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APPENDIX B

FIELD SAMPLING PLAN

INTERIM REMEDIAL ACTION

FIELD SAMPLING PLAN

for

OPERABLE UNIT 2
B BUILDING SOLVENT STORAGE SHED AREA

MOUND PLANT
MIAMISBURG, OHIO

Prepared for

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1. INTRODUCTION

1.1. PROJECT OBJECTIVE

Soil vapor concentrations of Freon 113, Trans-1,2-Dichloroethene (trans-12DCE), Cis-1,2-Dichloroethene (cis-12DCE), 1,1,1-Trichloroethane (111TCA), Trichloroethene (TCE), and Toluene were found to be elevated in a 1992 soil gas survey of the B Building Solvent Storage Shed Area. Because of the elevated concentrations of soil vapor, EG&G Mound Applied Technologies (EG&G MAT) has decided to remediate the soils as an Interim Remedial Action. This remedial action is being conducted under the Department of Energy (DOE) Streamlined Approach for Environmental Restoration (SAFER) program. The goal of the SAFER program is to design and conduct faster, cheaper, better and safer environmental restorations. An Engineering Evaluation/Cost Analysis (EE/CA), conducted by ICF Kaiser Engineers (ICF KE), determined that Soil Vapor Extraction (SVE) was the most suitable and cost effective remedial method. An SVE system will be installed to remediate the soils and lower the concentrations of the contaminants of concern below remedial goals. Sampling will occur to verify operational efficiency of the SVE system and verify the remediation of soils.

1.2. PROJECT ORGANIZATION

The remediation is being conducted by EG&G MAT for the DOE under the SAFER Program. ICF KE has been contracted by EG&G MAT to implement and manage the remediation. ICF KE has subcontracted the design, installation, and operation of the SVE system to ETG Environmental, Inc.

The EG&G MAT Project Manager is Gary Coons who has overall responsibility for the project. Keith Egan is the ICF KE Project Manager who is responsible for the implementation of the project, cost control, and scheduling. Jay Erickson is the ETG Project Manager and will be responsible for the installation, testing, and operation of the SVE system.

2. SITE BACKGROUND

2.1. SITE DESCRIPTION

Mound Plant occupies approximately 306 acres within the southern city limits of Miamisburg, Ohio (Figure 2.1). There are currently more than 100 buildings on the site, and the total floor space exceeds 925,000 square feet. Most of the buildings are located in the northwest area known as Main Hill. The B Building area is a flat area that is surrounded on three sides by buildings. The soil in the area consists mainly of clay, limestone, and shale with traces of sand and silt throughout.

2.2. B BUILDING SOLVENT STORAGE SHED AND TEMPORARY DRUM STORAGE AREA

The B Building Solvent Storage Shed Area had received waste solvent from B Building and also stored product-grade solvents. Waste solvent was pumped from B Building into sealed 55-gallon drums in the storage shed through automatic discharge hoses equipped with automatic shutoff devices. Before the shed was built, solvents were stored within the B Building, typically in 5-gallon cans.

The B Building temporary drum storage area was an outdoor unit located adjacent to the B Building solvent storage shed. Storage began in this area in 1988. It was intended for temporary storage. The shed area was approximately 15 feet on each side. The area to be remediated is approximately 110 feet by 50 feet.

The B Building Solvent Storage Shed was removed by EG&G MAT as part of the removal action. The concrete footing for the shed was also removed. The concrete pad used for the drum storage was left in place as a base for the SVE pump system.

A diagrammatic layout of the area is found in Figure 2.2.

2.3. PREVIOUS INVESTIGATIONS NEAR THE B BUILDING SOLVENT STORAGE SHED

2.3.1. Soil-Gas Survey: 1992

As part of a soil gas survey conducted by EG&G MAT in 1992, more than 200 investigative samples were collected and analyzed. The soil gas samples collected from the Main Hill, Area 7, Building 51, and Area J at Mound Plant were initially collected for the analysis of six target compounds, including TCE, trans-12DCE, cis-12DCE, 111TCE, toluene, and trichlorofluoromethane (Freon 11). These compounds were

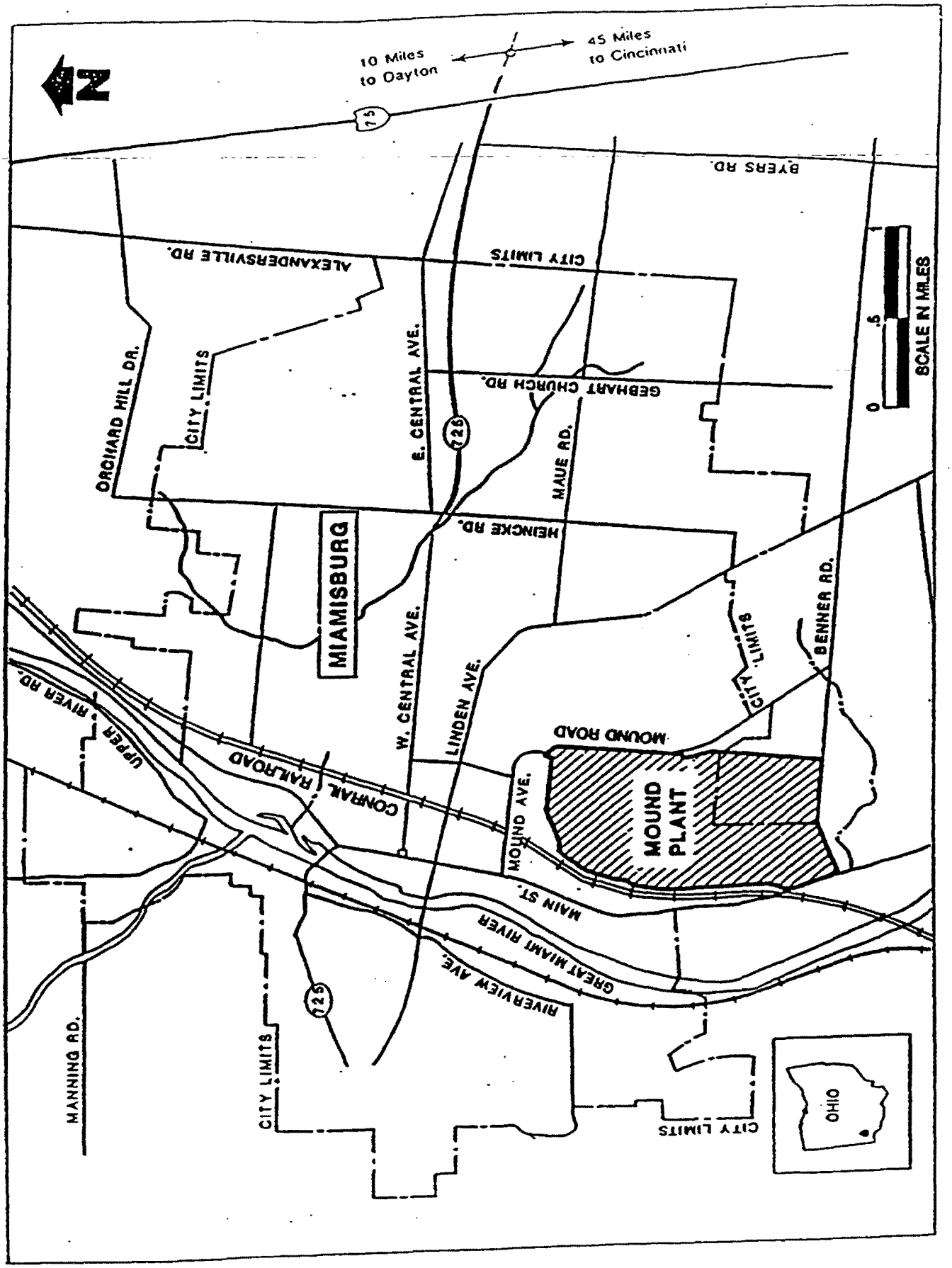


Figure 2.1. Site Location Map

targeted based on the results of previous contaminant characterization efforts, including the analysis of groundwater seeps and the study of underground storage tanks at the site. All soil vapor and groundwater samples were analyzed in an on-site mobile laboratory for volatile organic compounds (VOCs) using U.S. EPA Method 8021. Peaks on the gas chromatograph curves showed the presence of additional solvent-type VOCs. Following the completion of the first 10-day field shift, the target compound list was expanded to include 1,1,2-trichloro-1,2,2-fluoroethane (Freon 113) and tetrachloroethene which were the most prevalent of the additional VOCs detected based on interpretations made by the field laboratory chemist.

All soil gas sampling was performed by driving five-foot sections of drill rod and steel points into the subsurface and drawing soil vapor to a gas collection system mounted on a soil gas collection rig. After at least three purge volumes had been evacuated, a sample cartridge containing a three-layer carbon sorption tube was attached and used to collect the soil gas sample.

During this investigation, most soil gas probes were installed using a truck-mounted hydraulic hammer. A few locations required manual hammering due to rig access difficulty; however, all sample collection activities were consistent and utilized the truck-mounted soil gas collection rig. Soil gas sampling depths varied according either to planned objectives or to probe penetration refusal which was frequently caused by shallow bedrock or the presence of buried rock/debris.

Quality control samples were collected and analyzed throughout the field effort to monitor VOC interference, check data accuracy and instrument calibrations, and evaluate purging efficiencies. Prior to each day's soil gas sampling, field blanks of the entire sampling apparatus were taken and analyzed to check background contamination in the sampling system and cartridges. Duplicate soil gas samples were collected from each sampling location. Duplicate analyses were performed on at least 10% of the samples collected. For trip blanks, an unused sample cartridge was transported into the field with the sampling equipment. The trip blank cartridge was handled in the same manner as a sample, but a sample was not collected through this cartridge. The trip blank was returned to the laboratory with the other samples and analyzed. For ambient blanks, a randomly selected sampling cartridge was analyzed at the first daily location to detail interference from cartridges or the analytical system.

The results of the soil gas samples collected in 1992 near the B Building Solvent Storage Shed are presented on Table 2.1. and the locations can be found on Figure 2.3.

Table 2.1. Soil Gas Sample Results: 1992

Sample Location Number	Freon 113 (ppb)	Trans-12DCE (ppb)	Cis-12DCE (ppb)	111TCA (ppb)	TCE (ppb)	Toluene (ppb)
1093-0005	131,000	247	40,800	—	34,780	53
1094-0005	83	13	485	—	978	—
1097-0002	—	—	—	—	6	8
1197-0002	—	—	—	—	23	5
1198-0006	24	13	518	33	474	5
1199-0002	10,218	—	120	—	479	—
1201-0007	4,716	13	811	—	130	48
1201-1007[1]	5,895	—	612	—	117	43
1202-0002	6,419	66	2,499	9	1,921	3
1202-1002[2]	9,301	41	1,706	—	1,737	—
1203-0002	1,475	—	334	—	45	192

NOTES: 1. Duplicate of sample 1201-0007
2. Duplicate of sample 1202-0002
— Non detect at the Method Detection Limit

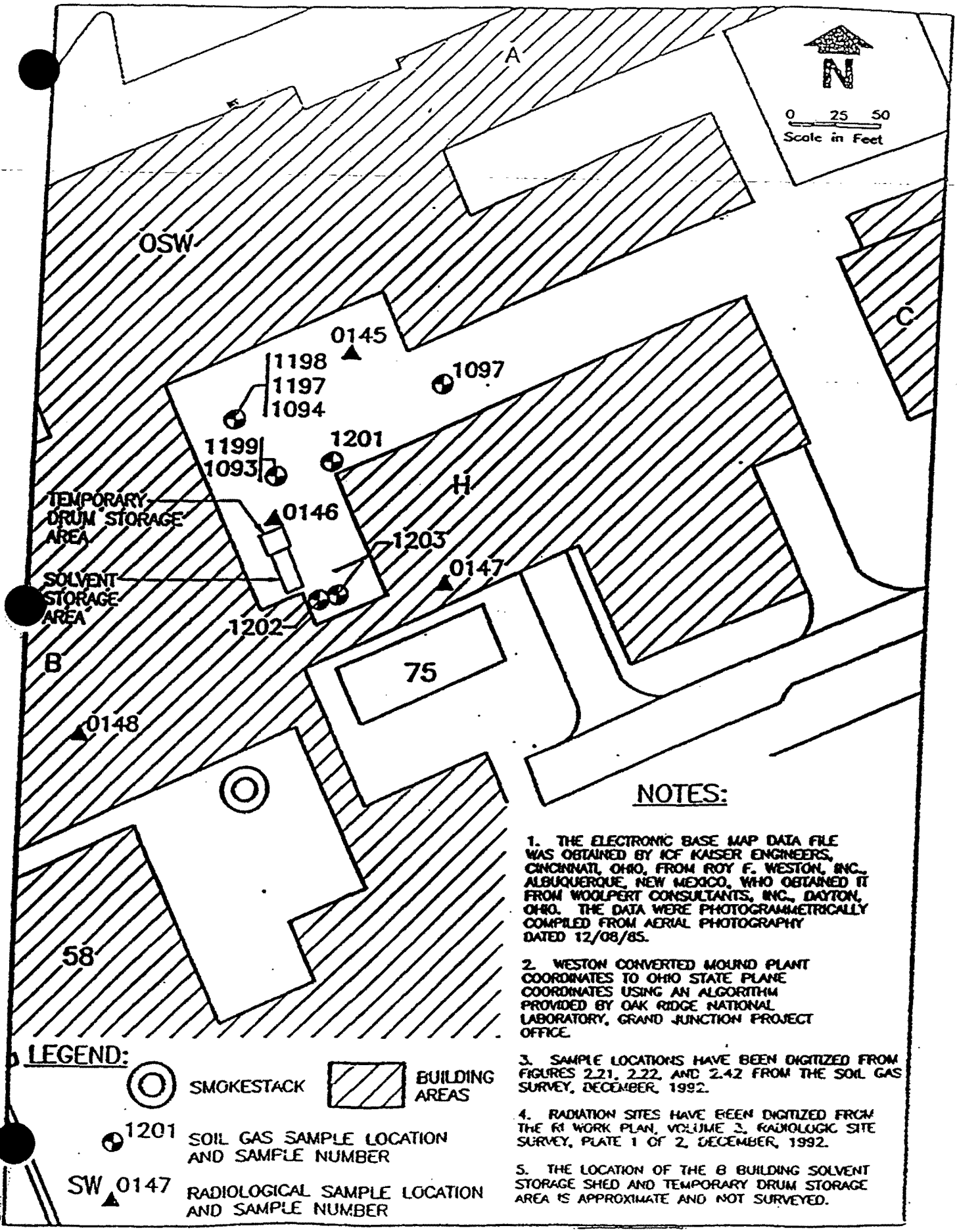


Figure 2.3. Radiological and Soil Gas Sample Locations near the B Building Solvent Storage Shed

2.4. SUMMARY OF REMEDIAL ACTIVITIES

A soil vapor extraction system will be installed to reduce the concentrations of the contaminants of concern found in the B-Building Solvent Storage Shed area soils. During the remedial activities, ICF KE and ETG will install up to five extraction wells and twelve injection wells. The injection wells will be used to pump the air into the soils and the extraction well will be used to withdrawal the vapors from the soils for treatment by carbon adsorption (see Figure 2.4 for the location of the proposed wells). A cap will be placed over the area and covered with gravel to prevent the infiltration of rain and surface water and to promote lateral air flows between the injection and withdrawal wells. A sample will be taken from each boring to determine the total concentration of volatile organics in the soil and also to determine the grain size of the soil.

Once the wells have been installed, the SVE system will be installed and operated for a 30 day pilot test. After the pilot test, the system will be modified as needed and operated for 6 months according to the operation and maintenance plan. If during the operational period any modifications need to be made to the system in order to increase its efficiency, they will be made. Sometime during the 6 month operation period, a review of the progress will be made to determine if SVE remediation should continue.

Table 2.2 describes the decision matrix used to determine the action that will be conducted for the B Building Solvent Storage Shed area remediation. Once the pilot test is completed, decisions will be made on the operational performance of the system. Modifications will be documented in a revised Field Sampling Plan.

Table 2.2. Conceptual Probable Conditions, Deviations, and Contingency Plans for SVE at Building B Solvent Storage Shed Area

	Probable Conditions	Possible Deviation	Possible Contingencies	Monitoring Parameters to Detect Deviation
Duration	less than 1 yr/$1M	more than 1 yr/$1M	-get waiver	midyear review
Depth	5' to bedrock	deeper	-sink wells deeper-increase extraction rate	observe during drilling
		shallower, therefore decreasing radius of influence	-more wells -use sealant on surface	observe during drilling, monitor radius of influence during operation
Areal Extent	discrete but condensed contamination within influence of well network	contamination outside radius of influence	-increased vacuum -more wells -selectively excavate discrete areas of contamination	monitor contribution of Building B VOC's to other areas
Contaminants	VOC spills (no free product)	free product	-excavate	extraction rate of contaminant concentration
	no radionuclides	radionuclides		monitoring during well installation
Permeability	adequate to reduce concentration of VOC's	too low	-more wells -increase extraction rate -excavate	vacuum efficiency as system performs
Vapors	air emission within allowable range	higher than allowable	-enhance off-gas treatment system	monitor emissions

3. DATA QUALITY OBJECTIVES

3.1. SOIL SAMPLING

The objective for soil sampling is to determine the total concentration of VOC's present in the soils to be remediated and to determine the grain size of the soil where the system will be installed. These samples will be collected at 0-2 ft. below ground (bg), 4-6 ft. bg, and 8-10 ft. bg. Field headspace analysis will be performed on the soil samples. The sample that has the highest concentration as a result of the field headspace will be sent to the laboratory for analysis. A composite sample will also be collected from each hole and sent to the laboratory for grain size analysis. This will help determine the correct amount of vacuum that needs to be applied for the system to operate efficiently and achieve the targeted preliminary remedial goal.

Field analyzed samples must be reasonably accurate if the objectives of this sampling are to be met. The important QA/QC parameter for the data quality objective for the soil samples analyzed in the field will be accuracy. Accuracy will be maintained by daily calibration of the field instruments.

Soil samples to be analyzed for volatile organics and grain size must be precise and accurate to meet the objective of sampling for these constituents. Field duplicates and laboratory QA/QC samples will be collected to monitor precision and accuracy. EPA developed methods will be used to help achieve the best possible precision and accuracy.

3.2. SOIL VAPOR SAMPLING

Soil vapor samples will be collected from the five withdrawal wells, the twelve soil probes, from after the carbon treatment process, and as a system composite. The objective of taking these samples is to monitor the reduction of soil gas from the area. The important QA/QC parameters to meet this objective is precision, accuracy, and quantitation limit. Field duplicates and laboratory QA/QC samples will be collected to monitor precision and accuracy. In addition, an EPA developed method will be used to help achieve low quantitation limits.

3.3. KNOCKOUT DRUM WATER SAMPLES

Knockout drum water samples will be analyzed by EG&G MAT to determine disposal requirements. The important QA/QC parameter to meet this objective is methodology. The correct analytical methods should be chosen to ensure that all regulated chemicals present in the sample are detected. EG&G MAT will use

a series of EPA methods for the analysis of this sample. Sampling and analytical methods used by Mound are described in the Waste Management Sampling and Analysis Plan (EG&G, 1988).

3.4. ANALYTICAL PARAMETERS

Soil samples will be analyzed for volatile organic compounds using EPA method 8240. Soil samples will also be analyzed for grain size using ASTM method D422.

Air samples will be analyzed for volatile organic compounds. Air analysis will be conducted using the protocol described in the "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air", EPA-600/4-84-014, April 1984. The samples will be analyzed with a gas chromatograph equipped with a photo ionization detector.

Knockout drum water samples will be analyzed by EG&G MAT using a series of EPA methods for the analysis of this sample. Methods for volatiles, semivolatiles, pesticides/PCBs, and inorganics will be used as necessary. Sampling and analytical methods used by Mound are described in the Waste Management Sampling and Analysis Plan (EG&G, 1988).

4. FIELD ACTIVITIES

4.1. EQUIPMENT AND SUPPLIES

Wells will be installed using a Bobcat skid steer loader fitted with a hydraulic auger power unit and 4.25 inch I.D. hollow stem augers. Soil samples will be collected using split spoon samplers. Gravel placed on the plastic site cover will be brought to the site using a dump truck. The gravel will be spread using the Bobcat skid steer loader fitted with a front load bucket. Trenching, if necessary, will be performed by a 580 Case backhoe. If concrete is cut, a walk-behind concrete saw will be used. Wells will be constructed with 2 inch diameter Schedule 40 PVC pipe. The wells will be connected to the pump station using 2 inch diameter Schedule 40 PVC pipe. All pipes will be connected using CamLock connectors.

Soil vapor probes will be driven to the desired depth using the Bobcat skid steer loader. Probes will be connected to the surface using 0.25 inch O.D. tygon tubing. Vapor samples will be collected using Tedlar bags connected to the sample ports or probes using 0.25 inch tygon tubing. Field analysis of worker breathing zone space will be conducted using a PID, an aerosol detector, and a explosivity detector.

4.2. DECONTAMINATION OF SOIL SAMPLING EQUIPMENT

Personnel and equipment will be decontaminated during the work effort to prevent cross contamination of samples and locations, to protect field personnel, and to prevent the spread of contamination within Mound Plant and off-plant. Personnel will be decontaminated as specified in the B Building Health and Safety Plan before leaving the work area for breaks or at the end of the day. Equipment decontamination will be according to Mound Plant ER Program SOP 1.6, General Equipment Decontamination. Following these decontamination procedures will minimize the possibility of spreading contamination.

4.3. SAMPLING LOCATIONS AND FREQUENCY

During the pilot study and the six month operation of the system, soil vapor samples will be collected. Soil vapor samples will collected during the pilot test at the frequency shown in Table 4.1. to determine the contaminant concentrations and the effect of the SVE on site soils. During the standard operation of the SVE system, soil vapor samples will be collected bimonthly to determine the contaminant concentrations and the effect of the SVE on site soils. Soil vapor samples will be collected from the withdrawal wells and soil probes and analyzed for volatile organic compounds.

During the pilot test and operational period, samples will be collected from the following sources: five (5) withdrawal wells, one (1) system composite, one (1) after the carbon treatment and twelve (12) soil

probes. Table 4.1 details the frequency and source of air sample collection for the pilot test. Figure 4.1 shows the sample locations for the wells and probes.

Table 4.1. Summary of Air Samples for the Pilot Test

Day of Pilot	SVE Well Samples	Composite Sample	After Carbon Sample	Soil Probe Samples	Total Samples
Day 1 - 15 min	5	1	1	12	19
Day 1 - 4 hour	5	1	0	0	6
Day 1 - 8 hour	5	1	0	0	6
Day 2	5	1	0	0	6
Day 8	5	1	0	6	12
Day 15	5	1	0	0	6
Day 22	5	1	0	0	6
Day 30	5	1	1	6	13
Total Air Samples for Pilot					86

Soil samples will be collected while installing the wells at 0-2 ft. bg., 4-6 ft. bg, and 8-10 ft. bg. Field headspace analysis will be performed on the soil samples from each well. The sample that has the highest concentration as a result of the field headspace will be sent to the laboratory for analysis of volatile organic compounds. A composite sample will also be collected from each hole and sent to the laboratory for grain size analysis. Sample locations are shown on Figure 4.1. At the end of the remediation, a confirmational soil sample will be collected from the area of highest preremediation concentrations of the chemicals of concern. This sample will be used to judge the effectiveness of the remediation.

In addition to the samples, the SVE pump system gauges will be monitored to record soil atmospheric pressures, well vacuum, blower and pump temperatures and air flow rates. System gauges will be monitored during the pilot test and the bimonthly maintenance. System Data will be recorded on the Site Visit Checklist discussed in Appendix C, Operations and Maintenance Plan.

4.4. FIELD DATA REDUCTION, VALIDATION, TRACKING AND RECORD KEEPING

All sampling activities will be recorded in a bound field notebook. Entries will be dated, legible, written in permanent ink, and contain accurate and complete documentation of all project activities. Language will be factual and objective. Legible corrections, which will be single lines through the error, will be

signed or initialed and dated by the person making the correction. Each page shall be initialled by the logger. Entries shall include:

1. Project name, address, and site identification number
2. Date(s)
3. General description of weather conditions
4. Name of all field personnel involved in the field activity
5. Chronological description of all field activity
6. References to appropriate field logs for details of each activity performed (e.g., reference sample information form for details of all samples collected that day), Test Equipment and Calibration Log, and the Health and Safety Plan
7. All variances from approved SOPs in the Implementation Plan, Sampling and Analysis Plan, or the Health and Safety Plan. It should also include the name of the person who gave approval for the variance.
8. All visitors to the site
9. Pertinent phone calls/meetings
10. Duplicate, background, and blank sample methods, ID numbers, and locations
11. Signature of field supervisor

SVE pump system data will be recorded on the Site Visit Checklist discussed in Appendix C, Operations and Maintenance Plan.

4.5 FIELD QA/QC SAMPLES

4.5.1. Pilot Test Samples

QA/QC samples will be obtained during the pilot test operation of the soil vapor extraction system. Duplicates will be obtained on each day of sampling at a rate of one per twenty samples. Duplicates will be collected in series from one sample location. The location chosen will be from an area expected to contain elevated concentrations of the contaminants of concern. Duplicates will be collected to monitor sampling precision. An ambient air blank will be obtained on the first day of sampling to monitor for atmospheric contamination. On each day of sampling, one sample will be designated the laboratory QA/QC sample to monitor laboratory precision and accuracy. Soil vapor QA/QC samples to be collected are summarized in Table 4.2.

Table 4.2. Soil Vapor QA/QC Samples

Day of Pilot	Duplicates	Blank	Lab QA Sample
Day 1	1	1	1
Day 2	1	0	1
Day 8	1	0	1
Day 15	1	0	1
Day 22	1	0	1
Day 30	1	0	1

QA/QC samples for the soil samples will include an equipment rinsate blank and a laboratory QA/QC sample. The equipment rinsate blank will be collected each day that soil samples are obtained. Samples will be designated the laboratory QA/QC samples at a frequency of one per twenty samples.

4.5.2. Operation And Maintenance Samples

Duplicate soil vapor samples will be collected during each bimonthly sample event conducted during the operation and maintenance phase of the remedial action. Duplicate samples will be used to monitor sampling precision. One sample will be designated the laboratory QA/QC to monitor analytical precision and accuracy. At the end of operation, duplicate remediation confirmation soil samples will be collected to assess the success of the remediation and the precision of the sampling.

4.6. CONTAINERS, PRESERVATION, AND HOLDING TIMES

Soil samples will be collected in glass sample jars, placed in coolers, and kept on ice during shipment. Soil samples will be extracted within 7 days of collection and analyzed with 28 days. Soil vapor samples will be collected in Tedlar bags, boxed and shipped overnight to the ETG laboratory. All soil vapor samples will be analyzed within 24 hours of collections although the actual holding time is 3 days. Table 4.3 summarizes the sample collection requirements.

4.7. CHAIN-OF-CUSTODY PROCEDURES

Chain-of-custody forms will be filled out for all samples collected and will be submitted to the appropriate laboratory. Soil samples will be shipped to the laboratory using the laboratories chain of custody forms. Soil vapor samples and soil grain size samples will be sent using ETG chain of custody forms.

Table 4.3. Sample Collection Requirements

Matrix	Analytical Method	Parameter	Sample Volume	Sample Container	Preservative	Holding Time
Soil	SW 8240	Volatile Organics in Soil	250 grams	Glass, Teflon lined lid	Chill to 4°C	14 days extraction; 40 days analysis
Soil Vapor	EPA 600	Volatile Organics in Air	1 liter	Tedlar Bag	Store in Dark	3 days
Soil	ASTM D4222	Grain Size of Soil	250 grams	Glass, Teflon lined lid	Chill to 4°C	None

All forms will contain information on the sample identification number, analytical method to be used, holding times, and sample contact personnel. The sample preservation method will also be noted.

Whenever the samples are transferred from one person to another, the chain of custody will be signed by the person receiving the samples. One copy of the chain of custody will be retained at the time of sample collection to be stored in the project QA/QC files. Another copy will be delivered with the sample results.

4.8. SAMPLE COLLECTION

A total of 36 soil samples will be collected, three from each borehole. Of these 36, 12 will be sent for analysis. The determination of which samples will be sent for analysis will be conducted in the field. The three samples will be analyzed for headspace volatile organics. The headspace samples will be analyzed with a PID and the one with the highest concentration for each borehole will be the sample that is sent for analysis. The remaining soil samples will be composited for grain size analysis. A total of 12 grain size samples will be collected. Samples collected for off-site analysis will be screened by a Mound Health Physist in the field and in the laboratory.

During the pilot test and the six month operation of the system, soil vapor samples will be collected in Tedlar bags from each extraction well and the process air stream. These Tedlar bags will be sent to a laboratory for analysis by a gas chromatograph (GC) equipped with a PID.

4.8.1. Worker Breathing Zone Samples

Worker breathing zone air will be monitored during contraction activities using a portable photoionization detector (PID) fitted with an 11.7eV lamp. The breathing zone air will also be analyzed for dust levels using a Miniram aerosol detector. In addition, the air will be monitored for flammability with a explosivity meter. The air will be monitored for elevated levels of volatile organic compounds, contaminated dust particles, and flammability to protect worker health and safety.

4.8.2. Headspace Soil Samples

Headspace field analysis will be performed by filling a sample jar halfway with a soil sample. The jar will be covered with aluminum foil and the lid. The jar will be heated to volatilize the organic compounds. The jar lid will be removed and the foil punctured. The headspace will then be analyzed using a portable PID fitted with a 11.7 eV lamp.

4.8.3. Process Air Stream and Pressure Probe Samples

Soil vapor samples will be collected in Tedlar bags. An air sample pump will used to purge each bag three times. The bags will then be connected to the sample ports and collected by the pressure differential between the bag and the sample. Bags will not be completely filled to prevent rupturing and will be kept out of direct sunlight to prevent degradation.

4.8.4. Wastewater Samples

Wastewater samples will be collected from the knockout drum located on the discharge line from the knockout tank pump. The sample will be collected using a bailer. These samples will be collected into 40 ml. vials for analysis by EG&G MAT to determine the disposal method. Samples will be preserved by EG&G MAT according to SOP 1.4. Sampling and analytical methods used by Mound are described in the Waste Management Sampling and Analysis Plan (EG&G, 1988).

4.8.5. Soil Samples

Soil samples will be collected using a split spoon sampler. The samples will then be placed a glass sample jars and stored on ice. Samples will be collected for analysis of the contaminants of concern and grain size.

4.9 SAMPLE IDENTIFICATION

Samples will be labeled using the sample identification system developed by the Mound Plant ER Program as described in SOP 1.3. The following presents a summary of the sample identification system.

Each sample will be assigned a unique sample identification number (SIDN) based on the operable unit, location, and depth. The SIDN will use the format:

M2XX-LLLL-SSSSS

where:

M2XX = M2 refers to Mound Facility, Operable Unit 2. The second two digits refers to the type of investigation.

- X1 = Surface and Subsurface Soil Investigation
- X2 = Hillside Seep Investigation

X3 = Groundwater Investigation

X4 = Soil gas Investigation

LLLL = The sample matrix and location. The first digit is used for the sample matrix and the last three the location.

1LLL = Soil Samples

2LLL = Sediment and Sludge Samples

3LLL = Water Samples

4LLL = Soil Gas Samples

5LLL = Material Samples

L000 = Sample Location

SSSSS = The particular sample type and descriptive information about the sample location.

0SSSS = Matrix Sample (Original Sample)

1SSSS = Duplicate Sample

2SSSS = Trip Blank

3SSSS = Blank

4SSSS = Laboratory QA/QC Sample

S0000 = Descriptive Information such as depth

For example, for the B Building Solvent Storage Shed Area, a sample identified as M2X4-4001-00006 would be the matrix (standard) soil vapor sample obtained at location #1 of Mound Operable Unit 2 at a depth of 6 feet (M = Mound, 2 = OU2, X4 = Soil Gas, 4 = Soil Vapor, 001 = Location 1, 0 = Matrix sample, 0006 = 6 ft.).

4.10. SAMPLE SHIPMENT AND PACKAGING

The procedures for sample packaging and shipping listed below will be followed to ensure that samples are intact when they arrive at the designated laboratory.

4.10.1. Soil Samples

1. Place the sample jars in the cooler with bubble pack around each jar.

2. Place the protected sample jars in the ice chest and add double bagged ice or blue ice maintain the proper temperature inside the ice chest. Additional ice may be added as necessary to maintain the temperature at 4 degrees Centigrade.

3. Fill empty spaces in the ice chest with either pelaspan (styrofoam popcorn), bubble wrap, or vermiculite.

4. Enclose the chain of custody (COC) form in the ice chest by placing it in a plastic zip-lock bag and taping the bag to the inside of the ice chest lid with strapping tape.

5. Seal the ice chest shut with strapping tape. Place custody seals to the front and back lid of the ice chest. Cover custody seals with clear tape.

6. Ship ice chest to the laboratory via Express Overnight Delivery as soon as possible. If samples are shipped on Friday, arrangements must be made with the laboratory for Saturday receipt.

4.10.2. Soil Vapor Samples

1. Place Tedlar bags in a cardboard box.

2. Fill the empty space of the box with bubble wrap or pelespan.

3. Enclose the chain of custody form by placing it in a plastic zip-lock bag and taping the bag to the inside of the ice chest lid with strapping tape.

4. Seal the box with strapping tape and custody seals. Cover custody seals with clear tape.

5. Ship the box to the ETG laboratory via Express Overnight delivery as soon as possible. If samples are shipped on Friday, arrangements must be made with the laboratory for Saturday receipt.

No other samples will be shipped off-site. Samples collected on-site will be stored in coolers and sealed with custody seals and transferred under chain of custody.

4.11. DISPOSAL OF INVESTIGATIVE-DERIVED MATERIALS

Contaminated materials will be placed in drums provided by EG&G MAT and moved to the staging area for disposal at a latter time. All drums will be labeled showing the date filled and the source of material. The procedures for the disposal of investigative-derived material can be found in Appendix 1 of this Field Sampling Plan as SOP 1.15.

5. ANALYTICAL METHODS AND PROCEDURES

5.1. WORKER BREATHING ZONE SAMPLES

Worker breathing zone samples will be analyzed for volatile organic compounds and dust using a PID fitted with an 11.7 eV lamp and a Miniram aerosol detector respectively. These methods will provide real time results to protect worker health. Air flammability will be measured with an explosivity monitor to protect worker safety. The PID will be operated following the manufacturer's instructions and SOP 6.2. The Miniram and the explosivity meter will be operated following the manufacturer's instructions and SOPs 1.12 and 6.1 respectively.

5.2. HEADSPACE SOIL SAMPLES

Soil headspace samples will be analyzed for volatile organic compounds using a PID fitted with an 11.7 eV lamp. This method will provide real time results for choosing the sample with the highest concentration of volatile organics. Aluminum foil will be placed over the jar and then the jar will be capped. The jar will be heated, the lid removed, and the PID probe will be used to puncture the foil and obtain a reading. The PID will be operated following the manufacturers instructions and SOP 6.2.

5.3. PROCESS AIR AND SOIL VAPOR SAMPLES

Soil vapor and process air analysis will be conducted using the method for volatile organics described in "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air", EPA-600/4-84-014, April 1984. The samples will be analyzed with a gas chromatograph equipped with a photoionization detector.

5.4. WASTEWATER SAMPLES (FROM KNOCKOUT DRUM)

Water samples from the knockout drum well be analyzed by EG&G MAT for volatiles, semivolatiles, pesticides/PCBs, and inorganics as necessary for proper disposal of the water. EPA developed methods will be selected by Mound as appropriate.

5.5. SOIL SAMPLES

Soil samples will be analyzed for volatile organic compounds using EPA method 8240. Soil samples will also be analyzed for grain size using ASTM method D4222.

6. DATA QUALITY MANAGEMENT DELIVERABLES

Quality assurance reports to management will consist of prior notification of activities and reports on activities. Reports will encompass both routine reports and special reports, including written reports and memoranda documenting data assessment activities, results of data validations, audits, nonconformances, corrective actions, and quality notices. The management hierarchy receiving some or all of the reports will include DOE DAO (the RPM), the EG&G MAT Manager of Environmental Restoration, the DOE AL Program Manager, and the DOE RI/FS contractor project manager. Reports may be distributed to RI/FS subcontractors at the discretion of the DOE RPM and the RI/FS contractor project manager.

Prior notification of all quality assurance activities will be provided to all managers through the vehicle of monthly progress reports that also contain information about all B Building Solvent Storage Shed Area activities, and through special trip notices that notify managers of contractor and subcontractor travel. Monthly progress reports will routinely discuss upcoming activities, including field work and scheduled audits. Any of the managers listed above may use the notification to identify the need for, and schedule quality assurance audits in connection with, scheduled field work.

Monthly reports will also describe the progress, the completion, and sometimes the results of quality assurance activities. Descriptions of the completion of activities will serve as notice to all managers of the availability of quality assurance reports. Results of quality assurance activities may be summarized for inclusion in monthly reports. Each quality assurance activity shall be documented in a report separate from any summary or description included in the monthly progress report.

Analytical reports from the laboratory will contain information on sample results, QA/QC results, calibration, and quantitation limits. Raw data will also be supplied. This information will be provided for data validation. Data validation, conducted according to EPA guidelines, will be performed to verify that the data meet the objectives of the project.

7. REFERENCES

DOE, 1994, "Statement of Work and Bid Package for the B Building Solvent Storage Shed Interim Remedial Action", U.S. Department of Energy, Albuquerque Field Office, February 17, 1994.

U.S. PEA, 1987, "Data Quality Objectives for Remedial Response Activities, Development Process," EPA - 540/G-87/003, March 1987.

U.S. EPA, 1989, "Preparation of U.S. EPA Region IX Sample Plan for EPA Lead Superfund Sites", U.S. EPA Region IX Quality Assurance Management Section, March 1989.

APPENDIX 1
STANDARD OPERATING PROCEDURES

SOP 1.1	General Instructions for Field Personnel
SOP 1.3	Sample Control and Documentation
SOP 1.4	Sample Containers and Preservation
SOP 1.5	Guide to Handling, Packaging, and Shipping of Samples
SOP 1.6	General Equipment Decontamination
SOP 1.12	Air Particulate Sampling with a Real-Time Personal Monitor
SOP 1.15	Guide to Management of Investigation-Derived Wastes
SOP 3.1	Water Level Measurements
SOP 4.1	Soil Boring
SOP 4.1.1	Addendum to SOP 4.1
SOP 4.3	Monitoring Well Installation
SOP 4.4	Monitoring Well Development
SOP 5.1	Soil and Rock Borehole Logging and Sampling
SOP 5.3	Subsurface Solid Sampling With Hand Auger and Thin-Wall Sampler
SOP 5.4	General Soil Gas Sampling and Field Chemical Analysis
SOP 6.1	Health and Safety Monitoring of Combustible Gas Levels
SOP 6.2	Health and Safety Monitoring or Organic Vapors with a Photoionization Detector

- Source: Mound Plant ER Program SOPs, Weston

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. which one

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.

$$1 \text{ Ci} < (10^{-3})(500 \text{ Ci})$$

$$1 \text{ Ci} < 0.5$$

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)

*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

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 1.12

AIR PARTICULATE SAMPLING WITH A REAL-TIME AEROSOL MONITOR

1. PURPOSE

To describe the equipment, operation, and procedures for collecting real-time air particulate data.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information about the scope of specific operations and the applicability of this procedure to the activities.

2.1 Functions of RAMs

Airborne particulate contaminants can present a significant threat to the health and safety of workers. Real-time aerosol monitoring (RAM) instruments are used to determine the relative concentrations of airborne particulates that may cause a respiratory hazard. These instruments can determine concentrations of airborne particulates in dust, fumes, smoke, and fog. The real-time data obtained from these instruments are used to establish the level of protection for the health and safety of workers and assist in the establishment of possible control measures. The RAM is typically calibrated at the factory and recalibrated by the manufacturer at least annually.

The RAM uses a pulsed, gallium arsenide light-emitting diode source. The radiation scattered by airborne particles is sensed by a silicon-photovoltaic hybrid detector. The instrument continuously senses the combined scattering from the population of particles present within its sensing volume (approximately 1 cm^3) when dimensions are large in comparison to the average separation between the individual airborne particles. The scattering sensing parameters have been designed for preferential response to the range of particle size from 0.1 to 10 microns.

Most RAMs read in units of mg/m^3. In order to quantify the results, apply the appropriate guidelines, and establish action levels, it is necessary to have some knowledge of the sample composition and to determine what percent of the total dust seen is respirable. In some cases, it may be necessary to perform continuous air monitoring in conjunction with the RAM measurements to help identify contaminant characteristics. In terms of dust content, it can be assumed that 100% of the dust produced is silica if drilling through sandstone. In areas where the dust produced is from other sources, quantitative analysis must be performed to determine the exact content of the dust-producing media. The analysis should include the silica content, type of silicates (crystalline, amorphous, coal dust, and others), and a general background analysis of the soil. The results of the soil analyses are then used to establish guidelines for action levels during work activities that are based on the current Threshold Limit Values (TLVs).

2.2 Limitations of RAMs

A. RAMs are designed for qualitative analysis. For that reason, they can be used to provide only an indication of total particulate concentration unless samples of the

medium of interest (like soil) are taken before the work begins and quantitative analyzed for content.

B. Certain models (GCA Model PDM-3 MINIRAM, for example) satisfy the requirements for intrinsically safe operation in methane and air mixtures Consult the manufacturer's operating manual for use of these instruments in unknown atmospheres when potentially combustible or flammable compounds may be present.

C. RAMs determine the concentrations of airborne particulates, but do not provide information about the hazardous or toxic nature of airborne particulates.

D. Over time, RAM performance may be affected by the slow buildup of dust in the sensor. Therefore, RAMs must be serviced and cleaned regularly.

E. RAMs respond preferentially to a physical particle size of 0.1 to 10 microns. Some fumes may contain particles smaller than this.

F. The particle size of 0.1 to 10 microns refers to the physical size, as opposed to the aerodynamic size. Different aerodynamic sizes may have different degrees of transportability and respirability.

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. The purpose of an office instrument checkout is to verify that an instrument will function properly, the batteries are serviceable, and the instrument can be zeroed and is ready for field use. Ensure the proper operation of the RAM according to instructions included in the operating manual, logbook, and the steps listed below.

1. Check the battery charge level. If in doubt, charge the battery as described in the operating manual.

2. Open the sensor chamber and visually examine the sensor. If cleaning is required, carefully follow the procedures contained in the operating manual.

   CAUTION: Do not touch the lens or the inside of the chamber.

3. Turn the unit on. Verify the operation of the instrument display and other controls according to the operating manual.

4. Perform the zero procedure described in the operating manual. This procedure must be performed in an area known to be free of dust.

   NOTE: The instruments are factory calibrated against a filter gravimetric reference using a standard test dust (Arizona road dust). If recalibration of the instrument is desired, consult the manufacturer's operating manual for the location of the factory that will perform the calibration.

5. If the RAM is not ready for use, initiate steps to have the malfunctions corrected, obtain a working replacement, and repeat the checkout procedures.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record all information related to the instrument checkout in the logbook. This information may include the date of the last factory calibration, the date the sensor was last cleaned, the date of replacing the battery pack, and any problems during the instrument checkout. Sign and date 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 initial information on the Real-Time Aerosol Field Monitoring Data form (Appendix 5.2). See Appendix 5.3 for instructions to complete the form.

3.2.3. Field

A. Perform the instrument checkout procedures as described in Section 3.2.1.C.

B. Record the initial information on the Real-time Aerosol Field Monitoring Data form (Appendix 5.2). See Appendix 5.3 for completion of the data form.

3.3. Operation

3.3.1. Sampling

For accurate results, follow the instructions contained in the operating manual.

A. Position the instrument near the aerosol source and obtain readings.

B. Position the instrument in the worker's breathing zone and obtain readings according to operating instructions.

C. Record data on the Real-Time Aerosol Field Monitoring Data form (Appendix 5.2) by following the instructions in Appendix 5.3.

3.3.2. Interpretation of Results/Action Levels

A. Apply the results of the quantitative soil sample analyses to the mg m^3 concentration obtained using the RAM. Consult the site Health and Safety Plan for the exact hazards and the action levels. Action levels are typically 50% of the threshold limit value (TLV).

B. Compare the applicable TLVs to these concentrations. If the estimated concentrations are greater than any of the applicable TLVs, the level of protection must be upgraded to include respiratory protection. Consult the site Health and Safety Plan for current TLVs of the known hazards and the proper respiratory protection. When quantitative contaminant results are not available, the TLV for an upgrade to respiratory protection specified by the site Health and Safety Plan is 10 mg/m^3 for total dust containing no asbestos and less than 1% crystalline silica.

Example: Analysis of the soil at a drilling site shows a mica content of 75%. Assuming that 50% of the dust is respirable, a RAM reading of 10 mg/m^3 would result in 3.75 mg/m^3 of mica being inhaled by the workers in that area (0.50 x 10 x 0.75 = 3.75). The TLV time-weighted average (TWA) for mica is a 3.0 mg/m^3, which is less than 3.75. Air purifying respirators with high-efficiency particulate filters would have to be employed.

C. Document all levels of protection in the logbook. Record the time spent in each level, the type of respirator in use, the persons involved, and the concentrations of contaminants.

3.4. Postoperation

3.4.1. Field

A. Turn all switches to the off position.

B Decontaminate or clean the instrument. If decontamination is required, follow the procedures specified in SOP 1.6, General Equipment Decontamination. If cleaning is required, refer to the manufacturer's operating manual.

C. Charge the instrument batteries as specified in the instrument manual.

D 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. Replace expendable items. Return the RAM to the equipment manager and identify any operational problems from previous use.

4. SOURCE

GCA/Environmental Instruments. n.d. "Instruction Manual for Model PDM-3 Miniature Real-Time Aerosol Monitor (Miniram)." GCA/Environmental Instruments publication. Bedford, Massachusetts: MIE Incorporated.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Real-Time Aerosol Field Monitoring Data Form

5.3. Data Form Completion

APPENDIX 5.1

REAL-TIME AEROSOL MONITOR EQUIPMENT AND SUPPLIES CHECKLIST

_____ RAM

_____ Operating manual

_____ Battery charger

_____ Spare battery pack

_____ Jeweler's screwdriver

_____ Current ACGIH TLV indices

APPENDIX 5.2

REAL-TIME AEROSOL FIELD MONITORING DATA FORM

REAL – TIME AEROSOL FIELD MONITORING DATA

FACILITY CODE _____ LOG DATE _____

LOGGER CODE _____ FIELD REP _____

MANUFACTURER _____

MODEL NO _____ SERIAL NO _____

DATE CALIBRATED _____ ACCEPTANCE CODE _____

FIELD MEASUREMENTS

LOCATION ID OR DESCRIPTION	TIME (HH:MM)	SAMPLE TYPE	ACTIVITY TYPE	CONCENTRATION (mg/m³)	COMMENTS

ACCEPTANCE CODES: A–ACCEPTABLE M–MARGINALLY ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

SAMPLE TYPES :
A – AREA G – GRAB P – PERSONAL T – TIME WEIGHTED AVERAGE O – OTHER (SPECIFY)

ACTIVITY TYPES:
AM – AMBIENT (BACKGROUND) TR – TRENCHING OPERATION CS – CONFINED SPACE
DR – DRILLING OPERATION SS – SURFACE SOIL SAMPLING OT – OTHER (SPECIFY)

COMPLETE BOLDED DATA FOR ENTRY INTO TIME
ADR–043 (3/88)

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.

REAL-TIME AEROSOL FIELD 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 that 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. Manufacturer. The name of the company that manufactures the real-time aerosol monitor (RAM) instrument being used.

6. Model No. The model number of the RAM.

7. Serial No. The serial number of the RAM.

8. Date Calibrated. The date when the RAM was calibrated. This data field follows the same format as the data field for log date.

9. Acceptance Code. One-character code assigned by the site manager.

10. 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.

11. Time (HH:MM). The time when a RAM reading was taken using the 24-hr clock in the format of hours:minutes (for example, 08:37 for 8:37 AM and 19:12 for 7:12 PM).

12. Sample Type. The type of sample taken by the RAM.

    T - Time-weighted average (TWA)
    G - Grab sample
    A - Area sample
    P - Personal sample
    O - Other (specify)

13. Activity Type. A two-character code describing the mode of investigation that is being monitored. Acceptable codes are included at the bottom of the field form.

14. Concentration (mg/m^3). The units in which the RAM reads. Unless otherwise specified in the FSP or WP, the units mg/m^3 will be used.

15. Comments. Any additional information.

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.

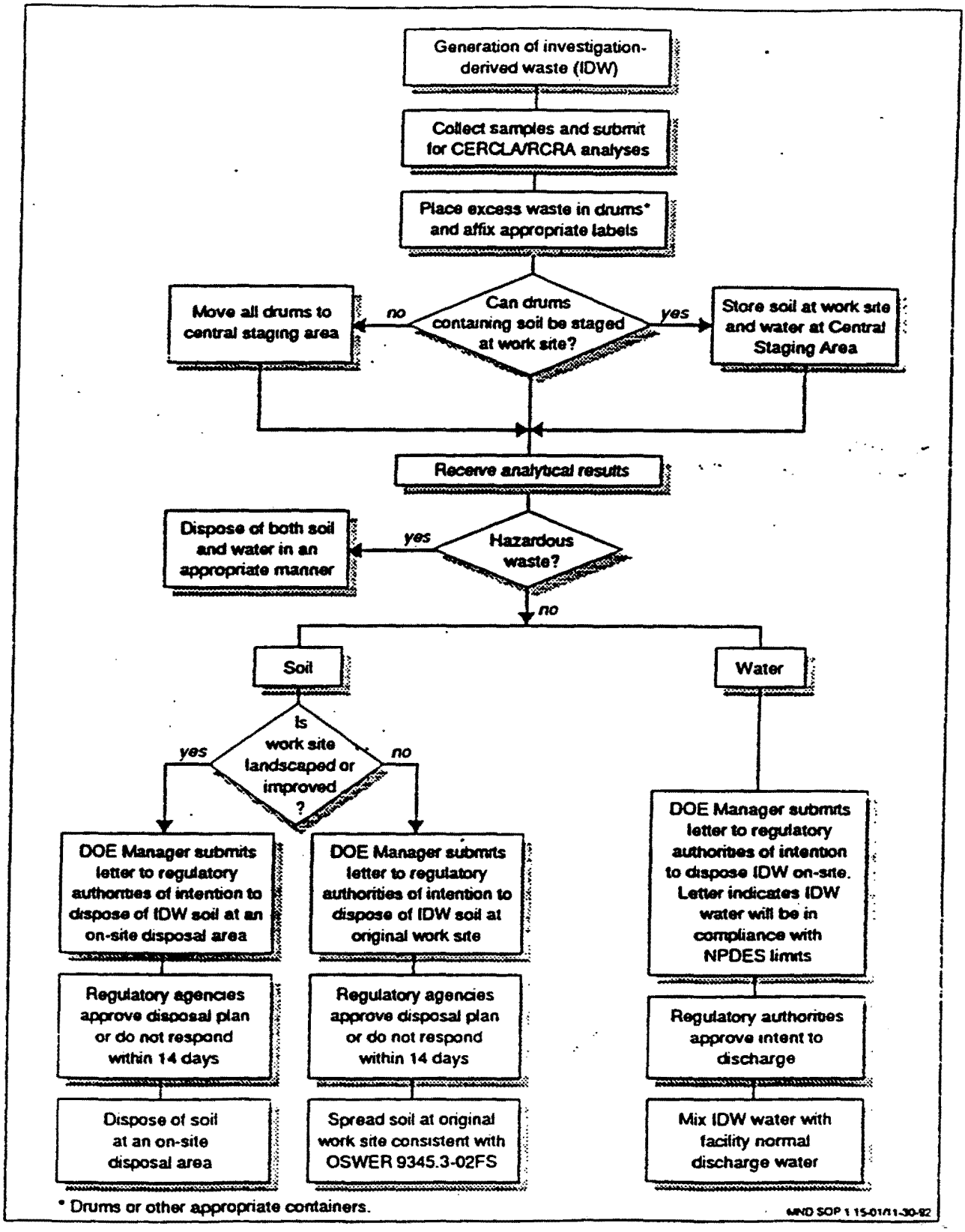
Hazardous IDM is material exhibiting the characteristics of ignitability, corrosivity, reactivity, or toxicity as specified in 40 CFR 261, Subpart C, or mixtures of IDM and hazardous wastes specifically listed in 40 CFR 261, Subpart D.

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 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. <u>Documentation</u>

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.

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 _____

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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 5.2

CUSTODY TRANSFER RECORD/LAB WORK REQUEST FORM

Custody Transfer Record/Lab Work Request

WESTON

WESTON Analytics Use Only

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

Refrigerators											
#/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

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

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.

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.

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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[8]	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[6]
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.
[6]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

APPENDIX 5.3, Continued

SAMPLING AND PRESERVATION PROCEDURES FOR RCRA GROUNDWATER DETECTION MONITORING*

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[c,e]	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

*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).

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

[1]Includes Cesium, Molybdenum, and Strontium, which are non-TAL metals, but are analyzed using the same methods.
[2]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.

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 4.1.1

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 4.3

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
- O – 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-005 (3/95)

FORM COMPLETED BY/DATE _____

TECHNICAL REVIEWER/DATE _____

APPENDIX 5.1, Continued

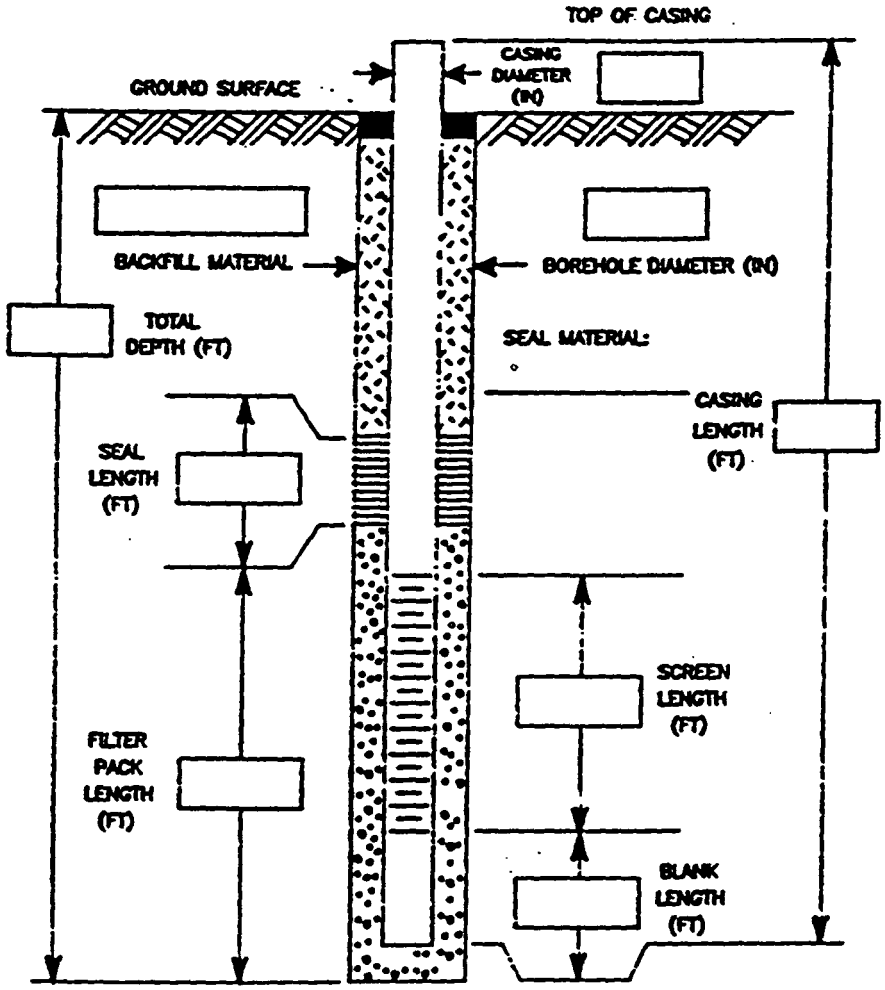
WELL COMPLETION INFORMATION FORM

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-006 (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

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

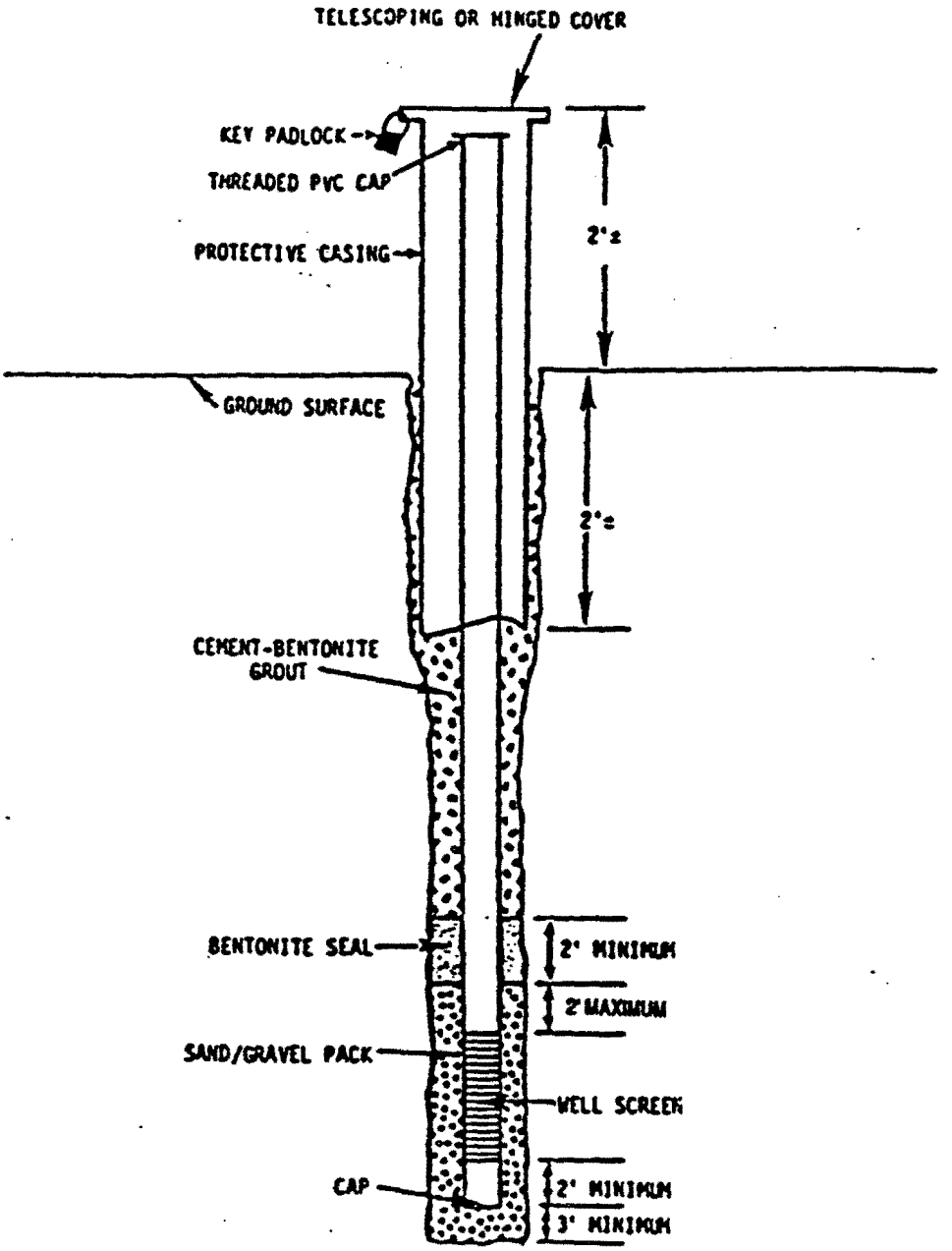
COMPLETE BOLDED DATA FOR ENTRY INTO TIMS

SWC–044 (1/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.3

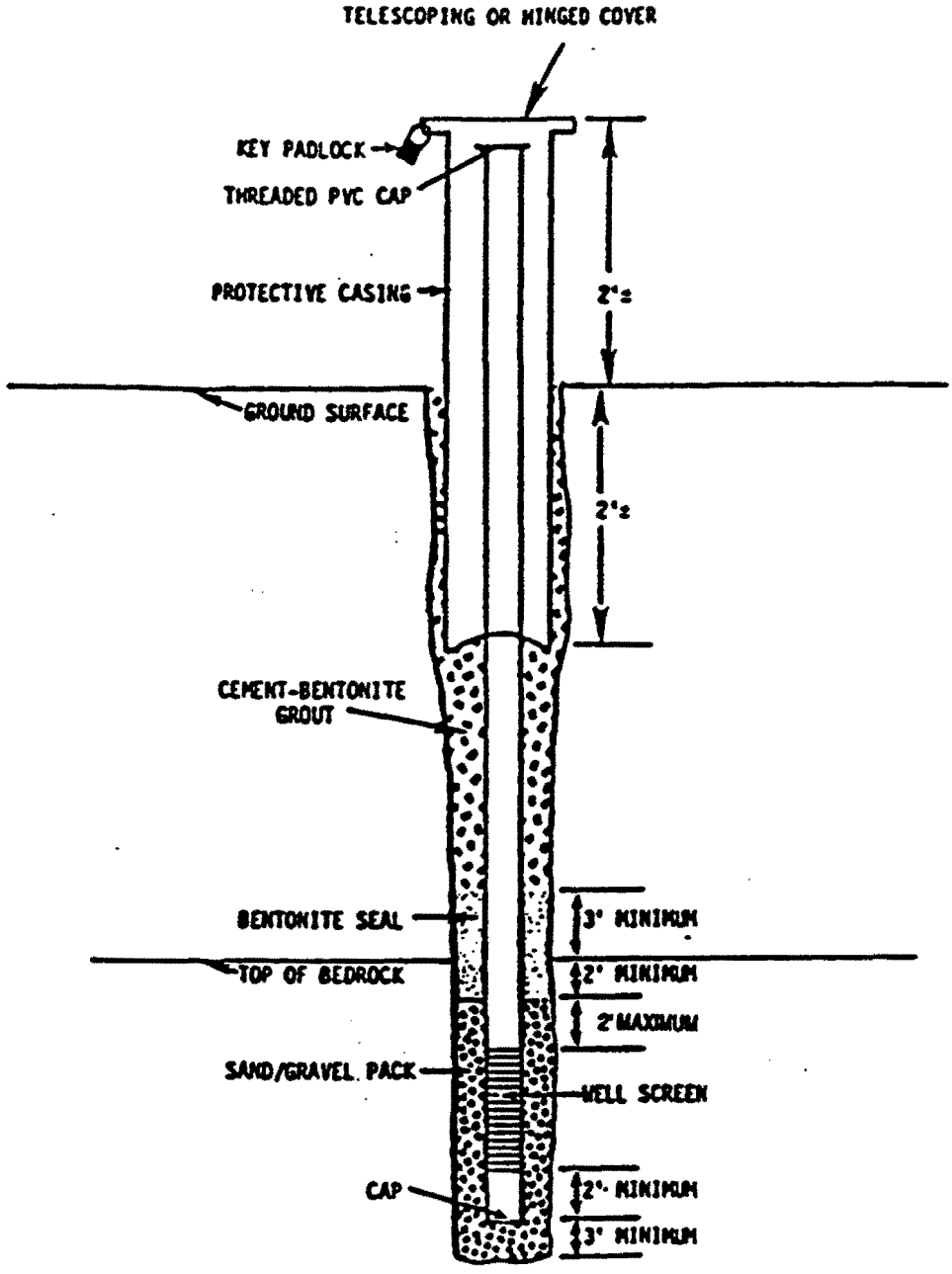
TYPICAL CONSTRUCTION OF OVERBURDEN WELL



TYPICAL CONSTRUCTION OF OVERBURDEN WELL

APPENDIX 5.4

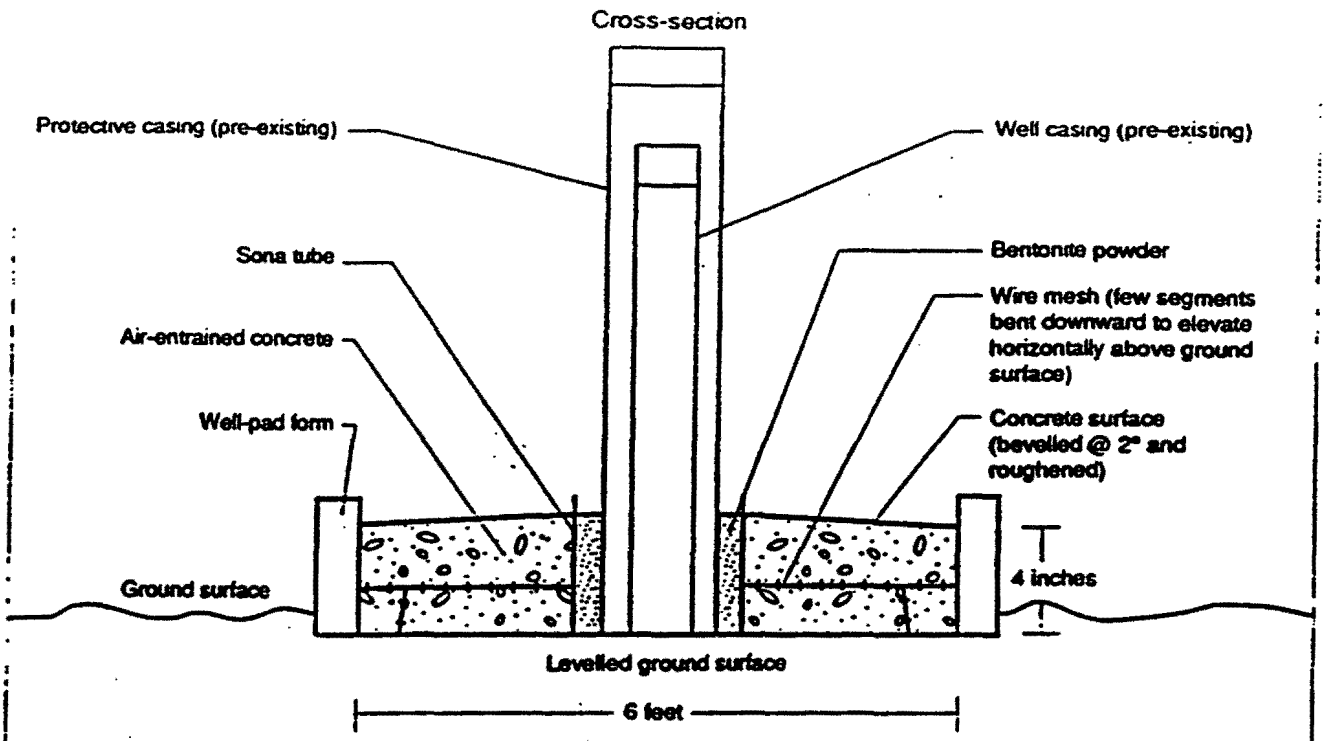
TYPICAL CONSTRUCTION OF BEDROCK WELL

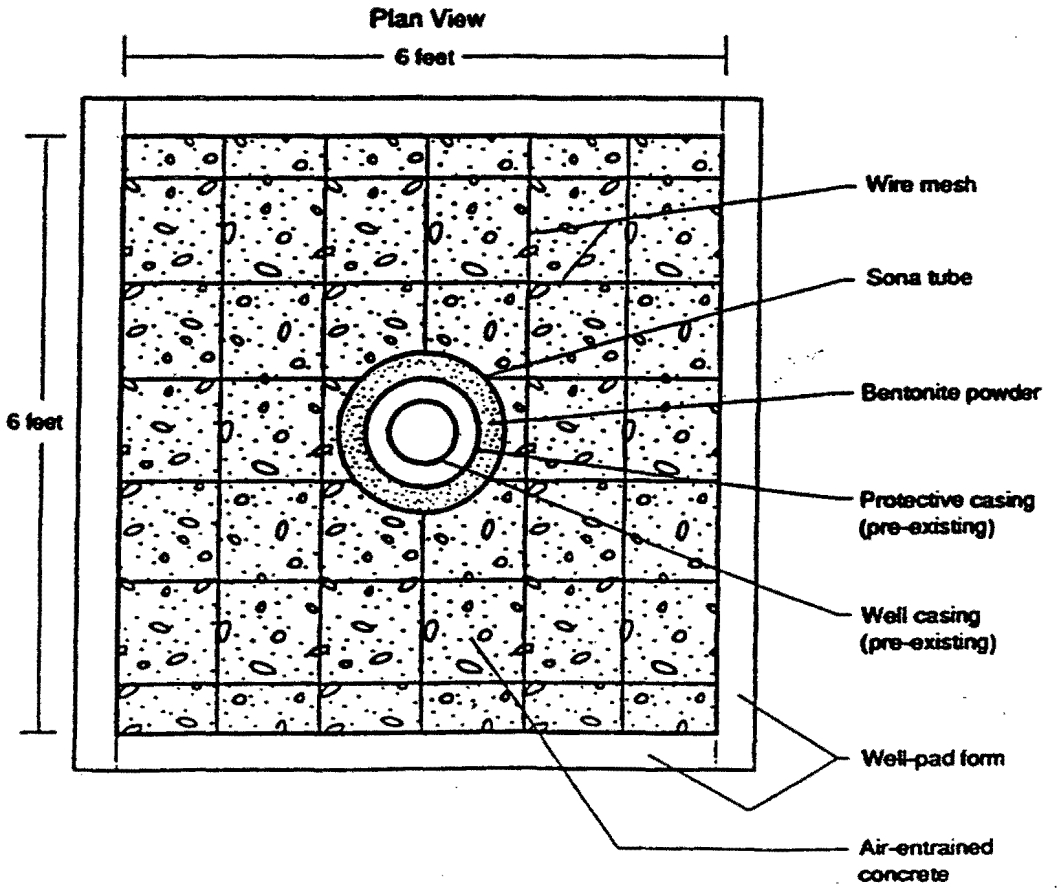


TYPICAL CONSTRUCTION OF BEDROCK WELL

APPENDIX 5.5

TYPICAL CONSTRUCTION OF WELL APRON

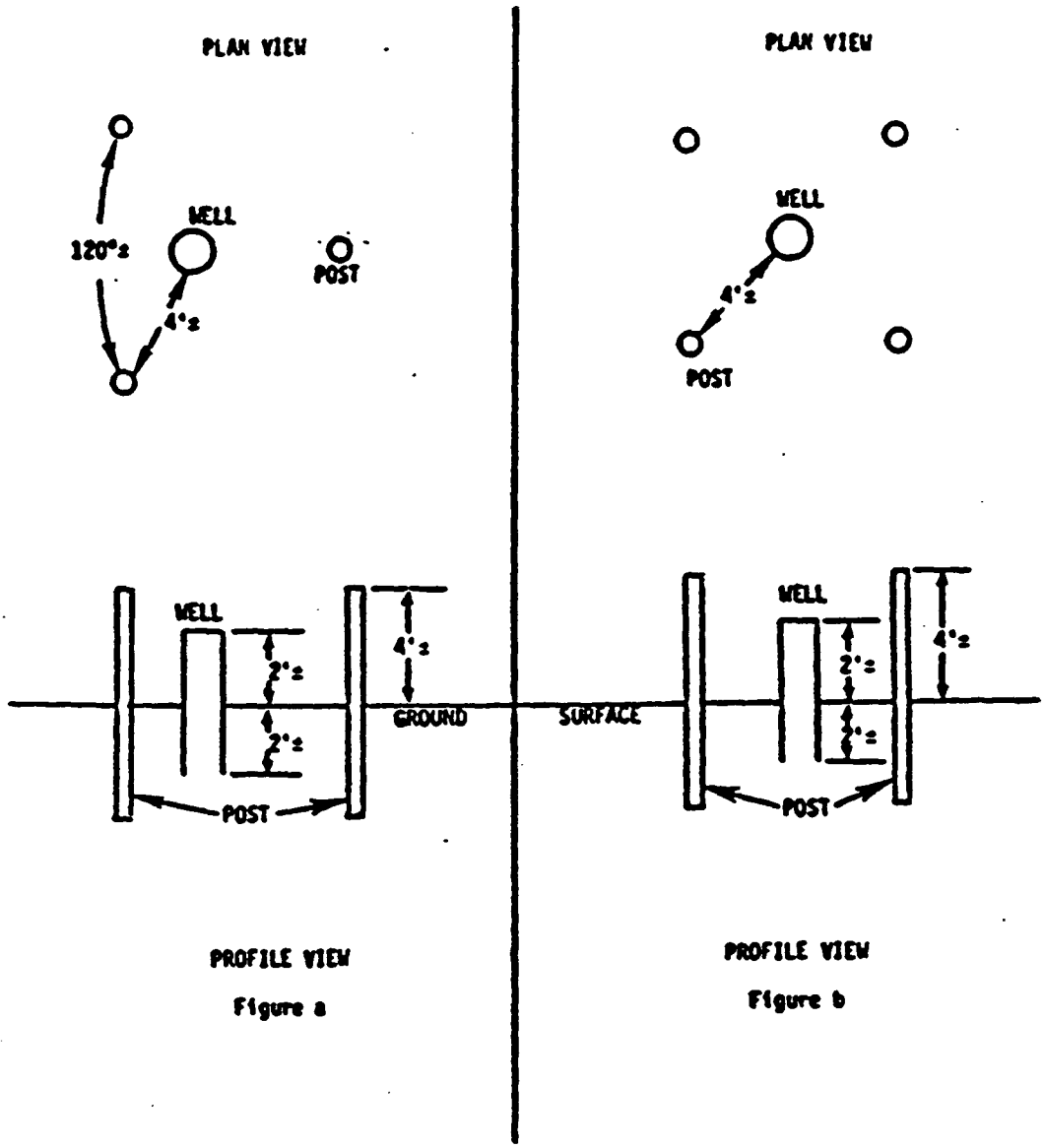




Appen5.5 2-24-92

APPENDIX 5.6

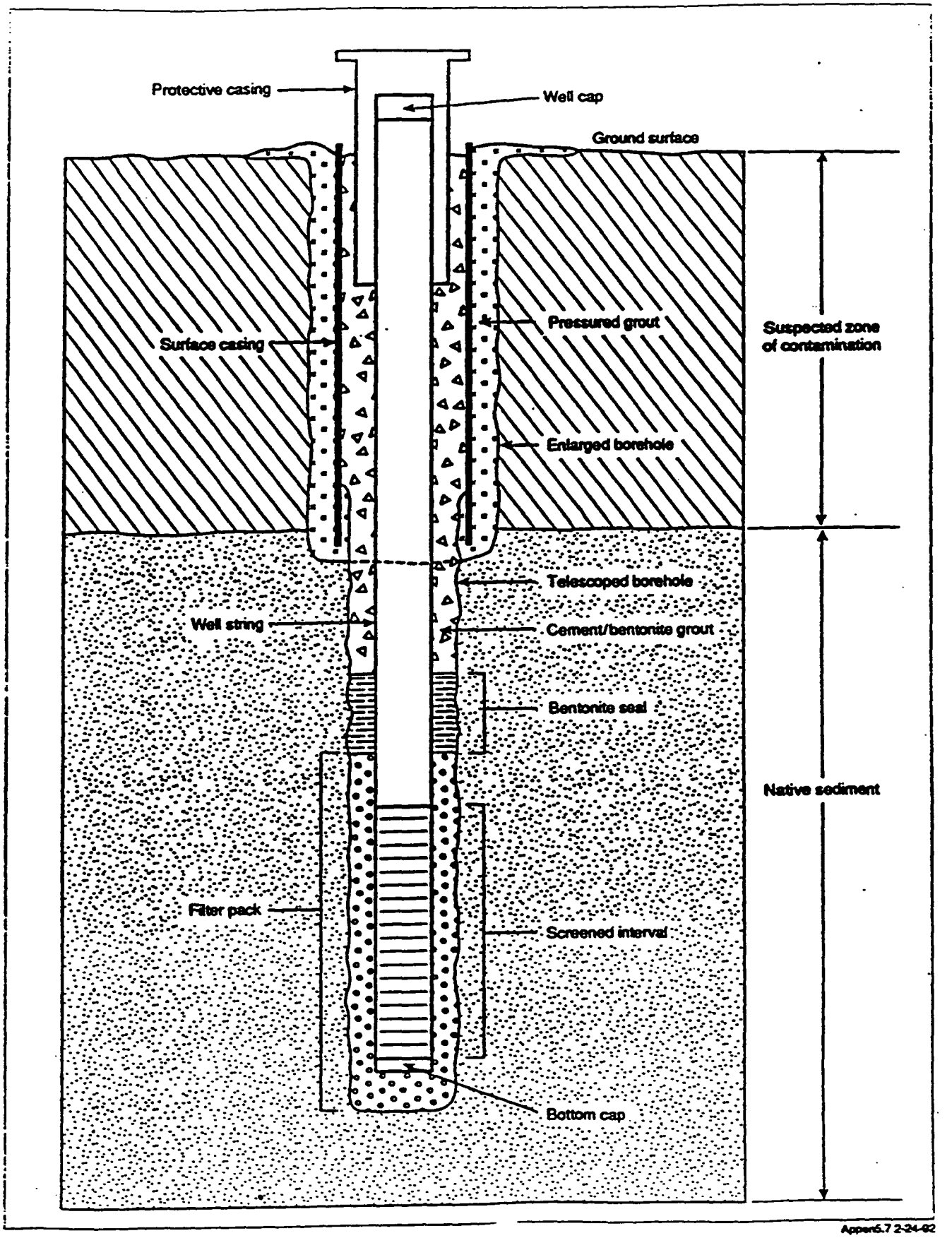
POST PLACEMENT AROUND WELL



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.

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**

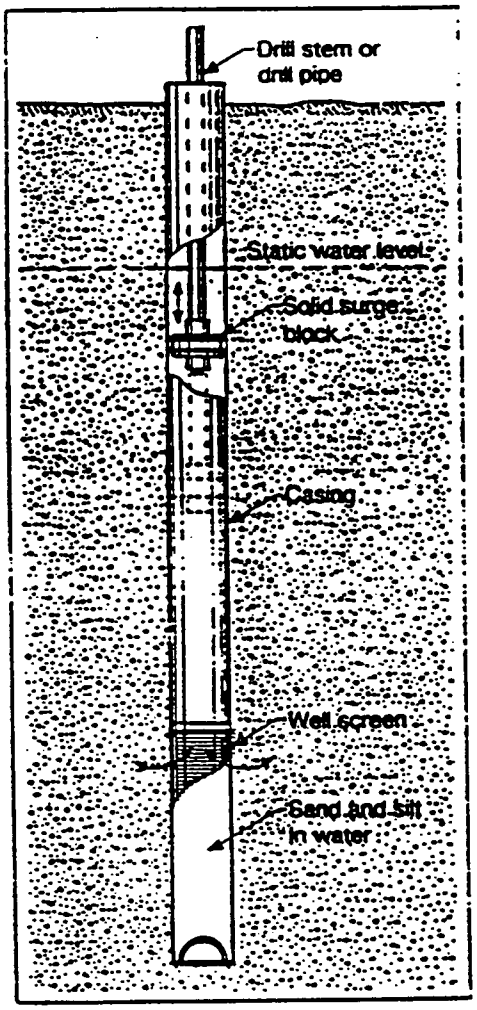
_____ **Water level measurement probe**

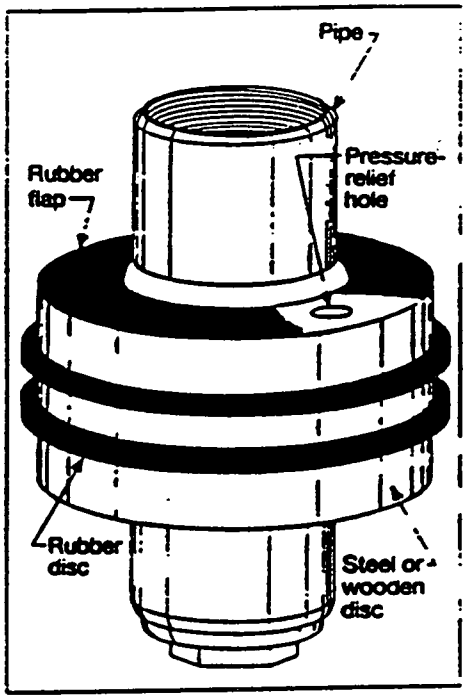
_____ **1000-ml Imhoff cone**

_____ **Plastic sheet**

APPENDIX 5.2

SURGE BLOCK SCHEMATICS





STANDARD OPERATING PROCEDURE 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
BHD-002 (3/95)

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 – 6 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 TMS

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.

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.

Drilling Methods

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 5.3

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)

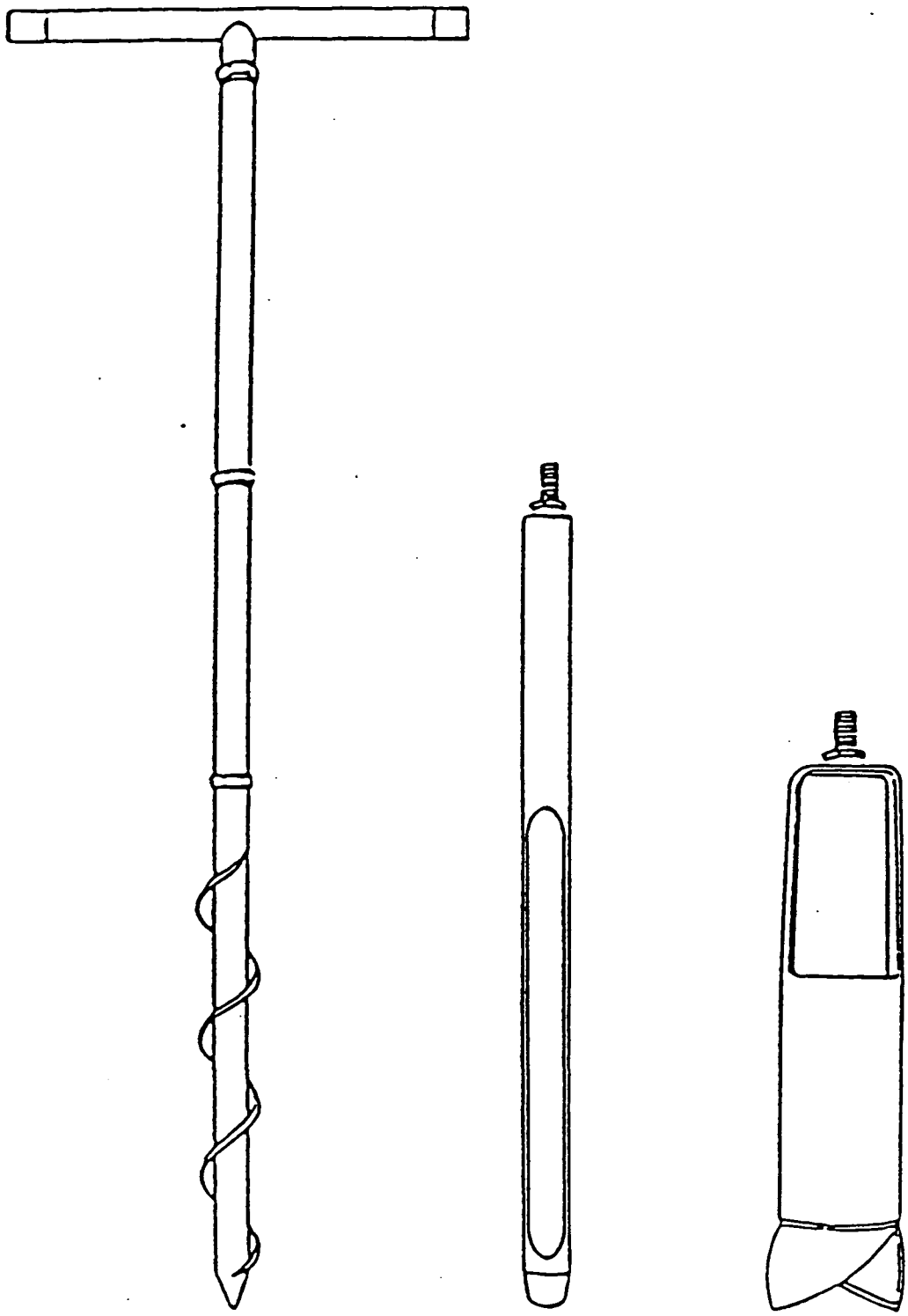
_____ Blue Ice or equivalent

_____ 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 TMS
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 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.

GMC-130 (1/88)

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. 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 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 TMS
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.

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 TMS

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
OWO-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 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. dditional information concerning boring techniques is contained in the SOP 4.2, Rock oring.

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.

APPENDIX 2
ETG QA/QC PLAN FOR SAMPLING PROCEDURES

MWR, INCORPORATED

QUALITY ASSURANCE/QUALITY CONTROL PLAN FOR SAMPLING PROCEDURES

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MWR, Inc.
QUALITY ASSURANCE/QUALITY CONTROL
PLAN FOR SAMPLING PROCEDURES

1.0 INTRODUCTION

The importance of a well-planned, well-executed, and well-documented sampling program cannot be overstated. It is the foundation on which the analyses and, ultimately, all remedial decisions are based. Valid results depend upon:

a. Ensuring that the sample taken is representative of the material or matrix being sampled;

b. Using proper decontamination procedures, sampling, sample handling, and preservation techniques;

c. Properly identifying the collected samples and documenting their collection in permanent field records;

d. Maintaining sample chain of custody; and

e. Properly packing and transporting the samples for laboratory analysis

MWR, Inc. (MWR) sampling procedures are patterned in accordance with Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual, U.S. Environmental Protection Agency Region IV, April 1, 1986, and Test Methods for Evaluating Solid Waste, SW 846, U.S. Environmental Protection Agency, Third Edition, November 1986.

2.0 SITE SAMPLING PLAN

2.1 Sampling Location

A specific site sampling plan is developed for each study conducted by MWR, Inc. Because sample site selection is a very important element in the analytical process, MWR maintains a policy of complete and open communication between all parties involved in a particular investigation. We typically encourage the regulating, as well as the regulated, parties to comment on and ultimately agree on the developed site sampling plan.

In most cases, a great deal of study must be initiated prior to the completion of the site sampling plan. Information on the type of activities conducted at a site and where potential contamination might be, as well as locating potentially uncontaminated background sites, is critical.

2.2 Selection of Parameters to be Measured

The parameters to be measured usually are dictated by the goals of an investigation. The parameters should be based on required monitoring conditions or on the field investigators or the requester's knowledge of the site being investigated.

2.3 Selection of Sampling Equipment

Equipment and materials used for sampling must be selected with consideration of the parameters of interest. Their use must not result in contamination of the sample with the parameters of concern or other artifacts at levels impacting the usage of the data. Equipment made with PVC may be used for most general inorganic parameters. Equipment made with Teflon and/or stainless steel is acceptable for both inorganic and organic parameters

2.4 Special Parameter/Sampling Technique Considerations

Some analytical parameters require special handling to preclude losses through volatilization or absorption. Major considerations are as follows:

a. Volatile parameters may not be sampled by means employing a vacuum or which aerate the sample. They should be obtained by a bailer or pressurized pumping system. Every effort must be made to minimize perturbation of the sample during sampling and any compositing steps, and minimize exposure to sources which may lead to contamination (i.e., solvent bearing containers/processes, combustion engines, etc.)

b. Saturated/Heterogeneous matrices - consideration must be given to those parameters for which the sample container is rinsed with the sample as to whether the sample is saturated or heterogeneous. If there is a potential for bias due to the rinsing, then skip the rinse procedure and note the occurrence in the sampling field notes.

c. When analysis is to be performed on dissolved parameters, the samples must be filtered in the field before the preservative is added. Filtration is performed by the use of one piece molded, in-line disposable cartridges of filter adapters with replaceable media. The filters are 0.45 micron pore size and are composed of non-contaminating synthetic fibers.

3.0 TYPES OF SAMPLES

3.1 Grab Samples

A grab sample is one individual sample collected at one instant in time. Grab sampling is normally associated with water or wastewater sampling. Grab samples are used to characterize the medium at a particular instant in time and are often associated with instantaneous monitoring well data or wastewater flow data. Grab sampling is conducted from water or process waste streams when:

a. The water or wastewater stream is not continuous (e.g., batch discharges or intermittent flow);

b. The characteristics of the water or wastewater stream are known to be constant or nearly so;

c. The sample is to be analyzed for parameters whose characteristics are likely to change significantly with time (e.g., dissolved gases, bacteria, etc.);

d. The sample is to be collected for analysis of a parameter, such as oil and grease, where the compositing process could significantly affect the observed concentration; and

e. Data on maximum/minimum concentrations are desired for a continuous water or wastewater stream.

Soil, sediment, liquid hazardous waste samples, etc., also may be considered grab samples.

3.2 Composite Samples

There are two types of water or wastewater composite samples: 1) timed composite, and 2) flow proportional composite samples. A timed composite sample is a compositing of at least eight discrete samples of equal volume and equal time interval for the compositing period. A flow proportional composite sample is a compositing of at least eight discrete samples collected proportional to the flow rate over the compositing period. Composite sampling is conducted when:

a. The water or wastewater stream is continuous;

b. The characteristics of the water or wastewater stream are not known to be constant;

c. Mass/unit time loading data are needed; and

d. A minimum number of samples are to be analyzed.

An areal composite is a sample composited from individual grab samples collected over an areal or cross-sectional basis. Areal composites shall be made up of equal volumes of grab samples; each grab sample shall be collected in an identical manner. Any number of grab samples may be composited to make an areal composite. Examples include sediment composites made up of sediment samples from a stream, soil samples from grid points on a grid system, water samples collected at various depths at the same point or from different points in a stream.

3.3 Split Sample

A split sample is a sample which has been portioned into two or more containers from a single collection event. Portioning assumes adequate mixing to ensure split samples are, for all practical purposes, identical.

3.4 Duplicate Sample

Duplicate samples are samples collected simultaneously from the same source under identical conditions and placed into separate containers. Duplicate samples are usually collected for comparative and quality control analysis.

3.5 Control Sample

A control sample is a sample collected upstream or upgradient from a source or site to isolate the effects of the source or site on the particular ambient medium being sampled.

3.6 Background Sample

A background sample is a sample collected from an area, water body, or site similar to the one being studied, but located in an area known or thought to be free from the pollutants of concern.

4.0 WATER SAMPLING

Water samples typically consist of individual grab, composite, or areal composite samples. Container and preservative preparation vary for different analysis and are usually supplied by a contracted laboratory. Various sources of water samples include:

4.1 Lagoon and Pit Sampling

For routine confirmation of waste constituents or qualitative characterization of wastewater streams, a single grab sample may be collected. Factors such as the size of the impoundment, the nature of the waste, influent and effluent points, etc., may necessitate the collection of an areal composite sample. In either case, the sample taken should be representative of the medium being sampled. For the collection of a sediment/bottom sludge sample, individual grab samples may be collected at several points along the perimeter of the lagoon or pit, using a hand auger or shovel. The samples may then be composited.

If a more rigorous characterization of the waste is necessary, other procedures should be used to ensure a truly representative sample. Specifically for water samples, divide the surface area into an imaginary grid. Take three samples if possible: One sample near the surface, one sample at mid-depth, and one sample at the bottom. Repeat the sampling at each grid over the entire pond or site. Samples should be taken using a Kemmerer Bottle, a brass container which allows for discrete depth sampling. For sediment/bottom sludge sampling, also divide the surface area into an imaginary grid. Take one sample from each grid over the entire lagoon or pit, using a split spoon sampler or other device with a mechanism for opening and closing the container for discrete depth sampling. Clean sampling gloves should be worn to avoid cross-contamination. Sampling equipment should be cleaned after each sampling point to avoid cross- contamination.

4.2 Drainage Ditches, Creeks, Run-off/Seepage Areas

Standard operating procedures consist of collecting water and sediment samples at the point of discharge into the surface water, downgradient (downstream) from the point of discharge, and upgradient (upstream) from the discharge point. Areas suspected to be least contaminated areas should be sampled first. At each sampling point, the water should be collected prior to the sediment sample. Care should be taken not to disturb the sediment during collection of the water samples. If wading is necessary, the sampling point should be approached from the downgradient side. The number and type (individual, grab or areal composite) of samples should be based on the specific site sampling plan; however, the inspector should be allowed latitude to use his/her best judgement to add the sampling program after a thorough site reconnaissance. Water samples can be collected with a bailer or a clean jar and then transferred into the appropriate laboratory containers. Clean gloves should be

worn for each sample to avoid cross-contamination. Sampling equipment should be cleaned after each sampling point to avoid cross-contamination.

4.3 Ground Water Sampling

4.3.1 Well Design and Construction

Monitoring well design and construction requires considerable planning and at least some understanding of the hydrogeology of the site. Monitoring well design criteria include depth, screen size, gravel pack specifications, and yield potential. Since the construction and design of monitoring wells are site specific an MWR hydrogeologist will always be consulted and assist in the installation of monitoring wells.

4.3.2 Well Development

Drilling procedures used to install monitoring well damage the aquifer by clogging the pores within the soil. Development of the well is necessary to restore the aquifer material to its original state, allowing the well to produce more water, and insuring that a representative sample is collected from the aquifer. Material clogging the pore spaces within the aquifer are removed and the sand (gravel) pack material near the well screen is rearranged to create a filter zone around the screen. This filter zone prevents finer aquifer material from entering the well. Development of wells can be accomplished by pumping or bailing the well until clean water is present. Well development will be placed into US DOT approved, labelled drums for appropriate testing and disposal.

4.3.3 Ground Water Level Measurement

a. General

The measurement of ground water level in wells is frequently conducted in conjunction with ground water sampling. The data from such measurements is needed to determine the "free" water surface and can be used to establish ground water gradients and, ultimately, the direction of ground water flow.

All ground water level measurements will be made in reference to an established reference point marked on the well casing. This reference point shall be well-documented in field records.

b. Specific Ground Water Level Measuring Techniques

Measuring the depth to the ground water table can be accomplished using the following methods:

i) Popper or Bell Sounder: A bell or cup-shaped weight that is hollow in the bottom is attached to a measuring tape and lowered into the well. A "plopping" or "popping" sound is made when the weight strikes the surface of the water. An accurate reading can be determined by lifting and lowering the weight in short strokes and reading the tape when the weight barely strikes the water.

ii) Weighted Tape: This method is the same as the "bell sounder" method, except any type of weight, such as a padlock or lead sinker, can be used to fasten to the tape measure.

iii) Chalked Tape: Chalk the end of a weighted tape and lower it into the well, recording the amount of tape lowered. Retrieve the tape from the well and subtract the wet, chalked area from the total measurement. The tape should be withdrawn quickly from the well because water has the tendency to rise up the chalk due to capillary action.

vi) Water Level Meter with stainless steel probe: A stainless steel probe with conductors is attached to a permanently embossed polyethylene tape with two stranded stainless steel conductors in the tape line. The probe is lowered down the well, when contact with water is made an audible buzzer will sound and a light will illuminate on the stand held on the surface.

v) Product Interface Meter: This meter uses a stainless steel probe with an infrared beam and receptor. When the probe enters a liquid the beam is refracted, activating a buzzer and lights on the stand held on the surface. To operate, lower the probe into the well. A single light illuminated and oscillating tone on the stand indicates water. A steady tone and two lights indicate free product. Read the level on the permanently embossed tape attached to the probe to determine water level or free product level. When free product is encountered measure the top of the product and the water/product interface so that product thickness can be determined. This measurement should be taken at least 3 times.

After water level measurements are taken in a well all equipment should be properly cleaned to avoid cross-contamination with other wells.

4.3.4 Well Purging

In order to ensure that a sample, representative of the surrounding aquifer, is taken 3 to 5 well volumes should be purged from the well before a sample is taken. This can be accomplished by pumping or bailing the well. If a pump or non-dedicated bailer is used decontamination of equipment should be performed before continuing to another well.

4.3.5 Sample Collection and Handling

MWR uses dedicated PVC bailers or disposable single check, weighted, polyethylene bailers and VOC samplers for ground water sampling. These bailers are constructed to allow the samples to be semi-isolated from the atmosphere until the sample is placed into the proper sampling containers. Securely attach string or twine to top of bailer and lower it down the well. When water is encountered, allow the bailer to fill up and retrieve it from the well. If water is being sampled for VOC analysis utilize the VOC sampler to deliver the water into the proper containers. The sampler may also be used to easily deliver water into containers when analyzing for other parameters but is not required. The proper volume and preservatives needed for an analysis should be determined before going into the field. Field filtration may be necessary when sampling for dissolved metals. This should also be determined and prepared for before going into the field.

4.3.6 QA/QC

a. To ensure that cross-contamination does not occur, clean sampling gloves should be worn during all stages of sampling.

b. To ensure field and laboratory QA/QC a minimum of one duplicate sample, one field blank, and one trip blank should be collected per round of sampling. The water used should be distilled, hydrocarbon free water.

c. Water samples should be placed into coolers and stored on ice (between 2° C and 4° C) during transport to the laboratory.

5.0 SOIL SAMPLING

MWR, Inc. soil sampling procedures are in accordance with Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual, U.S. Environmental Protection Agency, Region IV, April 1986, and Test Methods for Evaluating Solid Waste, SW-846, U.S. Environmental Protection Agency, Third Edition, November 1986.

5.1 Site Selection

Areas selected for soil sampling should be strategically located in order to collect a representative fraction of the soils with the minimum number of samples and effort. A surface inspection of the subject area should be made to locate pertinent features and to evaluate the relationship between these features and potential sources of pollution. For example, the locations and position of sediment depositional areas may be good indications of surface run-off direction.

In most instances, the first investigation of a site will be reconnaissance or screening-type study. Sampling in these instances will generally be confined to surface soils or shallow coring using hand equipment such as shovels, trowels, or hand augers. For screening purposes, surface soil/sediment sampling should be conducted in depositional areas primarily in the downstream or downgradient portion of the area of interest. An upgradient sample may be collected as a control site. (Note: Sampling at depositional area tends to bias the sampling toward higher concentrations.)

For more sophisticated investigations, power drilling equipment may be used. The number of samples or test holes and the specific depth of sampling will vary according to site conditions and the scope of the investigation. In general, a minimum of three to four sampling sites or test holes should be installed in order to adequately determine subsurface conditions.

5.2 Sampling Techniques

Surface soil or sediment samples can be obtained by means of grab sampling. This method consists of collecting the soil or sediment in a sample container by scooping with a trowel, shovel, jar, or bottle.

Shallow subsurface samples can be collected by continuous coring with a hand auger. Shallow depth samples may also be collected by digging a hole with a shovel, then removing all the loose soil and collecting a sample at the desired depth using a trowel.

For deeper sampling using a drilling rig, a large diameter auger is used to advance the hole to the desired depth. Samples can then be collected using a two inch diameter, 24 inch long split spoon sampler, in accordance with the American Society of Testing and Materials (ASTM) Method D-1586. This procedure is generally known as the Standard Penetration Test (SPT) for driving a split-barrel sampler to obtain a representative soil sample and to measure the resistance of the soil penetration of the sampler. The split-spoon sampling device is attached to the end of the drill rod, and lowered through the hollow stem auger. The spoon is then hammered into the undisturbed soil below the auger with a 140 pound hammer. The sampler is removed from the soil after it has been pounded 24 inches into the soil. Once removed, the sampler is opened, and the soil can be collected. The portions that are disturbed or contaminated with foreign material introduced through collection methodology are discarded, and the remainder is placed in the appropriate sample container(s) using a clean putty knife. Clean sample gloves should be worn for each sample to avoid cross-contamination. Samples should be stored on ice (between 2° C and 4° C for shipment to the laboratory. Split-spoons should be properly cleaned before being used for additional sampling.

6.0 VAPOR SAMPLING

6.1 Off-Gas Samples from MWR Pump Station

To ensure safety of the sampler, before entering the pump station, open the door and allow it to air out. The sample pump should be turned to the "on" position and allowed to run for approximately one minute before sampling is to be initiated. The gas sample bag (Tedlar bag) should be purged (filled and expelled) three times before taking a viable sample. Care must be taken that each sample container is properly labelled prior to sampling. Gas sample bags transported by air freight should be filled to only about half of their capacity; gas expansion due to pressure differential may cause sample bags to rupture if they are too full initially. It is important that the fastener or seal on the gas sample bag is secure before transport. Gas samples should be maintained away from direct sunlight, but it is not necessary to put gas samples on ice.

6.2 Soil Gas Sampling

Soil gas surveys are conducted to measure the concentration and distribution of Volatile Organic Vapors (VOC) in vadose zone soils. This is possible due to the relatively high vapor pressures of VOCs, which enable them to evaporate into the pore spaces of the vadose zone soils. The VOC vapors can be extracted from the soil pore spaces, and analyzed to determine the relative extent of soil contamination.

Soil gas samples are collected using 5/8 inch diameter, hollow, steel rods. Retractable probe tips are attached to a 3-foot long hollow steel rods, and are driven into the ground to selected depths using a demolition hammer. A length of plastic tubing is attached to the drive point of the probe and threaded through the rods to the surface. When the desired depth has been reached, the rods are withdrawn approximately three inches to open the probe and allow for sample extraction. The vapors are pumped into a two-liter Tedlar gas sampling bag. To ensure that a representative sample is collected, the sample bag should be purged three times before the vapor sample is collected.

7.0 SAMPLING OF DRUMS, BARRELS AND OTHER CONTAINERS

Drum/Barrel and container sampling should only be conducted when absolutely necessary. Whenever drum/barrel or container sampling is necessary, the first priority is collection of the samples from open containers, because open containers generally present less hazard to the sampler than closed containers.

A problem which often arises in container sampling is stratification and/or phase separation. If only one layer or phase is sampled, this should be noted and taken into account when interpreting analytical results. Where possible, samples should be collected throughout the entire depth of the container or at several different points to provide a representative sample.

7.1 Sampling Techniques

Samples from drums/barrels can be collected using a 4-foot long, 1/2-inch internal diameter glass tube. The tube is inserted into the opening of the drum/container as far as possible. The open end is then sealed either with the thumb or a rubber stopper to hold the sample in the tube while removing the tube from the drum/barrel. The sample is then placed in the appropriate container and the procedure repeated until an adequate amount of sample is collected. Sample volume should be held to the absolute minimum required for analysis.

8.0 SPECIFIC ANALYTICAL TECHNIQUES

8.1 pH

Only electronic (portable) meters with provisions for temperature compensation should be used for measurement of pH. Temperature resistant combination electrodes should be used in conjunction with the meters.

The meter should be checked before each field trip for any mechanical or electrical failures, weak batteries, and cracked or fouled electrodes. The meter also should be calibrated with standard solutions of known pH values (e.g. 4, 7, and 10). While in the field, the meter should be calibrated with the three buffers before using. Thereafter, the meter should be checked against two buffers before each reading. In case of an apparent pH violation, the electrode should be checked with a pH 7.0 buffer and recalibrated to the closest reference buffer. The sample then should be reanalyzed.

8.2 Dissolved Oxygen

The dissolved oxygen meter should be checked before each field trip for any mechanical or electrical failures and membrane continuity. All meters should be calibrated before each field trip.

8.3 Field Conductance

A portable specific conductance meter, wheatstone bridge type or equivalent, should be used. Each meter should be checked before each field trip. Batteries should be checked, and conductivity cells should be cleaned and checked against known standards. Before using in the field, check each day with known standards. Refer to the instrument instructions for temperature-conductance calculations. Duplicate field analyses should agree with +/- 10 percent.

8.4 Head Space Analysis for Volatile Organic Compounds

Head-space analysis of soil samples is a field screening procedure to identify the presence of volatile organic compounds (VOC's). This method provides quick, semi-quantitative analysis in the field, but is not an exact laboratory procedure. Its primary purpose is to select samples for laboratory analysis. It can also be used to determine the boundary of an assessment area.

Soil samples from the vadose zone are collected by split spoon sampling using American Society of Testing and Materials (ASTM) method D 1586. Clean sample gloves should be worn during sample collection to avoid cross contamination between samples. Soil collected from split spoons is placed into clean 1/2 pint mason jars or

zip lock bags immediately after removal of the split spoon from the ground. It is important that VOC's are not allowed to vaporize from the soil sample. The mason jar or bag should be filled half full. The fill level should be the same for each sample. The soil should be loose within the jar or bag, not packed tightly into the bottom of the container. Immediately after placing the soil into the jar, the top of the jar should be covered with two layers of aluminum foil, and sealed with the closure band provided with the jar. This band over the aluminum foil seals the container, and does not allow vapors to enter or exit the jar. The sealed sample containers should be labelled with sample identification numbers.

Once sealed and labelled, the samples should be placed in a warm environment to which will allow the VOC's to volatilize from the soil, and escape into the air space above the soil in the jar. A warm environment may include, but is not restricted to, the following: heated truck cab, heated office, or direct sunlight. A small oven may also be used to heat the samples. Samples should be allowed to warm for a pre-determined amount of time. Usually 30 minutes to 4 hours is sufficient, depending on soil particle size and temperature. All samples should be heated for the same amount of time.

When the samples have been allowed to warm for the appropriate time, the vapors in the head-space above the soil in the jar can be analyzed. This can be performed using a variety of different instruments, the most common of which is an HNu photo ionization detector (PID), or a portable Organic Vapor Analyzer (OVA) equipped with either a Flame Ionization Detector (FID) or PID. The probe of the instrument is inserted into the jar through the aluminum foil cover. The analyst must take care not to tear a large hole in the aluminum foil, as this will allow the vapors to escape from the container, and the analyzed VOC concentration will be artificially low.

When the probe is inserted into the container, the concentration measured by the meter will rise rapidly to a high reading, and then slowly fall off and stabilize at some value. Both the peak and the stabilized levels should be noted.

To ensure that VOC concentrations can be compared between samples, the analyst should strive for consistency in the sampling procedure. All samples should have the same fill levels and warming times. Clean sample gloves should be worn during sample collection to avoid cross-contamination between samples.

9.0 SAMPLE PRESERVATION

Samples for some analyses must be preserved in order to maintain their integrity. Preservatives required for routine analysis of samples collected should be determined and prepared by a third party laboratory before entering into the field. All samples should be preserved immediately upon collection in the field. Preservatives used should be noted on sample labels. The following samples are the only ones that should not immediately be preserved in the field:

a. Barrel or other source samples from hazardous waste sites (these samples may be preserved only with ice, if necessary);

b. Samples that have extremely low or high pH or samples that would evolve potentially dangerous gases if they were preserved; and

c. Well or ground water samples containing visible sediment that are not filtered in the field shall not be preserved with nitric acid in the field (these samples shall be preserved with ice and returned to the laboratory for additional sample preparation, and field records shall indicate why the sample was not preserved).

When preserving samples, the following steps should also be taken:

a. If samples are placed in an ice chest, personnel should ensure that the melted ice does not cause sample containers to be submerged; this may result in sample cross-contamination.

b. Plastic bags such as zip-lock bags should be used when small sample containers are placed in ice chests to prevent cross-contamination.

c. Lids on all containers should be securely tightened before placing in ice chests.

10.0 DOCUMENTATION

The importance of complete and accurate documentation related to sample collection and analysis cannot be ignored. The following section describes the level of detail that should be implemented for proper documentation during sample collection.

10.1 Sample Labelling

All containers should be labeled prior to sampling. The sampling point for each sample should be identified on the container label. This can be done by assigning a unique number to each sampling point. A more exact description of the sampling point should be documented in permanent field records.

10.2 Chain-of-Custody

The possession of samples should be traceable from the time the samples are taken until the analytical data is reviewed by the project management. A Chain of Custody (COC) form should be initiated in the field and should accompany the samples at all times.

10.3 Field Notes

Field notes should be used for recording the data collection activities performed at a site. The notebooks will be bound, waterproof field notebooks. Entries will include sufficient detail to reconstruct site activities without reliance on memory. At the beginning of each entry, the date, start time, weather, field personnel present, level of personal protection, and the name of the person making the entry will be recorded. The names of visitors and the purpose of their visit also will be recorded. In addition, the presence or occurrence of unusual objects or events related to the sampling activity will be entered into the field notebook.

All measurements and samples collected will be recorded. Whenever a sample is collected or measurement made, a detailed description of the sample's location, identification, and type will be recorded. The equipment used to collect samples will be noted along with the sampling time, sample description, sample depth and volume, and number of sample containers. All field equipment decontamination procedures will be documented.

11.0 EQUIPMENT DECONTAMINATION PROCEDURES

All equipment used in the field shall be decontaminated before it is returned from the field. At a minimum, this decontamination procedure shall consist of washing wigh laboratory detergent and rinsing with tap water. More stringent decontamination procedures may be required, depending on the contaminants sampled.

11.1 Cleaning Materials

11.1.1 Steam Cleaning

Large equipment such as drill rigs, augers, and associated drilling tools should be steam cleaned before drilling begins, between every borehole and before the equipment leaves the site. Split spoons samplers should be steam cleaned before drilling begins, before they leave the site and if possible between samples. When split spoons cannot be steam cleaned between samples they should should follow the procedures for other field equipment cleaning.

11.1.2 Small Equipment Decontamination:

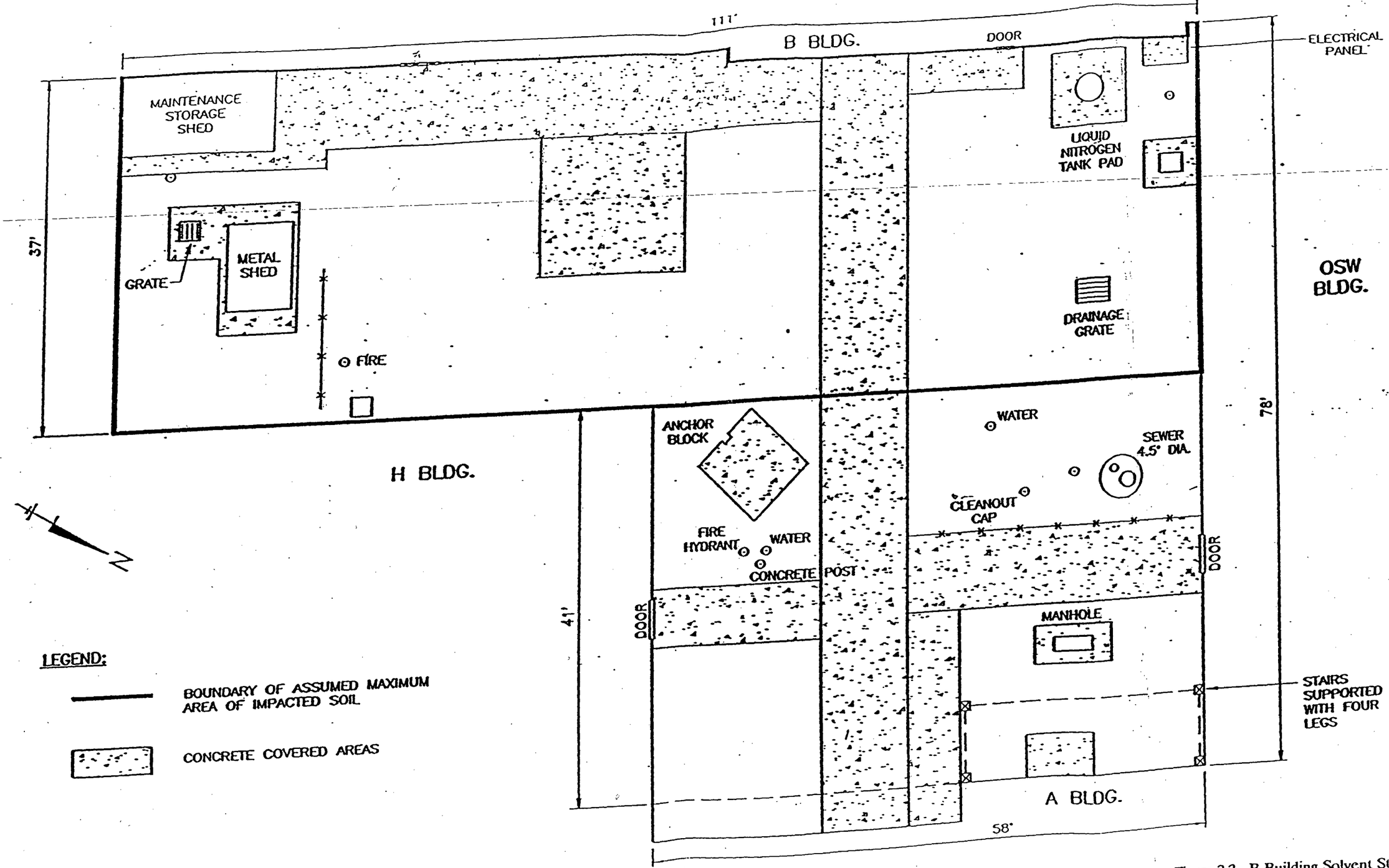
a. Start with an initial rinse with distilled, hydrocarbon free water;

b. Immerse and scrub in a mixture of laboratory grade detergent (i.e. Alconox, Detergent 8) and distilled, hydrocarbon free water;

c. rinse with distilled, hydrocarbon free water;

d. rinse with isopropyl alcohol, methanol, or acetone (this step should only be used if it is positively determined that these additives will not cause interference in analyses for dissolved-phase hydrocarbons or will not degrade sensitive equipment parts); and

e. 2 to 3 rinses with distalled, hydrocarbon free water.

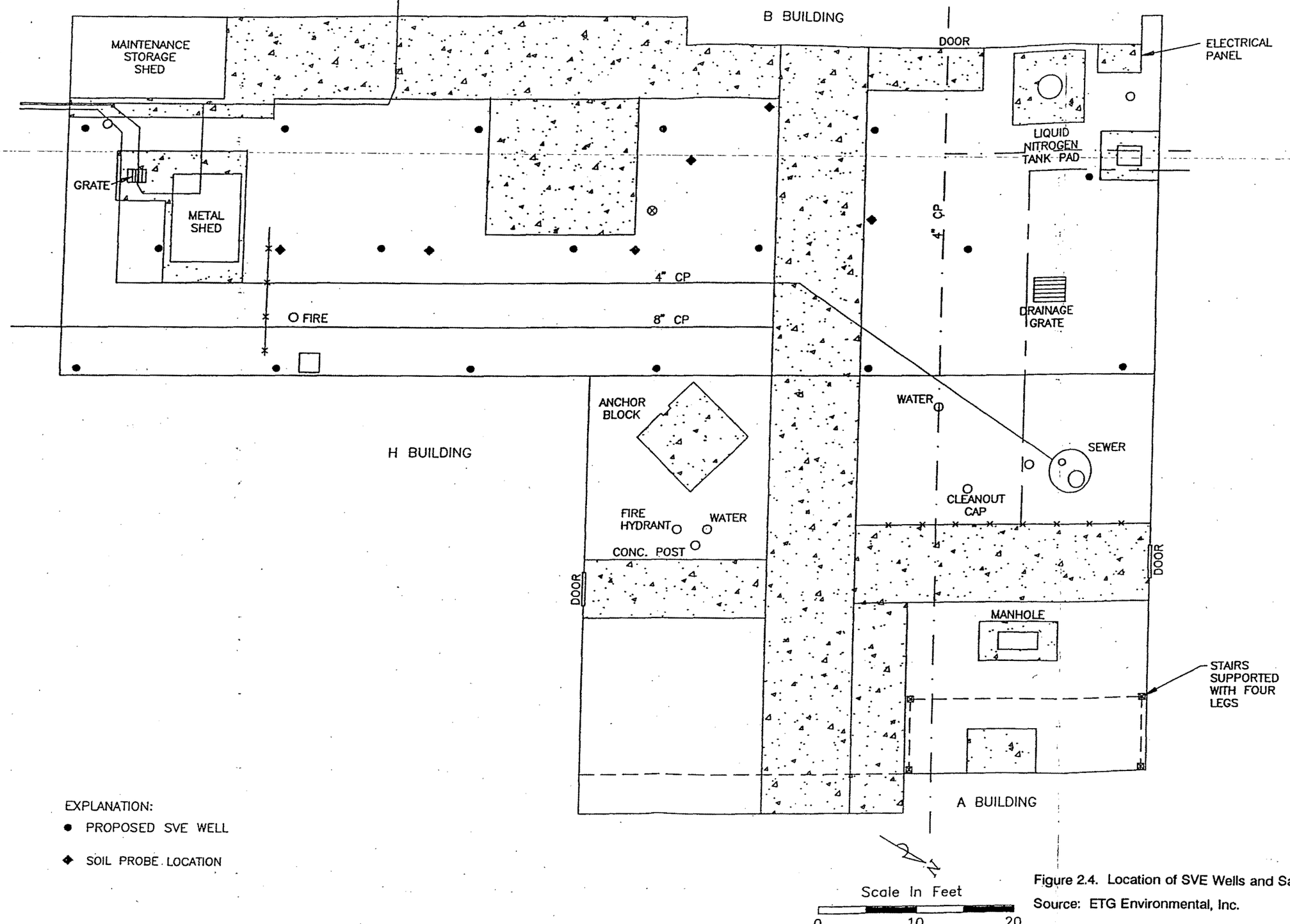


LEGEND:

BOUNDARY OF ASSUMED MAXIMUM AREA OF IMPACTED SOIL

CONCRETE COVERED AREAS

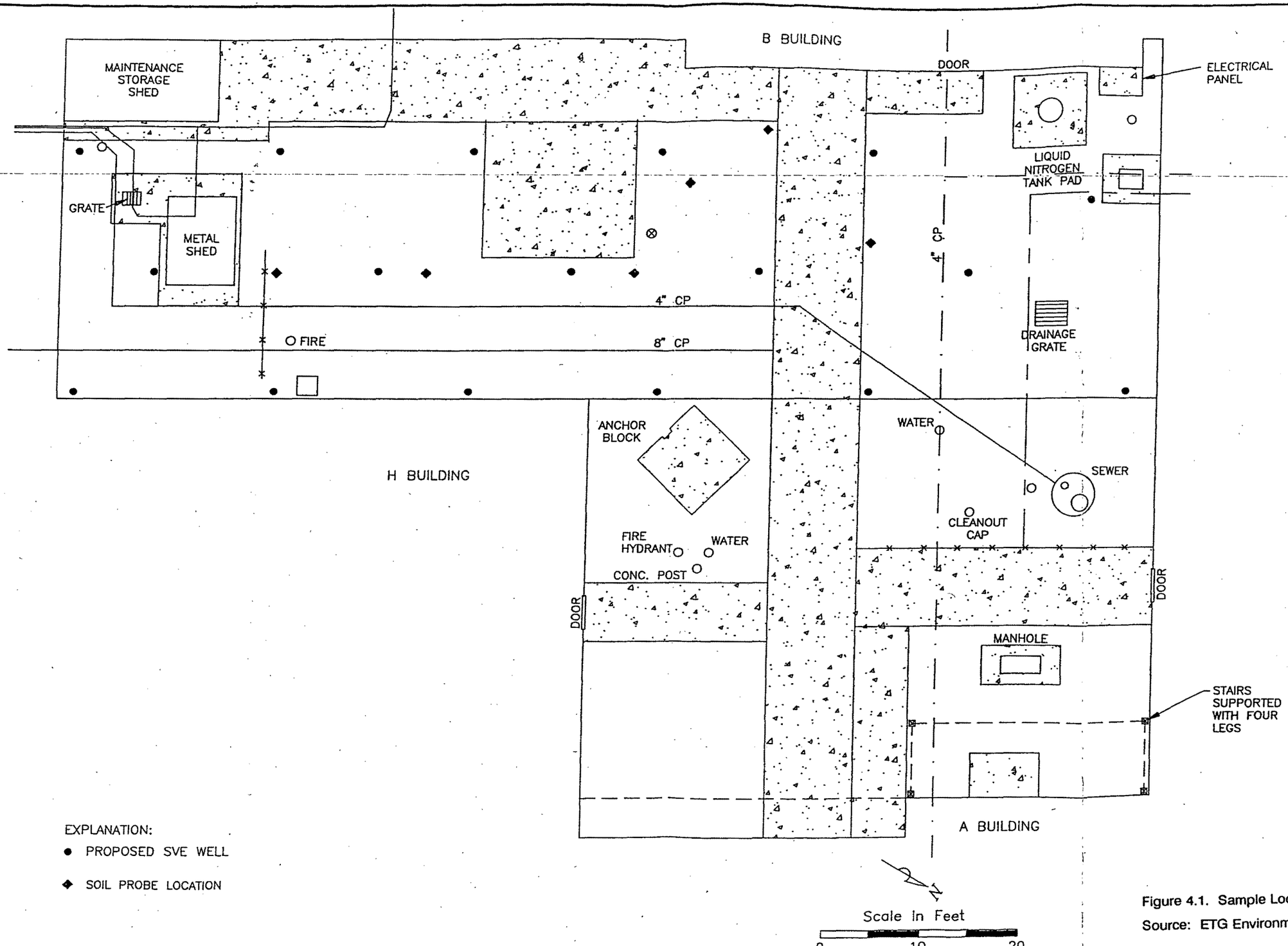
Figure 2.2. B Building Solvent Storage Shed Area



EXPLANATION:

- ● PROPOSED SVE WELL
- ◆ SOIL PROBE LOCATION

Figure 2.4. Location of SVE Wells and Sample Locations
Source: ETG Environmental, Inc.



EXPLANATION:

- ● PROPOSED SVE WELL
- ◆ SOIL PROBE LOCATION

Figure 4.1. Sample Location Map

Source: ETG Environmental, Inc.