Replace Septa	As needed
		Replace Column or Part of Column Packing	As needed
		Clean/Replace Detector	As needed
		Replace Glass Wool/Glass Insert	As needed
		Clean Injection Port	As needed
		Replace Reaction Tube (HALL only)	As needed
	Refrigerators	Temperature Checked and Logged	Daily
	Walk-In Coolers	Temperature Checked and Logged	Daily
	Ovens	Temperature Checked and Logged	Daily

TABLE 2. (5 of 6)

APPLICABLE ANALYTICAL METHOD	INSTRUMENT	ITEMS CHECKED/SERVICED	MINIMUM FREQUENCY
SW5030	GC Purge and Trap	Check Zone Temperatures	Daily when in use
	GC Purge and Trap Autosampler	Helium Tank Pressure (>500 PSI)	Daily when in use
		Purge and Trap Regulatore Pressure	Daily when in use
		Bake Trap	Daily when in use
		Replace Trap	As needed
		Acid Wash Purge Vessel	As needed
		Leak Test	As needed
	Total Organic Carbon Analyzer	Gas Tank Pressure	Daily when in use
		N^2 and O^2 Regulator Pressure	Daily when in use
		Zone Temperature	Daily when in use
		Purge and Detector Flow Rates	Daily when in use
		Clean Prot Valves	After 72 hours of operation
		Purge Gas and Detector Leak Test	After 72 hours of operation
	GC/MS	Diffusion Pump Oil	Bi-Weekly
		Mechanical Pump Oil	Quarterly
		Power Con. Air Filter	Bi-Weekly
		QEM Filter	Bi-Weekly
		Water Bay Filter	Bi-Weekly
		Interface Box	Bi-Weekly
		Vacuum Chaff Filter	Monthly
		Turbo Pump Oil	Quarterly
		Water Filter (if applicable)	Observe and change as needed
		Computer Air Filter	Monthly
		Card Cage Air Filter	Monthly
		Source-Clean Ceramics, Polish Lenses	As needed
		Clean Poles and Ceramics on the Poles	As needed
		Clean Contacts on the Component Boards	As needed

TABLE 2. (6 of 6)

APPLICABLE ANALYTICAL METHOD	INSTRUMENT	ITEMS CHECKED/SERVICED	MINIMUM FREQUENCY
SW5030 (continued)	GC/MS (continued)	Vacuum the Component Boards	As needed
		Clean all Fan Screens	Weekly
		Vacuum Outside of Instrument	Weekly
		Clean Grob and Replace Quartz Insert	As needed
		Replace Septum	Daily (each shift)
		Injection Port Liner Checked	Daily
		Column maintenance	As needed
		Disk Drive (CMD only)	Semi-Annual (Service Engineer) or as needed
		Printer	Quarterly

8. SPECIFIED ROUTINE PROCEDURES FOR ASSESSING PRECISION AND ACCURACY

The ITAS procedures for assessing analytical accuracy and precision are those specified in section 12 of the QAPP. In addition, blank duplicates are introduced once per month by the quality assurance group for one analysis (volatile organic compounds, semivolatile organic compounds, pesticides/PCBs, metals, explosives or general chemistry).

REMEDIAL INVESTIGATION/FEASIBILITY STUDY

OPERABLE UNIT 9

QUALITY ASSURANCE PROJECT PLAN

Attachment 3

Laboratory Specifications

Analytical Services - Geotechnical Analysis Laboratory, Oak Ridge, Tennessee

June 1992

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1. INTRODUCTION

The laboratory specifications attachment serves the purpose of providing elements of the Operable Unit 9 Quality Assurance Project Plan (QAPP) which are specific to a named laboratory. Providing the information in the form of an attachment allows for the use of more than one laboratory for an investigation. It is the hope that scheduling conflicts and laboratory capacity issues are minimized with the provisions of laboratory specifications attachments. This attachment, attachment 3, provides the information on the Geotechnical Analysis Laboratory (Geo Lab) operated by the IT Technology Development Laboratory (TDL) at the IT Environmental Technology Development Center (ETDC) in Oak Ridge, Tennessee.

2. LABORATORY RESPONSIBILITIES

The TDL Director and Quality Control Coordinator serve the same function for the ITAS TDL-Geotechnical Analysis Laboratory (Geo Lab). The following are the specific Geo Lab quality assurance related responsibilities:

- The director:
  - reports directly to Vice President, IT Analytical Services, or Regional Director Analytical Operations;
  - implements the Quality Assurance Program within the laboratory;
  - periodically determines the effectiveness of the Quality Assurance Program in the laboratory;
  - approves laboratory-specific attachments to the Quality Assurance Manual and Project-Specific Manuals (QAPjPs), SOPs, and revisions;
  - recommends to the Quality Assurance/Control Director, ITAS, changes in the Quality Assurance Program;
  - maintains current laboratory organization chart;
  - supervises laboratory participation in inter-laboratory accreditation and proficiency programs.
- The operations manager:
  - approves final issuance of laboratory reports;
  - manages laboratory daily analytical and treatability testing operations;
  - supervises Quality Control activities performed as part of routine operations;
  - consults on development of experimental plans;
  - reviews experimental plans for technical correctness and safety;
  - supervises the preparation and maintenance of laboratory records;
  - oversees preventive maintenance program;
  - organizes and schedules the analytical testing program with consideration for sample-holding times;
  - implements data verification procedures;
  - assigns analysts for data processing and validation activities;

- reviews and approves all analytical data;
- evaluates instrument performance and supervises instrument calibration and preventive maintenance programs;
- reports out-of-control or nonconforming situations to Laboratory Director and Quality Control Coordinator (QCC) as appropriate.

- The project manager:
  - provides technical overview of laboratory activities;
  - defines and oversees the training program;
  - approves final issuance of reports, as directed by the operations manager;
  - evaluates new analytical techniques, procedures, instrumentation, and quality control procedures and provide recommendations to the laboratory director;
  - defines the calibration program for instrumentation within the laboratory;
  - defines and oversee the instrument preventive maintenance program and schedule;
  - supervises the verification of software for data processing; and
  - recommends standards for purchasing instruments, equipment, reagents, gases, and chemicals.
- The quality control coordinator:
  - prepares Quality Control standards, arranges insertion of Quality Control samples into the laboratory sample stream, and reviews the results;
  - performs statistical analyses utilizing results of QC samples analyses;
  - informs the Laboratory Director and Group Managers of data which lie outside of acceptable limits;
  - serves as the "focal point" for reporting and disposition of nonconformances; verifies corrective action;
  - resolves ongoing and recurring nonconformances within the Laboratory;
  - recommends corrective actions for resolution of nonconformances; verifies corrective action;
  - reviews statistical data to verify the laboratory is meeting stated QC goals;
  - maintains current distribution lists for Laboratory-Specific Attachments and Project-Specific Manuals and SOPs;

- closes findings and recommendations of QA audits;
- notifies the Laboratory Director of out-of-control situations;
- stops production of data in a laboratory area where the review of QC data or procedures shows significant problems;
- reports nonconformances to the ITAS Director of Quality and Compliance or the Director, QA, Environmental Project Group if the situation is not corrected within the laboratory;
- assists in the performance of QA audits and performs QC audits;
- establishes and supervises the laboratory QA training program;
- prepares/reviews QA project plans.

- The health physicist:
  - ensures that the provisions of the ETDC Radioactive Materials Handling License are implemented;
  - acts as the Radiation Safety Officer; and
  - coordinates the receipt and shipment of all radioactive contaminated samples.
- Analysts/chemists/technicians:
  - perform analytical procedures and data recording in accordance with accepted methods;
  - perform and document calibration and preventive maintenance of instrumentation, as required in associated procedures;
  - perform data processing and validation; and
  - immediately report out-of-control situations, instrument malfunctions, calibration failures, or other nonconformances to the group leader and quality control coordinator, as appropriate.

The TDL-Geo Lab receives samples from the Mixed Waste Laboratory after the Mound Plant screening test results have been reviewed by the laboratory's health physicist and 1 in 10 samples are screened for gross alpha and beta.

3. ANALYTICAL METHODS

The TDL-Geo Lab laboratory has been identified to perform geotechnical analyses. Table I lists all possible analyses to be performed by TDL-Geo Lab. This table also lists the laboratory quantitation limits, which are at or below the project required limits specified in section 6 of the QAPP.

Table 1. Analytical Methods, Parameters, and Quantitation Limits - Soil/Sediment Samples

Parameters	Analytical Methods Soil/Sediment	Quantitation Limits Soil/Sediment
1. Cation Exchange Capacity	SW/9081	5 mg/L
2. Particle Size Analysis	ASTM D422-63	NA
3. Specific Gravity	ASTM D854-83	NA
4. Moisture Content	ASTM D2974-87	NA
5. Organic Content	ASTM D2974-87	NA
6. Hydraulic Conductivity	ASTM D2434-68	NA
7. Relative and Minimum Density	ASTM D4254-83	NA
8. Maximum Density	ASTM D4253-83	NA

4. LABORATORY SAMPLE CUSTODY PROCEDURES

Custody procedures specified in section 5 of the QAPP will be followed by TDL-Geo Lab.

5. LABORATORY DATA REDUCTION PROCEDURES

All raw analytical data are recorded in numbered and bound laboratory notebooks issued by the quality assurance officer. Data are recorded and are associated with the unique laboratory sample identification number and the field sample identifier. For inorganic (nonmetal) analyses, the bound notebook pages are preformatted for each analytical method. Those pages contain the following:

- analytical method,
- analyst,
- date,
- reagent concentrations,
- instrument settings (as applicable), and
- raw data.

The laboratory analysts sign and date all notebook entries daily. The notebook pages are reviewed periodically by the section manager before final data assembly. Copies of strip-chart outputs (for example, chromatograms) are maintained on file.

At the completion of a set of analyses, all calculations are completed and are checked by the analyst. Calculations using raw data to obtain final concentrations are performed according to the procedures described in the specified analytical method. Laboratory data reduction procedures are provided in the respective IT Laboratory SOPs and in the standard methods. The associated quality control data (laboratory duplicates, surrogates, matrix spikes, and MSDs) are entered onto quality control charts and are verified as being within control limits. If all data are acceptable, the data are entered into the laboratory computer system, and the data summaries (including raw data) are submitted to the section manager for review. After approval, data are subsequently entered into the project database format. Data outside control limits will be reported with a qualifier on the CLP reporting forms for CLP data packages. Case narratives will note any out-of-control situations for non-CLP analyses. After the laboratory section manager approves, the laboratory data manager is notified that the data are ready to be reported, and the completed analyses are removed from the laboratory backlog. A hard-copy data summary is then generated that is reviewed and

is signed by the laboratory section manager and/or laboratory manager.

The equation used to calculate sample dry weight for particle size analysis in SOP TDL-2104 will be as follows:

Sample dry weight = sample wet weight x [1 -(% moisture/100)]

This equation will supersede any other equations for sample dry weight in laboratory SOPs.

6. LABORATORY DATA VALIDATION PROCEDURES

Prior to the final production of analytical reports, laboratory data are reviewed and verified according to ITAS procedures described in the ITAS Quality Assurance Manual in section 10.2, Data Validation. The ITAS data review procedures are based on two activities:

- processing quality control sample results; and
- data validation of reporting analytical results.

Precision and accuracy of the analyses are evaluated with the quality control sample results. Control charts prepared from statistical evaluation of quality control sample results (e.g., matrix spikes and matrix spike duplicates) are used to compare results to established control limits.

Data Validation

Validation of data takes place on three levels in the Geo Lab. The first level of validation takes place during the analysis, and is designed to identify problems as they develop. The individual performing the analysis looks for anything out of the ordinary, or that may have an affect on the analysis. When something out of the ordinary is detected, it is reviewed by the analyst and the laboratory supervisor, and a decision is made as to what action(s) should be performed.

The second level ensures that data are accurately entered into the computer data base. A printout of the entered data shall be compared to the original data sheet by someone other than the person who entered the data. This review is documented on the original data sheet by the reviewer placing their initials and the date of review on the data sheet. Check marks should be used to identify those items that were reviewed. The computer printout need not be a permanent record.

At least 20 percent of all manual calculations shall be recalculated by someone other than the person who performed the original calculations. Calculations performed by validated computer program need not be checked.

Ensuring that the reported data are reasonable, and fully explained is the third level of validation. Either the laboratory supervisor, the project manager, or the operations manager will review the final report. This review will be for completeness, data reasonableness, and report format. If time allows, two of the above three people should review the report, but in no case shall there be less than two reviewers. This review will be documented on a report checklist (see Figure TDL 11-3 in the TDL QAM) which is maintained with the final report in the project file.

Data reports are reviewed against the processed data by the analyst or group leader. The project manager then reviews the data report to ensure that it meets project requirements. The operations manager gives final approval of issuance of the laboratory report.

7. PREVENTIVE MAINTENANCE

The preventive maintenance program is the responsibility of the project managers. An individual record is maintained for each equipment item requiring periodic maintenance. This record contains all information required to identify the item, and a dated and initialed entry describing each maintenance action. Calibration information may also be entered in the maintenance log. Table 2 summarizes the relevant equipment, items checked on the equipment, and the frequency of each check.

Table 2. Preventive Maintenance Requirements, ITAS Middlebrook Laboratories, Knoxville, Tennessee

Applicable Analytical Method	Instrument	Items Checked/Serviced	Minimum Frequency
CEC	Thermo Jarrell Ash	Vacuum pump	Quarterly
	Atom scan 25		Quarterly
Particle Size Analysis	Balance	Balance	Daily
	Sieve shaker	#200 Sieve and smaller	Replaced annually
	Thermometer	Calibrated	Replaced annually
	Hydrometer	Calibrated	Replaced annually
Specific Gravity	Balance	Balance	Daily
	Pycrometer	Pycrometer	Each use
Moisture Content	Oven	Thermometer	Calibrated annually
	Balance	Balance	Daily

8. SPECIFIED ROUTINE PROCEDURES FOR ASSESSING PRECISION AND ACCURACY

Quality control procedures for the analytical methods used by TDL-Geo Lab are specified in Table III.2 of the QAPP.

REMEDIAL INVESTIGATION/FEASIBILITY STUDY

OPERABLE UNIT 9

QUALITY ASSURANCE PROJECT PLAN

Attachment 4

Laboratory Specifications for IT Analytical

Services - St. Louis Laboratory

March 1993

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1. INTRODUCTION

The laboratory specifications attachment serves the purpose of providing elements of the Operable Unit 9 Quality Assurance Project Plan (QAPP) that are specific to a named laboratory. Providing the information in the form of an attachment allows for the use of more than one laboratory for an investigation. It is intended that scheduling conflicts and laboratory capacity issues are minimized with the provision of laboratory specifications attachments. This attachment, attachment 4, provides information on International Technologies Analytical Services (ITAS) St. Louis Laboratory in Earth City, Missouri.

2. LABORATORY RESPONSIBILITIES

ITAS is required to meet the quality assurance requirements presented in the QAPP. ITAS St. Louis participates in the USEPA RAD Intercomparison Studies, DOE Environmental Measurements Laboratory Quality Assurance Programs, USEPA Water Pollution Study (WP), and the USEPA Drinking Water Study (WS). The following are specific ITAS St. Louis Laboratory quality-assurance related responsibilities:

- The laboratory director
    - reports directly to the Vice President of ITAS;
    - implements the QAP within the laboratory;
    - periodically determines the effectiveness of the QAP in the laboratory;
    - approves laboratory-specific attachments to the Quality Assurance Manual, project-specific manuals, SOPs, and revisions;
    - recommends changes in the QAP to the ITAS director of quality assurance and compliance;
    - issues laboratory reports;
    - maintains a current laboratory organization chart; and
    - supervises laboratory participation in inter-laboratory accreditation and proficiency programs.
    - manages daily laboratory analytical operations and supervises quality control activities performed as part of routine analytical operations,
    - supervises the preparation and maintenance of laboratory records,
    - oversees the log-in of all samples received and supervises sample storage facilities, and
- The director of total quality
    - provides technical overview of laboratory activities and serves as an "in-house" consultant for the applicability of general quality control practices to specific needs;
    - leads the training of analysts in laboratory operations and analytical procedures;
    - evaluates analytical techniques, procedures, instrumentation, and quality control procedures and provides recommendations to the laboratory manager;
    - supervises the verification of software for data processing;

- recommends standards for purchasing instrumentation, equipment, reagents, gases, and chemicals; and
- defines the calibration program within the laboratory.

- The quality control coordinator
  - coordinates preparation of quality control standards, arranges insertion of quality control samples into the laboratory sample stream, and reviews the results;
  - performs statistical analyses, using results of quality control sample analyses to verify that the laboratory is meeting stated quality control goals;
  - informs the laboratory director and group leaders of data which occur outside of acceptable limits;
  - serves as the "focal point" for the reporting and disposition of nonconformances within the laboratory and verifies corrective actions for all nonconformances;
  - notifies the technical director and laboratory manager of out-of-control situations;
  - reports unresolved nonconformances to the ITAS director of quality assurance and compliance;
  - stops production of data in laboratory areas where the review of quality control data or procedures shows significant problems;
  - assists in the performance of quality assurance audits and performs quality control audits and surveillances;
  - closes findings and recommendations of quality assurance audits;
  - establishes and supervises the laboratory quality assurance training program;
  - maintains current distribution lists for laboratory-specific attachments, project-specific manuals, and SOPs; and
  - reviews a minimum of 5% of all laboratory data after analyst cross-checks.
  - defines the instrument preventive maintenance schedule and oversees the preventive maintenance program.
- Group supervisors
  - ensure calibration and preventive maintenance are performed as required,

  - perform data validation and final raw data reviews,
  - report out-of-control situations to the quality control coordinator,
  - review and create in-house data forms,
  - verify technical accuracy of internal procedures and forms, and
  - perform analytical procedures and data recording in accordance with accepted procedures.

- Analysts
  - perform analytical procedures and data recording in accordance with accepted methods;
  - perform and document calibration and preventive maintenance of instrumentation, as appropriate;
  - perform data processing and validation;
  - immediately report out-of-control situations, instrument malfunctions, calibration failures, or other nonconformances to the group leader and quality control coordinator, as appropriate; and
  - prepare data summaries or data reporting forms for use in preparation of final reports.

These responsibilities meet the general responsibilities identified in section 2.3 of the QAPP.

The ITAS St. Louis Laboratory may receive samples from the ITAS Oak Ridge Laboratory when the Oak Ridge Facility lacks sufficient capacity. Samples for an assigned field batch may not be split between two laboratories in order to maintain data comparability. The use of ITAS St. Louis must be approved by the EG&G subcontractor Quality Assurance Manager (QAM) prior to shipment of samples.

ITAS St. Louis participates in the USEPA RAD Intercomparison Studies, the US DOE Environmental Measurement Laboratory, Cross-check Program, the USEPA Water Pollution (WP) Study, and the USEPA Drinking Water Study (WS).

3. ANALYTICAL METHODS

ITAS St. Louis Laboratory has been identified as a laboratory to perform the radiological and chemical analyses listed on Table 1. The analytical methodology to be followed is specified in section 6 of the QAPP. The laboratory will meet the reporting limits specified in Section 6 of the QAPP for the analyses in Table 1.

Table III.1. Laboratory Detection Limits

Parameters	Analytical Methods		Method Detection Limit	
	Water	Soil/ Sediment	Water (µg/L)	Soil/ Sediment (µg/L)
1. Volatile Organic Compounds (VOCs), Groundwater				
	SW5030/ SW8021	NA		
Vinyl chloride			0.04	NA
Trichlorofluoromethane			0.06	NA
1,1-dichloroethene			0.06	NA
Methylene chloride (dichloromethane)			0.2	NA
1,1-dichloroethane			0.02	NA
Trichloromethane (chloroform)			0.08	NA
1,1,1-trichloroethane			0.10	NA
Carbon tetrachloride			0.07	NA
1,2-dichloroethane			0.04	NA
Trans-1,2-dichloroethene			0.04	NA
Trichloroethene			0.06	NA
1,2-dichloropropane			0.04	NA
Bromodichloromethane			0.06	NA
Dibromomethane			0.5	NA
1,1,2-trichloroethane			0.05	NA
Tetrachloroethene			0.2	NA
Dibromochloromethane			0.4	NA
Chlorobenzene			0.7	NA
1,1,1,2-tetrachloroethane			0.4	NA
Bromoform			0.05	NA
1,1,2,2-tetrachloroethane			0.07	NA
1,2,3-trichloropropane			0.4	NA
Phenyl bromide (bromobenzene)			0.5	NA
Chlorotoluene			0.4	NA
1,3-dichlorobenzene			0.07	NA
1,4-dichlorobenzene			0.06	NA
1,2-dichlorobenzene			0.8	NA
Benzene			0.2	NA
Chlorobenzene			0.1	NA
1,2-Dichlorobenzene			0.3	NA
1,3-Dichlorobenzene			0.1	NA
1,4-Dichlorobenzene			0.3	NA
Ethylbenzene			0.07	NA
Toluene			0.10	NA
Xylenes			0.2	NA
Additional Compounds:				
Cis-1,2-dichloroethene			0.4	NA
2-chloroethyl vinyl ether			0.6	NA
Cis-1,3-dichloropropene			0.05	NA
Trans-1,3-dichloropropene			0.04	NA
1-chlorohexane			0.5	NA
Bis(2-chloroisopropyl)ether			10	NA

NA - Not Applicable
TBD - To Be Determined

Table III.1. Laboratory Detection Limits (continued)

Parameters	Analytical Methods		Method Detection Limit	
	Water	Soil/ Sediment	Water (µg/L)	Soil/ Sediment (µg/L)
1. Volatile Organic Compounds (VOCs), Groundwater (continued)				
Additional Compounds (continued):				
Trichlorotrifluoroethane			0.3	NA
Diethylbenzene			0.1	NA
Vinyl acetate			0.1	NA
Carbon disulfide			TBD	NA
Acetone			TBD	NA
Methylethyl ketone (2-butanone)			TBD	NA
Methylisobutyl ketone (4-methyl-2-pentanone)			TBD	NA
Acrylonitrile	SW5030/ SW8030	NA	TBD	TBD
Acetonitrile	SW5030/ SW8030	NA	TBD	TBD
2. Volatile Organic Compounds (VOCs), Soil/Sediment and Surface Water	CLP SOW[c] Mod D	CLP SOW[c] Mod D		Low Soil/ Sediment[d]
Chloromethane			3	4
Bromomethane			1	3
Vinyl Chloride			1	3
Chloroethane			2	3
Methylene chloride			0.6	3
Acetone			5	8
Carbon disulfide			1	2
1,1-Dichloroethene			1	2
1,1-Dichloroethane			0.6	1
1,2-Dichloroethene (total)			0.7	1
Chloroform			0.1	0.96
1,2-Dichloroethane			0.3	0.66
2-Butanone			1	9.06
1,1,1-Trichloroethane			0.6	1.2
Carbon Tetrachloride			0.9	1.17
Bromodichloromethane			0.3	0.75
1,2-Dichloropropane			0.5	1.05
cis-1,3-dichloropropene			0.3	1.05
Trichloroethene			0.7	0.84
Dibromochloromethane			0.4	0.45
1,1,2-Trichloroethane			0.4	0.57
Benzene			0.4	1.05
trans-1,3-dichloropropene			0.4	0.84
Tribromomethane			0.5	0.48

NA - Not Applicable
TBD - To Be Determined

Table III.1. Laboratory Detection Limits (continued)

Parameters	Analytical Methods		Method Detection Limit	
	Water	Soil/ Sediment	Water (µg/L)	Soil/ Sediment (µg/L)
2. Volatile Organic Compounds (VOCs), Soil/Sediment and Surface Water (continued)	CLP SOW[c] Mod D	CLP SOW[c] Mod D		Low Soil/ Sediment[d]
4-Methyl-2-pentanone			1	1.86
2-Hexanone			2	3.18
Tetrachloroethene			0.8	1.11
Toluene			0.4	0.96
1,1,2,2-Tetrachloroethane			0.8	0.63
Chlorobenzene			0.3	0.96
Ethylbenzene			0.5	1.14
Styrene			0.3	0.93
Xylenes (total)			2	3.3
Additional Compounds:				
Acrylonitrile			3	20
Acetonitrile			20	70
Diethylbenzene			2	1
Trichlorotrifluoroethane			2	4
Hexane			2	2
Iodomethane			NA	1
Vinyl Acetate			2	1
3. Semivolatile Organic Compounds	CLP SOW[c] Mod D	CLP SOW[c] Mod D		Low Soil/ Sediment
Phenol			1	100
bis(2-chloroethyl) ether			1	100
2-Chlorophenol			1	100
1,3-Dichlorobenzene			2	60
1,4-Dichlorobenzene			2	40
1,2-Dichlorobenzene			2	80
2-Methylphenol			2	80
2,2'-oxybis (1-Chloropropane)*			3	200
4-Methylphenol			2	200
N-nitroso-di-n-dipropylamine			1	200
Hexachloroethane			2	100
Nitrobenzene			1	200
Isophorone			1	200
2-Nitrophenol			2	100
2,4-Dimethylphenol			4	80
bis(2-chloroethoxy) methane			2	70
2,4-Dichlorophenol			2	40
1,2,4-Trichlorobenzene			2	50

NA - Not Applicable
TBD - To Be Determined

Table III.1. Laboratory Detection Limits (continued)

Parameters	Analytical Methods		Method Detection Limit	
	Water	Soil/ Sediment	Water (µg/L)	Soil/ Sediment (µg/L)
3. Semivolatile Organic Compounds (continued)	CLP SOW[c] Mod D	CLP SOW[c] Mod D		Low Soil/ Sediment
Naphthalene			1	50
4-Chloroaniline			2	200
Hexachlorobutadiene			2	100
4-chloro-3-methylphenol (para-chloro-meta-cresol)			1	200
2-Methylnaphthalene			1	100
Hexachlorocyclopentadiene[6]			NA	80
2,4,6-Trichlorophenol			1	90
2,4,5-Trichlorophenol			1	100
2-Chloronaphthalene			1	100
2-Nitroaniline			1	100
Dimethylphthalate			1	70
Acenaphthylene			1	50
2,6-Dinitrotoluene			1	80
3-Nitroaniline			4	300
Acenaphthene			1	50
2,4-Dinitrophenol			1	70
4-Nitrophenol			2	200
Dibenzofuran			1	90
2,4-Dinitrotoluene			1	70
Diethylphthalate			0.5	200
4-Chlorophenyl-phenyl ether			1	200
Fluorene			1	200
4-Nitroaniline			1	90
4,6-Dinitro-2-methylphenol			1	90
N-nitrosodiphenylamine			4	70
4-bromophenyl-phenylether			1	100
Hexachlorobenzene			1	200
Pentachlorophenol			1	80
Phenanthrene			1	30
Anthracene			1	40
Carbazole			1	60
Di-n-butylphthalate			4	300
Fluoranthene			1	180
Pyrene			1	160

NA - Not Applicable
TBD - To Be Determined

Table III.1. Laboratory Detection Limits (continued)

Parameters	Analytical Methods		Method Detection Limit	
	Water	Soil/ Sediment	Water (µg/L)	Soil/ Sediment (µg/L)
3. Semivolatile Organic Compounds (continued)	CLP SOW[c] Mod D	CLP SOW[c] Mod D		Low Soil/ Sediment
Butylbenzylphthalate			3	190
3,3'-Dichlorobenzidine			3	70
Benzo(a)anthracene			1	20
Chrysene			1	30
bis(2-Ethylhexyl)phthalate			3	90
Di-n-octylphthalate			1	100
Benzo(b)fluoranthene			1	90
Benzo(k)fluoranthene			1	100
Benzo(a)pyrene			1	40
Indeno(1,2,3-cd)pyrene			1	200
Dibenz(a,h)anthracene			1	200
Benzo(g,h,i)perylene			1	200
Additional Compounds:				
2-benzyl-4-chlorophenol			3	200
Benzyl alcohol			1	80
Benzoic acid			30	400
4. Pesticides and PCBs	CLP SOW[c]	CLP SOW[c]		
alpha-BHC			0.02	1
beta-BHC			0.03	0.3
delta-BHC			0.03	0.4
gamma-BHC (Lindane)			0.02	1
Heptachlor			0.01	1
Aldrin			0.03	0.3
Heptachlor epoxide			0.03	0.4
Endosulfan I			0.01	2
Dieldrin			0.03	3
4,4'-DDE			0.05	0.7
Endrin			0.03	3
Endosulfan II			0.06	2
4,4'-DDD			0.03	3
Endosulfan sulfate			0.05	3
4,4'-DDT			0.03	3
Methoxychlor			0.21	15

NA - Not Applicable
TBD - To Be Determined

Table III.1. Laboratory Detection Limits (continued)

Parameters	Analytical Methods		Method Detection Limit	
	Water	Soil/ Sediment	Water (µg/L)	Soil/ Sediment (µg/L)
4. Pesticides and PCBs (continued)	CLP SOW[c]	CLP SOW[c]		
Endrin ketone			0.05	.7
Endrin aldehyde			0.04	0.6
alpha-Chlordane			0.03	0.8
gamma-Chlordane			0.03	0.8
Toxaphene			2	100
Aroclor-1016			0.3	20
Aroclor-1221			0.06	20
Aroclor-1232			0.5	20
Aroclor-1242			0.04	10
Aroclor-1248			0.2	10
Aroclor-1254			0.5	4
Aroclor-1260			0.3	20
5. Metals (Target Analyte List)	CLP SOW[a] Mod A	CLP SOW[a] Mod A		(mg/kg)
Aluminum			TBD	TBD
Antimony			TBD	TBD
Arsenic			TBD	TBD
Barium			TBD	TBD
Beryllium			TBD	TBD
Cadmium			TBD	TBD
Calcium			TBD	TBD
Chromium			TBD	TBD
Cobalt			TBD	TBD
Copper			TBD	TBD
Iron			TBD	TBD
Lead			TBD	TBD
Magnesium			TBD	TBD
Manganese			TBD	TBD
Mercury			TBD	TBD
Nickel			TBD	TBD
Potassium			TBD	TBD
Selenium			TBD	TBD
Silver			TBD	TBD
Sodium			TBD	TBD
Thallium			TBD	TBD
Vanadium			TBD	TBD
Zinc			TBD	TBD
Additional Elements:			TBD	TBD
Molybdenum			TBD	TBD
Tin			TBD	TBD
Bismuth			TBD	TBD
Lithium			TBD	TBD
6. Cyanide	CLP SOW[a]	CLP SOW[a]	3.86	

NA - Not Applicable
TBD - To Be Determined

Table III.1. Laboratory Detection Limits (continued)

Parameters	Analytical Methods		Method Detection Limit	
	Water	Soil/ Sediment	Water (µg/L)	Soil/ Sediment (µg/L)
7. Common Anions			(mg/L)	(mg/kg)
Nitrate-Nitrite[3]	E353.2[g]	E353.2[g]	NA	NA
Chloride[3]	E325.1[g]/ E325.2	SW9250[b]/ SW9251	NA NA	NA NA
Sulfate[3]	E375.2[g]	E375.2[g]	NA	NA
Nitrite	E354.1[g]	NA	NA	NA
Ammonia	E350.1[g]	NA	NA	NA
Fluoride[3]	E340.2[g]	E340.2[g]	NA	NA
8. Total Nitrogen	E351.3[g]	NA	NA	NA
9. Total Phosphorus	E365.1[g]	NA	NA	NA
10. Total Organic Carbon (TOC)[3]	E415.1/ E415.2[g]	E415.1/ E415.2	0.64	
11. Total Dissolved Solids (TDS)	E160.1[g]	NA		
12. Total Suspended Solids (TSS)	E160.2[g]	NA		
13. Alkalinity	E310.1[g]	NA		

[a] For non-CLP analyses, these are expected quantitation limits based on reagent grade water or a purified solid matrix. Actual quantitation limits may be higher depending upon the nature of the sample matrix. The limit reported on final laboratory reports will take into account the actual sample volume or weight, percent moisture (where applicable), and the dilution factor, if any. **The quantitation limits for the additional nonroutine analytes may vary, depending upon the results of the method validation study.**

[b] "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd edition, U.S. EPA, December 1987.

[c] "U.S. EPA Contract Laboratory Program, Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration." Document No. OLM01.8 Quantitation limits are contract-required quantitation limits (CRQLs) with the exception of additional organic compounds. The minimum quantitation limits will be reported by the laboratory.

[d] Medium Soil/Sediment CRQLs are 125 times the low soil/sediment CRQLs for volatile organic compounds and 60 times the low soil/sediment CRQLs for semivolatile organic compounds. Estimated detection limits for metals in soil are based on a 1-gram sample diluted to 200 mL.

[e] "U.S. EPA Contract Laboratory Program, Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration." Document No. ILM03.0. Quantitation limits are CRDLs except for vanadium, beryllium, antimony, aluminum and additional elements. The minimum quantitation limits will be reported by the laboratory.

[f] Based on a 10-gram soil sample and 100 mL volume of extractant and a soil moisture content between 0 and 10 percent (rounded). Actual quantitation limit will vary with the sample and extractant amounts and will depend upon the nature of the soil matrix.

NA - Not Applicable
TBD - To Be Determined

Table III.1. Laboratory Detection Limits (continued)

g "Methods for Chemical Analysis of Water and Wastes," U.S. EPA, EPA-600/4-79-020 revised March 1983

h If soils are acidic, CEC will be analyzed by "Method of Soil Analysis, Part 2 Chemical and Microbiological Properties," by H. D. Chapman, American Society of Agronomists. 1965.

i "1991 Annual Book of American Society of Testing Materials Standards," Section 4, Construction, Volume 04.08, Soil and Rock, Building Stones, Geotextiles," ASTM 1990.

k As cesium-137, assumes no interfering lines.

l Based on 900-mL sample size.

m Based on 650-gram dry sample.

n ND 9900 VAX/VMS Spectroscopy Application Package User's Manual (09-0196), Nuclear Data, Inc., Schaumberg, IL. August 1986.

o "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," U.S. EPA, EPA-600/4-80-032, latest version.

p Based on 100-mL sample size.

q Dependent upon percent moisture in sample, based on 10 grams.

r "The Radiochemistry of Plutonium," G.H. Coleman, NAS-NS-3058, National Academy of Sciences, September 1965.

s Based on 2-gram dry sample.

t "The Radiochemistry of Thorium," E.K. Hyde. NAS-NS-3004, National Academy of Sciences, January 1960.

u "Standard Test Methods for Radium in Water," ASTM, latest version.

v Based on 1,000-mL sample size.

w "Manual for the Certification of Laboratories Analyzing Drinking Water," USEPA, EPA/570/9-90/008, April 1990.

x These are the maximum quantitation limits that can be reported for residential well samples.

y Arsenic, selenium, antimony, cadmium, lead, and thallium will be analyzed by graphite, furnace with Zeeman background correction. Lead and antimony have the option for deuterium background correction.

z "The Radiochemistry of Uranium," J.E. Grindler, NAS-NS-3050, National Academy of Sciences, March 1962.

1 "The Radiochemistry of Barium, Calcium, and Strontium," D.N. Sunderman and D.W. Townley, NAS-NS-3010, National Academy of Sciences, January 1960.
"Determination of Strontium-89 and -90 in Soil With Total Sample Decomposition," D.B. Martin, Analytical Chemistry, October 1979.
"Procedures for Determination of Stable Elements and Radionuclides in Environmental Samples," Public Health Service Publication 999-RH-10, January 1965.

2 "EML Procedures Manual," HASL-300, Environmental Measurements Laboratory, U.S. Department of Energy 27th Edition.

3 Procedure includes a statement of work, provided in Appendix C.

4 Based on a 10.0 gram sample for dioxin analysis.

5 Performance data for hexachlorocylopentadiene recovery from water was poor. The analyte has been dropped from the semivolatile water TCL.

NA - Not Applicable
TBD - To Be Determined

4. LABORATORY SAMPLE CUSTODY PROCEDURES

4.1. Sample Receipt

- Samples will be shipped by the host lab, ITAS Oak Ridge, facility within 24 hours of receipt. Upon receipt, the sample custodian will inspect sample containers for integrity and will note the temperature inside the sample coolers on the chain of custody (Figure 5.1 of the QAPP) and on the login initiation checklist (Figure 4.1). The presence of leaking or broken containers will be noted on the chain-of-custody record (Figure 5.1 of the QAPP) and the login initiation checklist (Figure 4.1). The IT project manager for the Mound Plant ER Program will notify either the QAM or the sample document control administrator within 24 hours of the receipt of broken or leaking samples. The sample custodian will sign the chain-of-custody record (with date and time of receipt), thus assuming custody of the samples.

- The information on the chain-of-custody record will be compared by the sample custodian with that on sample tags and labels to verify sample identity. Any inconsistencies will be resolved with the QAM or sample document control administrator before sample analysis proceeds. The samples will be checked for the required sample containers, preservation, and volumes.

- Samples will be moved to one of the locked sample storage refrigerators for storage prior to analysis. The storage location will be recorded on the chain-of-custody record.

- The sample custodian will retain the original chain-of-custody record which is stored in the project file. An internal chain of custody is generated for tracking samples during storage and analysis and is kept with the samples/extracts at all times.

- After completion of master sample login, the Project Manager will alert the analysts of any analyses requiring immediate attention because of short holding times. A COC/Sample Request (Figure 4.2) is provided for analysts to request samples from the sample custodian.

4.2. Sample Storage

Samples will be maintained in storage in one of the locked storage refrigerators prior to sample preparation and analysis. Samples designated for analysis for volatile organic compounds will be stored in a separate refrigerator. The storage refrigerators are maintained at 4 $\pm$ 2°C. The sample custodian or designee will retrieve samples for analysis from the storage refrigerators on receipt of a completed COC/Sample request form, and will sign the chain-of-custody record. The sample custodian or his designee will deliver samples to the laboratory personnel. Copies of the COC/Sample Request Form will be retained by Sample Control

LOGIN INITIATION CHECKLIST

PROJECT #:_____

LOGIN #:_____

DATE:_____

ARRIVAL TIME:_____

INFORMATION CHECKLIST:	Circle		COMMENTS:
Air Bill included with Shipment	Y	N	_____
Damage to Shipping Containers	Y	N	_____
Shipping Containers Rad Surveyed	Y	N	_____
Custody Seals on Shipping Containers	Y	N	_____

SAMPLE INFORMATION CHECKLIST:			
Shipping Containers opened in Hood	Y	N	_____
Client chain of Custody included	Y	N	_____
Custody Seals on Sample Containers	Y	N	_____
emperature of Containers 4°C (±2)	Y	N	_____
Broken/Leaking Containers	Y	N	_____
Do Sample Containers match COC	Y	N	_____
Are Sample Preservatives Correct	Y	N	_____

Login Date and Time:_____ Review Date and Time:_____

Login Release Date and Time:_____

LIST OTHER NOTATIONS IN COMMENT SECTION:

Comment:_____

Custodian or Designee Signature:_____ SL-92-QA-0026

Figure 4.1.

Figure 4.2. Internal Chain-of-Custody Form

Requested By: _____

Time: _____ Date: _____

Time needed: _____ Date Needed: _____

Project # _____ RWP #: _____

Login # Sample	Container Description	Shelf Number	Sample Consumed Yes/No
Received By:	Relinquished By:	Reason for Transfer:	Date:

All listed samples MUST be transferred as a batch

after the signature of the analyst and date of the transfer are recorded on the form. When samples are returned to Sample Control again, the COC/Sample Request Form is dated and signed by Sample Control and retained in the project file.

4.3. Sample Tracking - Organic Analysis

For samples that require extraction prior to analysis, a sample extraction form is completed during the time of extraction. When samples are extracted for analysis by gas chromatography/mass spectroscopy (GC/MS) or liquid chromatography, all pertinent data are entered on the sample extraction form and taped into a bound laboratory notebook. Copies of extraction forms are used as the vehicle for custody transfer to the analyst. Copies are provided to the analysts to inform them that extracts are ready for analysis. The bound laboratory notebook is kept in the extraction laboratory.

Extracts are maintained in secured refrigerated storage by the sample preparation section until transferred to the analysts.

4.4. Sample Tracking - Metals Analysis

Samples are received by the sample preparation section for digestion prior to analysis for metals by atomic absorption/inductively coupled plasma spectroscopy. Sample digests are stored at room temperature in a secured area before analysis and for a minimum of six weeks after analysis. When samples are prepared for digestion, the preparation technician fills out a sample digestion record.

All information regarding sample digestion is entered onto the sample digestion record as the sample preparation proceeds and the record is taped into a bound laboratory notebook. The digestion record is used as the vehicle for custody transfer to the analyst. Upon completion of sample digestion, a copy of the sample digestion record is provided to the metals analysis section to alert them that digestates are ready for analysis. The bound laboratory notebook containing the digestion record is retained by the metals digestion laboratory.

4.5. Recordkeeping

Information related to sample tracking at the IT Laboratories is recorded in laboratory log-in books and in the Laboratory Information Management System (LIMS). This information includes

- project identification number;
- sample number;
- type of samples;
- date received;
- date put into storage after analysis was completed; and
- date of disposal.

Laboratory forms taped into notebooks are signed and dated daily by laboratory analysts. Corrections to notebook and form entries are made by drawing a single line through the erroneous entry and by writing the correct entry next to the one crossed out. All corrections are initialed and dated by the analyst. Laboratory supervisors or designated reviewers sign and date reviewed notebook pages.

5. LABORATORY DATA REDUCTION PROCEDURES

Analytical runlogs and bench sheets are maintained in numbered and bound laboratory notebooks issued by the quality assurance officer. Data are recorded and are associated with the unique laboratory sample identification number. For inorganic (nonmetal) analyses, the summary forms are taped into bound notebooks. Those pages contain the following:

- analytical method,
- analyst,
- date,
- reagent concentrations,
- instrument settings (as applicable), and
- raw data.

The laboratory analysts sign and date all summary forms taped into notebooks daily. The notebook pages are reviewed and signed by area supervisor or designated reviewer. Copies of strip-chart outputs (for example, chromatograms) are maintained on file.

At the completion of a set of analyses, all calculations are completed and are checked by the analyst. Calculations using raw data to obtain final concentrations are performed according to the procedures described in the specified analytical method. Laboratory data reduction procedures are provided in the respective IT Laboratory SOPs and in the CLP SOW. The associated quality control data are verified as being within control limits. If all data are acceptable, the data are entered into laboratory computer systems, or written on data summary forms, and the data summaries (including raw data) are submitted to the section manager for review. After approval, data are subsequently entered into the project database format. Data outside control limits will be reported with a qualifier on the CLP reporting forms for CLP data packages. Case narratives will note any out-of-control situations for non-CLP analyses. After the laboratory section manager approves the data, the data is submitted to data entry and reporting and the completed analyses are removed from the laboratory backlog. A hard-copy data summary is then generated that is reviewed and is signed by the project manager.

6. LABORATORY DATA VALIDATION PROCEDURES

Prior to the final production of analytical reports, laboratory data are reviewed and verified according to ITAS procedures described in the ITAS Quality Assurance Manual in section 10.2, Data Validation. The ITAS data review procedures are based on two activities:

- processing quality control sample results; and
- data validation of reporting analytical results.

Precision and accuracy of the analyses are evaluated with the quality control sample results. Control charts, method limits, or client control limits for quality control samples are compared to actual quality control sample results.

Data validation consists of review of data processing and data reporting. After the analyst completes his data processing and has reviewed the data, against method and client specific requirements, the data is reviewed by a peer in the same laboratory. The peer review includes calculations, equations, calibrations, chromatogram interpretations, etc. If errors are found, any changes are agreed upon by the originator of the data and the reviewer. A system review is performed by the group/team leader or their designee for compliance with client requirements and for proper peer review.

After data entry, a second person makes a one to one comparison of the raw data and the transcribed data. The final review of the data is performed by the project manager.

7. PREVENTIVE MAINTENANCE

IT Laboratories maintain full service contracts or have an equivalent maintenance program on all major instruments. These service contracts not only provide routine preventive maintenance, but also emergency repair service. Each analytical instrument is assigned an instrument logbook. All maintenance activities are recorded in the instrument log. The information entered in the instrument log includes

- date of service,
- person performing service,
- type of service performed and reason for service,
- replacement parts installed (if appropriate), and
- miscellaneous information.

Table 2 summarizes the type and frequency of maintenance of major instruments for IT Laboratories that will be used for the analytical program. Those parts commonly replaced, as specified in Table 2, are the spare parts kept in the laboratory. A listing of spare parts is also routinely maintained in files for each instrument.

TABLE VII.2

PREVENTIVE MAINTENANCE REQUIREMENTS FOR MAJOR INSTRUMENTS

ITAS ST. LOUIS, ST. LOUIS MISSOURI

APPLICABLE ANALYTICAL METHOD	INSTRUMENT	ITEMS CHECKED/SERVICED	MINIMUM FREQUENCY
Metals	Graphite Furnace Atomic Absorption Spectrometer	Clean Optical Windows	Daily
		Clean Contact Cylinders	Daily
		Check tubes and Platform	Daily
		Replace tubes and platform	As needed
		Check coolant level and add if needed	Monthly
		Replace contact cylinders	Semi annually
		Clean Optic	Annually
Metals	ICP	Check pump winding and if needed replace	Daily
		Clean intelligence controller filter	Monthly
		Check/clean nebulizer, mixing chamber, and torch	Monthly
		Check/clean pump capillary tubing, and if needed replace	Monthly
		Clean optical path windows	Monthly
		Clean RF generator filters	Monthly
		Change vacuum pump oil	Semi-annually
Metals	Cold Vapor Atomic Absorption	Clean Sample aspirator by flushing with D1 H_2O	Daily
		Check flow rate of stannous chloride	Daily
		Check tubing and replace if needed	Daily
		Clean windows with methanol	Weekly
		Clean cell in aqua regia	Monthly
		Clean Optics	Annually

TABLE VII.2 (continued)

APPLICABLE ANALYTICAL METHOD	INSTRUMENT	ITEMS CHECKED/SERVICED	MINIMUM FREQUENCY
SW8010,SW8020 Pesticides/PCBs	Gas Chromatograph	Inlet, Detector and Column Temperatures	Daily when instrument in use
		Gas pressures	Daily
		Column and Detector Flow Rates	Daily when instrument in use
		Check Zero and Noise Level	Daily when instrument in use
		Check Responses, Retention Times using a Check Standard	Daily when instrument in use
		Gas Purity check	As needed
		Check Pressure in Gas Tanks, Replace in <500 PSI	Weekly
		Clean Outside Surfaces of Instruments	Weekly
		Replace Septa	As needed
		Replace Column or Part of Column Packing	As needed
		Clean/Replace Detector	As needed
		Replace Glass Wool/Glass Insert	As needed
		Clean Injection Port	As needed
E415.1/415.2	Total Organic Carbon Analyzer	Check oxygen supply	Daily
		Check persulfate supply	Daily
		Check acid supply	Daily
		Check printer paper	Daily
		Check Sn and Cu scrubber	Daily
		Add a few drops of H_3PO_4 to GLS	Daily
		Check carrier gas flow rate (= 200 cc/min)	Daily
		Check liquid flow rate pump tubing conditions	Weekly
		Check for moisture in LiOH tube	Weekly
		Check for injection port, septum	Weekly
		Change pump tubing	Bi-weekly
		Change Sn and Cu	Monthly

TABLE VII.2 (continued)

APPLICABLE ANALYTICAL METHOD	INSTRUMENT	ITEMS CHECKED/SERVICED	MINIMUM FREQUENCY
Volatile and Semivolatile	GC/MS	Diffusion Pump Oil	Bi-Weekly
		Mechanical Pump Oil	Quarterly
		Vacuum Chaff Filter	Monthly
		Turbo Pump Oil	Quarterly
		Source-Clean Ceramics, Polish Lenses	As needed
		Clean Poles and Ceramics on the Poles	As needed
		Clean Contacts on the Component Boards	As needed
		Vacuum Outside of Instrument	Weekly
		Clean Grob and Replace Quartz Insert	As needed
		Replace Septum	Daily (each shift)
		Injection Port Liner Checked	Daily
		Column maintenance	As needed

TABLE VII.2 (continued)

APPLICABLE ANALYTICAL METHOD	INSTRUMENT	ITEMS CHECKED/SERVICED	MINIMUM FREQUENCY
Radioisotopes	Manual Alpha/Beta Counter	Clean fan filter	Monthly
	Gamma Spec System		
	MCA	Clean fan filter	Monthly
	Equipment Rack	Check for operation	Monthly
	Vacuum pump	Change fan filter	Monthly
		Change pump oil	Annually
	Germanium detectors	Fill LN, Dewers	Weekly
	Alpha Scintillation Counters	Electronic Check	Quarterly

Note: As needed, minimum frequency refers to the fact that the item is routinely checked during analysis, and the item is replaced/repaired when needed.

8. SPECIFIC PROCEDURES TO ASSESS PRECISION AND ACCURACY

The ITAS will assess analytical accuracy and precision as described specified in section 12 of the QAPP.

The precision of radiological analyses are assessed by replicate results. An expected mean range is calculated using several replicate results. A control limit equaling the mean range plus three standard deviations (SD) is established.

The accuracy of radiological analyses are assessed by analyses of spiked samples or reference standard samples. The expected accuracy of the recovered sample result, based on the activity of the known value is the mean +/- 3 SD. The control limit for the spiked or reference standard sample is >3SD or <3SD.

Laboratory control spikes are charted to establish upper and lower warning and control limits. A minimum of 20 points are used to establish warning limits of 2σ and control limits of 3σ.

APPENDIX H

DATA VALIDATION GUIDELINES FOR CHEMICAL AND RADIOLOGICAL ANALYSES

MOUND DATA VALIDATION GUIDELINES FOR CHEMICAL AND RADIOLOGICAL ANALYSES

1.0 INTRODUCTION

These guidelines are presented to ensure that data validation is performed consistently for chemical and radiological data collected for the Mound ER Program. However, these guidelines may not be inclusive of all Quality Control Check (QCC) deficiencies or conditions, and validators may need to use professional judgement in these limited cases. These cases may include, but are not limited to, evaluations of a grossly exceeded QCC criteria, QCCs not described in these procedures that could impact data quality, evaluations of trends related to QCC results from multiple field batches, or multiple QCC deficiencies. Additional data validation guidelines may be developed for analyses or methodologies not included in these guidelines. Such guidelines must be approved by the Quality Assurance Manager (QAM) before implementation.

2.0 GENERAL DATA VALIDATION GUIDELINES

2.1 GENERAL GUIDELINES

The following procedures apply to all data packages submitted for data validation.

- The QAM schedules, assigns, and monitors the data validation effort.
- The data package is first reviewed for completeness by the data validator. The Data Completeness Checklist in Attachment I is completed for each laboratory data package. Missing data is directed to the Quality Assurance Manager or his/her designee as soon as it is noted by submitting the signed checklist with comments describing the missing information. Data validation is to continue as is feasible until the discrepancy is resolved. Data validation is not performed without a complete data package, unless there is a documented data loss noted by the Quality Assurance Manager.
- All discrepancies in the data package is directed to Quality Assurance Manager for resolution and to determine whether qualification of the data is warranted.
- Data validation is performed in accordance with the U.S. EPA CLP Functional Guidelines (EPA, 1988) for CLP SOW analyses. Should there be conflicting criteria between the functional guidelines and the CLP SOW, the stricter of the two criteria will apply. Under all circumstances, the most recent revision of the Mound Operable Unit 9 Site-Wide QAPP is the final authority. Any clarifications are resolved by the Quality Assurance Manager.
- Data validation of non-CLP data is performed using the guidelines presented in Sections 4.0 and 5.0 of this document.
- Results of the equipment rinsate, ambient, sample bank, and trip blanks are used to qualify sample data. Results of laboratory blanks are used in qualifying field blank data and sample data, as with any investigative sample.
- In addition to the specific review of the QCCs in these procedures, at least 10% of all calculations are verified and identifications are reviewed by the validators.
- Any QCCs not specifically found in the following procedures but outlined in the QAPP will be evaluated against the QAPP criteria.

2.2 CALCULATIONS

A portion of all laboratory sample result calculations will be re-calculated and verified following the guidelines described below.

- For manual calculations, 10 percent of all calculations in the batch will be verified.
- For automated calculations, one calculation per batch will be verified.

If a calculation error is found, the data set will be submitted to the laboratory for verification of all the sample calculations. The laboratory will be required to make all necessary corrections to the data.

In addition to verifying sample calculations, the validators verify:

- Initial calibration - at least one RRF and %RSD for VOA, Pesticides/PCB; two RRF and %RSD for semivolatiles for each.
- Continuing calibration - at least one RRF and %D for VOA and Pesticides/PCBs and two for semivolatiles for each continuing calibration.
- Surrogate - at least one set of surrogates from one sample within a batch for VOA and Pesticide/PCB, and at least two surrogates from one sample within a batch for SV (one acid, one base).
- MS/MSD - at least one compound recovery and RPD for each analyte group.
- LCS - at least one compound.

3.0 DATA QUALIFICATION

3.1 DATA QUALIFIERS

The primary data qualifiers to be applied, as described in the CLP Functional Guidelines and in Sections 4.0 and 5.0 of this Appendix, are the following:

U - The material was analyzed for, but was not detected. The associated numerical value is the sample quantitation limit.

J - The associated numerical value is an estimated quantity.

R - The data are unusable (compound may or may not be present). Resampling and reanalysis is necessary for verification.

N - Presumptive evidence of presence of material.

NJ - Presumptive evidence of the presence of the material at an estimated quantity.

UJ - The material was analyzed for, but was not detected. The sample quantitation limit is an estimated quantity.

Subqualifiers are used to assist in data assessment by indicating the source of the primary qualifier. These subqualifiers are attached to the primary qualifier, separated by a hyphen. The following is a list of allowable subqualifiers:

SUBQUALIFIERS - ORGANICS

B - Qualified due to method blank or a field blank
C - Qualified due to calibration
H - Holding time exceeded
K - Qualified due to surrogate recovery
S - Qualified due to matrix spike recovery
I - Qualified due to internal standard
P - Pesticide/PCB results have >25% difference on two different columns
(+) - Potential positive bias (added after subqualifier with a parentheses)
(-) - Potential negative bias (added after subqualifier with a parentheses)

SUBQUALIFIERS - INORGANICS

B - Qualified due to method blank or field blank
C - Qualified due to calibration
H - Holding time exceeded
S - Qualified due to matrix spike recovery
I - Interference (ICP serial dilution, ICS, or GFAA spike recovery)

D - Duplicate (replicate) limits exceeded
L - Qualified due to LCS
(+) - Potential positive bias (added after subqualifier with a parentheses)
(-) - Potential negative bias (added after subqualifier with a parentheses)

Examples of final qualification might be J-C, UJ-S(+), UJ-BC(-), etc.

Use of additional qualifiers and sub-qualifiers must be approved by the Quality Assurance Manager.

3.2 ADDITIONAL CASES FOR DATA QUALIFICATION

Pesticide/PCB analyses. If the %D of the results obtained between the two columns is greater than 100%, then the sample result for that analyte should be rejected (R). If the %D of the results obtained between the two columns is greater than 100% and both results are less than CRQL, then the sample result for that analyte should be qualified as non-detected (U). See data validation guidelines for CLP SOW Modification D.

4.0 DATA VALIDATION PROCEDURES OF NON-CLP CHEMICAL ANALYSES

The following guidelines are presented for the validation of data generated by chemical methods other than the CLP SOW.

4.1 TOTAL ORGANIC CARBON - EPA METHODS 415.1 AND 415.2

Holding Time: Verify the samples were analyzed within the holding time period specified in Tables IV.3 and IV.4 of the QAPP. Qualify results as estimated with (J) or (UJ) if holding time was exceeded. If the holding time was grossly exceeded, professional judgement may be used for qualifying the data as unusable (R).

Calibration: Verify initial 5 point calibration had a correlation coefficient ≥ 0.995. Verify that a continuing calibration was run every 20 samples and its response was within 15% of true value. If any samples were analyzed with a non-compliant calibration standard, then the results associated with the non-compliant standard are estimated (J).

Blanks: Method blank must be analyzed every 20 samples and contamination must be less than the PQL.

Equipment blank samples are qualified using qualification guidance levels derived from method blank contamination. Qualification level for samples are determined from the maximum contamination levels in method and equipment blank contamination. If the contamination is greater than the PQL, then:

Qualification Guidance Level = 5 x contamination in blank.

Qualification Guidelines:

If results < PQL, then no action is taken.

If results < 5 x contamination, then report the value with a (U).

If results > 5 x contamination, then no action is taken.

If gross contamination is evident, then all associated sample results should be flagged as unusable (R).

Matrix Spike: Recovery should be 75 - 125%. Follow US EPA Functional Guidelines for Evaluating Inorganic Analysis.

Qualification Guidelines:

If sample result is <4 x spike level and %R <75% estimate all positive and non-detected results;

If %R >125% estimate positive results (J); and

If %R <10% reject all results (R).

Matrix Spike Duplicate: The Relative Percent Deviation (RPD) should be ≤20%. If >20% use professional judgement.

Replicate: Verify at least 4 analyses of each sample were performed. The %RSD for the four analyses should be ≤ 25%. If %RSD >25% qualify the result as estimated (J). The inhomogeneity of soil, may prevent achieving the required %RSD criteria. Professional judgement should be used to determine if matrix effects are the cause of non-compliance with the criteria.

Duplicate: Verify a duplicate sample was analyzed for every 10 field samples or less of each matrix. The RPD must be ≤ 25% for water and ≤ 50% for soils. If the criteria was not met, estimate, (J) all sample results associated with the duplicate sample.

4.2 FLUORIDE - EPA METHOD 340.2
SULFATE - EPA METHOD 375.2
TOTAL NITROGEN - EPA METHOD 351.3
TOTAL PHOSPHORUS - EPA METHOD 365.1
NITRITE - EPA METHOD 354.1
AMMONIA - EPA METHOD 350.1/350.2

Holding Time: Verify the samples were analyzed within the holding time period specified in Tables IV.3 and IV.4 of the QAPP. Qualify results as estimated with (J) or (UJ) if holding time was exceeded. If the holding time was grossly exceeded, professional judgement may be used for qualifying the data as unusable (R).

Calibration: Verify initial 4 point (3 points plus one reagent blank) calibration had a correlation coefficient ≥ 0.995. Verify that a continuing calibration check was run every 20 samples and its response was within 15% of true value. If any samples were analyzed with a non-compliant calibration standard, then the results associated with the non-compliant standard must be estimated (J).

Blanks: Method blank must be analyzed every 20 samples and contamination must be less than PQL.

Equipment blank sample are qualified using qualification guidance levels derived from method blank contamination. Qualification level for samples are determined from the maximum contamination levels in method and equipment blank contamination. If the contamination is greater than the PQL, then:

Qualification Guidance Level = 5 x contamination in blank.

Qualification Guidelines:

If results < PQL, then no action is taken.

If results < 5 x contamination, then report the value with a (U).

If results > 5 x contamination, then no action is taken.

Matrix Spike: Recovery should be 75 - 125%. Follow US EPA Functional Guidelines for Evaluating Inorganic Analysis.

Qualification Guidelines:

If sample result is <4x spike level and %R <75% estimate all positive results and non-detected results;

If %R >125% estimate positive and accept non-detected results; and

If %R <10% reject all results (R).

Matrix Spike Duplicate: The Relative Percent Deviation (RPD) should be < 20%. If >20% use professional judgement.

Duplicate: Verify a duplicate sample was analyzed for every 10 field samples or less of each matrix. The RPD must be ≤25% for water and ≤50% for soils. If criteria was not met, estimate (J) all sample results associated with that duplicate sample.

4.3 CHLORIDE - EPA SW-846 METHOD 9250 OR 9251/EPA METHODS 325.1 OR 325.2

Holding Time: Verify the samples were analyzed within the holding time period in Tables IV.3 and IV.4 of the QAPP. If the holding time was exceeded, qualify results as estimated with (J) or (UJ). If the holding time was grossly exceeded, professional judgement may be used for qualifying the data as unusable (R).

Calibration: Verify initial 4 point (3 points plus one reagent blank) calibration had a correlation coefficient ≥0.995. Verify that a continuing calibration check was run every 20 samples and its response was within 15% of true value. If any samples were analyzed with a non-compliant calibration standard, then the results associated with the non-compliant standard must be estimated (J).

Blanks: Method blank must be analyzed every 20 samples and contamination must be less than PQL.

Equipment blank sample are qualified using qualification guidance levels derived from method blank contamination. Action level for samples are determined from the maximum contamination levels in method and equipment blank contamination. If the contamination is greater than the PQL, then:

Qualification Guidance Level = 5 x contamination in blank.

Qualification Guidelines:

If results < PQL, then no action is taken.

If results < 5 x contamination, then report the value with a (U).

If results > 5 x contamination, then no action is taken.

Laboratory Control Sample: Verify a Laboratory Control Sample (LCS) was analyzed with each initial calibration to demonstrate its validity. If the QAPP criteria was not met, then:

a. If the recovery is below criteria and greater than 10 percent, qualify positive results estimated, (J) and non-detects unusable, (R).

b. If the recovery is less than or equal to 10 percent, then qualify all results unusable, (R).

c. For recoveries greater than the specified criteria, no action is taken for non-detects and positive results will be qualified estimated, (J). For recoveries which grossly exceed the specified criteria, positive results may be qualified unusable, (R), based on the validator's professional judgment.

Matrix Spike: Recovery should be 75 - 125%. Follow US EPA Functional Guidelines for Evaluating Inorganic Analysis.

Qualification Guidelines:

If sample result is <4x spike level and %R <75% estimate all positive and non-detected results;

If %R >125% estimate positive results (J) and accept non-detects; and

If %R <10% reject all results (R).

Matrix Spike Duplicate: The Relative Percent Deviation (RPD) should be < 20%. If >20% use professional judgement.

Duplicate: Verify a duplicate sample was analyzed for every 10 field samples or less of each matrix. The RPD must be ≤25% for water and ≤50% for soils. If criteria was not met the estimate (J) all sample results associated with that duplicate sample.

4.4 NITRATE-NITRITE - EPA METHOD 353.2

Holding Time: Verify the samples were analyzed within the holding time period in Tables IV.3 and IV.4 of the QAPP. If the holding time was exceeded qualify results as estimated with (J) or (UJ). If the holding time was grossly exceeded, professional judgement may be used for qualifying the data as unusable (R).

Calibration: Verify initial 4 point (3 points plus one reagent blank) calibration had a correlation coefficient ≥0.995. Verify that a continuing calibration check was run every 20 samples and that its response was within 15% of true value. If any samples were analyzed with a non-compliant calibration standard, then the results associated with a non-compliant standard must be estimated (J).

Blanks: Method blank must be analyzed every 20 samples and contamination must be less than PQL.

Equipment blank sample are qualified using qualification guidance levels derived from method blank contamination. Qualification level for samples are determined from the maximum contamination levels in method and equipment blank contamination. If the contamination is greater than the PQL, then:

Qualification Guidance Level = 5 x contamination in blank.

Qualification Guidelines:

If results < PQL, then no action is taken.

If results < 5 x contamination, then report the value with a (U).

If results > 5 x contamination, then no action is taken.

Laboratory Control Sample: Verify a Laboratory Control Sample (LCS) was analyzed with each initial calibration to demonstrate its validity. If the QAPP criteria was not met, then:

a. If the recovery is below criteria and greater than 10 percent, qualify positive results estimated, (J) and non-detects unusable, (R).

b. If the recovery is less than or equal to 10 percent, then qualify all results unusable, (R).

c. For recoveries greater than the specified criteria, no action is taken for non-detects and positive results will be qualified estimated, (J). For recoveries which grossly exceed the specified criteria, positive results may be qualified unusable, (R), based on the validator's professional judgment.

Matrix Spike: Recovery should be 75 - 125%. Follow US EPA Functional Guidelines for Evaluating Inorganic Analysis.

Qualification Guidelines:

If sample result is <4x spike level and %R <75% estimate all positive and non-detected results;

If %R >125% estimate positive results (J) and accept non-detects; and

If %R <10% reject all results (R).

Matrix Spike Duplicate: The Relative Percent Deviation (RPD) should be < 20%. If >20% use professional judgement.

Duplicate: Verify a duplicate sample was analyzed for every 10 field samples or less of each matrix. The RPD must be ≤25% for water and ≤50% for soils. If criteria was not met, estimate (J) all sample results associated with that duplicate sample.

4.5 EXPLOSIVES - EPA SW846 METHOD 8330 INCLUDING PETN

Holding Time: Verify the samples were extracted and analyzed holding times specified in Tables IV.3 and IV.4 of the QAPP. Qualify results as estimated with (J) and (UJ) if holding times were exceeded. If the holding time was grossly exceeded, professional

judgement may be used for qualifying the data as unusable (R).

Calibration: Verify the Percent Relative Standard Deviation (% RSD) of the Response Factors (RF) for the initial 5 point calibration was ≤20%. Verify that a continuing calibration check was run every 10 samples and that the % difference (%D) in RFs was within 15% of average RF from the initial calibration. If any samples were analyzed with a non-compliant calibration standard, then the positive results associated with a non-compliant standard must be estimated (J).

If %D or %RSD was >50% then all positive and non-detected values for that analyte must be estimated (J) and unusable (R), respectively. If the %D or %RSD is grossly outside criteria, professional judgement may be used for qualifying the data unusable (R).

Blanks: Method blank must be analyzed for each batch of samples extracted for each matrix and contamination must be less than PQL.

Equipment blank sample are qualified using qualification guidance levels derived from method blank contamination. Action Level for samples are determined from the maximum contamination levels in method and equipment blank contamination. If the contamination is greater than the PQL, then for each affected analyte:

Qualification Guidance Level = 5 x contamination in blank.

Qualification Guidelines:

If results < PQL, then no action is taken.

If results < 5 x contamination, then report the value with a (U).

If results > 5 x contamination, then no action is taken.

Matrix Spike: Recoveries are compound dependant and should correspond to those specified in the QAPP for soils and water.

Matrix Spike Duplicate: The RPDs are compound dependant and should correspond to those specified in the QAPP for soils and water.

The positive values for those compounds that fail MS/MSD criteria but have recoveries >10% should be estimated in the unspiked sample.

For a matrix spike analyte which is outside QAPP recovery criteria, but whose recovery is greater than 10%, then positive analyte sample results in associated samples are qualified estimated (J). Non-detected analyte results in associated samples are evaluated on professional judgement.

For a matrix spike analyte which is outside QAPP recovery criteria, but whose

recovery is less than 10%, then positive analyte sample results in associated samples are qualified estimated (J). Non-detected analyte results in associated

samples are rejected (R).

Surrogates: Two surrogates are used in this analysis:

a. 4-Nitrobutene is the surrogate corresponding to PETN. If recovery for 4-nitrobutene is not within QC limits as specified in Table III.3 of the QAPP, the sample must be re-extracted and reanalyzed. If the recovery is still outside QC limits, but >10%, then a positive result for PETN is qualified as estimated (J) and nondetected PETN result is evaluated on professional judgment. If 4-nitrobutene recovery is <10%, then positive PETN result is estimated and nondetected PETN result is rejected (R).

Verify that the wavelength of the detector is set 220nm for PETN and nitrobutene analysis. Unless supporting documentation for selecting a wavelength other than 220nm is present, reject (R) all data at a different wavelength other than 220nm.

b. 4-Nitrotoluene is used as the surrogate for all the remaining analytes. If recovery for 4-nitrotoluene is not within QC limits as specified in Table III.3 of the QAPP, the sample must be re-extracted and reanalyzed. If the recovery is still outside QC limits, but >10%, then positive results are qualified as estimated (J) and nondetected results are evaluated on professional judgment. If 4-nitrotoluene recovery is <10%, then positive results are estimated and nondetected results are rejected (R).

Laboratory Control Sample: Laboratory control sample (LCS) recoveries must be within QC limits (Table III.3) or all associated samples must be re-extracted with another LCS. If the QAPP criteria was not met, then:

a. If the recovery is below criteria and greater than 10 percent, qualify positive results estimated, (J) and non-detects unusable, (R).

b. If the recovery is less than or equal to 10 percent, then qualify all results unusable, (R).

c. For recoveries greater than the specified criteria, no action is taken for non-detects and positive results will be qualified estimated, (J). For recoveries which grossly exceed the specified criteria, positive results may be qualified unusable, (R), based on the validator's professional judgment.

Duplicate: Verify a duplicate sample was analyzed for every 10 field samples or less of each matrix. The RPD must be ≤25% for water and ≤50% for soils. If criteria was not met, then estimate (J) the positive results for that analyte(s) in both samples. If one of the sample result is >PQL and the other is non-detected, then both results are estimated.

4.6 TOTAL DISSOLVED SOLIDS - EPA METHOD 160.1
TOTAL SUSPENDED SOLIDS - EPA METHOD 160.2

Holding Time: Verify the samples were analyzed within the holding time in Tables IV.3 and IV.4 of the QAPP. If the holding time was exceeded, qualify results as estimated with (J) or (UJ). If the holding time was grossly exceeded, professional judgement may be used for qualifying the data as unusable (R).

Balance Check: Verify the balance was checked with S class weights daily before use. If balance was not calibrated, qualify all results obtained on that balance as estimated since the last successful calibration.

Blanks: Method blank must be analyzed every 20 samples and contamination must be less than PQL.

Equipment blank sample are qualified using qualification guidance levels derived from method blank contamination. Qualification guidance level for samples are determined from the maximum contamination levels in method and equipment blank contamination. If the contamination is greater than the PQL, then:

Qualification Guidance Level = 5 x contamination in blank.

Qualification Guidelines:

If results < PQL, then no action is taken.

If results < 5 x contamination, then report the value with a (U).

If results > 5 x contamination, then no action is taken.

Laboratory Control Sample: Verify a Laboratory Control Sample (LCS) was analyzed with each initial calibration to demonstrate its validity. If the QAPP criteria was not met, then:

a. If the recovery is below criteria and greater than 10 percent, qualify positive results estimated, (J) and non-detects unusable, (R).

b. If the recovery is less than or equal to 10 percent, then qualify all results unusable, (R).

c. For recoveries greater than the specified criteria, no action is taken for non-detects and positive results will be qualified estimated, (J). For recoveries which grossly exceed the specified criteria, positive results may be qualified unusable, (R), based on the validator's professional judgment.

Duplicate: Verify a duplicate sample was analyzed for every 10 field samples or less of each matrix. The RPD must be ≤25% for water. If RPD >25% qualify all sample results associated with that duplicate sample as estimated (J).

4.7 ALKALINITY - EPA METHOD 310.1

Holding Time: Verify the samples were analyzed within the holding time specified in Tables IV.3 and IV.4 of the QAPP. If the holding time was exceeded, qualify results as estimated with (J) or (UJ). If the holding time was grossly exceeded, professional judgement may be used for qualifying the data as unusable (R).

Calibration: Verify the pH meter was calibrated with pH 4.0 and pH 7.0 standards at the beginning and after every 10 samples. If the pH meter calibration was not performed at the required frequency, qualify all associated samples estimated (J).

Calibration checks should be within 0.1 pH units.

Blanks: Method blank must be analyzed every 20 samples and contamination must be less than PQL.

Equipment blank sample are qualified using qualification guidance levels derived from method blank contamination. Qualification level for samples are determined from the maximum contamination levels in method and equipment blank contamination. If the contamination is greater than the PQL, then:

Qualification Guidance Level = 5 x contamination in blank.

Qualification Guidelines:

If results < PQL, then no action is taken.

If results < 5 x contamination, then report the value with a (U).

If results > 5 x contamination, then no action is taken.

Duplicate: Verify a duplicate sample was analyzed for every 10 field samples or less of each matrix. The RPD must be ≤35% for water. If RPD >35% qualify all sample results associated with this duplicate sample as estimated (J).

4.8 LITHIUM, MOLYBDENUM, BISMUTH, AND TIN - CLP SOW MODIFICATION A

Follow the Functional Guidelines for Evaluating Inorganic Analyses (FGEIA) (EPA, 1988) and apply the following additional criteria:

The following changes have been incorporated into the CLP SOW Document No. ILM03.0 as Modification A:

Introduction: TAL metals analysis has been extended to include lithium, molybdenum, bismuth and tin. These additional elements have the following CRDLs:

Analyte	CDRL Water (ug/L)	CDRL Soil (mg/kg)
Lithium	100	10
Molybdenum	20	2
Bismuth	150	30
Tin	50	10

All data deliverables for the OU 9 programs are required to include these added elements.

In addition, lower detection limits have been specified for four elements. These are as follows:

Analyte	CDRL Water (ug/L)	CDRL Soil (mg/kg)
Aluminum	20	4
Antimony	10	2
Beryllium	1	0.2
Vanadium	10	2

See the CLP SOW Modification A for details on analytical methodology for these additional metals.

Holding Time: Apply the same holding times as other TAL metals (180 days).

Initial and Continuing Calibration Verification: Additional elements as listed above must be incorporated in the calibration. The same criteria as established in the FGEIA are to be utilized in the evaluation of these analytes.

CRDL Standard for AA and ICP: Additional elements as listed above must be incorporated in the TAL. The same criteria as established in the FGEIA are to be utilized in the evaluation of these elements.

Blanks: Additional elements and lower CRDLs as presented above must be included in the blank analyses. The same criteria as established in the FGEIA are to be utilized in the evaluation of these analytes in the laboratory blanks. If there is no contamination in the laboratory blanks, then sample data will be qualified based on the field blank result under the FGEIA blank rules.

ICP Interference Check Sample: Solution AB shall include the following analytes:

Analyte	mg/L
Lithium	1.0
Molybdenum	1.0
Bismuth	1.0
Tin	1.0

A level ±20% of the true value is to be used as the acceptance criteria. Follow FGEIA for qualification if %D >20%.

Matrix Spike Recovery: Spikes shall include the following elements at the concentrations specified below:

Analyte	For ICP/Flame AA		For Furnace AA	
	Water (ug/L)	Soil (mg/kg)	Water (ug/L)	Soil (mg/kg)
Lithium	100	10		
Molybdenum	20	2		
Bismuth	150	30		
Tin	50	10	100	50

Spike recoveries for these elements must meet the same criteria as established in the FGEIA.

Post Digest Spike Sample Recovery: No change. Apply FGEIA guidelines.

Duplicates: Additional elements as listed above must be incorporated in the TAL. The aqueous sample criteria for these analytes shall be ≤ 25% RPD for field duplicates. For laboratory duplicates the criteria is ± 20% RPD if the result is ≥ 5x the CRDL, and if the result is ≤ 5 x CRDL, the criteria is ± the CRDL.

For soil samples, the criteria shall be ≤ 50% RPD for field duplicates. For laboratory duplicates the criteria is ± 35% RPD if the result is ≥ 5 x the CRDL, and if the result is ≤ 5 x CRDL, the criteria is ± 2 x CRDL. Qualification of data is to be performed using the guidelines in FGEIA.

Laboratory Control Sample: All of the four additional elements (Li, Mo, Sb and Sn) will be included in the LCS analysis. The acceptance criteria for these analytes must be in accordance with the FGEIA.

ICP Serial Dilutions: If sample results are > 50 x the IDL, a serial dilution is required. The results of this dilution for these elements must be ± 10%. Positive results exceeding this criteria will be estimated (J).

IDL (Quarterly): Additional elements and lower CRDLs as listed above must be incorporated. Follow FGEIA for these additional elements.

ICP Interelement Correction Factors (Annually): Additional elements as listed above must be incorporated. Follow FGEIA for these additional elements.

ICP Linear Ranges (Quarterly): Additional elements as listed above must be incorporated. Follow FGEIA for these additional elements.

Analysis Run Log: Additional elements as listed above must be incorporated.

4.9 LITHIUM, MOLYBDENUM, BISMUTH, AND TIN - CLP SOW MODIFICATION B

Follow the Functional Guidelines for Evaluating Inorganic Analyses (FGEIA) (EPA, 1988) and apply these additional criteria:

The following changes have been incorporated into the CLP SOW Document No. ILM03.0 as Modification B:

Introduction: Metals analysis has been extended to include lithium, molybdenum, bismuth, and tin. These additional elements have the following CRDLs:

Analyte	CDRL Water (ug/L)
Lithium	100
Molybdenum	20
Bismuth	150
Tin	50

All data deliverables for the OU 9 program are required to include these added elements.

In addition, lower water detection limits have been specified for nine elements. These are as follows:

Analyte	CDRL Water (ug/L)
Aluminum	20
Beryllium	1
Vanadium	10
Arsenic	2
Antimony	10
Cadmium	2
Lead	2
Selenium	2
Thallium	2

These detection limits require the additional sensitivity provided by graphite furnace atomic absorption for As, Sb, Cd, Pb, Se, and Tl. Zeeman background correction must be used (Pb and Sb have the option of using deuterium background correction).

Holding Time: Apply the same holding times as other TAL metals (180 days).

Initial and Continuing Calibration Verification: Additional elements as listed above must be incorporated in calibrations. The same criteria as established in the FGEIA are to be utilized in the evaluation of these elements.

CRDL Standard for AA and ICP: Additional elements as listed above must be incorporated in the CRDL standards. The same criteria as established in the FGEIA are to be utilized in the evaluation of these elements.

Blanks: Additional elements and lower CRDLs as presented above must be included in the

blank analyses. The same criteria as established in the FGEIA are to be utilized in the evaluation of these analytes in the laboratory blanks. If there is no contamination in the laboratory blanks, then sample data will be qualified based on the field blank result under the FGEIA blank rules.

ICP Interference Check Sample: Solution AB shall include the following analytes:

Analyte	mg/L
Lithium	1.0
Molybdenum	1.0
Bismuth	1.0
Tin	1.0

A level ±20% of the true value must be used as the acceptance criteria. Follow FGEIA for qualification for %D >20%.

Matrix Spike Recovery: Spikes shall include the following elements at the specified concentrations:

Analyte	Water (ug/L)
Lithium	2000
Molybdenum	300
Bismuth	2000
Tin	500

Spike recoveries for these elements must meet the criteria as established in the FGEIA.

Post Digest Spike Sample Recovery: No change. Apply FGEIA guidelines.

Duplicates: Additional elements as listed above must be incorporated in the TAL. The aqueous sample criteria for these analytes shall be ≤ 25% RPD for field duplicates. For laboratory duplicates, the criteria is ± 20% RPD if the result is ≥ 5 x the CRDL, and if the result is ≤ 5 x CRDL, the criteria is ± the CRDL. For soil samples, the criteria shall be ≤ 50% RPD for field duplicates. For laboratory duplicates the criteria is ± 35% RPD if the result is ≥ 5 x the CRDL, and if the result is ≤ 5 x CRDL, the criteria is ± 2 x CRDL. Qualification of data is to be performed using

the guidelines in FGEIA.

Laboratory Control Sample: All of the four additional elements (Li, Mo, Sb, and Sn) will be included in the LCS analysis. The acceptance criteria for these analytes must be in accordance with the FGEIA.

ICP Serial Dilutions: No change.

IDL (Quarterly): Additional elements and lower CRDLs as listed above must be incorporated. Follow FGEIA for these additional elements.

ICP Interelement Correction Factors (Annually): Additional elements as listed above must be incorporated. Follow FGEIA for these additional elements.

ICP Linear Ranges (Quarterly): Additional elements as listed above must be incorporated. Follow FGEIA for these additional elements.

Analysis Run Log: Additional elements as listed above must be incorporated.

4.10 LANTHANIDES - CLP SOW MODIFICATION C

Follow the Functional Guidelines for Evaluating Inorganic Analyses (FGEIA) (EPA, 1988) and apply these additional elements:

The following additions have been incorporated into the CLP SOW Document No. ILM01.0 as Modification C:

Introduction: Lanthanide series analytes in soil has been added to the TAL in CLP SOW Document No. ILM01.0. These additional elements have the following CRDLs:

Analyte	CDRL Water (ug/L)	CDRL Soil (ug/kg)
Lanthanum	NA	40,000
Cerium	NA	40,000
Praseodymium	NA	40,000
Neodymium	NA	40,000
Samarium	NA	40,000
Europium	NA	40,000
Gadolinium	NA	40,000
Terbium	NA	40,000
Dysprosium	NA	40,000
Holmium	NA	40,000
Erbium	NA	40,000
Thulium	NA	40,000
Ytterbium	NA	40,000
Lutetium	NA	40,000

The samples for lanthanide analysis must be digested following Method 3050 using 1 g of soil, a final volume of 200 mL, and the digestate analyzed by ICP. The wavelength to be used for each element is specified in the QAPP. Data deliverables as required for CLP metals analysis are required for these added elements.

Holding Time: Apply the same holding times as in the SOW for other TAL metals (180 days).

Initial and Continuing Calibration Verification: The lanthanide elements listed above must be incorporated in the calibration. The same criteria as established in the FGEIA for ICP are to be utilized in the evaluation of these analytes.

CRDL Std. for ICP: Lanthanide elements listed above must be incorporated in the CRDL standards. The same criteria as established in the FGEIA are to be utilized in the evaluation of these elements.

Blanks: Lanthanide elements listed above must be included in the analyte list and meet the CLP SOW criteria. The same criteria as established in the FGEIA are to be utilized in the evaluation of these analytes in the laboratory blanks. If the contaminant level in a field blank is greater than a laboratory blank, then sample data will be qualified based on the field blank result and not the laboratory blank result under the FGEIA blank rules.

ICP Interference
Check Sample: Solution AB shall include the following analytes:

Analyte	ug/L
Lanthanum	200
Cerium	200
Praseodymium	200
Neodymium	200
Samarium	200
Europium	200
Gadolinium	200
Terbium	200
Dysprosium	200
Holmium	200
Erbium	200
Thulium	200
Ytterbium	200
Lutetium	200

A level ± 20% of the true value is to be used as the acceptance criteria. Follow the FGEIA for qualification if the %D >20%. Titanium may act as interferant for some of these elements. Possible interference should be evaluated for each sample. Should it appear that there are significant concentrations of interferants present in the sample, follow the guidance in the FGEIA for qualification.

Matrix Spike Recovery: Matrix spikes shall include the above elements at the concentrations specified in SOW Modification C. Spike recoveries for these elements must meet the same criteria as established in the FGEIA (75%-125%). Any element not meeting this criteria will be evaluated for useability and will be estimated (J) for positive results and estimated (UJ) for non-detected results.

Post Digest Spike Sample Recovery: No change. Apply FGEIA guidelines.

Duplicates: Lanthanide elements listed above must meet the CLP SOW criteria. For soil samples, the criteria shall be ≤ 50% RPD for field duplicates. For laboratory duplicates the criteria is ± 35% RPD if the result is ≥ 5 x the CRDL, and if the result is ≤ 5 x CRDL, the criteria is ± 2 x CRDL. For aqueous samples, the criteria for these analytes shall be ≤ 25% RPD for field duplicates. For laboratory duplicates the criteria is ± 20% RPD if the result is ≥ 5 x the CRDL, and if the result is ≤ 5 x CRDL, the criteria is ± the CRDL. Qualification of data is to be performed using the guidelines in FGEIA.

Laboratory Control Sample: At least four of the lanthanide series elements must be added to the LCS sample. The acceptance criteria for these analytes must be in accordance with the FGEIA.

ICP Serial Dilutions: If sample results are > 50 x the IDL, a serial dilution is required. The results of this dilution for these elements must be ± 10%. Positive results exceeding this criteria will be estimated (J).

IDL (Quarterly): Lanthanide elements listed above must be included in the analyte list and must meet the CLP SOW criteria; follow FGEIA for these additional lanthanide elements.

ICP Interelement Correction Factors (Annually): Lanthanide elements listed above must be included in the analyte list and must meet the CLP SOW criteria; follow FGEIA for these additional lanthanide elements.

ICP Linear Ranges (Quarterly): Lanthanide elements listed above must be included in the analyte list and must meet the CLP SOW criteria; follow FGEIA for these additional lanthanide elements.

Analysis Run Log: Lanthanide elements listed above must be included in the analyte list and must meet the CLP SOW criteria; follow FGEIA for these additional lanthanide elements.

4.11 VOLATILE AND SEMIVOLATILE ORGANIC COMPOUNDS - CLP SOW MODIFICATION D

Follow the Functional Guidelines For Evaluating Organic Analysis (FGFEOA) and apply the FGFEOA to these additional criteria:

Introduction: The Target Compound List (TCL) for volatile analysis in SOW Document No. OLM01.8 has been extended to include 7 additional compounds and CRQLs for most analytes has been lowered to 5 ug/L. 2-benzyl-4-chlorophenol has been added to the TCL for semivolatile analysis.

4.11.1 Volatiles

The CRQLs for most of the analytes has been lowered (See Table VI. 1) and seven additional compounds have been added to the TCL in OLM01.8 and their CRQL are as follows:

Analyte	CDRL Water (ug/L)	CDRL Soil (ug/kg)
Vinyl Acetate	10	10
Acrylonitrile	100	100
Acetonitrile	100	100
Diethylbenzene	5	20
1,1,2-Trichloro-1,2,2-trifluoroethane	5	10
Hexane	10	10
Iodomethane	NA	10

Holding Time: Apply the FGFEOA criteria.

BFB Check: Apply the FGFEOA criteria.

Calibration: Verify the seven (7) additional compounds and their quantitation ions are included in the Target Compound List (TCL) at the required concentration (specified in the Modification D), that they meet the SOW calibration criteria and follow the FGFEOA.

Blanks: No change except trichlorotrifluoroethane must be included in the category of common laboratory contaminants and therefore the Action Level will be based on the 10 x contamination level.

Surrogates: Apply the FGFEOA criteria.

Matrix Spike: No change except Acrylonitrile must be added to the matrix spike sample at 300 ug/L for water samples and at 300 ug/kg for soil samples. The acrylonitrile recovery limits for water samples is 70-130% and for soil samples is 60-140%.

Matrix Spike Duplicate: No change except the Relative Percent Deviation for acrylonitrile for water samples is 15% and for soil samples is 25%.

I.S. Retention Time/area: Apply the FGFEOA criteria.

Duplicate: The RPD criteria for these compounds must be ≤ 35% for water samples and ≤ 50 % for soils. The same validation criteria apply to these additional compounds.

4.11.2 Semivolatiles

Three additional compounds have been added to the TCL in OLM0.1.8 and their CRQL are as follows:

Analyte	CDRL Water (ug/L)	CDRL Soil (ug/kg)
Benzoic Acid	50	1600
Benzyl Alcohol	10	330
2-Benzyl-4-chlorophenol	10	330

Holding Time: Apply the FGFEOA criteria.

Calibration: Verify the additional compounds 2-benzyl-4-chlorophenol, benzoic acid and benzyl alcohol are included in the Target Compound List (TCL) at the required concentration and that they meet the minimum response factor (RF) requirement of 0.01 and the SOW calibration criteria and follow the FGFEOA.

Blanks: Apply the FGFEOA criteria.

Surrogates: Apply the FGFEOA criteria.

Matrix Spike: Apply the FGFEOA criteria.

Matrix Spike Duplicate: No change. Apply the same FGFEOA criteria.

Internal Standard Retention Time/Area: Apply the same FGFEOA criteria.

Duplicate: The RPD must be ≤ 55% for water samples and no limits have been set for soils. The same validation criteria apply to these additional compounds.

4.11.3 Pesticides/PCBs

CRQLs based on Modification D

Compound	CRQL µg/L
Pesticides/PCBs	
alpha-BHC	0.01
beta-BHC	0.01
delta-BHC	0.01
gamma-BHC (Lindane)	0.01
Heptachlor	0.01
Aldrin	0.01
Heptachlor epoxide	0.01
Endosulfan I	0.01
Dieldrin	0.02
4,4'-DDE	0.02
Endrin	0.01
Endosulfan II	0.02
4,4'-DDD	0.02
Endosulfan sulfate	0.02
4,4'-DDT	0.02
Methoxychlor	0.10
Endrin ketone	0.02
Endrin aldehyde	0.02
alpha-Chlordane	0.01
gamma-Chlordane	0.01
Toxaphene	1.0
Aroclor-1016	0.5
Aroclor-1221	0.5
Aroclor-1232	0.5
Aroclor-1242	0.5
Aroclor-1248	0.5
Aroclor-1254	0.5
Aroclor-1260	0.5

Holding Time: Apply the FGFEOA criteria.

Retention Time Windows: Apply the FGFEOA criteria.

Calibration: Apply the FGFEOA criteria.

Blanks: Apply the FGFEOA criteria.

Sulfur Cleanup Blank: Apply the same FGFEOA criteria. If any of the analyte recoveries are outside QC, then all positive results for that analyte should be estimated (J) in all associated samples limits. When any analyte %R is <80%, non-detected sample results should be estimated and if %R is >120%, then non-detected results should be accepted for that analyte. When recovery is <10% for any analyte, then all non-detected results for that analyte should be rejected (R).

If recovery of three or more analytes is below 10% all associated sample results should be evaluated and if necessary, qualified based on professional experience.

Florisil Cartridge

Check: Apply the same FGFEOA criteria. If any of the analyte recoveries are outside QC, then all positive results for that analyte should be estimated (J) in all associated samples limits. When any analyte %R is <80%, non-detected sample results should be estimated and if %R is >120%, then non-detected results should be accepted for that analyte. When recovery is <10% for any analyte, then all non-detected results for that analyte should be rejected (R).

If recovery of three or more analytes is below 10% all associated sample results should be evaluated and if necessary, qualified based on professional experience.

Pesticide GPC Calibration: Apply the same FGFEOA criteria. If any of the analyte recoveries are outside QC criteria, then all positive results for that analyte should be estimated (J) in all associated samples.

Qualification guidelines: If the %R is <80%, non-detected sample results should be estimated if %R is >120%, then non-detected results should be accepted for that analyte.

If recovery is <10% for any analyte, then all non-detected results for that analyte should be rejected (R). For severe QC failures all data should be evaluated and if necessary, rejected (R) based on professional judgement.

Sample Quantitation: Apply the same FGFEOA criteria. When the %D between the two column results is >100%, it is highly unlikely that the analyte is present or its quantitation is correct or it is the same analyte, therefore, the resultant value should be considered unusable (R). However, if both results are <CRQL and %D is >100%, the value should be reported as non-detected (UJ).

Instrument Blank: Apply the FGFEOA criteria.

Surrogates: Apply the FGFEOA criteria.

Matrix Spike: Apply the same FGFEOA criteria.

Matrix Spike Duplicate: No change.

Duplicate: The RPD must be ≤ 35% for water samples and no limits have been set for soils. The same validation criteria apply to these additional compounds.

4.12 VOLATILE ORGANICS - EPA SW846 Method 8021

Holding Time: Verify that the samples were analyzed within the holding time (HT) period of 14 days. Qualify results as estimated with (J) and (UJ) if HT were exceeded. If HT was grossly exceeded professional judgement should be used for qualifying the data as unusable (R).

Calibration: Verify that the percent relative standard deviation (%RSD) of the response factors (RF) for the initial 5 point calibration was $\leq$ 20%. Verify that a continuing calibration was run every 10 samples and that the %difference (%D) in RFs was within 15% of average RF from the initial calibration. If any samples were analyzed with a non-compliant calibration standard, then the results associated with the non-compliant standard must be estimated (J). If %D or %RSD was >50%, then all positive and non-detected values for that analyte must be estimated (J) and (UJ).

Verify retention time windows as per Table III.2 of the QAPP.

Blanks: Method blanks must be analyzed one per 20 samples of a given matrix per day and contamination must be less than PQL.

Verify that trip blanks are performed one per shipping container to laboratory.

Verify that equipment blanks are performed one every 10 samples or less. Sample bank blanks and ambient blanks are performed one every 20 or less. These field blanks are qualified using qualification guidance levels derived from blank contamination. Qualification level for samples are based on the maximum contamination levels in the blanks.

Qualification Guidance Level
for acetone, methylene chloride,
toluene, 2-butanone = 10 x contamination in blank.

Qualification Guidance Level
for other compounds = 5 x contamination in blank

Qualification Guidelines:
If results <PQL, report PQL as U.
If results >PQL and < qualification guidance level, then report the value as U.
If results >PQL and > qualification guidance level, then report the value unqualified.

Surrogates: The recoveries for the surrogates bromochloromethane and 1,4-dichlorobutane should be within QC limits specified in Table III.3 of the QAPP. If recoveries are not within QC limits, the samples should be reextracted and reanalyzed. If recoveries are still outside limits then associated positive sample results should be estimated (J). If recoveries are below 10%, then associated sample results should be qualified as unusable (R).

Internal Standards: The recoveries of internal standards fluorobenzene and 2-bromo-1-chloropropane should be within QC Limits specified Table III.3 of the QAPP. If recoveries are not within QC limits, the samples should be reanalyzed. If recoveries are still outside limits then associated sample results should be estimated (J) and (UJ). If extremely low area counts are reported, then associated non-detected sample results should be qualified as unusable (R).

Laboratory Control Sample (LCS): Verify that an LCS was performed 1 per 20 samples of a given matrix per day. Verify that LCS recoveries are within QC limits specified in Table III.3 of the QAPP.

If LCS recoveries are not within QC limits, then all associated samples must be reanalyzed with another LCS. Professional judgement should be used to evaluate data associated with failed LCS analysis. If recoveries are below 10%, then associated results should be qualified as unusable (R).

Matrix Spike (MS)/ Matrix Spike Duplicate (MSD): Verify that an MS/MSD was performed one per 20 samples of a given matrix. Verify that MS/MSD recoveries are within QC limits specified in Table III.3 in the QAPP. The positive values for those compounds that fail MS/MSD criteria should be estimated in the unspiked sample. If recoveries are below 10%, then associated results should be qualified as unusable (R).

Duplicate: Verify that a duplicate sample was analyzed for every 10 field samples or less of each matrix within the criterion specified in Table III.3 in the QAPP. If criteria was not met, then estimate (J) the positive results for that analyte(s) in both samples. If one of the sample results is > PQL and the other is non-detected, then both results are estimated (J).

Compound Identification and Quantitation Limits: Verify that the secondary column confirmation was performed for all results > PQL. If the percent difference (%D) between the two results is > 25, estimate the result. If the %D > 100, it is highly unlikely that the analyte is present or its quantitation is correct or it is the same analyte, therefore, the resultant value should be considered unusable (R). However, if both results are < CRQL and %D > 100% the value should be reported as non-detected (UJ).

Verify that quantitation limits Table VI.1 in the OU 9 QAPP were met.

4.13 VOLATILE ORGANIC COMPOUNDS - EPA METHOD 502.2

Holding Time: Verify that the samples were analyzed within the holding time (HT) period of 14 days. Qualify results as estimated with (J) and (UJ) if HT were exceeded. If HT was grossly exceeded professional judgement should be used for qualifying the data as unusable (R).

Calibration: Verify that the percent relative standard deviation (%RSD) of the response factors (RF) for the initial 5 point calibration was $\leq$ 10%. Verify that a continuing calibration was run every 10 samples and that the %difference (%D) in RFs was within 20% of average RF from the initial calibration. If any samples were analyzed with a non-compliant calibration standard, then the results associated with the non-compliant standard must be estimated (J). If %D or %RSD was >50%, then all positive and non-detected values for that analyte must be estimated (J) and (UJ).

Verify retention time windows are as specified in Table III.2 of the QAPP.

Blanks: Method blanks must be analyzed one per 20 samples of a given matrix per day and contamination must be less than PQL.

Verify that trip blanks are performed one per shipping containeer to laboratory.

Verify that equipment blanks, sample bank blanks and ambient blanks are performed one every 10 samples or less. These field blanks are qualified using qualification guidance levels derived form method blank contamination. Qualification level for samples are based on the maximum contamination levels in blanks.

Qualification Guidance Level
for acetone, methylene chloride,
toluene, 2-butanone = 10 x contamination in blank.

Qualification Guidance Level
for other compounds = 5 x contamination in blank.

Qualification Guidelines:
If results <PQL, report PQL as U.
If results >PQL and < qualification guidance level, then report the value as U.
If results >PQL and > qualification guidance level, then report the value unqualified.

Surrogates: The recoveries for the surrogates fluorobenzene and 1-chloro-2-bromopropane should be within QC limits as specified in Table III.3 of the QAPP. If recoveries are not within QC limits, the samples should be reextracted and reanalyzed. If recoveries are still outside limits professional judgement should be used. If recoveries are below 10%, then associated sample results could be considered as unusable (R).

Laboratory Fortified Blank (LFB): Verify that an LFB was performed 1 per 20 samples of a given matrix per day. Verify that LFB recoveries are within QC limits as specified in Table III.3 of the QAPP or all associated samples must be reextracted with another LFB. Professional judgement should be used to evaluate data associated with failed LFB analysis. If recoveries are below 10%, then associated sample results should be considered as unusable (R).

Matrix Spike (MS)/ Matrix Spike Duplicate (MSD): Verify that an MS/MSD was performed one per 20 samples of a given matrix. Verify that MS/MSD recoveries are within QC limits as specified in Table III.3 of the QAPP. The positive values for those compounds that fail MS/MSD criteria should be estimated in the unspiked sample. If recoveries are <10%, then associated results should be considered unusable (R).

Duplicate: Verify that a duplicate sample was analyzed for every 10 field samples or less of each matrix. The RPD must be $\leq$ 25. If criteria was not met, then estimate (J) the positive results for that analyte(s) in both samples. If one of the sample results is > PQL and the other is non-detected, then both results are estimated (J).

Compound Identification and Quantitation Limits: Verify that the secondary column confirmation was performed for all results > PQL. If the percent difference (%D) between the two results is > 25, estimate the result. If the %D > 100, it is highly unlikely that the analyte is present or its quantitation is correct or it is the same analyte, therefore, the resultant value should be considered unusable (R). However, if both results are < CRQL and %D > 100% the value should be reported as non-detected (UJ).

Verify that quantitation limits stated in the OU 9 QAPP were met.

4.14 ACRYLONITRILE, ACETONITRILE - EPA SW846 Methods 5030/8030

Holding Time: Verify that the samples were analyzed within the holding time (HT) period of 14 days. Qualify results as estimated with (J) and (UJ) if HT were exceeded. If HT was grossly exceeded professional judgement should be used for qualifying the data as unusable (R).

Calibration: Verify that the initial 5 point calibrations had a relative standard deviation (%RSD) <20. Verify that a continuing calibration was run every 10 samples and that its response was within 15% of true value. If any samples were analyzed with a non-compliant calibration standard, then the results associated with the non-compliant standard must be estimated (J). If %D or %RSD was > 50%, then all positive and non-detected values for that analyte must be estimated (J) and (UJ).

Verify retention time windows as specified in Table III.2 in the QAPP.

Blanks: Method blanks must be analyzed one per 20 samples of a given matrix per day and contamination must be less than PQL. Verify that equipment blanks are performed one per 10 samples; sample bank blanks and ambient blanks are performed one per 20 samples. These field blanks are qualified using qualification guidance levels derived form method blank contamination. Qualification level for samples are determined from the maximum contamination levels in blanks.

Qualification Guidance Level = 5 x contamination in blank.

Qualification Guidelines:
If results <PQL, report PQL as U.
If results >PQL and <5 x contamination, then report the value as U.
If results >PQL and >5 x contamination, then report the value unqualified.

Surrogates: Non-specified for this analysis.

Laboratory Control Sample (LCS): Verify that an LCS was performed 1 per 20 samples of a given matrix per day. Verify that LCS recoveries are within QC limits as specified in Table III.3 of the QAPP.

If LCS recoveries are not within QC limits, then all associated samples must be re-extracted with another LCS. Professional judgement should be used to evaluate data associated with failed LCS analysis. If recoveries are below 10%, then associated results are qualified as unusable (R).

Matrix Spike (MS)/ Matrix Spike Duplicate (MSD): Verify that an MS/MSD was performed one per 20 samples of a given matrix. Verify that MS/MSD recoveries are within QC limits as specified in Table III.3 of the QAPP.

The positive values for those compounds that fail MS/MSD criteria should be estimated in the unspiked sample. If recoveries are below 10%, then associated results should be qualified as unusable (R).

Duplicate: Verify that a duplicate sample was analyzed for every 10 field samples or less of each matrix. The RPD must be $\leq$ 35% for waters and $\leq$ 50% for soils. If criteria was not met, then estimate (J) the positive results for that analyte(s) in both samples. If one of the sample results is > PQL and the other is non-detected, then both results are estimated (J).

Compound Quantitation Limits: Verify that the quantitation limits were met as specified in Table VI.1 of the QAPP.

5.0 DATA VALIDATION GUIDELINES FOR RADIOLOGICAL DATA

The following guidelines are presented for the validation of radiological analyses. For radiological analyses, see QAPP Table VI.1 for a more detailed listing of the source of the listed method.

5.1 GROSS ALPHA/GROSS BETA

Holding Time: Verify the samples were analyzed within the holding time specified in Tables IV.3 and IV.4 of the QAPP. If holding time was exceeded, the sample results should be estimated (J) or (UJ).

Calibration: Verify the instrument being used has been calibrated according to the requirements of the procedure and the QAPP, Section 7. The frequency of calibration should be performed at a minimum of once a year.

Source Check: Verify the check source was counted on the same day, before or during the run of samples being measured and that its value is within 3x Standard Deviation (SD) of its mean value. If this criterion is not met, qualify all of the results as estimated, (J), measured on that day.

Background: Verify the background was counted each day, that the background was within 3xSD of its mean and the appropriate background was used to subtract from the sample counts. If the background was >3xSD, qualify all of the results measured using that background as estimated, (J).

Self Absorption Factor: Verify the correct self-absorption factor was used based on the weight of the material on the planchet counted.

Efficiency: Verify the correct efficiency was used in the calculations.

Duplicate: Verify a duplicate field sample was taken for every 10 or fewer field samples. For water the duplicate result must be within 4xSD of the result for the original. If this criterion is not met, qualify the results for that sample as estimated, (J).

Result: Verify the result is properly reported with its associated error. Also verify that any data qualification letters are present.

5.2 TRITIUM

Holding Time: Verify the samples were analyzed within the holding time specified in Tables IV.3 and IV.4 of the QAPP. If holding time was exceeded, the sample results should be qualified as estimated (J) or (UJ). If the holding time was grossly exceeded, professional judgement may be used for qualifying the data as unusable (R).

Calibration: Verify the instrument being used has been calibrated according to the requirements of the procedure and the QAPP, Section 7. The frequency of calibration should be at a minimum of once a year.

Source Check: Verify the check source was counted on the same day before or during the run of samples being measured and that its value is within 3xSD of its mean value. If this criterion is not met, qualify all of the results measured on that day as estimated, (J).

Background: Verify the background was counted each day, that the background was within 3xSD of its mean and that the appropriate background was used to subtract from the sample counts. If the background was >3xSD, qualify all of the results measured on that day as estimated, (J).

Efficiency: Verify the correct efficiency was used in the calculation.

Method Blank: Verify the method blank activity is ≤2x the MDA. If the blank activity is greater than 2x the MDA, then use professional judgement. If the blank activity is greater than 2x the MDA and the sample activity is **less** than 3x the blank activity, then the result is rejected, (R). If the blank activity is greater than 2x the MDA and the sample activity is **greater** than 3x the blank activity, the result is estimated, (J).

Method Spike: Verify the matrix spike is within ±3x SD of the theoretical spike value. If the method spike is outside the specified criteria in Table III.2 of the QAPP, results will be qualified estimated, (J). If the spike recovery grossly exceeds the criteria, results may be rejected, (R) based on professional judgement.

Duplicate: Verify that a duplicate field sample was taken for every 10 or fewer field samples. For water the duplicate result must be within 4xSD of the result for the original. If this criterion is not met, qualify the results for that sample as estimated, (J).

Decay Correction: If applicable, verify that the result was properly decayed to the sample date.

Replicate: Verify a replicated sample was run 1 per 20 samples of a similar matrix and that the result is within 4x SD of the normalized range. If this criterion is not met, qualify both original and replicate samples as estimated, (J).

Result: Verify the result is properly reported with its associated error. Also verify that data qualification letters are present if required.

5.3 PLUTONIUM ISOTOPES - NAS, 1965

Holding Time: Verify the samples were analyzed within the holding time specified in tables IV.3 and IV.4 of the QAPP. If holding time was exceeded, the sample results should be qualified as estimated (J) or (UJ).

Calibration: Verify each counter being used has been calibrated for each isotope of interest either by counting a standard of the isotope prepared in the same geometry as is used for samples or by calculation from an efficiency vs. energy calibration curve. The data reduction used must be the same as is used to calculate the sample data. This calibration should be done at least annually. Also verify that the correct branching ratio for each isotope was used in the calculations.

Source Check: Verify the check source was counted each day and that its value is within 3xSD of its mean value for each counter used. If this criterion is not met, qualify all of the results measured before the next acceptable check source count was obtained as estimated, (J).

Background: Verify the background was counted for each counter at least once each week, the background was within 3xSD of its mean, and the appropriate background was used to subtract from the sample counts. If the background was >3xSD, qualify all of the results measured using that background as estimated, (J).

Efficiency: Verify the correct efficiency was used in the calculations.

Yield: Verify the yield was correctly determined using the counts obtained for the tracer(^{236}Pu) added at the start of the sample analysis, the counts from 100% of the tracer (^{236}Pu) added and that the yield was correctly applied to each isotope.

Method Blank: Verify the method blank activity is $\leq$2x the MDA. If the blank activity is greater than 2x the MDA and the sample activity is **less** than 3x the blank activity, then the result is rejected, (R). If the blank activity is greater than 2x the MDA and the sample activity is **greater** than 3x the blank activity, the result is estimated, (J).

Method Spike: Verify a method spike was run 1 per 20 samples of a given matrix or 1 per batch of samples prepared per day, whichever is more frequent. The results must be within 3xSD of the known value. If the method spike is outside the specified criteria in Table III.2 of the QAPP, results will be qualified estimated, (J). If the spike recovery grossly exceeds the criteria, results may be rejected, (R) based on professional judgement.

Matrix Spike: Verify a matrix spike was run 1 per 20 samples of a similar matrix. The result must be within 3xSD, of the known value. If greater than 3xSD use professional judgement. If the matrix spike is outside the specified criteria in Table III.2 of the QAPP, results will be qualified estimated, (J). If the spike recovery grossly exceeds the criteria, results may be rejected, (R) based on professional judgement.

Replicate: Verify a replicate sample was run 1 per 20 samples of a similar matrix and that the result is within 4xSD of the normalized range. If this criterion is not met, qualify both original and replicate samples as estimated, (J).

Duplicate: Verify a duplicate field sample was taken for every 10 or fewer field samples. For water the duplicate result must be within 4xSD of the result for the original. If this criterion is not met, qualify the results for that sample as estimated, (J).

Result: Verify the result is properly reported with its associated error. Also verify required data qualification letters are present.

5.4 STRONTIUM - 90 - NAS 1960/MARTIN 1979/PHS 1965

Efficiency: Verify the correct efficiency was used in the calculations.

Replicate: Verify a replicate sample was run 1 per 20 samples of a similar matrix and that the result is within 4xSD of the normalized range. If this criterion is not met, qualify both original and replicate samples as estimated, (J).

Holding Time: Verify the samples were analyzed within the holding time specified in tables IV.3 and IV.4 of the QAPP. If holding time was exceeded, the sample results should be qualified as estimated (J) or (UJ).

Calibration: Verify each counter used has been calibrated using ^{90}Sr. This calibration should be done at least annually. Also verify that the correct ^{90}Sr efficiency was used in the calculations.

Source Check: Verify the check source was counted each day and that its value is within 3xSD of its mean value for each counter used. If this criterion is not met, qualify all of the results measured before the next acceptable check source count was obtained as estimated, J.

Background: Verify the background was counted for each counter at least once each week, the background was within 3xSD of its mean and the appropriate background was used to subtract from the sample counts. If the background was, >3xSD, qualify all of the results measured using that background as estimated, (J).

NOTE: If all strontium present is assumed to be Strontium-90, the ingrowth of yttrium is not required.

Sr Yield: Verify that the strontium yield was correctly determined either gravimetrically or by the use of a tracer (i.e. ^{85}Sr) and that the yield was correctly applied.

Y Grow-in: Verify that the grow-in factor was calculated and applied correctly based on the time of start of grow-in and the time of yttrium separation.

Method Blank: Verify that a method blank was run each day and that the result of the blank was ≤ 2xMDA. If the blank activity is greater than 2x the MDA and the sample activity is **less** than 3x the blank activity, then the result is rejected, (R). If the blank activity is greater than 2x the MDA and the sample activity is **greater** than 3x the blank activity, the result is estimated, (J).

Method Spike: Verify the matrix spike is within ±3x SD of the spiked value. If the spike result is outside criteria, then use professional judgement. If the method spike is outside the specified criteria in Table III.2 of the QAPP, results will be qualified estimated, (J). If the spike recovery grossly exceeds the criteria, results may be rejected, (R) based on professional judgement.

Matrix Spike: Verify a matrix spike was run 1 per 20 samples of a similar matrix. The result must be within 3xSD, of the known value. If greater than 3xSD use professional judgement. If the matrix spike is outside the specified criteria in Table III.2 of the QAPP, results will be qualified estimated, (J). If the spike recovery grossly exceeds the criteria, results may be rejected, (R) based on professional judgement.

Duplicate: Verify a duplicate field sample was taken for every 10 or fewer field samples. For water the duplicate result must be within 4xSD of the result for the original. If this criterion is not met, qualify the results for that sample as estimated, (J).

Result: Verify the result is properly reported with its associated error. Also verify that any required data qualification letters are present.

5.5 GAMMA SPECTROMETRY - NUCLEAR DATA, INC., 1986

Holding Time: Verify the samples were analyzed within the holding time specified in tables IV.3 and IV.4 of the QAPP. If holding time was exceeded, the sample results should be qualified as estimated (J) or (UJ).

Calibration: Verify each counter being used has been calibrated for each isotope of interest either by counting a standard of the isotope prepared in the same geometry as is used for samples or by calculation from an efficiency vs. energy calibration curve. The data reduction used must be the same as is used to calculate the sample data. This calibration should be done at least annually. Also verify that the correct branching ratio for each isotope was used in the calculations.

Mixed Standard: Verify a standard containing a mixture of isotopes covering the energy range of interest was counted and that the results obtained were within ± 5% of the known value.

Source Check: Verify the check source was counted each day and its value is within 3xSD of its mean value for each counter used. If this criterion is not met, qualify all of the results measured, before the next acceptable check source count was obtained, as estimated, (J).

Background: Verify the background was counted for each counter at least once each month and the appropriate background was used to subtract from the sample counts.

Replicate: Verify a replicate sample was run 1 per 20 samples of a similar matrix and the result is within 4xSD of the normalized range. If this criterion is not met, qualify both original and replicate samples as estimated, (J).

Duplicate: Verify a duplicate field sample was taken for every 10 or fewer field samples. For water the duplicate result must be within 4xSD of the result for the original. If this criterion is not met, qualify the results for that sample as estimated, (J).

Result: Verify the results are properly reported with their associated errors. This is generally 2xSD based on counting statistics. Also verify that any data qualification letters are present.

5.6 THORIUM ISOTOPES - NAS, 1960

Holding Time: Verify the samples were analyzed within the holding time specified in tables IV.3 and IV.4 of the QAPP. If holding time was exceeded, the sample results should be qualified as estimated (J) or (UJ).

Calibration: Verify each counter being used has been calibrated for each isotope of interest either by counting a standard of the isotope prepared in the same geometry as is used for samples or by calculation from an efficiency vs. energy calibration curve. The data reduction used must be the same as is used to calculate the sample data. This calibration should be done at least annually. Also verify the correct branching ratio for each isotope was used in the calculations.

Source Check: Verify the check source was counted each day and that its value is within 3xSD of its mean value for each counter used. If this criterion is not met, qualify all of the results measured before the next acceptable check source count was obtained as estimated, (J).

Background: Verify the background was counted for each counter at least once each week, the background was within 3xSD of its mean and the appropriate background was used to subtract from the sample counts. If the background was >3xSD, qualify all of the results measured using that background as estimated, (J).

Efficiency: Verify the correct efficiency was used in the calculations.

Yield: Verify the yield was correctly determined using the counts obtained for the tracer (^{234}Th or ^{229}Th) added at the start of the sample analysis and the counts from 100% of the tracer (^{234}Th or ^{229}Th) added and the yield was correctly applied to each isotope.

Method Blank: Verify a method blank was run each day and that the result of the blank was ≤ 2xMDA. If the blank activity is greater than 2x the MDA and the sample activity is **less** than 3x the blank activity, then the result is rejected, (R). If the blank activity is greater than 2x the MDA and the sample activity is **greater** than 3x the blank activity, the result is estimated, (J).

Method Spike: Verify a method spike was run 1 per 20 samples of a given matrix or 1 per batch of samples prepared in a day, whichever is more frequent. The results must be within 3xSD of the known value. If the method spike is outside the specified criteria in Table III.2 of the QAPP, results will be qualified estimated, (J). If the spike recovery grossly exceeds the criteria, results may be rejected, (R) based on professional judgement.

Matrix Spike: Verify a matrix spike was run 1 per 20 samples of a similar matrix. The result must be within 3xSD of the known value. If the matrix spike is outside the specified criteria in Table III.2 of the QAPP, results will be qualified estimated, (J). If the spike recovery grossly exceeds the criteria, results may be rejected, (R) based on professional judgement.

Duplicate: Verify a duplicate field sample was taken for every 10 or fewer field samples. For water the duplicate result must be within 4xSD of the result for the original. If this criterion is not met, qualify the results for that sample as estimated, (J).

Replicate: Verify a replicate sample was run 1 per 20 samples of a similar matrix and that the result is within 4xSD of the normalized range.

Result: Verify the result is properly reported with its associated error. Also verify that any required data qualification letters are present.

5.7 URANIUM ISOTOPES - NAS, 1962

Holding Time: Verify the samples were analyzed within the holding time specified in tables IV.3 and IV.4 of the QAPP. If holding time was exceeded, the sample results should be qualified as estimated (J) or (UJ).

Calibration: Verify each counter being used has been calibrated for each isotope of interest either by counting a standard of the isotope prepared in the same geometry as is used for samples or by calculation from an efficiency .vs energy calibration curve. The data reduction used must be the same as is used to calculate the sample data. This calibration should be done at least annually. Also verify that the correct branching ratio for each isotope was used in the calculations.

Source Check: Verify the check source was counted each day and that its value is within 3xSD of its mean value for each counter used. If this criterion is not met, qualify all of the results measured before the next acceptable check source count was obtained as estimated, (J).

Background: Verify the background was counted for each counter at least once each week, the background was within 3xSD of its mean and the appropriate background was used to subtract from the sample counts. If the background was >3xSD, qualify all of the results measured using that background as estimated, (J).

Efficiency: Verify the correct efficiency was used in the calculations.

Yield: Verify the yield was correctly determined using the counts obtained for the tracer (^{232}U) added at the start of the sample analysis, the counts from 100% of the tracer (^{232}U) added and the yield was correctly applied to each isotope.

Method Blank: Verify the method blank activity is ≤2x the MDA. If the blank activity is greater than 2x the MDA and the sample activity is **less** than 3x the blank activity, then the result is rejected, (R). If the blank activity is greater than 2x the MDA and the sample activity is **greater** than 3x the blank activity, the result is estimated, (J).

Method Spike: Verify a method spike was run 1 per 20 samples of a given matrix or 1 per batch of samples prepared in a day, whichever is more frequent. The results must be within 3xSD of the known value. If the method spike is outside the specified criteria in Table III.2 of the QAPP, results will be qualified estimated, (J). If the spike recovery grossly exceeds the criteria, results may be rejected, (R) based on professional judgement.

Matrix Spike: Verify a matrix spike was run 1 per 20 samples of a similar matrix. The result must be within 3xSD of the known value. If the matrix spike is outside the specified criteria in Table III.2 of the QAPP, results will be qualified estimated, (J). If the spike recovery grossly exceeds the criteria, results may be rejected, (R) based on professional judgement.

Duplicate: Verify a duplicate field sample was taken for every 10 or fewer field samples. For water the duplicate result must be within 4xSD of the result for the original. If this criterion is not met, qualify the results for that sample as estimated, (J).

Replicate: Verify a replicate sample was run 1 per 20 samples of a similar matrix and that the result is within 4xSD of the normalized range.

Result: Verify the result is properly reported with its associated error. Also verify that any required data qualification letters are present.

5.8 AMERICIUM - 241 - EML AM-01 (WATER SAMPLES)

Holding Time: Verify the samples were analyzed within the holding time specified in tables IV.3 and IV.4 of the QAPP. If holding time was exceeded, the sample results should be qualified as estimated (J) or (UJ).

Calibration: Verify each counter being used has been calibrated by counting a standard of the isotope prepared in the same geometry as is used for samples. The data reduction used must be the same as is used to calculate the sample data. This calibration should be done at least annually. Also verify that the correct isotopic efficiency was used in the calculations.

Source Check: Verify the check source was counted each day and that its value is within 3xSD of its mean value for each counter used. If this criterion is not met, qualify all of the results measured before the next acceptable check source count was obtained as estimated, (J).

Background: Verify the background was counted for each counter at least once each week, the background was within 3xSD of its mean and the appropriate background was used to subtract from the sample counts. If the background was >3xSD, qualify all of the results measured using that background as estimated, (J).

Efficiency: Verify the correct efficiency was used in the calculations.

Yield: Verify the yield was correctly determined using the counts obtained for the tracer (^{243}Am) added at the start of the sample analysis, the counts from 100% of the tracer (^{243}Am) added and that the yield was correctly applied.

Method Blank: Verify the method blank activity is ≤2x the MDA. If the blank activity is greater than 2x the MDA and the sample activity is **less** than 3x the blank activity, then the result is rejected, (R). If the blank activity is greater than 2x the MDA and the sample activity is **greater** than 3x the blank activity, the result is estimated, (J).

Method Spike: Verify a method spike was run 1 per 20 samples of a given matrix or 1 per batch of samples prepared in a day, whichever is more frequent. The results must be within 3xSD of the known value. If the method spike is outside the specified criteria in Table III.2 of the QAPP, results will be qualified estimated, (J). If the spike recovery grossly exceeds the criteria, results may be rejected, (R) based on professional judgement.

Matrix Spike: Verify a matrix spike was run 1 per 20 samples of a similar matrix. The result must be within 3xSD of the known value. If the matrix spike is outside the specified criteria in Table III.2 of the QAPP, results will be qualified estimated, (J). If the spike recovery grossly exceeds the criteria, results may be rejected, (R) based on professional judgement.

Replicate: Verify a replicate sample was run 1 per 20 samples of a similar matrix and that the result is within 4xSD of the normalized range.

Duplicate: Verify a duplicate field sample was taken for every 10 or fewer field samples. For water the duplicate result must be within 4xSD of the result for the original. If this criterion is not met, qualify the results for that sample as estimated, (J).

Result: Verify the result is properly reported with its associated error. Also verify any data qualification letters are present.

5.9 RADIUM-226 (WATER SAMPLES)

Holding Time: Verify the samples were analyzed within the holding time specified in tables IV.3 and IV.4 of the QAPP. If holding time was exceeded, the sample results should be qualified as estimated (J) or (UJ).

Calibration: Verify each counter being used has been calibrated by counting a standard of the isotope prepared in the same geometry as is used for samples. The data reduction used must be the same as is used to calculate the sample data. This calibration should be done at least annually. Also verify that the correct isotopic efficiency was used in the calculations.

Source Check: Verify the check source was counted each day and that its value is within 3xSD of its mean value for each counter used. If this criterion is not met, qualify all of the results measured before the next acceptable check source count was obtained as estimated, (J).

Background: Verify the background was counted for each counter at least once each week, the background was within 3xSD of its mean and the appropriate background was used to subtract from the sample counts. If the background was >3xSD, qualify all of the results measured using that background as estimated, (J).

Efficiency: Verify the correct efficiency was used in the calculations.

Yield: Verify the yield was correctly determined using the counts obtained for the tracer (^{133}Ba) added at the start of the sample analysis, the counts from 100% of the tracer (^{133}Ba) added and the yield was correctly applied.

Method Blank: Verify the method blank activity is $\leq$2x the MDA. If the blank activity is greater than 2x the MDA and the sample activity is **less** than 3x the blank activity, then the result is rejected, (R). If the blank activity is greater than 2x the MDA and the sample activity is **greater** than 3x the blank activity, the result is estimated, (J).

Method Spike: Verify a method spike was run 1 per 20 samples of a given matrix or 1 per batch of samples prepared in a day, whichever is more frequent. The results must be within 3xSD of the known value. If the method spike is outside the specified criteria in Table III.2 of the QAPP, results will be qualified estimated, (J). If the spike recovery grossly exceeds the criteria, results may be rejected, (R) based on professional judgement.

Matrix Spike: Verify a matrix spike was run 1 per 20 samples of a similar matrix. The result must be within 3xSD of the known value. If the matrix spike is outside the specified

criteria in Table III.2 of the QAPP, results will be qualified estimated, (J). If the spike recovery grossly exceeds the criteria, results may be rejected, (R) based on professional judgement.

Replicate: Verify a replicate sample was run 1 per 20 samples of a similar matrix and that the result is within 4xSD of the normalized range.

Duplicate: Verify a duplicate field sample was taken for every 10 or fewer field samples. For water the duplicate result must be within 4xSD of the result for the original. If this criterion is not met, qualify the results for that sample as estimated, (J).

Result: Verify the result is properly reported with its associated error. Also verify any data qualification letters are present.

6.0 DATA VALIDATION REPORTING GUIDELINES

Validation report contents must be in a narrative format and must follow the outline presented in Attachment II.

Data outlier summary forms presented in Attachment III are to be completed as described in this section. All forms associated with the analytical method must be completed for each data validation report and must be signed and dated by the data validator.

6.1 HOLDING TIME FORMS

Complete the appropriate form from Attachment III for all samples with date of sampling, date of extraction/date of analysis and write number of days between each event in the right-hand corner and note whether extraction or analysis holding time was exceeded.

6.2 BLANK DATA SUMMARY FORMS

Complete the appropriate form from Attachment III. Enter blank outliers only and note appropriate action level based on 5x or 10x. Enter the associated sample IDs.

6.3 SURROGATE RECOVERY FORMS

Complete header section. Complete remainder of table only for those samples which have surrogate outliers. If no outliers, then write 'None'.

6.4 MATRIX SPIKE RECOVERY FORMS

Complete header section. Complete remainder of table only for those samples which have MS/MSD outliers. Enter the percent recovery as appropriate. The RPD should be entered in parentheses. If no outliers, write 'None'.

6.5 CALIBRATION FORMS

Complete header section, instrument, and date and time for each calibration run. Enter the outlying RF, RRF, RSD, or %D as necessary. List all associated sample IDs at bottom of form.

6.6 FIELD DUPLICATE FORMS

Complete header section and sample IDs. Enter outlying RPD values for analytes. If no values are outside the required range, so state.

6.7 INTERNAL STANDARD FORMS

Complete header section. In area limits box, write actual area values from Form VIII. For IS outliers, enter the sample ID and enter the actual outlying area value.

6.8 INSTRUMENT PERFORMANCE FORM

Complete header section, instrument, column type, date, and time. Enter any outliers; if none, so state.

6.9 REPLICATE DATA SUMMARY FORM

Complete header section. If outliers, enter sample IDs, outlier value, and qualification designation.

6.10 QUALIFIED DATA SUMMARY FORMS

Form 1s for CLP analysis should be copied and the proper qualifiers/subqualifiers added as discussed in Section 4 and attached to the validation report.

6.11 DATA SUMMARY FORMS FOR ANIONS

Complete header section. Fill in remainder if criteria was exceeded.

6.12 SAMPLE CALCULATIONS

A sample calculation should be provided in the upper right hand corner of tables for surrogate recovery, matrix spike recovery, calibration, field duplicate, and replicate tables along with the data validators initials and date. This calculation should show the formula, actual sample values, and final result. Use the following as a guideline for calculations to show:

> Initial calibration - at least one RRF and %RSD for VOA,Pest/PCB; two RRF and %RSD for semivolatiles for each.

Continuing calibration - at least one RRF and %D for VOA and/or two for semivolatiles for each continuing calibration.

Surrogate - at least one set of surrogates from one sample within a batch for VOA and pest/PCB, and at least two surrogates from one sample within a batch for SV (one acid, one base).

MS/MSD - at least one compound recovery and RPD for each analyte group.

LCS - at least one compound.

The first draft report of data validation results is delivered to the Quality Assurance Manager or his/her designee within 20 days from date of data receipt for a senior technical review. Requested corrections to the first draft reports must be submitted within 10 calendar days, unless otherwise noted.

7.0 OVERALL DATA ASSESSMENT PROCEDURES

For each qualification, data validators are responsible for evaluating the potential impact of the qualified result on the usability of the data. Any bias must be noted as a potential bias in the text of the validation report, along with the estimated amount of bias if feasible. When the bias is determined to be positive or negative, include either (+) or (-), respectively, after the subqualifier to denote the impact of the bias.

8.0 ATTACHMENTS

I DATA COMPLETENESS CHECKLISTS

II DATA VALIDATION REPORT FORMAT

III QC OUTLIER SUMMARY FORMS

ATTACHMENT I

DATA COMPLETENESS CHECKLIST

DATA PACKAGE COMPLETENESS CHECKLIST
EG&G MOUND PROJECT

DATE: _____ W.O.#: _____

LABORATORY BATCH #: _____ OPERABLE UNIT NO.: _____

LABORATORY NAME/LOCATION: _____ COLLECTION DATE(S): _____

METALS/CYANIDE

- ☐ TABLE OF CONTENTS (Checklist)
- ☐ I. CASE NARRATIVE
  - ☐ COVER PAGE
  - ☐ CASE NARRATIVE
  - ☐ CROSS REFERENCE OF SAMPLE I.D TO LABORATORY I.D.
  - ☐ DESCRIPTION OF ALL QUALIFIERS USED BY THE LABORATORY
  - ☐ APPLICABLE LABORATORY SOP AND REVISION DATE
- ☐ IIA. SAMPLE DATA
  - ☐ RESULTS FORM I - IN
- ☐ IIB. QUALITY CONTROL DATA
  - ☐ INITIAL AND CONTINUING CALIBRATION VERIFICATION [FORM II (PART I) - IN]
  - ☐ CRDL STANDARD FOR AA AND ICP [FORM II (PART 2) - IN]
  - ☐ BLANKS [FORM III - IN]
  - ☐ ICP INTERFERENCE CHECK SAMPLE [FORM IV - IN]
  - ☐ SPIKE SAMPLE RECOVERY [FORM VA (PART I) - IN]
  - ☐ POST DIGEST SPIKE SAMPLE RECOVERY [FORM VB (PART 2) - IN]
  - ☐ DUPLICATES [FORM VI - IN]
  - ☐ LABORATORY CONTROL SAMPLE [FORM VII - IN]
  - ☐ STANDARD ADDITION RESULTS [FORM VIII - IN]
  - ☐ ICP SERIAL DILUTIONS [FORM IX - IN]
  - ☐ INSTRUMENT DETECTION LIMITS (QUARTERLY) [FORM X - IN]
  - ☐ ICP INTERELEMENT CORRECTION FACTORS (ANNUALLY) [FORM XI (PART I) - IN]
  - ☐ ICP INTERELEMENT CORRECTION FACTORS (ANNUALLY) [FORM XI (PART 2) - IN]
  - ☐ ICP LINEAR RANGES (QUARTERLY) [FORM XII - IN]
  - ☐ PREPARATION LOG [FORM XIII - IN]
  - ☐ ANALYSIS RUN LOG [FORM XIV - IN]
- ☐ IIC. RAW DATA
  - ☐ EXAMPLE CALCULATION
  - ☐ INSTRUMENT SETTINGS
  - ☐ ICP RAW DATA
  - ☐ FURNACE AA RAW DATA
  - ☐ MERCURY RAW DATA
  - ☐ CYANIDE RAW DATA
  - ☐ PREPARATION AND DISTILLATION LOGS RAW DATA
  - ☐ PERCENT SOLIDS DETERMINATION LOGS

DATA PACKAGE COMPLETENESS CHECKLIST (CONT.)
EG&G MOUND PROJECT

DATE: _____ W.O.#: _____

LABORATORY BATCH #: _____ OPERABLE UNIT NO.: _____

LABORATORY NAME/LOCATION: _____ COLLECTION DATE(S): _____

METALS/CYANIDE

☐ IID. STANDARDS
- ☐ PREPARATION RECORDS
- ☐ ANALYSIS RECORDS AA AND ICP LOGS

☐ IIE. SAMPLE RECEIPT
- ☐ TRAFFIC REPORTS
- ☐ SAMPLE LOG IN RECORD

☐ IIF. NONCONFORMANCE RECORDS / CORRESPONDENCE / TELEPHONE COMMUNICATIONS RECORDS / ETC.[1]

Laboratory Reviewer: _____ Date: _____

WESTON Verified By: _____ Date: _____

Comments: _____

_____

_____

_____

[1] Any records not specified, but pertaining to the sample analysis

DATA PACKAGE COMPLETENESS CHECKLIST
EG&G MOUND PROJECT

DATE: _____ W.O.#: _____

LABORATORY BATCH #: _____ OPERABLE UNIT NO.: _____

LABORATORY NAME/LOCATION: _____ COLLECTION DATE(S): _____

VOLATILES ORGANIC COMPOUNDS (VOCs)

- ☐ TABLE OF CONTENTS (CHECK LIST)
- ☐ IIIA. CASE NARRATIVE
  - ☐ COVER PAGE
  - ☐ CASE NARRATIVE
  - ☐ CROSS REFERENCE OF SAMPLE ID TO LABORATORY ID
  - ☐ DESCRIPTION OF ALL QUALIFIERS USED BY THE LABORATORY APPLICABLE LABORATORY SOP AND REVISION DATE
- ☐ QC SUMMARY
  - ☐ SYSTEM MONITORING COMPOUND SUMMARY (FORM II VOA)
  - ☐ MATRIX SPIKE/MATRIX SPIKE DUPLICATE SUMMARY (FORM III VOA)
  - ☐ METHOD BLANK SUMMARY (FORM IV VOA)
  - ☐ GC/MS INSTRUMENT PERFORMANCE CHECK (FORM V VOA)
  - ☐ INTERNAL STANDARD AREA AND RT SUMMARY (FORM VIII VOA)
  - ☐ LABORATORY CONTROL SAMPLE
- ☐ IIIB. SAMPLE DATA
  - ☐ EXAMPLE CALCULATION
  - ☐ TARGET COMPOUND RESULTS - ORGANIC ANALYSIS DATA SHEET (FORM I VOA)
  - ☐ TENTATIVELY IDENTIFIED COMPOUNDS (FORM I VOA - TIC)
  - ☐ RECONSTRUCTED TOTAL ION CHROMATOGRAMS (RIC)
  - ☐ QUANTITATION REPORT
  - ☐ RAW SPECTRA AND BACKGROUND - SUBTRACTED MASS SPECTRA OF TARGET COMPOUNDS IDENTIFIED
  - ☐ GC/MS LIBRARY SEARCH SPECTRA FOR TIC (3 BEST LIBRARY MATCHES)
  - ☐ QUANTITATION / CALCULATION OF TIC CONCENTRATIONS
- ☐ IIIC. STANDARD(S) DATA
  - ☐ INITIAL CALIBRATION DATA (FORM VI VOA)
  - ☐ VOA STANDARD(S) RECONSTRUCTED ION CHROMATOGRAMS AND QUANTITATION REPORTS
  - ☐ CONTINUING CALIBRATION (FORM VII VOA)
  - ☐ VOA STANDARD(S) RECONSTRUCTED ION CHROMATOGRAMS AND QUANTITATION REPORTS

DATA PACKAGE COMPLETENESS CHECKLIST (CONT.)
EG&G MOUND PROJECT

DATE: _____ W.O.#: _____

LABORATORY BATCH #: _____ OPERABLE UNIT NO.: _____

LABORATORY NAME/LOCATION: _____ COLLECTION DATE(S): _____

VOLATILES ORGANIC COMPOUNDS (VOCs)

- ☐ IIID. RAW QC DATA
  - ☐ BFB / BAR GRAPH SPECTRUM / MASS LISTING
  - ☐ BLANK DATA
    - ☐ RECONSTRUCTED TOTAL ION CHROMATOGRAM AND QUANTITATION REPORTS
    - ☐ TARGET COMPOUND SPECTRA
    - ☐ GC/MS LIBRARY SEARCH SPECTRA FOR TIC
    - ☐ QUANTITATION / CALCULATION OF TIC CONCENTRATIONS
  - ☐ MATRIX SPIKE DATA
    - ☐ TABULATED RESULTS (FORM I VOA)
    - ☐ RECONSTRUCTED ION CHROMATOGRAM(S)
  - ☐ MATRIX SPIKE DUPLICATE DATA
    - ☐ TABULATED RESULTS (FORM I VOA)
    - ☐ RECONSTRUCTED ION CHROMATOGRAM(S)
  - ☐ INSTRUMENT SETTINGS
  - ☐ INSTRUMENT RUN LOGS
  - ☐ PERCENT SOLIDS DETERMINATION LOGS
- ☐ IIIE. SAMPLE RECEIPT
  - ☐ TRAFFIC REPORTS
  - ☐ SAMPLE LOG IN RECORD
- ☐ IIIF. NONCONFORMANCE RECORDS / CORRESPONDENCE / TELEPHONE COMMUNICATIONS RECORDS / ETC.[1]

Laboratory Reviewer: _____ Date: _____

WESTON Verified By: _____ Date: _____

Comments: _____

_____

_____

_____

[1] Any records not specified, but pertaining to the sample analysis

DATA PACKAGE COMPLETENESS CHECKLIST
EG&G MOUND PROJECT

DATE: _____ W.O.#: _____

LABORATORY BATCH #: _____ OPERABLE UNIT NO.: _____

LABORATORY NAME/LOCATION: _____ COLLECTION DATE(S): _____

SEMIVOLATILES ORGANIC COMPOUNDS

- ☐ TABLE OF CONTENTS (CHECK LIST)
- ☐ IVA. CASE NARRATIVE
  - ☐ COVER PAGE
  - ☐ CASE NARRATIVE
  - ☐ CROSS REFERENCE OF SAMPLE ID TO LABORATORY ID
  - ☐ DESCRIPTION OF ALL QUALIFIERS USED BY THE LABORATORY
  - ☐ APPLICABLE LABORATORY SOP AND REVISION DATE
- ☐ QC SUMMARY
  - ☐ SURROGATE PERCENT RECOVERY SUMMARY (FORM II SV)
  - ☐ MATRIX SPIKE/MATRIX SPIKE DUPLICATE SUMMARY (FORM III SV)
  - ☐ METHOD BLANK SUMMARY (FORM IV SV)
  - ☐ GC/MS INSTRUMENT PERFORMANCE CHECK (FORM V SV)
  - ☐ INTERNAL STANDARD AREA AND RT SUMMARY (FORM VIII SV)
  - ☐ LABORATORY CONTROL SAMPLE
- ☐ IVB. SAMPLE DATA
  - ☐ EXAMPLE CALCULATION
  - ☐ TARGET COMPOUND RESULTS - ORGANIC ANALYSIS DATA SHEET (FORM I SV)
  - ☐ TENTATIVELY IDENTIFIED COMPOUNDS (FORM I SV - TIC)
  - ☐ RECONSTRUCTED TOTAL ION CHROMATOGRAMS (RIC)
  - ☐ QUANTITATION REPORT
  - ☐ RAW SPECTRA AND BACKGROUND - SUBTRACTED MASS SPECTRA OF TARGET COMPOUNDS IDENTIFIED
  - ☐ GC/MS LIBRARY SEARCH SPECTRA FOR TIC (3 BEST LIBRARY MATCHES)
  - ☐ QUANTITATION / CALCULATION OF TIC CONCENTRATIONS
- ☐ IVC. STANDARD(S) DATA
  - ☐ INITIAL CALIBRATION DATA (FORM VI SV-1, SV-2)
  - ☐ SV STANDARD(S) RECONSTRUCTED ION CHROMATOGRAMS AND QUANTITATION REPORTS
  - ☐ CONTINUING CALIBRATION (FORM VII SV-1, SV-2)
  - ☐ SV STANDARD(S) RECONSTRUCTED ION CHROMATOGRAMS AND QUANTITATION REPORTS
  - ☐ SEMIVOLATILE GPC CALIBRATION DATA
- ☐ IVD. RAW QC DATA
  - ☐ DFTPP
    - ☐ RECONSTRUCTED TOTAL ION CHROMATOGRAM (RIC)
    - ☐ BAR GRAPH SPECTRUM
    - ☐ MASS LISTING

DATA PACKAGE COMPLETENESS CHECKLIST (CONT.)
EG&G MOUND PROJECT

DATE: _____ W.O.#: _____

LABORATORY BATCH #: _____ OPERABLE UNIT NO.: _____

LABORATORY NAME/LOCATION: _____ COLLECTION DATE(S): _____

SEMIVOLATILES ORGANIC COMPOUNDS

- ☐ BLANK DATA
  - ☐ TABULATED RESULTS (FORM I SV-1, SV-2)
  - ☐ TIC'S (FORM I SV-TIC)
  - ☐ RECONSTRUCTED ION CHROMATOGRAM
  - ☐ TARGET COMPOUND SPECTRA
  - ☐ GC / MS LIBRARY SEARCH SPECTRA FOR TIC
  - ☐ QUANTITATION / CALCULATION OF TIC CONCENTRATIONS
- ☐ MATRIX SPIKE DATA
  - ☐ TABULATED RESULTS (FORM I)
  - ☐ RECONSTRUCTED ION CHROMATOGRAM(S)
- ☐ MATRIX SPIKE DUPLICATE DATA
  - ☐ TABULATED RESULTS (FORM I SV-1, SC-2)
  - ☐ RECONSTRUCTED ION CHROMATOGRAM(S)
- ☐ INSTRUMENT SETTINGS
- ☐ INSTRUMENT RUN LOGS
- ☐ SAMPLE EXTRACTION/PREPARATION LOGS
- ☐ PERCENT SOLIDS DETERMINATION LOGS

☐ IVE. SAMPLE RECEIPT

- ☐ TRAFFIC REPORTS
- ☐ SAMPLE LOG IN RECORD

☐ IVF. NONCONFORMANCE RECORDS / CORRESPONDENCE / TELEPHONE COMMUNICATIONS RECORDS / ETC. [1]

Laboratory Reviewer: _____ Date: _____

WESTON Verified By: _____ Date: _____

Comments: _____

_____

_____

_____

[1] Any records not specified, but pertaining to the sample analysis

DATA PACKAGE COMPLETENESS CHECKLIST
EG&G MOUND PROJECT

DATE: _____ W.O.#: _____

LABORATORY BATCH #: _____ OPERABLE UNIT NO.: _____

LABORATORY NAME/LOCATION: _____ COLLECTION DATE(S): _____

PESTICIDES AND PCBs

- ☐ TABLE OF CONTENTS (CHECK LIST)

- ☐ VA. CASE NARRATIVE
  - ☐ COVER PAGE
  - ☐ CASE NARRATIVE
  - ☐ CROSS REFERENCE OF SAMPLE ID TO LABORATORY ID
  - ☐ DESCRIPTION OF ALL QUALIFIERS USED BY THE LABORATORY
  - ☐ APPLICABLE LABORATORY SOP AND REVISION DATE

- ☐ QC SUMMARY
  - ☐ SURROGATE PERCENT RECOVERY SUMMARY (FORM II PEST)
  - ☐ MATRIX SPIKE/MATRIX SPIKE DUPLICATE SUMMARY (FORM III PEST)
  - ☐ METHOD BLANK SUMMARY (FORM IV PEST)
  - ☐ LABORATORY CONTROL SPIKE

- ☐ VB. SAMPLE DATA
  - ☐ EXAMPLE CALCULATION
  - ☐ TARGET COMPOUND RESULTS - ORGANIC ANALYSIS DATA SHEET (FORM I PEST)
  - ☐ PESTICIDE CHROMATOGRAMS
  - ☐ GC INTEGRATION REPORT
  - ☐ PESTICIDE CHROMATOGRAMS SECOND GC COLUMN
  - ☐ GC INTEGRATION REPORT
  - ☐ MANUAL WORK SHEETS

- ☐ VC. STANDARD(S) DATA
  - ☐ INITIAL CALIBRATION OF SINGLE COMPONENT ANALYTES (FORM VI PEST-1, PEST-2)
  - ☐ INITIAL CALIBRATION OF MULTICOMPONENT ANALYTES (FORM VI PEST-3)
  - ☐ ANALYTE RESOLUTION SUMMARY (FORM VI PEST-4)
  - ☐ CALIBRATION VERIFICATION SUMMARY (FORM VII PEST-1)
  - ☐ CALIBRATION VERIFICATION SUMMARY (FORM VII PEST-2)
  - ☐ ANALYTICAL SEQUENCE (FORM VIII PEST)
  - ☐ FLORISIL CARTRIDGE CHECK (FORM IX PEST-1)
  - ☐ PESTICIDE GPC CALIBRATION (FORM IX PEST-2)
  - ☐ PESTICIDE IDENTIFICATION SUMMARY SINGLE COMPONENT ANALYTES (FORM X PEST-1)
  - ☐ PESTICIDE IDENTIFICATION SUMMARY MULTICOMPONENT ANALYTES (FOR X PEST-2)
  - ☐ CHROMATOGRAMS AND DATA SYSTEM PRINTOUTS
  - ☐ RETENTION TIMES AND CORRESPONDING PEAK AREAS PRINTOUTS
  - ☐ PESTICIDE GPC CALIBRATION DATA

DATA PACKAGE COMPLETENESS CHECKLIST (CONT.)
EG&G MOUND PROJECT

DATE: _____ W.O.#: _____

LABORATORY BATCH #: _____ OPERABLE UNIT NO.: _____

LABORATORY NAME/LOCATION: _____ COLLECTION DATE(S): _____

PESTICIDES AND PCBs

- ☐ VD. RAW QC DATA
  - ☐ BLANK DATA
    - ☐ TABULATION RESULTS (FORM I PEST)
    - ☐ CHROMATOGRAMS AND DATA SYSTEM PRINTOUTS
    - ☐ RETENTION TIMES AND CORRESPONDING PEAK AREAS PRINTOUTS
  - ☐ MATRIX SPIKE DATA
    - ☐ CHROMATOGRAMS AND DATA SYSTEM PRINTOUTS
  - ☐ MATRIX SPIKE DUPLICATE DATA
    - ☐ CHROMATOGRAMS AND DATA SYSTEM PRINTOUTS
  - ☐ INSTRUMENT SETTINGS
  - ☐ INSTRUMENT RUN LOGS
  - ☐ SAMPLE EXTRACTION/PREPARATION LOGS
  - ☐ PERCENT SOLIDS DETERMINATION LOGS
- ☐ VE. SAMPLE RECEIPT
  - ☐ TRAFFIC REPORTS
  - ☐ SAMPLE LOG IN RECORD
- ☐ VF. NONCONFORMANCE RECORDS / CORRESPONDENCE / TELEPHONE COMMUNICATIONS RECORDS / ETC. [1]

Laboratory Reviewer: _____ Date: _____

WESTON Verified By: _____ Date: _____

Comments: _____

_____

_____

_____

[1] Any records not specified, but pertaining to the sample analysis

DATA PACKAGE COMPLETENESS CHECKLIST
EG&G MOUND PROJECT

DATE: _____ W.O.#: _____

LABORATORY BATCH #: _____ OPERABLE UNIT NO.: _____

LABORATORY NAME/LOCATION: _____ COLLECTION DATE(S): _____

ANION (circle): NO_2-NO_3 SO4 Cl F TOC

NITRATE-NITRITE, SULFATE, CHLORIDE, FLOURIDE, TOTAL ORGANIC CARBON

- ☐ TABLE OF CONTENTS (CHECK LIST).

- ☐ I. CASE NARRATIVE
  - ☐ COVER PAGE
  - ☐ CASE NARRATIVE
  - ☐ CROSS REFERENCE OF SAMPLE ID TO LABORATORY ID
  - ☐ DESCRIPTION OF ALL QUALIFIERS USED BY THE LABORATORY
  - ☐ APPLICABLE LABORATORY SOP AND REVISION DATE
  - ☐ SUMMARY OF SAMPLE RESULTS
  - ☐ SUMMARY OF QUALITY CONTROL RESULTS
  - ☐ SUMMARY OF ANALYSIS AND PREPARATION DATES

- ☐ IIA. SAMPLE DATA
  - ☐ EXAMPLE CALCULATION SHEET
  - ☐ INSTRUMENT SETTINGS
  - ☐ ANALYTICAL RAW DATA (BEHIND EACH RESULT)

- ☐ IIB. STANDARDS DATA
  - ☐ STANDARDS PREPARATION DATA
  - ☐ INITIAL AND CONTINUING CALIBRATION

- ☐ IIC. RAW QC DATA
  - ☐ QUALITY CONTROL RESULTS (BLANKS, LCS, MS/MSD, REPLICATE (TOC ONLY))
  - ☐ QUALITY CONTROL RAW DATA (BEHIND EACH RESULT)
  - ☐ INSTRUMENT RUN LOGS/INSTRUMENT CALIBRATION/TUNING
  - ☐ SAMPLE PREPARATION/EXTRACTION/DIGESTION LOGS
  - ☐ PERCENT SOLIDS DETERMINATION LOGS

DATA PACKAGE COMPLETENESS CHECKLIST (CONT.)
EG&G MOUND PROJECT

DATE: _____ W.O.#: _____

LABORATORY BATCH #: _____ OPERABLE UNIT NO.: _____

LABORATORY NAME/LOCATION: _____ COLLECTION DATE(S): _____

ANION (circle): NO_2-NO_3 SO4 Cl F TOC

NITRATE-NITRITE, SULFATE, CHLORIDE, FLOURIDE, TOTAL ORGANIC CARBON

☐ III. SAMPLE RECEIPT

- ☐ TRAFFIC REPORTS
- ☐ SAMPLE LOG IN RECORD

☐ IV. NONCONFORMANCE RECORDS / CORRESPONDENCE / TELEPHONE COMMUNICATIONS RECORDS / ETC. [1]

Laboratory Reviewer: _____ Date: _____

WESTON Verified By: _____ Date: _____

Comments: _____

[1] Any records not specified, but pertaining to the sample analysis

DATA PACKAGE COMPLETENESS CHECKLIST
EG&G MOUND PROJECT

DATE: _____ W.O.#: _____

LABORATORY BATCH #: _____ OPERABLE UNIT NO.: _____

LABORATORY NAME/LOCATION: _____ COLLECTION DATE(S): _____

EXPLOSIVES (USATHAMA AND PETN)

- ☐ TABLE OF CONTENTS (Checklist)

- ☐ I. CASE NARRATIVE
  - ☐ COVER PAGE
  - ☐ CASE NARRATIVE
  - ☐ CROSS REFERENCE OF SAMPLE ID TO LABORATORY ID
  - ☐ DESCRIPTION OF DATA QUALIFIERS USED IN THE REPORT
  - ☐ APPLICABLE LABORATORY SOP AND REVISION DATE
  - ☐ SUMMARY OF SAMPLE RESULTS
  - ☐ SUMMARY OF QUALITY CONTROL RESULTS
  - ☐ SUMMARY OF ANALYSIS AND PREPARATION DATES

- ☐ IIA. SAMPLE DATA
  - ☐ EXAMPLE CALCULATION
  - ☐ INSTRUMENT SETTINGS
  - ☐ ANALYTICAL RAW DATA (BEHIND EACH RESULT)

- ☐ IIB. STANDARDS DATA
  - ☐ STANDARDS PREPARATION DATA
  - ☐ INITIAL AND CONTINUING CALIBRATION
  - ☐ RETENTION TIME WINDOWS
  - ☐ INSTRUMENT CALIBRATION / TUNING
  - ☐ RAW DATA BEHIND EACH RESULT

- ☐ IIC. RAW QC DATA
  - ☐ QUALITY CONTROL RESULTS (BLANKS, LCSs, MS / MSDs)
  - ☐ QUALITY CONTROL RAW DATA (BEHIND EACH RESULT)
  - ☐ INSTRUMENT RUN LOG
  - ☐ SAMPLE PREPARATION / EXTRACTION / DIGESTION LOGS
  - ☐ PERCENT SOLIDS DETERMINATION LOGS

- ☐ III. SAMPLE RECEIPT
  - ☐ TRAFFIC REPORTS
  - ☐ SAMPLE LOG IN RECORD

DATA PACKAGE COMPLETENESS CHECKLIST
EG&G MOUND PROJECT

DATE: _____ W.O.#: _____

LABORATORY BATCH #: _____ OPERABLE UNIT NO.: _____

LABORATORY NAME/LOCATION: _____ COLLECTION DATE(S): _____

EXPLOSIVES (USATHAMA AND PETN)

☐ IV. NONCONFORMANCE RECORDS / CORRESPONDENCE / TELEPHONE COMMUNICATIONS RECORDS / ETC.[1]

Laboratory Reviewer: _____ Date: _____

WESTON Verified By: _____ Date: _____

Comments: _____

_____

_____

_____

[1] Any records not specified, but pertaining to the sample analysis

DATA PACKAGE COMPLETENESS CHECKLIST
EG&G MOUND PROJECT

DATE: _____ W.O.#: _____

LABORATORY BATCH #: _____ OPERABLE UNIT NO.: _____

LABORATORY NAME/LOCATION: _____ COLLECTION DATE(S): _____

RADIOISOTOPES

- ☐ TABLE OF CONTENTS
- ☐ I. CASE NARRATIVE
  - ☐ COVER PAGE
  - ☐ CASE NARRATIVE
  - ☐ CROSS REFERENCE OF SAMPLE ID TO LABORATORY ID
  - ☐ DESCRIPTION OF DATA QUALIFIERS USED IN THE REPORT
  - ☐ SUMMARY OF SAMPLE RESULTS
  - ☐ SUMMARY OF QUALITY CONTROL RESULTS
  - ☐ SUMMARY OF ANALYSIS AND PREPARATION DATES
  - ☐ APPLICABLE LABORATORY SOP AND REVISION DATE
- ☐ IIA. SAMPLE DATA
  - ☐ EXAMPLE CALCULATION PAGE
  - ☐ TRITIUM CALCULATION AND RESULT SHEET (RAW DATA PART OF STANDARDS DATA)
  - ☐ GAMMA - SPECTROMETRY (RESULTS FOLLOWED BY RAW DATA)
  - ☐ ALPHA - SPECTROMETRY (RESULTS FOLLOWED BY RAW DATA)
  - ☐ Sr-90 (RAW DATA PART OF STANDARDS DATA)
  - ☐ Ra-226 (RAW DATA PART OF STANDARDS DATA)
  - ☐ Am-241 (RAW DATA PART OF STANDARDS DATA)
  - ☐ SAMPLE PREPARATION / EXTRACTION / DIGESTION LOGS
  - ☐ PERCENT SOLIDS DETERMINATION
  - ☐ INSTRUMENT RUN LOGS
- ☐ IIB. STANDARDS DATA

  MONTHLY COMPILATION PROVIDED SEPARATELY
- ☐ IIC. RAW QC DATA
  - ☐ QUALITY CONTROL RESULTS (BLANKS, MS/MSD, REPLICATE)
  - ☐ QUALITY CONTROL RAW DATA (BEHIND EACH RESULT)
- ☐ III. SAMPLE RECEIPT
  - ☐ TRAFFIC REPORTS
  - ☐ SAMPLE LOG IN RECORD

DATA PACKAGE COMPLETENESS CHECKLIST
EG&G MOUND PROJECT

DATE: _____ W.O.#: _____

LABORATORY BATCH #: _____ OPERABLE UNIT NO.: _____

LABORATORY NAME/LOCATION: _____ COLLECTION DATE(S): _____

RADIOISOTOPES

☐ IV. NONCONFORMANCE RECORDS / CORRESPONDENCE / TELEPHONE COMMUNICATIONS RECORDS / ETC.[1]

Laboratory Reviewer: _____ Date: _____

WESTON Verified By: _____ Date: _____

Comments: _____

[1] Any records not specified, but pertaining to the sample analysis

ATTACHMENT II

DATA VALIDATION REPORT FORMAT
EG&G MOUND ER PROGRAM

ATTACHMENT II

DATA VALIDATION REPORT FORMAT
EG&G MOUND ER PROGRAM

I. TITLE - "Report of Data Validation Results"

II. HEADER - Name of Project, Operable Unit, Description of Task (e.g., Groundwater monitoring), Work Order Number, and date of report.

III. CASE SUMMARY

State the following:

- Case/Batch number
- Number of samples and type of matrix
- Date of Collection
- Chain of Custody identifier, if any
- Type of analysis (Discuss impacts if incorrect method used)
- Condition of samples when received by the laboratory, any lost data
- List the client sample IDs applicable to the report.

IV. HOLDING TIMES

Discuss results of holding times and those outside the required holding time.

V. RESULTS OF LABORATORY QUALITY CONTROL CHECKS

For each laboratory quality control check required to be performed, discuss whether the frequency, acceptance criteria, and corrective actions were met. Summarize which samples were affected and how the data was impacted.

The laboratory quality control checks for each analysis are listed below:

<u>Volatiles and Semivolatiles</u>

a. GC/MS Tuning
b. Calibration
c. Blanks
d. Surrogate Spike Recoveries
e. Matrix spike/Matrix Spike Duplicate Recoveries
f. Internal Standards
g. Compound Identification
h. System Performance
i. Compound Quantitation and Contract Required Quantitation Limits (CRQLs)
j. Tentatively Identified Compounds
k. Laboratory Control Sample

ATTACHMENT II

DATA VALIDATION REPORT FORMAT
EG&G MOUND ER PROGRAM

Pesticides/PCBs

a. GC/ECD Performance Check
b. Performance Evaluation Mixture
   i) Resolution
   ii) Retention Time
   iii) Recovery
   iv) DDT/Endrin Breakdown
c. Calibration
d. Blanks
e. Surrogate Spike Recoveries
f. Matrix spike/Matrix Spike Duplicate Recoveries
g. Pesticide Cleanup Checks
   i) GPC Recoveries
   ii) Florosil Cartridge Cleanup
h. Compound Identification
i. System Performance
j. Compound Quantitation and Reported CRQLs
k. Laboratory Control Sample

Inorganic Metals and Cyanide

a. Calibration and CRDL
b. Blanks
   i) Preparation Blanks
   ii) Calibration Blanks
c. Interference Check Sample
d. Laboratory Control Sample
e. Duplicate Sample Analysis
f. Matrix Spike Sample Analysis
   i) ICP Metals
   ii) GFAA Metals
   iii) Cyanide
g. Furnace Atomic Absorption QC
h. ICP Serial Dilution
i. Sample Result Verification

Anions

a. Calibration
b. Blanks
   i) Preparation Blanks
   ii) Calibration Blanks
c. Laboratory Control Sample
d. Matrix Spike/Matrix Spike Duplicate Sample Analysis
e. Sample Result Verification

ATTACHMENT II

DATA VALIDATION REPORT FORMAT
EG&G MOUND ER PROGRAM

VI. RESULTS OF ASSOCIATED FIELD QUALITY CONTROL CHECKS

A. Field Duplicates
B. Field Blanks (equipment blanks, etc.)

VII. OVERALL ASSESSMENT OF DATA

- Discuss overall assessment of data and categorize data in one or more of the following (use these as subsections to this section):

  - Data had no problem/or qualified due to minor problems.
  - Data qualified due to major problems.
  - Data unacceptable.
  - Problems, but does not affect data.

Discuss how all findings in the review could impact the data usability.

ATTACHMENT I	-	Data Outlier Summary Forms
ATTACHMENT II	-	Qualified Data Summary Reports *
ATTACHMENT III	-	Data Completeness Checklist
ATTACHMENT IV	-	Laboratory Case Narrative
ATTACHMENT V	-	Chain-of-Custody

* Form is for CLP analyses, data summary reports from laboratory for non-CLP analyses

ATTACHMENT III

QC OUTLIER SUMMARY FORMS

HOLDING TIME SUMMARY
ANIONS: CL, SO4, NO3-NO2, F, TOC

PREPARED BY: _____

DATE: _____

MOUND PROJECT

LABORATORY BATCH # _____

OPERABLE UNIT NO.: _____

LABORATORY NAME/LOCATION: _____

COLLECTION DATE(s): _____

LABORATORY SAMPLE ID	MOUND SAMPLE ID	DATE COLLECTED	DATE ANALYZED	NUMBER OF DAYS PAST HOLDING TIME

CL - SW9251/E325.2

NO3/NO2 - E353.2

SO4 - E375.2

F - E340.2

TOC - E415.1/E415.2

DATA SUMMARY TABLE
ANIONS: CL, SO4, NO3-NO2, F

PREPARED BY: _____ MOUND PROJECT

DATE: _____ OPERABLE UNIT NO.: _____

LABORATORY BATCH #: _____ COLLECTION DATE(s): _____

LABORATORY NAME/LOCATION: _____

INSTRUMENT ID FOR:

CHLORIDE: _____ NITRATE - NITRITE: _____ TOC: _____

SULFATE: _____ FLUORIDE: _____

	CALIBRATION		BLANKS		
	INITIAL	CONTINUING	METHOD ID	METHOD ID	EQUIPMENT ID
ANALYTE	COEFF < 0.995	%D>15			
CHLORIDE					
SULFATE					
NITRATE-NITRITE					
FLUORIDE					
TOC					
APPLIES TO SAMPLES:					
(CLIENT ID)					

MATRIX SPIKE/MATRIX SPIKE DUPLICATE / LCS (75-125% R, <20% RPD)

		CHLORIDE		SULFATE		NITRATE-NITRITE		FLUORIDE		TOC	
SAMPLE ID	MATRIX	%R	%RPD	%R	%RPD	%R	%RPD	%R	%RPD	%R	%RPD

FIELD DUPLICATES (WATER = < 25% RPD)

	SAMPLE ID	SAMPLE ID	SAMPLE ID	SAMPLE ID
ANALYTE				
CHLORIDE				
SULFATE				
NITRATE-NITRITE				
FLUORIDE				
TOC				

REVIEWER INITALS: _____

DATE: _____

HOLDING TIME SUMMARY
ALPHA ISOTOPIC ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

MOUND PROJECT

OPERABLE UNIT NO.: _____

COLLECTION DATE(s): _____

QC Limits: None.

LABORATORY SAMPLE ID	MOUND SAMPLE ID	PLUTONIUM			URANIUM			THORIUM			AMERICIUM		
		SAMP DATE	COUNT DATE	DAYS	SAMP DATE	COUNT DATE	DAYS	SAMP DATE	COUNT DATE	DAYS	SAMP DATE	COUNT DATE	DAYS

CHECK SOURCE SUMMARY
ALPHA ISOTOPIC ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

MOUND PROJECT

OPERABLE UNIT NO.: _____

COLLECTION DATE(s): _____

QC Limits: +/- 3 SD from mean value

LABORATORY SAMPLE ID	MOUND SAMPLE ID	PLUTONIUM		URANIUM		THORIUM		AMERICIUM	
		CT. DATE	COMMENTS	CT. DATE	COMMENTS	CT. DATE	COMMENTS	CT. DATE	COMMENTS

BACKGROUND SUMMARY
ALPHA ISOTOPIC ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

MOUND PROJECT

OPERABLE UNIT NO.: _____

COLLECTION DATE(s): _____

QC Limits: < MDA FOR THE SAMPLE

LABORATORY SAMPLE ID	MOUND SAMPLE ID	PLUTONIUM			URANIUM			THORIUM			AMERICIUM		
		SAMP CT DATE	BKGD CT DATE	COM.	SAMP CT DATE	BKGD CT DATE	COM.	SAMP CT DATE	BKGD CT DATE	COM.	SAMP CT DATE	BKGD CT DATE	COM.

METHOD SPIKE SUMMARY
ALPHA ISOTOPIC ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

EG&G MOUND PROJECT

OPERABLE UNIT: _____

COLLECTION DATES: _____

QC Limits: +/− 3 SD of Known Value

LABORATORY SAMPLE ID	MOUND SAMPLE ID	PLUTONIUM				URANIUM			
		AMT ADDED pCi/	AMT FOUND pCi/	DIFFERENCE STD DEV	COMMENT	AMT ADDED pCi/	AMT FOUND pCi/	DIFFERENCE STD DEV	COMMENT

METHOD SPIKE SUMMARY
ALPHA ISOTOPIC ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

EG&G MOUND PROJECT

OPERABLE UNIT: _____

COLLECTION DATES: _____

QC Limits: +/- 3 SD of Known Value

LABORATORY SAMPLE ID	MOUND SAMPLE ID	THORIUM				AMERICIUM			
		AMT ADDED pCi/	AMT FOUND pCi/	DIFFERENCE STD DEV	COMMENT	AMT ADDED pCi/	AMT FOUND pCi/	DIFFERENCE STD DEV	COMMENT

MATRIX SPIKE SUMMARY
ALPHA ISOTOPIC ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

EG&G MOUND PROJECT

OPERABLE UNIT: _____

COLLECTION DATES: _____

QC Limits: +/- 3 SD of Known Value

LABORATORY SAMPLE ID	MOUND SAMPLE ID	PLUTONIUM				URANIUM			
		AMT ADDED pCi/	AMT FOUND pCi/	DIFFERENCE STD DEV	COMMENT	AMT ADDED pCi/	AMT FOUND pCi/	DIFFERENCE STD DEV	COMMENT

MATRIX SPIKE SUMMARY
ALPHA ISOTOPIC ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

EG&G MOUND PROJECT

OPERABLE UNIT: _____

COLLECTION DATES: _____

QC Limits: +/– 3 SD of Known Value

LABORATORY SAMPLE ID	MOUND SAMPLE ID	THORIUM				AMERICIUM			
		AMT ADDED pCi/	AMT FOUND pCi/	DIFFERENCE STD DEV	COMMENT	AMT ADDED pCi/	AMT FOUND pCi/	DIFFERENCE STD DEV	COMMENT

YIELD SUMMARY
ALPHA ISOTOPIC ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

MOUND PROJECT

OPERABLE UNIT NO.: _____

COLLECTION DATE(s): _____

QC Limits: _____ %

LABORATORY SAMPLE ID	MOUND SAMPLE ID	PLUTONIUM		URANIUM		THORIUM		AMERICIUM	
		YIELD	COMMENT	YIELD	COMMENT	YIELD	COMMENT	YIELD	COMMENT

REPLICATES SUMMARY
ALPHA ISOTOPIC ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

EG&G MOUND PROJECT

OPERABLE UNIT: _____

COLLECTION DATES: _____

QC Limits: +/- 4 SD of Normalized Range

LABORATORY SAMPLE ID	MOUND SAMPLE ID	PLUTONIUM				URANIUM			
		ORG RESULT pCi/	REP RESULT pCi/	DIFFERENCE STD DEV	COMMENT	ORG RESULT pCi/	REP RESULT pCi/	DIFFERENCE STD DEV	COMMENT

REPLICATES SUMMARY
ALPHA ISOTOPIC ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

EG&G MOUND PROJECT

OPERABLE UNIT: _____

COLLECTION DATES: _____

QC Limits: +/- 4 SD of Normalized Range

LABORATORY SAMPLE ID	MOUND SAMPLE ID	THORIUM				AMERICIUM			
		ORG RESULT pCi/	REP RESULT pCi/	DIFFERENCE STD DEV	COMMENT	ORG RESULT pCi/	REP RESULT pCi/	DIFFERENCE STD DEV	COMMENT

HOLDING TIME SUMMARY
DIOXIN/FURAN COMPOUNDS
SW8290

PREPARED BY: _____

DATE: _____

MOUND PROJECT

LABORATORY BATCH # _____

OPERABLE UNIT NO.: _____

LABORATORY NAME/LOCATION: _____

COLLECTION DATE(s): _____

LABORATORY SAMPLE ID	MOUND SAMPLE ID	DATE COLLECTED	DATE EXTRACTED	DATE ANALYZED	NUMBER OF DAYS PAST HOLDING TIME*

* 30 DAYS EXTRACTION / 45 DAYS ANALYSIS FROM DATE OF COLLECTION.

INTERNAL STANDARD RECOVERY OUTLIERS
DIOXIN/FURAN COMPOUNDS
SW8290

PREPARED BY: _____ MOUND PROJECT

DATE: _____ OPERABLE UNIT NO.: _____

LABORATORY BATCH #: _____ COLLECTION DATE(s): _____

LABORATORY NAME/LOCATION: _____

QC LIMITS

40-135%

ANALYTE	SAMPLE ID	SAMPLE ID	SAMPLE ID	SAMPLE ID	SAMPLE ID
$^{13}C_{12}$-2378-TCDD					
$^{13}C_{12}$-2378-TCDF					
$^{13}C_{12}$-12378-PECDD					
$^{13}C_{12}$-12378-PECDF					
$^{13}C_{12}$-123678-HXCDD					
$^{13}C_{12}$-123478-HXCDF					
$^{13}C_{12}$-1234678-HPCDD					
$^{13}C_{12}$-1234678-HPCDF					
$^{13}C_{12}$-OCDD					

MATRIX SPIKE RECOVERY OUTLIERS
DIOXIN/FURAN COMPOUNDS
SW8290

PREPARED BY: _____

MOUND PROJECT

DATE: _____

OPERABLE UNIT NO.: _____

LABORATORY BATCH #: _____

COLLECTION DATE(s): _____

LABORATORY NAME/LOCATION: _____

QC LIMITS: RECOVERY (RPD)
60-148% (50%)

ANALYSIS	SAMPLE ID	SAMPLE ID	SAMPLE ID	SAMPLE ID	SAMPLE ID
2378-TCDD					
2378-TCDF					
12378-PECDD					
12378-PECDF					
23478-PECDF					
123478-HXCDD					
123678-HXCDD					
123789-HXCDD					
123478-HXCDF					
123678-HXCDF					
123789-HXCDF					
234678-HXCDF					
1234678-HPCDD					
1234678-HPCDF					
1234789-HPCDF					
OCDD					
OCDF					

BLANK DATA SUMMARY TABLE
DIOXIN/FURAN COMPOUNDS
SW8290

LABORATORY BATCH #: _____ MOUND PROJECT

LABORATORY NAME/LOCATION: _____ OPERABLE UNIT NO.: _____

COLLECTION DATE(s): _____

ANALYTE	METHOD BLANK ID	METHOD BLANK ID	EQUIPMENT BLANK ID	ACTION LEVEL
2378-TCDD				
2378-TCDF				
12378-PECDD				
12378-PECDF				
23478-PECDF				
123478-HXCDD				
123678-HXCDD				
123789-HXCDD				
123478-HXCDF				
123678-HXCDF				
123789-HXCDF				
234678-HXCDF				
1234678-HPCDD				
1234678-HPCDF				
1234789-HPCDF				
OCDD				
OCDF				
TOTAL TCDD				
TOTAL TCDF				
TOTAL PECDD				
TOTAL PECDF				
TOTAL HXCDD				
TOTAL HXCDF				
TOTAL HPCDD				
TOTAL HPCDF				

APPLIES TO SAMPLES (CLIENT ID): _____ _____

_____ _____

_____ _____

_____ _____

_____ _____

REVIEWER INITIALS: _____

DATE: _____

CALIBRATION OUTLIERS
DIOXIN/FURAN COMPOUNDS
SW8290

PREPARED BY: _____

DATE: _____

MOUND PROJECT

LABORATORY BATCH #: _____

OPERABLE UNIT NO.: _____

LABORATORY NAME/LOCATION: _____

COLLECTION DATE(s): _____

INSTRUMENT #: _____

COLUMN: _____

ANALYTE	ION RATIO LIMITS	INITIAL			CONTINUING			
		DATE/TIME:			DATE/TIME:		DATE/TIME:	
		ION RATIO	SN < 2.5	RRF RSD*	ION RATIO	RRF RSD*	ION RATIO	RRF RSD*
2378-TCDD	0.65-0.89							
2378-TCDF	0.65-0.89							
12378-PECDD	1.32-1.78							
12378-PECDF	1.32-1.78							
23478-PECDF	1.32-1.78							
123478-HXCDD	1.05-1.43							
123678-HXCDD	1.05-1.43							
123789-HXCDD	1.05-1.43							
123478-HXCDF	1.05-1.43							
123678-HXCDF	1.05-1.43							
123789-HXCDF	1.05-1.43							
234678-HXCDF	1.05-1.43							
1234678-HPCDD	0.88-1.20							
1234678-HPCDF	0.88-1.20							
1234789-HPCDF	0.88-1.20							
OCDD	0.76-1.02							
OCDF	0.76-1.02							
$^{13}C_{12}$-2378-TCDD	0.65-0.89							
$^{13}C_{12}$-2378-TCDF	0.65-0.89							
$^{13}C_{12}$-12378-PECDD	1.32-1.78							
$^{13}C_{12}$-12378-PECDF	1.32-1.78							
$^{13}C_{12}$-123678-HXCDD	0.43-0.59							
$^{13}C_{12}$-123478-HXPCF	0.43-0.59							
$^{13}C_{12}$-1234678-HPCDD	0.37-0.51							
$^{13}C_{12}$-1234678-HPCDF	0.37-0.51							
$^{13}C_{12}$-OCDD	0.76-1.02							

AFFECTED SAMPLES:
(CLIENT ID)

REVIEWER INITIALS: _____

DATE: _____

* QC LIMITS: +/- 20% FOR UNLABELED, +/- 30% FOR LABELED.

HOLDING TIMES SUMMARY
GAMMA ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

EG&G MOUND PROJECT

OPERABLE UNIT: _____

COLLECTION DATES: _____

QC LIMITS: NONE.

LABORATORY SAMPLE ID	MOUND SAMPLE ID	SAMPLE DATE	COUNT DATE	DAYS	COMMENTS

CHECK SOURCE SUMMARY
GAMMA ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

EG&G MOUND PROJECT

OPERABLE UNIT: _____

COLLECTION DATES: _____

QC LIMITS: +/- 3 SD FROM MEAN VALUE

LABORATORY SAMPLE ID	MOUND SAMPLE ID	SAMPLE COUNT DATE	RESULT	COMMENTS

BACKGROUND SUMMARY
GAMMA ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

EG&G MOUND PROJECT

OPERABLE UNIT: _____

COLLECTION DATES: _____

QC LIMITS: COUNTED WITHIN ONE WEEK OF SAMPLE
NO PEAKS IDENTIFIED WITH +/- 20% ERROR

LABORATORY SAMPLE ID	MOUND SAMPLE ID	SAMPLE COUNT DATE	BACKGROUND COUNT DATE	COMMENTS

REPLICATES SUMMARY
GAMMA ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

EG&G MOUND PROJECT

OPERABLE UNIT: _____

COLLECTION DATES: _____

QC LIMITS: +/- 4 SD OF NORMALIZED RANGE

LABORATORY SAMPLE ID	MOUND SAMPLE ID	ORIG RESULT pCi/	REP RESULT pCi/	DIFF STD DEV	COMMENTS

HOLDING TIMES SUMMARY
STRONTIUM-90 ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

EG&G MOUND PROJECT

OPERABLE UNIT: _____

COLLECTION DATES: _____

QC LIMITS: NONE.

LABORATORY SAMPLE ID	MOUND SAMPLE ID	SAMPLE DATE	COUNT DATE	DAYS	COMMENTS

CHECK SOURCE SUMMARY
STRONTIUM-90 ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

EG&G MOUND PROJECT

OPERABLE UNIT: _____

COLLECTION DATES: _____

QC LIMITS: +/- 3 SD FROM MEAN VALUE

LABORATORY SAMPLE ID	MOUND SAMPLE ID	COUNT DATE	RESULT	COMMENTS

BACKGROUND SUMMARY
STRONTIUM-90 ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

EG&G MOUND PROJECT

OPERABLE UNIT: _____

COLLECTION DATES: _____

QC LIMITS: +/- 3 SD FROM MEAN VALUE

LABORATORY SAMPLE ID	MOUND SAMPLE ID	SAMPLE COUNT DATE	BACKGROUND COUNT DATE	COMMENTS

YIELD SUMMARY
STRONTIUM-90 ANALYSES

PREPARED BY: _____ EG&G MOUND PROJECT

DATE: _____ OPERABLE UNIT: _____

LABORATORY BATCH # _____ COLLECTION DATES: _____

LABORATORY NAME/LOCATION: _____ QC LIMITS: ____ % (Sr) ____ % (Y)

LABORATORY SAMPLE ID	MOUND SAMPLE ID	STRONTIUM		YTTRIUM		GENERAL COMMENTS
		YIELD	CMT	YIELD	CMT	

MATRIX SPIKE SUMMARY
STRONTIUM-90 ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

EG&G MOUND PROJECT

OPERABLE UNIT: _____

COLLECTION DATES: _____

QC LIMITS: +/- 3 SD OF KNOWN VALUE

LABORATORY SAMPLE ID	MOUND SAMPLE ID	AMOUNT ADDED pCi/	AMOUNT FOUND pCi/	DIFF STD DEV	COMMENTS

REPLICATES SUMMARY
STRONTIUM-90 ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

EG&G MOUND PROJECT

OPERABLE UNIT: _____

COLLECTION DATES: _____

QC LIMITS: +/- 4 SD OF NORMALIZED RANGE

LABORATORY SAMPLE ID	MOUND SAMPLE ID	ORIG RESULT pCi/	REP RESULT pCi/	DIFF STD DEV	COMMENTS

HOLDING TIMES SUMMARY
TRITIUM ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

EG&G MOUND PROJECT

OPERABLE UNIT: _____

COLLECTION DATES: _____

QC LIMITS: NONE.

LABORATORY SAMPLE ID	MOUND SAMPLE ID	SAMPLE DATE	COUNT DATE	DAYS	COMMENTS

CHECK SOURCE SUMMARY
TRITIUM ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

EG&G MOUND PROJECT

OPERABLE UNIT: _____

COLLECTION DATES: _____

QC LIMITS: +/- 3 SD FROM MEAN VALUE

LABORATORY SAMPLE ID	MOUND SAMPLE ID	COUNT DATE	RESULT	COMMENTS

BACKGROUND SUMMARY
TRITIUM ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

EG&G MOUND PROJECT

OPERABLE UNIT: _____

COLLECTION DATES: _____

QC LIMITS: +/- 3 SD FROM MEAN VALUE

LABORATORY SAMPLE ID	MOUND SAMPLE ID	SAMPLE COUNT DATE	BACKGROUND COUNT DATE	COMMENTS

METHOD SPIKE SUMMARY
TRITIUM ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

EG&G MOUND PROJECT

OPERABLE UNIT: _____

COLLECTION DATES: _____

QC LIMITS: +/– 3 SD OF KNOWN VALUE

LABORATORY SAMPLE ID	MOUND SAMPLE ID	AMOUNT ADDED pCi/	AMOUNT FOUND pCi/	DIFF STD DEV	COMMENTS

MATRIX SPIKE SUMMARY
TRITIUM ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

EG&G MOUND PROJECT

OPERABLE UNIT: _____

COLLECTION DATES: _____

QC LIMITS: +/- 3 SD OF KNOWN VALUE

LABORATORY SAMPLE ID	MOUND SAMPLE ID	AMOUNT ADDED pCi/	AMOUNT FOUND pCi/	DIFF STD DEV	COMMENTS

REPLICATES SUMMARY
TRITIUM ANALYSES

PREPARED BY: _____

DATE: _____

LABORATORY BATCH # _____

LABORATORY NAME/LOCATION: _____

EG&G MOUND PROJECT

OPERABLE UNIT: _____

COLLECTION DATES: _____

QC LIMITS: +/- 4 SD OF NORMALIZED RANGE

LABORATORY SAMPLE ID	MOUND SAMPLE ID	ORIG RESULT pCi/	REP RESULT pCi/	DIFF STD DEV	COMMENTS

HOLDING TIME SUMMARY
INORGANIC COMPOUNDS
CLP SOW – ILM01.0

PREPARED BY: _____

DATE: _____

MOUND PROJECT

LABORATORY BATCH # _____

OPERABLE UNIT NO.: _____

LABORATORY NAME/LOCATION: _____

COLLECTION DATE(s): _____

LABORATORY SAMPLE ID	MOUND SAMPLE ID	DATE COLLECTED	DATE ANALYZED	NUMBER OF DAYS PAST HOLDING TIME

LABORATORY QC DATA SUMMARY TABLE
INORGANIC COMPOUNDS
CLP SOW – ILM01.0

PREPARED BY: _____ MOUND PROJECT

DATE: _____ OPERABLE UNIT NO.: _____

LABORATORY BATCH #: _____ COLLECTION DATE(s): _____

LABORATORY NAME/LOCATION: _____

LCS MATRIX: _____

ANALYTE	LCS > +/- 20%	LCS > +/- 20%	ICP SERIAL DILUTION > 10% D	QUALIFICATION
ALUMINUM				
ANTIMONY				
ARSENIC				
BARIUM				
BERYLLIUM				
CADMIUM				
CALCIUM				
CHROMIUM				
COBALT				
COPPER				
IRON				
LEAD				
MAGNESIUM				
MANGANESE				
MERCURY				
NICKEL				
POTASSIUM				
SELENIUM				
SILVER				
SODIUM				
THALLIUM				
VANADIUM				
ZINC				
LITHIUM				
BISMUTH				
MOYLBDENUM				
TIN				
CYANIDE				
APPLIES TO SAMPLES:				
(CLIENT ID)				

REVIEWER INITALS: _____

DATE: _____

MATRIX SPIKE RECOVERY DATA SUMMARY TABLE
INORGANIC COMPOUNDS
CLP SOW – ILM01.0

PREPARED BY: _____ MOUND PROJECT

DATE: _____ OPERABLE UNIT NO.: _____

LABORATORY BATCH #: _____ COLLECTION DATE(s): _____

LABORATORY NAME/LOCATION: _____

ANALYTE	MOUND SAMPLE ID	MOUND SAMPLE ID	MOUND SAMPLE ID	MOUND SAMPLE ID	MOUND SAMPLE ID
ALUMINUM					
ANTIMONY					
ARSENIC					
BARIUM					
BERYLLIUM					
CADMIUM					
CALCIUM					
CHROMIUM					
COBALT					
COPPER					
IRON					
LEAD					
MAGNESIUM					
MANGANESE					
MERCURY					
NICKEL					
POTASSIUM					
SELENIUM					
SILVER					
SODIUM					
THALLIUM					
VANADIUM					
ZINC					
LITHIUM					
BISMUTH					
MOLYBDENUM					
TIN					
CYANIDE					

QC LIMITS
75–125%

REVIEWER INITALS: _____

DATE: _____

BLANK OUTLIERS
INORGANIC COMPOUNDS
CLP SOW – ILM01.0

PREPARED BY: _____ MOUND PROJECT

DATE: _____ OPERABLE UNIT NO.: _____

LABORATORY BATCH #: _____ COLLECTION DATE(s): _____

LABORATORY NAME/LOCATION: _____

PREPARATION BLANK MATRIX (SOIL/WATER): _____

PREPARATION BLANK CONCENTRATION UNITS (UG/L OR MG/KG):_____

ANALYTE	EQUIP BLANK	PREP BLANK	INIT CAL BLANK	CCB1	CCB2	CCB3	MAX CONC	ACTION LEVEL
ALUMINUM								
ANTIMONY								
ARSENIC								
BARIUM								
BERYLLIUM								
CADMIUM								
CALCIUM								
CHROMIUM								
COBALT								
COPPER								
IRON								
LEAD								
MAGNESIUM								
MANGANESE								
MERCURY								
NICKEL								
POTASSIUM								
SELENIUM								
SILVER								
SODIUM								
THALLIUM								
VANADIUM								
ZINC								
LITHIUM								
BISMUTH								
MOLYBDENUM								
TIN								
CYANIDE								

ASSOCIATED SAMPLES (CLIENT ID):

_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

REVIEWER INITIALS: _____

DATE: _____

CALIBRATION OUTLIERS
INORGANIC COMPOUNDS
CLP SOW – ILM 01.0

PREPARED BY: _____ MOUND PROJECT

DATE: _____ OPERABLE UNIT NO.: _____

LABORATORY BATCH #: _____ COLLECTION DATE(s): _____

LABORATORY NAME/LOCATION: _____

INITIAL CALIBRATION SOURCE: _____

CONTINUING CALIBRATION SOURCE : _____

ANALYTE	CALIBRATION VERIFICATION			CONTINUING CALIBRATION VERIFICATION					
	TRUE	FOUND	%R(1)	TRUE	FOUND	%R(1)	FOUND	%R(1)	M
ALUMINUM									
ANTIMONY									
ARSENIC									
BARIUM									
BERYLLIUM									
CADMIUM									
CALCIUM									
CHROMIUM									
COBALT									
COPPER									
IRON									
LEAD									
MAGNESIUM									
MANGANESE									
MERCURY									
NICKEL									
POTASSIUM									
SELENIUM									
SILVER									
SODIUM									
THALLIUM									
VANADIUM									
ZINC									
LITHIUM									
BISMUTH									
MOLYBDENUM									
TIN									
CYANIDE									

ASSOCIATED SAMPLES:
(CLIENT ID)

REVIEWER INITIALS: _____

(1) CONTROL LIMITS: MERCURY 80–120; OTHER METALS 90–110; CYANIDE 85–115

DATE: _____

DUPLICATE SAMPLE (REPLICATE) DATA SUMMARY TABLE
INORGANIC COMPOUNDS
CLP SOW – ILM01.0

PREPARED BY: _____

DATE: _____ MOUND PROJECT

LABORATORY BATCH #: _____ OPERABLE UNIT NO.: _____

LABORATORY NAME/LOCATION: _____ COLLECTION DATE(s): _____

QC LIMITS
IF RESULT > 5X CRDL, THEN +/– 20% RPD
IF RESULT < 5X CRDL, THEN +/– CRDL

ANALYTE	CRDL WATER	CRDL SOIL	MOUND SAMPLE ID	MOUND SAMPLE ID	MOUND SAMPLE ID	RPD	QUALIFICATION
ALUMINUM	20	4					
ANTIMONY	10	2					
ARSENIC	10	2					
BARIUM	200	40					
BERYLLIUM	1	0.2					
CADMIUM	5	1					
CALCIUM	5000	1000					
CHROMIUM	10	2					
COBALT	50	10					
COPPER	25	5					
IRON	100	20					
LEAD	3	0.6					
MAGNESIUM	5000	1000					
MANGANESE	15	3					
MERCURY	0.2	0.1					
NICKEL	40	8					
POTASSIUM	5000	1000					
SELENIUM	5	1					
SILVER	10	2					
SODIUM	5000	1000					
THALLIUM	10	2					
VANADIUM	10	2					
ZINC	20	4					
LITHIUM	100	10					
BISMUTH	150	30					
MOLYBDENUM	20	2					
TIN	50	10					
CYANIDE	10	2					

REVIEWER INITALS: _____

DATE: _____

FIELD DUPLICATE DATA SUMMARY TABLE
INORGANIC COMPOUNDS
CLP SOW – ILM01.0

PREPARED BY: _____ MOUND PROJECT

DATE: _____ OPERABLE UNIT NO.: _____

LABORATORY BATCH #: _____ COLLECTION DATE(s): _____

LABORATORY NAME/LOCATION: _____

QC LIMITS
WATER: +/– 25% RPD

ANALYTE	MOUND SAMPLE ID	MOUND SAMPLE ID	MOUND SAMPLE ID	RPD	QUALIFICATION
ALUMINUM					
ANTIMONY					
ARSENIC					
BARIUM					
BERYLLIUM					
CADMIUM					
CALCIUM					
CHROMIUM					
COBALT					
COPPER					
IRON					
LEAD					
MAGNESIUM					
MANGANESE					
MERCURY					
NICKEL					
POTASSIUM					
SELENIUM					
SILVER					
SODIUM					
THALLIUM					
VANADIUM					
ZINC					
LITHIUM					
BISMUTH					
MOLYBDENUM					
TIN					
CYANIDE					

REVIEWER INITALS: _____

DATE: _____

HOLDING TIME SUMMARY
PESTICIDE/PCB COMPOUNDS
CLP SOW – OLM01.8

PREPARED BY: _____

DATE: _____

MOUND PROJECT

LABORATORY BATCH # _____

OPERABLE UNIT NO.: _____

LABORATORY NAME/LOCATION: _____

COLLECTION DATE(s): _____

LABORATORY SAMPLE ID	MOUND SAMPLE ID	DATE COLLECTED	DATE EXTRACTED	DATE ANALYZED	NUMBER OF DAYS PAST HOLDING TIME

SURROGATE RECOVERY OUTLIERS
PESTICIDES/PCB COMPOUNDS
CLP SOW – OLM01.8

PREPARED BY: _____

DATE: _____

LABORATORY BATCH #: _____

LABORATORY NAME/LOCATION: _____

MOUND PROJECT

OPERABLE UNIT NO.: _____

COLLECTION DATE(s): _____

SOIL QC LIMITS

TETRACHLORO-M-XYLENE (TCMX) (60-150%)

DECACHLOROBIPHENYL (DCB) (60-150%)

WATER QC LIMITS

TETRACHLORO-M-XYLENE (TCMX) (60-150%)

DECACHLOROBIPHENYL (DCB) (60-150%)

LABORATORY SAMPLE ID	MOUND SAMPLE ID	SAMPLE MATRIX	TCMX	DCB

MATRIX SPIKE RECOVERY OUTLIERS
PESTICIDE/PCB COMPOUNDS
CLP SOW – OLM01.8

PREPARED BY: _____

MOUND PROJECT

DATE: _____

OPERABLE UNIT NO.: _____

LABORATORY BATCH #: _____

COLLECTION DATE(s): _____

LABORATORY NAME/LOCATION: _____

SOIL QC LIMITS: RECOVERY (%RPD)
LINDANE: 32–127% (50%)
HEPTACHLOR: 34–111% (31%)
ALDRIN: 42–122% (43%)
DIELDRIN: 36–146% (38%)
ENDRIN: 30–147% (45%)
4,4'–DDT: 25–160% (50%)

WATER QC LIMITS: RECOVERY (%RPD)
LINDANE: 56–123% (15%)
HEPTACHLOR: 40–131% (20%)
ALDRIN: 40–120% (22%)
DIELDRIN: 52–126% (18%)
ENDRIN: 56–121% (21%)
4,4'–DDT: 38–127% (27%)

LABORATORY SAMPLE ID	MOUND SAMPLE ID	SAMPLE MATRIX	LINDANE	HEPTACHLOR	ALDRIN	DIELDRIN	ENDRIN	4,4'–DDT

BLANK DATA SUMMARY TABLE
PESTICIDE/PCB COMPOUNDS
CLP SOW – OLM01.8

PREPARED BY: _____ MOUND PROJECT

DATE: _____ OPERABLE UNIT NO.:_____

LABORATORY BATCH/CASE #: _____ COLLECTION DATE(s):_____

LABORATORY NAME/LOCATION: _____

ANALYTE	METHOD BLANK ID	INSTRUMENT BLANK ID	EQUIPMENT BLANK ID	SULFUR CLEANUP BLANK ID	ACTION LEVEL
ALPHA-BHC					
BETA-BHC					
DELTA-BHC					
GAMMA-BHC (LINDANE)					
HEPTACLOR					
ALDRIN					
HEPTACLOR EPOXIDE					
ENDOSULFAN I					
DIELDRIN					
4,4'-DDE					
ENDRIN					
ENDOSULFAN II					
4,4'-DDD					
ENDOSULFAN SULFATE					
4,4'-DDT					
METHOXYCLOR					
ENDRIN KETONE					
ENDRIN ALDEHYDE					
ALPHA-CHLORDANE					
GAMMA-CHLORDANE					
TOXAPHENE					
AROCLOR 1016					
AROCLOR 1221					
AROCLOR 1232					
AROCLOR 1242					
AROCLOR 1248					
AROCLOR 1254					
AROCLOR 1260					
DIBUTYLCHLORENDATE					
TETRACHLORO-M-XYLENE					

APPLIES TO SAMPLES (CLIENT ID):

_____ _____ _____

_____ _____ _____

_____ _____ _____

REVIEWER INITIALS:_____

DATE:_____

CALIBRATION OUTLERS
PESTICIDE/PCB COMPOUNDS
CLP SOW – OLM01.8

PREPARED BY: _____ MOUND PROJECT

DATE: _____ OPERABLE UNIT NO.: _____

LABORATORY BATCH/CASE #: _____ COLLECTION DATE(s): _____

LABORATORY NAME/LOCATION: _____

INSTRUMENT #: COLUMN TYPE: DATE/TIME:	INIT. CAL.			CONT. CAL.			CONT. CAL.		
	AVG. CF	RSD > 20%	*	CF	RFD > 25%	*	CF	RFD > 25%	*
ALPHA-BHC									
BETA-BHC									
DELTA-BHC									
GAMMMA-BHC (LINDANE)									
HEPTACLOR									
ALDRIN									
HEPTACLOR EPOXIDE									
ENDOSULFAN I									
DUELDRIN									
4,4'-DDE									
ENDRIN									
ENDOSULFAN II									
4,4'-DDD									
ENDOSULFAN SULFATE									
4,4'-DDT									
METHOXYCLOR									
ENDRIN KETONE									
ENDRIN ALDEHYDE									
ALPHA-CHLORDANE									
GAMMA-CHLORDANE									
TOXAPHENE									
AROCLOR 1016									
AROCLOR 1221									
AROCLOR 1232									
AROCLOR 1242									
AROCLOR 1248									
AROCLOR 1254									
AROCLOR 1260									
DIBUTYLCHLORENDATE									
TETRACHLORO-M-XYLENE									

ASSOCIATED SAMPLES: (CLIENT ID)			

REVIEWER INITIALS: _____

* THESE FLAGS SHOULD BE APPLIED TO THE ANALYTES ON THE SAMPLE DATA SHEETS.

DATE: _____

GC/ECD INSTRUMENT PERFORMANCE CHECK OUTLIERS
PESTICIDE/PCB COMPOUNDS
CLP SOW – OLM01.8

PREPARED BY: _____ MOUND PROJECT

DATE: _____ OPERABLE UNIT NO.: _____

LABORATORY BATCH/CASE #: _____ COLLECTION DATE(s): _____

LABORATORY NAME/LOCATION: _____

INSTRUMENT #:		RT WINDOW		ANALYTE CONCENTRATION			RESOLUTION
COLUMN TYPE:							
DATE/TIME:	RT	FROM	TO	TRUE	CALC	%RPD	<100%
ANALYTE							
ALPHA-BHC							
BETA-BHC							
GAMMA-BHC (LINDANE)							
ENDRIN							
4,4'-DDT							
METHOXYCLOR							
TCMX							
DBC							

4,4'-DDT BREAKDOWN > 20%: _____%

ENDRIN BREAKDOWN > 20%: _____%

COMBINED BREAKDOWN > 30%: _____%

RESOLUTION CHECK MIXTURE

DATE/TIME:	RESOLUTION
INSTRUMENT #:	
COLUMN TYPE:	<60%
ANALYTE	
ENDOSULFAN I	
DIELDRIN	
4,4'-DDE	
ENDOSULFAN SULFATE	
METHOXYCLOR	
ENDRIN KEYTONE	
GAMMA-CHLORDANE	

APPLIES TO SAMPLES (CLIENT ID):

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

REVIEWER INITIALS: _____

DATE: _____

FIELD DUPLICATE DATA SUMMARY TABLE
PESTICIDE/PCB COMPOUNDS
CLP SOW – OLM01.8

PREPARED BY: _____

MOUND PROJECT

DATE: _____

OPERABLE UNIT NO.: _____

LABORATORY BATCH/CASE #: _____

COLLECTION DATE(s): _____

LABORATORY NAME/LOCATION: _____

QC LIMITS
WATER = ≤ 35% RPD

ANALYTE	MOUND SAMPLE ID	MOUND SAMPLE ID	MOUND SAMPLE ID	MOUND SAMPLE ID
ALPHA-BHC				
BETA-BHC				
DELTA-BHC				
GAMMMA-BHC (LINDANE)				
HEPTACLOR				
ALDRIN				
HEPTACLOR EPOXIDE				
ENDOSULFAN I				
DIELDRIN				
4,4'-DDE				
ENDRIN				
ENDOSULFAN II				
4,4'-DDD				
ENDOSULFAN SULFATE				
4,4'-DDT				
METHOXYCLOR				
ENDRIN KETONE				
ENDRIN ALDEHYDE				
ALPHA-CHLORDANE				
GAMMA-CHLORDANE				
TOXAPHENE				
AROCLOR 1016				
AROCLOR 1221				
AROCLOR 1232				
AROCLOR 1242				
AROCLOR 1248				
AROCLOR 1254				
AROCLOR 1260				
DIBUTYLCHLORENDATE				
TETRACHLORO-M-XYLENE				

REVIEWER INITIALS: _____

DATE: _____

PESTICIDE GPC CALIBRATION CHECK OUTLIERS
PESTICIDE/PCB COMPOUNDS
CLP SOW – OLM01.8

PREPARED BY: _____

MOUND PROJECT

DATE: _____

OPERABLE UNIT NO.: _____

LABORATORY BATCH/CASE #: _____

COLLECTION DATE(s): _____

LABORATORY NAME/LOCATION: _____

QC LIMITS
80 – 120%

GPC COLUMN: _____

CALIBRATION DATE: _____

GC COLUMN 1: _____

GC COLUMN 2: _____

ANALYTE	PERCENT RECOVERY
gamma-BHC	
Heptaclor	
Aldrin	
Dieldrin	
Endrin	
4,4'-DDT	

APPLIES TO SAMPLES (CLIENT ID):

_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

REVIEWER INITIALS: _____

DATE: _____

PESTICIDE FLORISIL CARTRIDGE CHECK OUTLIERS
PESTICIDE/PCB COMPOUNDS
CLP SOW – OLM01.8

PREPARED BY: _____

MOUND PROJECT

DATE: _____

OPERABLE UNIT NO.: _____

LABORATORY BATCH/CASE #: _____

COLLECTION DATE(s): _____

LABORATORY NAME/LOCATION: _____

QC LIMITS
80 – 120%

FLORISIL CARTRIDGE LOT NO.: _____

DATE OF ANALYSIS _____

GC COLUMN (1): _____ ID: _____ (mm)

GC COLUMN (2): _____ ID: _____ (mm)

ANALYTE	PERCENT RECOVERY
alpha–BHC	
gamma–BHC (Lindane)	
Heptaclor	
Endosulfan I	
Dieldrin	
Endrin	
4,4'–DDD	
4,4'–DDT	
Methoxyclor	
Tetrachloro–m–xylene	
Decachlorobiphenyl	

APPLIES TO SAMPLES (CLIENT ID):

_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

REVIEWER INITIALS: _____

DATE: _____

PESTICIDE IDENTIFICATION SUMMARY TABLE
PESTICIDE/PCB COMPOUNDS
CLP SOW – OLM01.8

PREPARED BY: _____ MOUND PROJECT

DATE: _____ OPERABLE UNIT NO.: _____

LABORATORY BATCH/CASE #: _____ COLLECTION DATE(s): _____

LABORATORY NAME/LOCATION: _____

QC LIMITS
%D less than or equal to 25%

ANALYTE	MOUND SAMPLE ID			MOUND SAMPLE ID			MOUND SAMPLE ID			MOUND SAMPLE ID		
	Col 1	Col 2	%D	Col 1	Col 2	%D	Col 1	Col 2	%D	Col 1	Col 2	%D
ALPHA-BHC												
BETA-BHC												
DELTA-BHC												
GAMMMA-BHC (LINDANE)												
HEPTACLOR												
ALDRIN												
HEPTACLOR EPOXIDE												
ENDOSULFAN I												
DIELDRIN												
4,4'-DDE												
ENDRIN												
ENDOSULFAN II												
4,4'-DDD												
ENDOSULFAN SULFATE												
4,4'-DDT												
METHOXYCLOR												
ENDRIN KETONE												
ENDRIN ALDEHYDE												
ALPHA-CHLORDANE												
GAMMA-CHLORDANE												
TOXAPHENE												
AROCLOR 1016												
AROCLOR 1221												
AROCLOR 1232												
AROCLOR 1242												
AROCLOR 1248												
AROCLOR 1254												
AROCLOR 1260												
DIBUTYLCHLORENDATE												
TETRACHLORO-M-XYLENE												

REVIEWER INITIALS: _____

DATE: _____

HOLDING TIME SUMMARY
SEMIVOLATILE ORGANIC COMPOUNDS
CLP SOW – OLM01.8

PREPARED BY: _____

MOUND PROJECT

DATE: _____

OPERABLE UNIT NO.: _____

LABORATORY BATCH # _____

COLLECTION DATE(s): _____

LABORATORY NAME/LOCATION: _____

LABORATORY SAMPLE ID	MOUND SAMPLE ID	DATE COLLECTED	DATE EXTRACTED	DATE ANALYZED	NUMBER OF DAYS PAST HOLDING TIME

SURROGATE RECOVERY OUTLIERS
SEMIVOLATILE ORGANIC COMPOUNDS
CLP SOW – OLM01.8

PREPARED BY: _____

DATE: _____

LABORATORY BATCH #: _____

LABORATORY NAME/LOCATION: _____

MOUND PROJECT

OPERABLE UNIT NO.: _____

COLLECTION DATE(s): _____

SOIL QC LIMITS

NITROBENZENE–d5 (NBZ) (23–120%)
2–FLUOROBIPHENYL (FBP) (30–115%)
P–TERPHENYL–d14 (TPH) (18–137%)
PHENOL–d5 (PHL) (24–113%)
2–FLUOROPHENOL (2FP) (25–121%)
2,4,6–TRIBROMOPHENOL (TBP) (19–122%)
2–CHLOROPHENOL–D4 (2CP) (20–130%)
1,2–DICHLOROBENZENE–D4 (DCB) (20–130%)

WATER QC LIMITS

NITROBENZENE–d5 (NBZ) (35–114%)
2–FLUOROBIPHENYL (FBP) (43–116%)
P–TERPHENYL–d14 (TPH) (33–141%)
PHENOL–d5 (PHL) (10–110%)
2–FLUOROPHENOL (2FP) (10–110%)
2,4,6–TRIBROMOPHENOL (TBP) (10–123%)
2–CHLOROPHENOL–D4 (2CP) (33–110%)
1,2–DICHLOROBENZENE–D4 (DCB) (16–110%)

LABORATORY SAMPLE ID	MOUND SAMPLE ID	SAMPLE MATRIX	NBZ	FBP	TPH	PHL	2FP	TBP	2CP	DCB

MATRIX SPIKE RECOVERY OUTLIERS
SEMIVOLATILE ORGANIC COMPOUNDS
CLP SOW – OLM01.8

PREPARED BY: _____

DATE: _____

LABORATORY BATCH #: _____

LABORATORY NAME/LOCATION: _____

MOUND PROJECT

OPERABLE UNIT NO.: _____

COLLECTION DATE(s): _____

SOIL QC LIMITS: RECOVERY (%RPD)

PHENOL: 26–90% (35%)
2–CHLOROPHENOL: 25–102% (50%)
1,4–DICHLOROBENZENE: 28–104% (27%)
N–NITROSO–DI–N–PROPYLAMINE: 41–126% (38%)
1,2,4–TRICHLOROBENZENE: 38–107% (23%)
4–CHLORO–3–METHYLPHENOL: 26–103% (33%)
ACENAPHTHENE: 31–137% (19%)
4–NITROPHENOL: 11–114% (50%)
2,4–DINITROTOLUENE: 28–89% (47%)
PENTACHLOROPHENOL: 17–109% (47%)
PYRENE: 35–142% (36%)

WATER QC LIMITS: RECOVERY (%RPD)

PHENOL: 12–110% (42%)
2–CHLOROPHENOL: 27–123% (40%)
1,4–DICHLOROBENZENE: 36–97% (28%)
N–NITROSO–DI–N–PROPYLAMINE: 41–116% (38%)
1,2,4–TRICHLOROBENZENE: 39–98% (28%)
4–CHLORO–3–METHYLPHENOL: 23–97% (42%)
ACENAPHTHENE: 46–118% (31%)
4–NITROPHENOL: 10–80% (50%)
2,4–DINITROTOLUENE: 24–96% (38%)
PENTACHLOROPHENOL: 9–103% (50%)
PYRENE: 26–127% (31%)

LABORATORY SAMPLE ID	MOUND SAMPLE ID	SAMPLE MATRIX	PHENOL	2–CHLORO PHENOL	1,4–DI CHLOROBENZENE	N–NITROSO–DI–N–PROPLYAMINE	1,2,4–TRI CHLOROBENZENE	4–CHLORO–3–METHYLPHENOL

MATRIX SPIKE RECOVERY OUTLIERS
SEMIVOLATILE ORGANIC COMPOUNDS
CLP SOW – OLM01.8

SOIL QC LIMITS: RECOVERY (%RPD)
PHENOL: 26–90% (35%)
2-CHLOROPHENOL: 25–102% (50%)
1,4-DICHLOROBENZENE: 28–104% (27%)
N-NITROSO-DI-N-PROPYLAMINE: 41–126% (38%)
1,2,4-TRICHLOROBENZENE: 38–107% (23%)
4-CHLORO-3-METHYLPHENOL: 26–103% (33%)
ACENAPHTHENE: 31–137% (19%)
4-NITROPHENOL: 11–114% (50%)
2,4-DINITROTOLUENE: 28–89% (47%)
PENTACHLOROPHENOL: 17–109% (47%)
PYRENE: 35–142% (36%)

WATER QC LIMITS: RECOVERY (%RPD)
PHENOL: 12–110% (42%)
2-CHLOROPHENOL: 27–123% (40%)
1,4-DICHLOROBENZENE: 36–97% (28%)
N-NITROSO-DI-N-PROPYLAMINE: 41–116% (38%)
1,2,4-TRICHLOROBENZENE: 39–98% (28%)
4-CHLORO-3-METHYLPHENOL: 23–97% (42%)
ACENAPHTHENE: 46–118% (31%)
4-NITROPHENOL: 10–80% (50%)
2,4-DINITROTOLUENE: 24–96% (38%)
PENTACHLOROPHENOL: 9–103% (50%)
PYRENE: 26–127% (31%)

LABORATORY SAMPLE ID	MOUND SAMPLE ID	SAMPLE MATRIX	ACEN APHTHENE	4-NITRO PHENOL	2,4-DI NITROTOLUENE	PENTA CHLOROPHENOL	PYRENE	

BLANK DATA SUMMARY TABLE
SEMIVOLATILE ORGANIC COMPOUNDS
CLP SOW – OLM01.8

PREPARED BY: _____ MOUND PROJECT

DATE: _____ OPERABLE UNIT NO.: _____

LABORATORY BATCH #: _____ COLLECTION DATE(s): _____

LABORATORY NAME/LOCATION: _____

ANALYTE	METHOD BLANK ID	EQUIPMENT BLANK ID	ACTION LEVEL
PHENOL			
BIS(2-CHLOROETHYL)ETHER			
2-CHLOROPHENOL			
1,3-DICHLOROBENZENE			
1,4-DICHLOROBENZENE			
BENZYL ALCOHOL			
1,2-DICHLOROBENZENE			
2-METHYLPHENOL			
2,2'-OXYBIS(1-CHLOROPROPANE)			
4-METHYLPHENOL			
N-NITROSO-DI-N-PROPYLAMINE			
HEXACHLOROETHANE			
NITROBENZENE			
ISOPHORONE			
2-NITROPHENOL			
2,4-DIMETHYLPHENOL			
BENZOIC ACID			
BIS(2-CHLOROETHOXY)METHANE			
2,4-DICHLOROPHENOL			
1,2,4-TRICHLOROBENZENE			
NAPHTHALENE			
4-CHLOROANILINE			
HEXACHLOROBUTADIENE			
4-CHLORO-3-METHYLPHENOL			
2-METHYLNAPHTHALENE			
HEXACHLOROCYCLOPENTADIENE			
2,4,6-TRICHLOROPHENOL			
2,4,5-TRICHLOROPHENOL			
2-CHLORONAPHTHALENE			
2-NITROANILINE			
DIMETHYL PHTHALATE			
ACENAPHTHYLENE			

REVIEWER INITIALS: _____
DATE: _____

BLANK DATA SUMMARY TABLE
SEMIVOLATILE ORGANIC COMPOUNDS

ANALYTE	METHOD BLANK ID	EQUIPMENT BLANK ID	ACTION LEVEL
2,6-DINITROTOLUENE			
3-NITROANILINE			
ACENAPHTHENE			
2,4-DINITROPHENOL			
4-NITROPHENOL			
DIBENZOFURAN			
2,4-DINITROTOLUENE			
DIETHYLPHTHALATE			
4-CHLOROPHENYL-PHENYLETHER			
FLUORENE			
4-NITROANILINE			
4,6-DINITRO-2-METHYLPHENOL			
N-NITROSODIPHENYLAMINE			
4-BROMOPHENYL-PHENYLETHER			
HEXACHLOROBENZENE			
PENTACHLOROPHENOL			
PHENANTHRENE			
ANTHRACENE			
CARBAZOLE			
DI-N-BUTYLPHTHALATE			
FLUORANTHENE			
PYRENE			
BUTYLBENZYLPHTHALATE			
3,3'-DICHLOROBENZIDINE			
BENZO(A)ANTHRACENE			
CYRYSENE			
BIS(2-ETHYLHEXYL)PHTHALATE			
DI-N-OCTYL PHTHALATE			
BENZO(B)FLUORANTHENE			
BENZO(K)FLUORANTHENE			
BENZO(A)PYRENE			
INDENO(1,2,3-CD)PYRENE			
DIBENZ(A,H)ANTHRACENE			
BENZO(G,H,I)PERYLENE			
2-BENZYL-4-CHLOROPHENOL			

APPLIES TO SAMPLES (CLIENT ID):

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

REVIEWER INITIALS:_____

DATE:_____

CALIBRATION OUTLIERS
SEMIVOLATILE TCL COMPOUNDS
CLP SOW – OLM01.8

PREPARED BY: _____ MOUND PROJECT

DATE: _____ OPERABLE UNIT NO.: _____

LABORATORY BATCH #: _____ COLLECTION DATE(s): _____

LABORATORY NAME/LOCATION: _____

INSTRUMENT # DATE/TIME:	INIT. CAL.			CONT. CAL.			CONT. CAL.			CONT. CAL.		
	RRF < 0.05	RSD > 30%	*	RRF < 0.05	%D > 25%	*	RRF < 0.05	%D > 25%	*	RRF < 0.05	%D > 25%	*
PHENOL												
BIS(2-CHLOROETHYL)ETHER												
2-CHLOROPHENOL												
1,3-DICHLOROBENZENE												
1,4-DICHLOROBENZENE												
BENZYL ALCOHOL												
1,2-DICHLOROBENZENE												
2-METHYLPHENOL												
2,2'-OXYBIS(1-CHLOROPROPANE)												
4-METHYLPHENOL												
N-NITROSO-DI-N-PROPYLAMINE												
HEXACHLOROETHANE												
NITROBENZENE												
ISOPHORONE												
2-NITROPHENOL												
2,4-DIMETHYLPHENOL												
BENZOIC ACID												
BIS(2-CHLOROETHOXY)METHANE												
2,4-DICHLOROPHENOL												
1,2,4-TRICHLOROBENZENE												
NAPHTHALENE												
4-CHLOROANILINE												
HEXACHLOROBUTADIENE												
4-CHLORO-3-METHYLPHENOL												
2-METHYLNAPHTHALENE												
HEXACHLOROCYCLOPENTADIENE												
2,4,6-TRICHLOROPHENOL												

AFFECTED SAMPLES:
(CLIENT ID)

REVIEWER INITIALS: _____

* THESE FLAGS SHOULD BE APPLIED TO THE ANALYTES ON THE SAMPLE DATA SHEETS.

DATE: _____

CALIBRATION OUTLIERS
SEMIVOLATILE TCL COMPOUNDS
CLP SOW – OLM01.8

INSTRUMENT # DATE/TIME:	INIT. CAL.			CONT. CAL.			CONT. CAL.			CONT. CAL.		
	RRF < 0.05	RSD > 30%	*	RRF < 0.05	%D > 25%	*	RRF < 0.05	%D > 25%	*	RRF < 0.05	%D > 25%	*
2,4,5-TRICHLOROPHENOL												
2-CHLORONAPHTHALENE												
2-NITROANILINE												
DIMETHYL PHTHALATE												
ACENAPHTHYLENE												
2,6-DINITROTOLUENE												
3-NITROANILINE												
ACENAPHTHENE												
2,4-DINITROPHENOL												
4-NITROPHENOL												
DIBENZOFURAN												
2,4-DINITROTOLUENE												
DIETHYLPHTHALATE												
4-CHLOROPHENYL-PHENYLETHER												
FLUORENE												
4-NITROANILINE												
4,6-DINITRO-2-METHYLPHENOL												
N-NITROSODIPHENYLAMINE												
4-BROMOPHENYL-PHENYLETHER												
HEXACHLOROBENZENE												
PENTACHLOROPHENOL												
PHENANTHRENE												
ANTHRACENE												
CARBAZOLE												
DI-N-BUTYLPHTHALATE												
FLUORANTHENE												
PYRENE												
BUTYLBENZYLPHTHALATE												
3,3'-DICHLOROBENZIDINE												
BENZO(A)ANTHRACENE												
CHRYSENE												
BIS(2-ETHYLHEXYL)PHTHALATE												
DI-N-OCTYL PHTHALATE												
BENZO(B)FLUORANTHENE												
BENZO(K)FLUORANTHENE												
BENZO(A)PYRENE												
INDENO(1,2,3-CD)PYRENE												
DIBENZ(A,H)ANTHRACENE												
BENZO(G,H,I)PERYLENE												
2-BENZYL-4-CHLOROPHENOL												

INTERNAL STANDARD RECOVERY OUTLIERS
SEMIVOLATILE ORGANIC COMPOUNDS
CLP SOW – OLM01.8

PREPARED BY: _____

DATE: _____

LABORATORY BATCH #: _____

LABORATORY NAME/LOCATION: _____

MOUND PROJECT

OPERABLE UNIT NO.: _____

COLLECTION DATE(s): _____

1,4-DICHLOROBENZENE-D4 (DCB)
NAPHTHALENE-D8 (NPT)
ACENAPHTHENE-D10 (ANT)
PHENANTHRENE-D10 (PHN)
CHRYSENE-D12 (CRY)
PERYLENE-D12 (PRY)

QC LIMITS
-50% TO +100%
RT ≤ 30 SECONDS

	DAILY STD AREA	AREA LIMITS -50%	AREA LIMITS +100%
DCB			
NPT			
ANT			
PHN			
CRY			
PRY			

LABORATORY SAMPLE ID	MOUND SAMPLE ID	SAMPLE MATRIX	(IS1) DCB	(IS2) NPT	(IS3) ANT	(IS4) PHN	(IS5) CRY	(IS6) PRY

FIELD DUPLICATE DATA SUMMARY TABLE
SEMIVOLATILE ORGANIC COMPOUNDS
CLP SOW – OLM01.8

PREPARED BY: _____

DATE: _____

LABORATORY BATCH #: _____

LABORATORY NAME/LOCATION: _____

MOUND PROJECT

OPERABLE UNIT NO.: _____

COLLECTION DATE(s): _____

QC LIMITS

WATER = ≤ 35% RPD

ANALYTE	MOUND SAMPLE ID	MOUND SAMPLE ID	MOUND SAMPLE ID	MOUND SAMPLE ID	RPD
PHENOL					
BIS(2-CHLOROETHYL)ETHER					
2-CHLOROPHENOL					
1,3-DICHLOROBENZENE					
1,4-DICHLOROBENZENE					
BENZYL ALCOHOL					
1,2-DICHLOROBENZENE					
2-METHYLPHENOL					
2,2'-OXYBIS(1-CHLOROPROPANE)					
4-METHYLPHENOL					
N-NITROSO-DI-N-PROPYLAMINE					
HEXACHLOROETHANE					
NITROBENZENE					
ISOPHORONE					
2-NITROPHENOL					
2,4-DIMETHYLPHENOL					
BENZOIC ACID					
BIS(2-CHLOROETHOXY)METHANE					
2,4-DICHLOROPHENOL					
1,2,4-TRICHLOROBENZENE					
NAPHTHALENE					
4-CHLOROANILINE					
HEXACHLOROBUTADIENE					
4-CHLORO-3-METHYLPHENOL					
2-METHYLNAPHTHALENE					
HEXACHLOROCYCLOPENTADIENE					
2,4,6-TRICHLOROPHENOL					
2,4,5-TRICHLOROPHENOL					
2-CHLORONAPHTHALENE					
2-NITROANILINE					
DIMETHYL PHTHALATE					
ACENAPHTHYLENE					

REVIEWER INITIALS: _____

DATE: _____

FIELD DUPLICATE DATA SUMMARY TABLE
SEMIVOLATILE ORGANIC COMPOUNDS
CLP SOW – OLM01.8

ANALYTE	MOUND SAMPLE ID	MOUND SAMPLE ID	MOUND SAMPLE ID	MOUND SAMPLE ID	RPD
2,6-DINITROTOLUENE					
3-NITROANILINE					
ACENAPHTHENE					
2,4-DINITROPHENOL					
4-NITROPHENOL					
DIBENZOFURAN					
2,4-DINITROTOLUENE					
DIETHYLPHTHALATE					
4-CHLOROPHENYL-PHENYLETHER					
FLUORENE					
4-NITROANILINE					
4,6-DINITRO-2-METHYLPHENOL					
N-NITROSODIPHENYLAMINE					
4-BROMOPHENYL-PHENYLETHER					
HEXACHLOROBENZENE					
PENTACHLOROPHENOL					
PHENANTHRENE					
ANTHRACENE					
CARBAZOLE					
DI-N-BUTYLPHTHALATE					
FLUORANTHENE					
PYRENE					
BUTYLBENZYLPHTHALATE					
3,3'-DICHLOROBENZIDINE					
BENZO(A)ANTHRACENE					
CHRYSENE					
BIS(2-ETHYLHEXYL)PHTHALATE					
DI-N-OCTYL PHTHALATE					
BENZO(B)FLUORANTHENE					
BENZO(K)FLUORANTHENE					
BENZO(A)PYRENE					
INDENO(1,2,3-CD)PYRENE					
DIBENZ(A,H)ANTHRACENE					
BENZO(G,H,I)PERYLENE					
2-BENZYL-4-CHLOROPHENOL					

REVIEWER INITIALS: _____

DATE: _____

MATRIX SPIKE RECOVERY OUTLIERS
VOLATILE ORGANIC COMPOUNDS
CLP SOW – OLM01.8

PREPARED BY: _____

DATE: _____

LABORATORY BATCH #: _____

LABORATORY NAME/LOCATION: _____

MOUND PROJECT

OPERABLE UNIT NO.: _____

COLLECTION DATE(s): _____

SOIL QC LIMITS: RECOVERY (RPD)
1,1-DCE: 59 – 172% (22%)
TRICHLOROETHENE: 62 – 137% (24%)
BENZENE: 66 – 142% (21%)
TOLUENE-D8: 59 – 139% (21%)
CHLOROBENZENE: 60 – 133% (21%)

WATER QC LIMITS: RECOVERY (RPD)
1,1-DCE: 61 – 145% (14%)
TRICHLOROETHENE: 71 – 120% (14%)
BENZENE: 76 – 127% (11%)
TOLUENE-D8: 76 – 125% (13%)
CHLOROBENZENE: 75 – 130% (13%)

LABORATORY SAMPLE ID	MOUND SAMPLE ID	SAMPLE MATRIX	1,1-DCE	TRICHLOROETHENE	BENZENE	TOLUENE	CHLOROBENZENE

HOLDING TIME SUMMARY
VOLATILE ORGANIC COMPOUNDS
CLP SOW – OLM01.8

PREPARED BY: _____

DATE: _____

MOUND PROJECT

LABORATORY BATCH # _____

OPERABLE UNIT NO.: _____

LABORATORY NAME/LOCATION: _____

COLLECTION DATE(s): _____

LABORATORY SAMPLE ID	MOUND SAMPLE ID	DATE COLLECTED	DATE EXTRACTED	DATE ANALYZED	NUMBER OF DAYS PAST HOLDING TIME

© MAR 93

SYSTEM MONITORING COMPOUND RECOVERY OUTLIERS
VOLATILE ORGANIC COMPOUNDS
CLP SOW – OLM01.8

PREPARED BY: _____

DATE: _____

LABORATORY BATCH #: _____

LABORATORY NAME/LOCATION: _____

MOUND PROJECT

OPERABLE UNIT NO.: _____

COLLECTION DATE(s): _____

SOIL QC LIMITS
TOLUENE-d8 (84-138%)
BROMOFLUOROBENZENE (59-113%)
1,2-DICHLOROETHANE-d4 (70-121%)

WATER QC LIMITS
TOLUENE-d8 (88-110%)
BROMOFLUOROBENZENE (86-115%)
1,2-DICHLOROETHANE-d4 (76-114%)

LABORATORY SAMPLE ID	MOUND SAMPLE ID	SAMPLE MATRIX	TOLUENE-d8	BROMO FLUOROBENZENE	1,2-DICHLOROETHANE-d4

BLANK DATA SUMMARY TABLE
VOLATILE ORGANIC COMPOUNDS
CLP SOW – OLM01.8

LABORATORY BATCH #: _____

LABORATORY NAME/LOCATION: _____

MOUND PROJECT

OPERABLE UNIT NO.: _____

COLLECTION DATE(s): _____

ANALYTE	METHOD BLANK ID	METHOD BLANK ID	TRIP BLANK ID	AMBIENT BLANK ID	EQUIP BLANK ID	ACTION LEVEL
CHLOROMETHANE						
BROMOMETHANE						
VINYL CHLORIDE						
CHLOROETHANE						
METHYLENE CHLORIDE						
ACETONE						
CARBON DISULFIDE						
1,1-DICHLOROETHENE						
'-DICHLOROETHANE						
,2-DICHLOROETHANE(TOTAL)						
CHLOROFORM						
1,2-DICHLOROETHANE						
2-BUTANONE						
1,1,1,-TRICHLOROETHANE						
CARBON TETRACHLORIDE						
VINYL ACETATE						
BROMODICHLOROMETHANE						
1,2-DICHLOROPROPANE						
CIS-1,3-DICHLOROPROPENE						
TRICHLOROETHENE						

APPLIES TO SAMPLES (CLIENT ID):

_____ _____ _____

_____ _____ _____

_____ _____ _____

_____ _____ _____

_____ _____ _____

REVIEWER INITIALS: _____

DATE: _____

BLANK DATA SUMMARY TABLE
VOLATILE ORGANIC COMPOUNDS
CLP SOW – OLM01.8

LABORATORY BATCH #: _____

LABORATORY NAME/LOCATION: _____

MOUND PROJECT

OPERABLE UNIT NO.: _____

COLLECTION DATE(s): _____

ANALYTE	METHOD BLANK ID	METHOD BLANK ID	TRIP BLANK ID	AMBIENT BLANK ID	EQUIP BLANK ID	ACTION LEVEL
DIBROMOCHLOROMETHANE						
1,1,2-TRICHLOROETHANE						
BENZENE						
TRANS-1,3-DICHLOROPROPENE						
BROMOFORM						
4-METHYL-2-PENTANONE						
2-HEXANONE						
TETRACHLOROETHENE						
TOLUENE						
1,1,2,2-TETRACHLOROETHANE						
CHLOROBENZENE						
ETHYLBENZENE						
STYRENE						
XYLENE (TOTAL)						
VINYL ACETATE						
ACRYLONITRILE						
ACETONITRILE						
DIETHYLBENZENE						
TRICHLOROTRIFLUOROETHANE						
HEXANE						
IODOMETHANE						

APPLIES TO SAMPLES (CLIENT ID):

_____ _____ _____

_____ _____ _____

_____ _____ _____

_____ _____ _____

REVIEWER INITIALS: _____

DATE: _____

CALIBRATION OUTLIERS
VOLATILE TCL COMPOUNDS
CLP SOW – OLM01.8

PREPARED BY: _____

DATE: _____ MOUND PROJECT

LABORATORY BATCH #: _____ OPERABLE UNIT NO.: _____

LABORATORY NAME/LOCATION: _____ COLLECTION DATE(s): _____

MATRIX (SOIL/WATER) : _____

INSTRUMENT #	INIT. CAL.			CONT. CAL.			CONT. CAL.			CONT. CAL.		
DATE/TIME:												
	RRF < 0.05	RSD > 30%	*	RRF <0.05	D +/– 25%	*	RRF <0.05	D +/– 25%	*	RRF <0.05	D +/– 25%	*
CHLOROMETHANE												
BROMOMETHANE												
VINYL CHLORIDE												
CHLOROETHANE												
METHYLENE CHLORIDE												
ACETONE												
CARBON DISULFIDE												
1,1-DICHLOROETHENE												
1,1-DICHLOROETHANE												
1,2-DICHLOROETHANE(TOTAL)												
CHLOROFORM												
1,2-DICHLOROETHANE												
2-BUTANONE												
1,1,1,-TRICHLOROETHANE												
CARBON TETRACHLORIDE												
BROMODICHLOROMETHANE												
1,2-DICHLOROPROPANE												
CIS-1,3-DICHLOROPROPENE												
TRICHLOROETHENE												
DIBROMOCHLOROMETHANE												

AFFECTED SAMPLES: (CLIENT ID)			

REVIEWER INITIALS: _____

DATE: _____

* THESE FLAGS SHOULD BE APPLIED TO THE ANALYTES ON THE SAMPLE DATA SHEETS.

CALIBRATION OUTLIERS
VOLATILE TCL COMPOUNDS
CLP SOW – OLM01.8

PREPARED BY: _____

DATE: _____ MOUND PROJECT

LABORATORY BATCH #: _____ OPERABLE UNIT NO.: _____

LABORATORY NAME/LOCATION: _____ COLLECTION DATE(s): _____

MATRIX (SOIL/WATER) : _____

INSTRUMENT #	INIT. CAL.			CONT. CAL.			CONT. CAL.			CONT. CAL.		
DATE/TIME:												
	RRF < 0.05	RSD > 30%	*	RRF <0.05	D +/– 25%	*	RRF <0.05	D +/– 25%	*	RRF <0.05	D +/– 25%	*
1,1,2-TRICHLOROETHANE												
BENZENE												
TRANS-1,3-DICHLOROPROPENE												
BROMOFORM												
4-METHYL-2-PENTANONE												
2-HEXANONE												
TETRACHLOROETHENE												
TOLUENE												
1,1,2,2-TETRACHLOROETHANE												
CHLOROBENZENE												
ETHYLBENZENE												
STYRENE												
XYLENE (TOTAL)												
VINYL ACETATE												
ACRYLONITRILE												
ACETONITRILE												
DIETHYLBENZENE												
TRICHLOROTRIFLUOROETHANE												
HEXANE												
IODOMETHANE												

AFFECTED SAMPLES:
(CLIENT ID)

REVIEWER INITIALS: _____

DATE: _____

* THESE FLAGS SHOULD BE APPLIED TO THE ANALYTES ON THE SAMPLE DATA SHEETS.

INTERNAL STANDARD RECOVERY OUTLIERS
VOLATILE ORGANIC COMPOUNDS
CLP SOW – OLM01.8

PREPARED BY: _____

MOUND PROJECT

DATE: _____

OPERABLE UNIT NO.: _____

LABORATORY BATCH #: _____

COLLECTION DATE(s): _____

LABORATORY NAME/LOCATION: _____

QC LIMITS
AREA: –50% TO +100%
RT +/– 30 SECONDS

	DAILY STANDARD AREA	AREA LIMITS –50%	AREA LIMITS +100%
BROMOCHLOROMETHANE			
1,4-DIFLUOROBENZENE			
CHLOROBENZENE-D5			

LABORATORY SAMPLE ID	MOUND SAMPLE ID	SAMPLE MATRIX	IS1 BROMOCHLOROMETHANE (BCM)	IS2 1,4-DIFLUOROBENZENE (DFB)	IS3 CHLOROBENZENE-D5 (CBZ)

FIELD DUPLICATE DATA SUMMARY TABLE
VOLATILE ORGANIC COMPOUNDS

PREPARED BY: _____

MOUND PROJECT

DATE: _____

OPERABLE UNIT NO.: _____

LABORATORY BATCH #: _____

COLLECTION DATE(s): _____

LABORATORY NAME/LOCATION: _____

QC LIMITS:
WATER = ≤ 35% RPD

ANALYTE	MOUND SAMPLE ID	MOUND SAMPLE ID	MOUND SAMPLE ID	MOUND SAMPLE ID
CHLOROMETHANE				
BROMOMETHANE				
VINYL CHLORIDE				
CHLOROETHANE				
METHYLENE CHLORIDE				
ACETONE				
CARBON DISULFIDE				
1,1-DICHLOROETHENE				
1,1-DICHLOROETHANE				
1,2-DICHLOROETHANE(TOTAL)				
CHLOROFORM				
1,2-DICHLOROETHANE				
2-BUTANONE				
1,1,1,-TRICHLOROETHANE				
CARBON TETRACHLORIDE				
VINYL ACETATE				
BROMODICHLOROMETHANE				
1,2-DICHLOROPROPANE				
CIS-1,3-DICHLOROPROPENE				
TRICHLOROETHENE				
DIBROMOCHLOROMETHANE				

REVIEWER INITIALS: _____

DATE: _____

FIELD DUPLICATE DATA SUMMARY TABLE
VOLATILE ORGANIC COMPOUNDS

PREPARED BY: _____

DATE: _____

LABORATORY BATCH #: _____

LABORATORY NAME/LOCATION: _____

MOUND PROJECT

OPERABLE UNIT NO.: _____

COLLECTION DATE(s): _____

QC LIMITS:
WATER = ≤ 35% RPD

ANALYTE	MOUND SAMPLE ID	MOUND SAMPLE ID	MOUND SAMPLE ID	MOUND SAMPLE ID
1,1,2-TRICHLOROETHANE				
BENZENE				
TRANS-1,3-DICHLOROPROPENE				
BROMOFORM				
4-METHYL-2-PENTANONE				
2-HEXANONE				
TETRACHLOROETHENE				
TOLUENE				
1,1,2,2-TETRACHLOROETHANE				
CHLOROBENZENE				
ETHYLBENZENE				
STYRENE				
XYLENE (TOTAL)				
VINYL ACETATE				
ACRYLONITRILE				
ACETONITRILE				
DIETHYLBENZENE				
TRICHLOROTRIFLUOROETHANE				
HEXANE				
IODOMETHANE				

REVIEWER INITIALS: _____

DATE: _____