

ATTACHMENT A

STANDARD OPERATING PROCEDURES

SOP Description	SOP ID
Soil Sampling for Analyses of Non-Volatile Constituents	No. 1 (Rev. 0)
Soil Sampling for Volatile Organic Compounds	No. 2 (Rev. 0)
Surface Water Sampling	No. 3 (Rev. 0)
Surface Water Discharge Measurement	No. 4 (Rev. 0)
Sediment Sampling for Chemical Analysis	No. 5 (Rev. 0)
Groundwater Sampling for Chemical Analysis	No. 6 (Rev. 0)
Equipment Decontamination	No. 7 (Rev. 0)
Sample Handling and Shipping	No. 8 (Rev. 0)
Field Documentation	No. 9 (Rev. 1)
Field Equipment Calibration	No. 10 (Rev. 0)
GPS Data Collection	No. 11 (Rev. 0)
Investigation Derived Waste (IDW) Management	No. 12 (Rev. 0)
Groundwater Elevation Measurements	No. 13 (Rev. 0)
Collection of Outdoor Ambient Air Samples	AMB-LIBBY-OU3 (Rev. 0)
Sampling, Preparation, and Analysis of Tree Bark for Asbestos	TREE-LIBBY-OU3 (Rev. 0)
Preparation and Analysis of Organic Debris for Asbestos	DEBRIS-LIBBY-OU3 (Rev. 0)
Soil Sample Preparation	ISSI-LIBBY-01 (Rev. 8)
Qualitative Estimation of Asbestos in Coarse Soil by Visual Examination Using Stereomicroscopy and Polarized Light Microscopy (PLM)	SRC-LIBBY-01 (Rev. 2)
Analysis of Asbestos Fibers in Soil By Polarized Light Microscopy (PLM)	SRC-LIBBY-03 (Rev. 2)

Libby Superfund Site Operable Unit 3 Standard Operating Procedure

Date: September 26, 2007

OU3 SOP 1 (Rev. 0)

Title: SOIL SAMPLING FOR NON-VOLATILE ORGANIC COMPOUND ANALYSIS

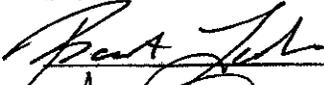
APPROVALS:

TEAM MEMBER

SIGNATURE/TITLE

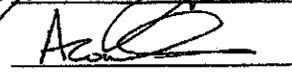
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EPA Remedial Project Manager



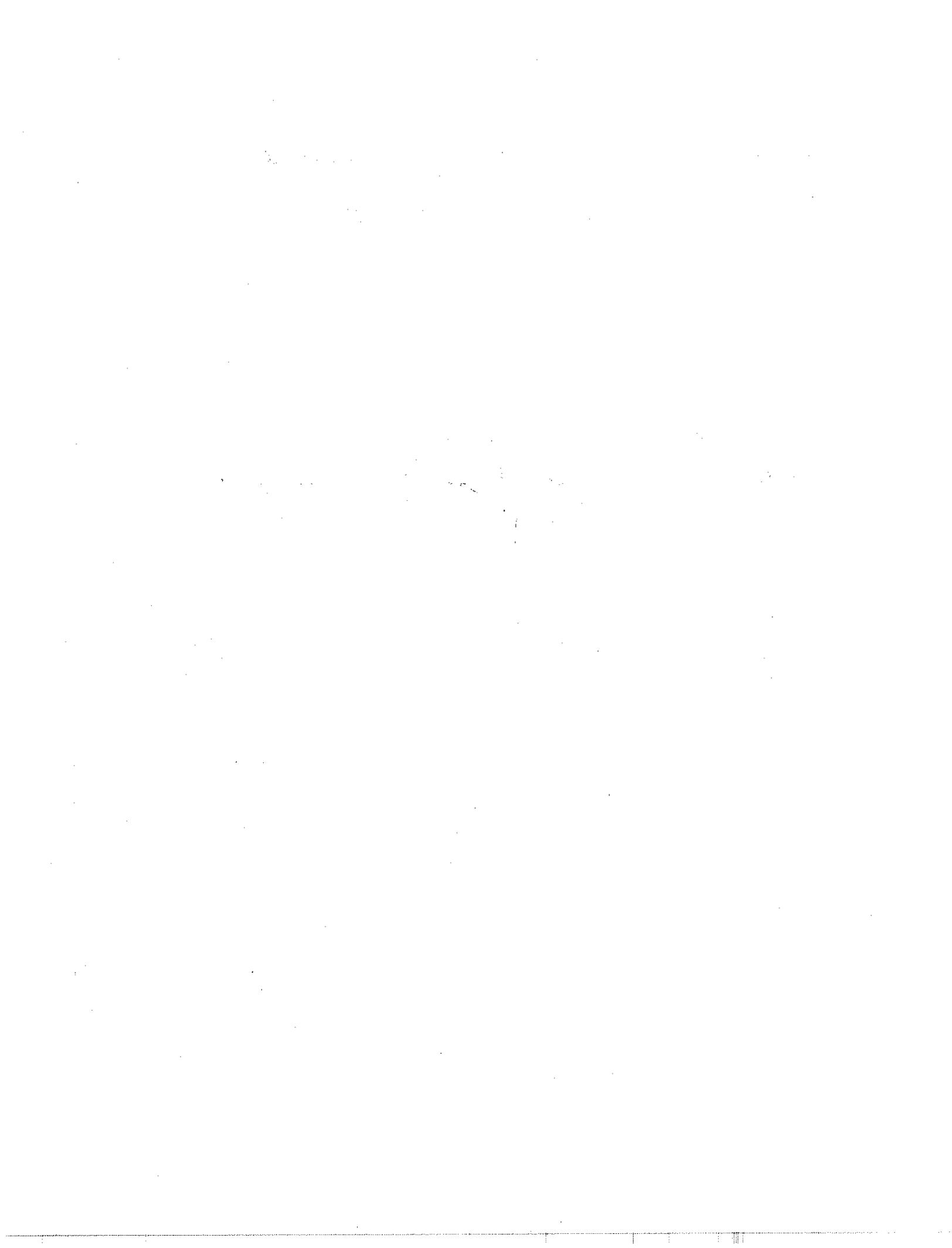
9/26/07

SOP Author



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1.0 INTRODUCTION

This standard operating procedure (SOP) is based on MWH SOP-15, Surface Soil Sampling, Revision 1.0, March 2006, modified for soil sampling use at the Libby Asbestos Superfund Site OU3. This SOP describes methods and equipment commonly used for collecting environmental surface and subsurface soil samples for chemical and geotechnical analyses. The information presented in this SOP is generally applicable to the collection of all soil samples, including waste material. This SOP is not applicable for the collection of volatile organic compounds (VOCs), or samples where the analyte(s) may react with the sampling equipment. This SOP defines sample collection procedures using hand augers, shovels/trowels, and soil core samplers.

This document focuses on methods and equipment that are readily available and typically applied in collecting surface and subsurface soil samples. It is not intended to provide an all-inclusive discussion of sample collection methods. Specific sampling problems may require the adaptation of existing equipment or design of new equipment. Such innovations shall be clearly described in the project-specific sampling plan and approved by the Project Manager and the Quality Manager.

2.0 HEALTH AND SAFETY WARNING

Asbestos fibers are thin and long fibers so small that they cannot be seen by the naked eye. Asbestos fibers are easily inhaled when disturbed and when embedded in the lung tissue can cause health problems. Significant exposure to asbestos increases the risk of lung cancer, mesothelioma, asbestosis (non-cancerous lung disease), and other respiratory diseases (ATSDR 2006).

3.0 DEFINITIONS

Environmental Sample: A solid sample collected for chemical or geotechnical analysis.

Hand Auger: A hand auger consists of a stainless steel tube with two sharpened spiral wings at the tip. The auger typically cuts a 2-inch to 3-inch diameter boring. Because the auger is hand-driven, penetration in dense or gravelly soil may be difficult.

Shovel/Trowel: Various shovel/trowel designs and sizes are commercially available for a variety of sampling applications. These devices are hand-driven and are typically used for sampling relatively soft, unconsolidated soil deposits. Some designs (e.g., the Sharpshooter™) can be driven into hard, rocky soil by opening a deep, narrow hole. Shovels or trowels used for surface soil sampling shall be made of stainless steel.

Soil Core Sampler: Soil core samplers consist of variable diameter (commonly 1-2 inches), stainless-steel tubes that can be attached to a hammer using a cap to allow for driving into surface soil. The steel tubes can also be fitted with aluminum or stainless steel liners for the collection of undisturbed samples. Polyethylene liner caps are used to seal the ends of the tube after sample collection. Soil core samplers can be used to obtain soil samples for chemical or geotechnical analysis. The use of liners allows for the collection of undisturbed samples, minimal loss of volatiles, and easy shipping to the analytical laboratory.

4.0 RESPONSIBILITIES

This section presents a brief definition of field roles, and the responsibilities generally associated with them. This list is not intended to be comprehensive and often additional personnel may be involved. Project team member information shall be included in project-specific plans (e.g., work plan, field sampling plan, quality assurance plan, etc.), and field personnel shall always consult the appropriate documents to determine project-specific roles and responsibilities. In addition, one person may serve in more than one role on any given project.

Project Manager: Selects site-specific sampling methods, sample locations, and constituents to be analyzed with input from other key project staff.

Quality Control Manager: Overall management and responsibility for quality assurance and quality control (QA/QC). Selects QA/QC procedures for the sampling and analytical methods, performs project audits, and ensures that data quality objectives are fulfilled.

Field Team Leader (FTL) and/or Field Geologist, Hydrogeologist, or Engineer: Implements the sampling program, supervises other sampling personnel, and ensures compliance with SOPs and QA/QC requirements. Prepares daily logs of field activities. **Sampling Technician (or other designated personnel):** Assists the FTL, geologist, hydrogeologist, or engineer in the implementation of tasks. Performs the actual sample collection, packaging, and documentation (e.g., sample label and log sheet, chain-of-custody record, etc).

4.0 SOIL SAMPLING PROCEDURES

Soil samples may be collected as grab samples or as composite samples, based on sampling objectives stated in the field sampling plan.

- Grab sample: A sample taken from a particular location. Grab samples are useful in determining discrete concentrations, but also allow evaluation of spatial variability when multiple samples are collected.
- Composite sample: A number of samples that are individually collected from differing locations then combined (homogenized) into a single sample for subsequent analysis. Composite samples are useful when averaged or normalized concentration estimates of a waste stream or an area are desired.

For details pertaining to sample locations, number of samples, grab versus composite samples, and type of analyses required, refer to the field sampling plans.

4.1 Sampling Equipment and Techniques

The sampling method employed is determined based on the soil conditions, and can include the use of hand augers, shovels/trowels, or soil core samplers. In addition, the following equipment is needed to collect soil samples:

- Field notebook, indelible marker
- Global Positioning System (GPS) unit
- Marking stakes
- Digital Camera
- Compass
- 100 m measuring tapes
- Hand scoop, trowel, hand auger, core sampler, or shovel
- Detergent solution (0.1-0.3 % Alconox)
- Distilled water
- Latex gloves
- Ziploc bags
- Paper Towel
- Chain of custody and sample labels
- Coolers
- Sample jars
- Plastic sheeting

For soil sample collection, the procedures outlined below shall be followed.

1. Don appropriate health and safety equipment
2. Setup clean plastic sheeting in area for processing soil samples

3. *For sample collection locations in forested areas:* Collect any organic debris (e.g., twigs, leaves, pine needles) from the soil surface and place into a large, air-tight, re-sealable plastic bag.
4. Advance the decontaminated soil sampling device into the soil, to the desired depth (see the field sampling plan for the appropriate sample depths) and collect soil. Follow manufacturer's instructions for operating auger and coring devices.
5. Place samples (grab or aliquots/sub-samples for a composite) into a large, air-tight, re-sealable plastic bag to homogenize (for samples requiring VOC analysis, refer to SOP No. 2). To homogenize, seal the bag and mix the contents manually by hand kneading. Particle size reduction may take place during mixing.
6. Label sample bags/jars with the Index ID, sample location, and sample analysis information in accordance with the procedures in SOP No. 9.
7. Fill labeled sample bags/jars using decontaminated spatulas or spoons.
8. Complete the appropriate soil Field Sample Data Sheet (FSDS) form to document the station and sample details (see SOP No. 9, Attachment 1). Document soil characteristics, sample location, other field data specified in the sampling plan, as well as any changes to this SOP, in a field logbook.
9. Locate the sample using GPS according to SOP No. 11 and record location coordinates on the FSDS form.
10. Pack sample jars in bubble wrap to avoid breakage during shipment.

Procedures for sample handling and shipping are presented in SOP No. 8.

4.2 Homogenizing Composite Samples

When a composite sample is required, separate grab samples will be collected at the specified number of sub-sampling sites and then combined to create the composite, as described below.

At each discrete sub-sampling site, approximately 100 grams of solids will be collected and placed into a large, air-tight, re-sealable plastic bag. The same bag will be used to collect 100 gram aliquots of soil from each discrete sampling location, as specified by the field sampling plan. Once all required sub-samples have been collected and combined into one bag, the bag will be sealed, and those materials will be manually mixed by hand kneading or massaging. Particle-size reduction may take place during mixing.

Sample containers used for shipping to the laboratory will be filled from the mixed solids. A plastic scoop or spoon may be used to remove the mixed solids from the bag for placement into the laboratory sample jars.

5.0 QUALITY ASSURANCE AND QUALITY CONTROL

Field duplicates and equipment rinsate samples will be collected at the frequencies documented in the field sampling plan.

All sampling data must be documented in the field logbooks and/or field forms, including the rationale for deviations from this SOP. The Field Team Leader or designated QA reviewer will check and verify that field documentation has been completed per this procedure and other procedures referenced herein. All equipment must be operated according to the manufacturer's specifications, including calibration and maintenance.

6.0 DECONTAMINATION

All equipment used in the sampling process shall be decontaminated prior to field use and between sample locations. Decontamination procedures are presented in SOP No. 7. Personnel shall don appropriate personal protective equipment as specified in the health and safety plan. Any investigation-derived waste generated in the sampling process shall be managed in accordance with the procedures outlined in SOP No. 12.

7.0 REFERENCES

Agency for Toxic Substances and Disease Registry. 2006. Asbestos Exposure and Your Health.



Libby Superfund Site Operable Unit 3 Standard Operating Procedure

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OU3 SOP 2 (Rev. 0)

Title: SOIL SAMPLING FOR VOLATILE ORGANIC COMPOUND ANALYSIS

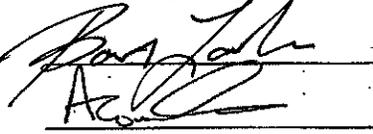
APPROVALS:

TEAM MEMBER

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DATE

EPA Remedial Project Manager



9/26/07

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1.0 INTRODUCTION

This standard operating procedure (SOP) is based on MWH SOP-13, Surface and Subsurface Soil Sampling, Revision 2.0, April 2007, modified for use at the Libby Asbestos Superfund Site OU3. This SOP describes methods and equipment that shall be used for collecting environmental surface soil and subsurface soil samples for volatile organic compound (VOC) analysis. This SOP, prepared in accordance with SW-846 (December 1996), defines sample collection procedures for screening and definitive sampling levels, using a soil sampler, methanol, and sodium bisulfate preservation methods according to Method 5035A. The procedures for collecting soil samples for non-VOC are described in SOP No.1.

This document focuses on methods and equipment that are specific to sampling surface soil and subsurface soil for VOC analysis. It is not intended to provide an all-inclusive discussion of soil sample collection methods. Specific sampling problems may require the adaptation of existing equipment or design of new equipment. Such innovations shall be clearly described in the project-specific sampling plan.

2.0 HEALTH AND SAFETY WARNING

Asbestos fibers are thin and long fibers so small that they cannot be seen by the naked eye. Asbestos fibers are easily inhaled when disturbed and when embedded in the lung tissue can cause health problems. Significant exposure to asbestos increases the risk of lung cancer, mesothelioma, asbestosis (non-cancerous lung disease), and other respiratory diseases (ATSDR 2006).

3.0 DEFINITIONS

Environmental Sample: A solid sample collected for VOC analysis.

Hand Auger: A hand auger consists of a stainless steel tube with two sharpened spiral wings at the tip. The auger typically cuts a 2-inch to 3-inch diameter boring. Because the auger is hand-driven, penetration in dense or gravelly soil may be difficult.

Shovel/Trowel: Various shovel/trowel designs and sizes are commercially available for a variety of sampling applications. These devices are hand-driven and are typically used for sampling relatively soft, unconsolidated soil deposits. Some designs (e.g., the Sharpshooter™) can be driven into hard, rocky soil by opening a deep, narrow hole. Shovels or trowels used for surface soil sampling shall be made of stainless steel.

Soil Core Sampler: Soil core samplers consist of variable diameter (commonly 1-2 inches), stainless-steel tubes that can be attached to a hammer using a cap to allow for driving into surface soil. The steel tubes can also be fitted with aluminum or stainless steel liners for the collection of undisturbed samples. Polyethylene liner caps are used to seal the ends of the tube after sample collection. Soil core samplers can be used to obtain soil samples for chemical or geotechnical analysis. The use of liners allows for the collection of undisturbed samples, minimal loss of volatiles, and easy shipping to the analytical laboratory.

Terra Core™ Sampler: The Terra Core is a one time use transfer tool, designed to easily take samples from hard packed soils and transfer them to the appropriate containers for in-field chemical preservation. The Terra Core transfers soil samples as described in USEPA SW-846 Method 5035.

Trip Blank: A sample of distilled de-ionized water collected and preserved like a regular sample to determine if any contamination results during sample shipment.

4.0 RESPONSIBILITIES

This section presents a brief definition of field roles, and associated responsibilities. This list is not intended to be comprehensive and often additional personnel may be involved. Project team member information shall be included in project-specific plans (e.g., work plan, field sampling

plan, quality assurance plan, etc.), and field personnel shall always consult the appropriate documents to determine project-specific roles and responsibilities. In addition, one person may serve in more than one role on any given project.

Project Manager: Selects site-specific sampling methods, sample locations, and constituents to be analyzed with input from other key project staff.

Quality Control Manager: Overall management and responsibility for quality assurance and quality control (QA/QC). Selects QA/QC procedures for the sampling and analytical methods, performs project audits, and ensures that data quality objectives are fulfilled.

Field Team Leader (FTL) and/or Field Geologist, Hydrogeologist, or Engineer: Implements the sampling program, supervises other sampling personnel, and ensures compliance with SOPs and QA/QC requirements. Prepares daily logs of field activities.

Sampling Technician (or other designated personnel): Assists the FTL and/or geologist, hydrogeologist, or engineer in the implementation of tasks. Performs the actual sample collection, packaging, and documentation (e.g., sample label and log sheet, chain-of-custody record, etc).

5.0 SOIL SAMPLING PROCEDURES

Sampling Equipment and Techniques

Soil samples can be collected using hand augers, shovels/trowels, or specialized soil-core samplers as described herein and in SOP No.1. In addition, the following equipment is needed to collect soil samples:

- Field notebook, indelible marker
- Global Positioning System (GPS) unit
- Marking stakes

- Digital Camera
- Compass
- 100 m measuring tapes
- Hand scoop, trowel, hand auger, core sampler, or shovel
- Detergent solution (0.1-0.3 % Alconox)
- Distilled water
- Latex gloves
- Ziploc bags
- Paper Towels
- Chain of custody and sample labels
- Coolers
- Sample jars
- Plastic sheeting
- Weighing balance

At each sampling location, collect discrete grab samples for VOC analysis first. Every effort should be made to cause the least amount of disturbance to the soil sample to minimize loss of VOCs. Immediately transfer soil to a wide-mouth 4-ounce jar or a vial with a chemical preservative using a syringe or Terra Core™ sampler to minimize loss of VOCs. The steps for use are as follows:

1. Don appropriate health and safety equipment.
2. Setup clean plastic sheeting in area for processing soil samples.
3. Have ready a tared 40ml glass VOA vial with a septum-sealed screw-cap containing a stirring bar and the appropriate preservative (Sodium Bisulfate and Methanol).
4. Test the soil for effervescence. If vigorous effervescing occurs than the Sodium Bisulfate preservation is not acceptable (see below for preservation options). NEVER cap a vial containing effervescing soil as the effervescing will create high pressures in the sealed vial, which may then EXPLODE.

Libby Superfund Site Operable Unit 3 Standard Operating Procedure

5. If no effervescence occurs, check the pH to determine that the quantity of acid is adequate to overcome any buffering capacity and reach a pH of less than 2. Add additional acid if the pH is above 2.
6. Advance the decontaminated soil sampling device into the soil, to the desired depth (6 inches or less for surface soil samples, greater than 6 inches for subsurface soil samples). Follow manufacturer's instructions for operating auger and coring devices.
7. Carefully remove large rocks, heavy root mass, twigs, and leaves from the soil sample.
8. With the plunger seated in the handle, push the Terra Core into freshly exposed soil until the sample chamber is filled. A filled chamber will deliver approximately 5 grams of soil.
9. Wipe all soil or debris from the outside of the Terra Core™ sampler. The soil plug should be flush with the mouth of the sampler. Remove any excess soil that extends beyond the mouth of the sampler.
10. Rotate the plunger that was seated in the handle top 90° until it is aligned with the slots in the body. Place the mouth of the sampler into the tared 40ml VOA vial containing the appropriate preservative, and extrude the sample by pushing the plunger down. Quickly place the lid back on the tared 40ml VOA vial.
11. Weigh filled VOA to determine that sample weight is approximately 5 grams, and record on sample label.
12. Label sample jars with the Index ID, sample location, and sample analysis information in accordance with the procedures in SOP No. 9.
13. Complete the appropriate soil Field Sample Data Sheet (FSDS) form to document the station and sample details (see SOP-9, Attachment 1). Document soil characteristics, sample location, as well as any changes to this SOP in the field logbook.

14. Locate the sample using GPS according to SOP No. 11 and record location coordinates on the FSDS form.
15. Pack samples jars in bubble wrap to avoid breakage during shipment.
16. Store and ship samples on ice at 4 degrees Celsius. For further details on shipping and handling refer to SOP-8.
17. Include a trip blank in every cooler.

Note: When capping the 40ml VOA vial, be sure to remove any soil or debris from the threads of the vial.

The soil samples must be of small enough particle size to use the syringe or Terra Core™ sampler. Soils that are conducive to using the syringe or Terra Core™ sampler include soils that are classified as clays, silts and fine to medium grain sands and some coarse grain sands. If larger particle size materials need to be collected, a 5.0 gram sample will be collected with a spatula or scoop and carefully placed into the vial.

Preservation: Methanol or Sodium Bisulfate preservation is used with the Terra Core™ sampler. Methanol preservation (see below) is required for Massachusetts Department of Environmental Protection Volatile Petroleum Hydrocarbon analyses (i.e., method required by Montana Department of Environmental Quality for risk-based evaluation of petroleum releases). Refer to SW-846 Method 5035A (U.S. EPA, 1996) for full details on sample preservation.

A sodium bisulfate preservative solution is used for the collection of soil samples in which the suspected VOC concentration is in the range of 0.5 to 200 micrograms per kilogram ($\mu\text{g}/\text{kg}$). For soil samples in which the VOC concentration is suspected to be greater than 200 $\mu\text{g}/\text{kg}$, either a bulk sample may be collected (the laboratory will add a water miscible solvent) or the sample is collected in a vial that contains a water-miscible organic solvent (methanol).

Soil samples of suspected low VOC concentration (0.5 - 200 µg/kg) are to be collected as described above into a pre-weighed vial that already contains a stirring bar and a sodium bisulfate preservative solution.

Soil samples that contain carbonate minerals may effervesce when in contact with the sodium bisulfate. If this occurs, two options can be considered: (1) the sample will be collected in a vial containing laboratory grade DI water or (2) 5 mL of organic-free reagent water can be added to each vial. The water and the preservative will form an acid solution that will reduce or eliminate the majority of the biological activity in the sample, thereby preventing biodegradation of the volatile target analytes. If this still occurs, the sample shall be collected in an un-preserved vial or other sampling container.

Soil samples of suspected high VOC concentration (greater than 200 µg/kg) are to be collected in a pre-weighed vial that contains methanol, as described below.

1. Collect approximately a 5 gram sample (weighed in the field) and place the sample in a pre-weighed vial with a septum-sealed screw-cap that contains 5 milliliters (mL) of water-miscible organic solvent, (methanol). The vial can either be prepared by the laboratory or prepared in the field at the time of sampling. Immediately prior to use, the vial shall be weighed and the weight (in grams [g]) of the methanol and vial recorded.
2. Weigh the sealed vial containing the sample to ensure that 5.0 ± 0.5 g of sample was added. The balance should be calibrated in the field using class S weights at a weight appropriate for the sample containers. Record the weight of the sealed vial containing the sample to the nearest 0.01 g. It may be necessary to conduct several trial runs to determine the amount of soil required to meet the 5.0 ± 0.5 g criteria. Once filled, the soil vial cannot be opened without compromising the integrity of the sample.
3. If there is a reduction in weight of greater than 0.01 g then the vial shall not be used for sample collection. After weighing, the scale shall be tarred. Five (5) grams ± 0.5 g of sample shall be transferred to the vial immediately after sample collection and in a manner that minimizes loss of VOCs. Quickly brush any soil off the vial threads and immediately seal the vial with the septum and screw-cap. Store samples on ice at 4°C.

4. All samples for VOC analysis shall be cooled to approximately 4°C, packed in appropriate containers, and shipped to the laboratory on ice. For further details on shipping and handling refer to SOP-8.
5. Document sample location using global positioning system (GPS) according to SOP-11.

Oily Waste Samples: If oily waste samples are known to be soluble in methanol then sample vials may be used as described above. However, if oily waste samples are not known to be or are not soluble in methanol then the sample should be collected in an un-preserved vial.

6.0 QUALITY ASSURANCE AND QUALITY CONTROL

Field duplicates and equipment rinsate samples will be collected at the frequencies documented in the field sampling plan.

All sampling data must be documented in the field logbooks and/or field forms, including the rationale for deviations from this SOP. The Field Team Leader or designated QA reviewer will check and verify that field documentation has been completed per this procedure and other procedures referenced herein. All equipment must be operated according to the manufacturer's specifications, including calibration and maintenance.

7.0 DECONTAMINATION

All non-disposable equipment used in the sampling process shall be decontaminated prior to field use and between sample locations. Decontamination procedures are presented in SOP-7. Personnel shall don appropriate personal protective equipment as specified in the project-specific health and safety plan. Note that when handling the vials that contain methanol, methanol resistant gloves shall be worn. Investigation-derived waste generated in the sampling process shall be managed in accordance with the procedures of SOP-12.

8.0 REFERENCES

U.S. Environmental Protection Agency. 1996. SW-846 Method 5035A Revision 0, Closed System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples.

Agency for Toxic Substances and Disease Registry. 2006. Asbestos Exposure and Your Health.



Libby Superfund Site Operable Unit 3 Standard Operating Procedure

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OU3 SOP 3 (Rev. 0)

Title: SURFACE WATER SAMPLING

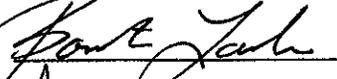
APPROVALS:

TEAM MEMBER

SIGNATURE/TITLE

DATE

EPA Remedial Project Manager





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SOP Author

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1.0 INTRODUCTION

This standard operating procedure (SOP) is based on MWH SOP-12, Surface Water Sampling, Revision 1.0, March 2004, modified for use at the Libby Asbestos Superfund Site OU3. This SOP describes methods and equipment commonly used for collecting environmental samples of surface water for either on-site examination and chemical testing or for laboratory analysis. The information presented in this SOP is generally applicable to all environmental sampling of surface waters except where the analyte(s) may interact with the sampling equipment. The collection of concentrated sludges or hazardous waste samples from disposal or process lagoons often requires methods, precautions, and equipment different from those described herein.

This document focuses on methods and equipment that are readily available and typically applied in collecting surface water samples. It is not intended to provide an all-inclusive discussion of sample collection methods. Specific sampling problems may require the adaptation of existing equipment or design of new equipment. Such innovations shall be clearly described in the project-specific sampling plan and approved by the Project Manager and the Quality Manager.

2.0 HEALTH AND SAFETY WARNING

All personnel engaged in surface water sampling must follow health and safety protocols described in the health and safety plan. Asbestos fibers are thin and long fibers so small that they cannot be seen by the naked eye. Asbestos fibers are easily inhaled when disturbed and when embedded in the lung tissue can cause health problems. Significant exposure to asbestos increases the risk of lung cancer, mesothelioma, asbestosis (non-cancerous lung disease), and other respiratory diseases (ATSDR 2006).

3.0 DEFINITIONS

Bailer: A long, narrow, tubular device with an open top and a check valve at the bottom. Bailers may be made of Teflon[®], Polyethylene, or stainless steel.

Specific Conductance: How well water can conduct an electrical current.

Dip Sampler: A sample collection container that may be held directly or attached to a pole, used to collect surface water samples from the surface or just beneath the surface of a water body.

Dissolved Oxygen (DO): A measure of the quantity of oxygen dissolved in water. DO data is collected in the field using direct measure probes.

Environmental Sample: A liquid sample collected for chemical analysis. These samples are used to support remedial investigation, feasibility studies, treatability studies, remediation design and performance assessment, waste characterization, etc.

Oxidation-Reduction Potential (ORP): A measurement of the reducing or oxidation potential of a given system or medium. ORP data is collected in the field using direct-measure probes.

Peristaltic Pump: A low volume pump that operates by suction lift.

pH: A measure of the acidity or alkalinity of a solution, numerically equal to 7 for neutral solutions, increasing with increasing alkalinity to a maximum value of 14, and decreasing with increasing acidity to a minimum value of 1.

Temperature: A measure of the thermal energy contained in a given system. Units are commonly in degrees Celsius (°C).

Turbidity: Cloudiness in water due to suspended and colloidal organic and inorganic material. Units are commonly in Nephelometric Turbidity Units (NTUs).

4.0 RESPONSIBILITIES

This section presents a brief definition of field roles, and the responsibilities generally associated with them. This list is not intended to be comprehensive and often, additional personnel may be involved. Project team member information will be included in project-specific plans (e.g., work

OU3 SOP 3

Rev. No. 0

Date: September 26, 2007

Page 3 of 11

plan, field sampling plan, quality assurance plan, etc.), and field personnel will always consult the appropriate documents to determine project-specific roles and responsibilities. In addition, one person may serve in more than one role on any given project.

Project Manager: Selects site-specific field sampling program with input from other key project staff, and applicable oversight agencies.

Quality Control Manager: Overall management and responsibility for quality assurance and quality control (QA/QC). Selects QA/QC procedures for the sampling and analytical methods, performs project audits, and ensures that data quality objectives are fulfilled.

Field Team Leader (FTL) and/or Geologist, Hydrogeologist, or Engineer: Implements the sampling program, supervises other sampling personnel, and ensures compliance with SOPs and QA/QC requirements. Prepares daily logs of field activities.

Sampling Technician (or other designated personnel): Assists the FTL and/or geologist, hydrogeologist, or engineer in the implementation of tasks. Performs the actual sample collection, packaging, and documentation (e.g., sample label and log sheet, chain-of-custody record, etc).

5.0 SURFACE WATER SAMPLING PROCEDURES

5.1 Background

The methods and procedures described in this SOP were developed from these sources:

U.S. Geological Survey, variously dated. *National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Chapters A1-A9*. Available online at <http://pubs.water.usgs.gov/twri9A>.

- U.S. Environmental Protection Agency, Region 8, 2003. *SOP EH-#1 Technical Standards Operating Procedure – Surface Water Sampling East Helena Site, Montana*. Available online at http://www.epa.gov/region8/r8risk/pdf/r8-src_eh-01.pdf

5.2 Surface Water Sample Collection

Rivers, Streams and Ponds: Where multiple sampling stations exist along a moving water source (i.e., a creek or drainage channel), water samples generally will be collected from downstream to upstream locations, to minimize the effect of sampling activities on the samples collected. The samples will be grab samples collected from representative flowing water (usually the mid-channel), that is the portion of the water with the maximum flow at any given sampling station, unless otherwise specified.

A surface water sample will be collected according to one of the following, or similar, techniques.

1. Direct Method -- Sample bottle is uncapped and inverted, submerged to the specified depth, turned upright pointing upstream, removed from the water, and then capped. Add preservative, if any, after sample collection.
2. Dipper Method -- Sample bottle or container attached to a pole is dipped in the water, raised above the water, and then capped (if actual sample bottle used).
3. Bailer Method -- A appropriate sampling bailer with a ball check valve is submerged to the desired sample depth, either directly or by suspending the bailer on a rope from a pole.
4. Peristaltic Pump Method -- The sample is collected through a section of new, clean, flexible Tygon (polyvinylchloride) tubing. The tubing intake will be secured manually or by attaching weights. This procedure may be modified to collect the sample through a Teflon tube into a sample flask by running the pump on a vacuum.
5. Kemmerer Bottle -- Use a properly decontaminated Kemmerer bottle. Set the sampling device so that the upper and lower stoppers are pulled away from the body, allowing water to enter the tube. Lower the pre-set sampling device to the predetermined depth. Avoid disturbing the bottom. Once at the required depth, send the weighted messenger down the suspension line, closing the device. Retrieve the sampler and discharge the first 10-20 mL from the drain to clear water that may not be representative of the sample. Repeat as needed to fill collect the needed volume.
6. Van Dorn Sampler -- Set the device so that the end stoppers are pulled away from the body allowing surface water to enter the tube. Lower the sampler to the predetermined depth. Once at the required depth send the weighted messenger

down the suspension line, closing the sampling device. Retrieve the sampler and decant the first 10-20 mL from the drain to clear water that may not be representative of the sample from the valve. Repeat as needed until the required volume to fill sample bottles is collected.

7. Bacon Bomb Sampler -- Lower the bacon bomb sampler carefully to the desired depth, allowing for the trigger to remain slack at all times. When the desired depth is reached, pull the trigger line until taut. This will allow the sampler to fill. Release the trigger line and retrieve the sampler. Decant the first 10-20 mL from the drain to clear water that may not be representative of the sample from the valve. Repeat as needed until the required volume to fill sample bottles is collected.

For very shallow waters, a syringe method can be used, where a disposable plastic filtering syringe may be used to collect a sample without disturbing the sediment. Alternatively, at low flowing seeps and springs a small depression may be created to capture water. If a depression is made, the disturbance-related turbidity should be allowed to clear (settle) before the sample is collected.

5.3 Sampling Equipment and Techniques

The selection of sampling equipment listed above depends on the site conditions and sample type required. In addition, the following equipment is needed to collect surface water samples:

- Field notebook, indelible marker
- Global Positioning System (GPS) unit
- Marking stakes
- Digital Camera
- Compass
- 100 m measuring tapes
- Detergent solution (0.1-0.3 % Alconox)
- Distilled water
- Latex gloves
- Ziploc bags
- Paper Towel

- Chain of custody and sample labels
- Coolers
- Sample bottles
- Plastic sheeting

For collecting surface water samples, the procedures outlined below shall be followed.

1. Don appropriate health and safety equipment
2. Setup clean plastic sheeting in area for processing samples
3. Collect a surface water sample beginning from the most downstream location using one of the methods specified above
4. Place a stake or pole at or near the sampling location for future ease of identification
5. The first collected water will be used to rinse the sampling equipment. Sample bottles that do not contain preservative should be rinsed with the sample water prior to filling
6. Pour the sample from the sampling equipment down the side of the sample container in such a manner as to minimize turbulence during the transfer, or alternatively, collect the sample directly into the sample container. However, a primary concern with sample collection directly into sample containers is the loss of sample preservative from the sample container as it is dipped directly into the surface water.
7. Collect samples for Volatile Organic Compounds (VOC) first. Do not collect samples for VOC analysis using a peristaltic pump.
8. Label sample containers with the sample location and sample analysis information in accordance with the procedures in SOP-9.

9. Measure and record water quality parameters pH, DO, temperature, specific conductance, ORP, and turbidity using equipment calibrated according to manufacturer's specifications
10. Measure stream discharge according to SOP-4 and locate the sample using a site map or GPS according to SOP-11.
11. Pack samples containers to avoid leakage or breakage during shipment.
12. Store and ship samples on ice at 4 degrees Celsius. For further details on shipping and handling refer to SOP-8.

5.4 Sample Filtration: When required, a field-filtered water sample will be collected using a disposable, in-line 0.45 µm filter. The water sample will be pumped through the filter using a peristaltic pump and a section of Tygon (polyvinylchloride) or non-reactive (Teflon[®]) tubing or other appropriate method. An aliquot of approximately 100 ml of sample will be run through the tubing and filter prior to collection into the sampling containers. Both the filter and tubing will be disposed of between samples.

5.5 Sample Containers and Volumes: Certified clean sample containers appropriate to the analytical method will be obtained from the water analysis laboratory or other approved source. Different containers will be required for specific groups of analytes in accordance with U. S. EPA Methods, project specific requirements, and/or other local jurisdictional guidance. The sampler will confirm with the laboratory performing the analyses that the appropriate bottleware and preservatives are used and ensured that sufficient volume of the sample is collected.

Sample bottles and bottle caps will be protected from dust or other contamination between time of receipt by the sampling personnel and time of actual usage at the sampling site. Sampling equipment that will be used at multiple sampling locations will be cleaned after sampling at each location is completed. Decontamination of equipment will be completed in accordance with SOP-7.

5.6 Sample Preservation and Storage: If required by the project or analytical method, water samples submitted for chemical analysis will be stored at 4°C in ice-cooled, insulated containers immediately after collection. Preservation and storage methods depend on the chemical constituents to be analyzed and should be discussed with the water analysis laboratory prior to sample collection. EPA and/or other local jurisdictional requirements and/or the requirements of a project-specific plan (e.g., sampling and analysis plan, work plan, quality assurance project plan, etc.) shall be adhered to in preservation and storage of water samples.

5.7 Documentation: At each surface water station, sample details will be recorded on a Surface Water field sample data sheet (FSDS) form (see SOP-9, Attachment 1). Sampling conditions, including any deviations from this SOP in field logbook according to SOP-9. The sampling conditions that should be noted in the field log book will include:

- A. Project identification;
- B. Location identification (sampling station);
- C. Detailed description of sampling location;
- D. Sampling methods and equipment;
- E. Condition of water (standing or moving);
- F. Instrument calibration and cleaning record; and
- G. Sketch map showing location of sampling station and permanent landmarks, and locate using a global positioning system according to SOP-11.

When the sampling activity is completed, the record will be checked by the Project Manager or his/her designee, and the original record will be placed in the project file.

6.0 QUALITY ASSURANCE AND QUALITY CONTROL

Field splits, field blanks, equipment rinsates, and matrix spike samples will be collected at the frequencies documented in the field sampling plan. Calibration checks will be performed at least once prior to and at least once following each day of instrument use in the field and the results documented in the field log book. All sampling data must be documented in the field logbooks and/or field forms, including rationales deviations from this SOP. The Field Team Leader or designated QA reviewer will check and verify that field documentation has been completed per this procedure and other procedures referenced herein. All equipment must be operated according to the manufacturer's specifications, including calibration and maintenance.

7.0 DECONTAMINATION

All equipment used in the sampling process shall be decontaminated prior to field use and between sample locations. Decontamination procedures are presented in SOP-7. Personnel shall don appropriate personal protective equipment as specified in the health and safety plan. Any investigation-derived waste generated in the sampling process shall be managed in accordance with the procedures outlined in SOP-12.

8.0 REFERENCES

Agency for Toxic Substances and Disease Registry. 2006. Asbestos Exposure and Your Health.

Feltz, H.R., 1980. Significance of Bottom Material Data in Evaluating Water Quality in Contaminants and Sediments. Ann Arbor, Michigan, Ann Arbor Science Publishers, Inc., Vol. 1, pp. 271-287.

Kittrell, F.W., 1969. A Practical Guide to Water Quality Studies of Streams. U.S. Federal Water Pollution Control Administration, Washington, D.C., 135 pp.

U.S. Environmental Protection Agency (USEPA), 1980. Standard Operating Procedures and Quality Assurance Manual. Water Surveillance Branch, USEPA Surveillance and Analytical Division, Athens, Georgia.

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U.S. Environmental Protection Agency. 2007. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. U.S. Environmental Protection Agency, Office of Environmental Information. EPA/600/B-07/001. April 2007.

U.S. Geological Survey (USGS), 1977. National Handbook of Recommended Methods for Water-Data Acquisition. Office of Water Data Coordination, Reston, Virginia.

Libby Superfund Site Operable Unit 3 Standard Operating Procedure

Date: September 26, 2007

OU3 SOP 4 (Rev. 0)

Title: SURFACE WATER DISCHARGE MEASUREMENT

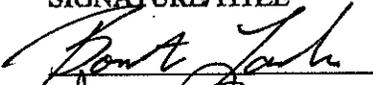
APPROVALS:

TEAM MEMBER

SIGNATURE/TITLE

DATE

EPA Remedial Project Manager



9/26/07

SOP Author



9/26/07

Revision Number	Date	Reason for Revision
0	09/26/2007	--



1.0 INTRODUCTION

This Standard Operating Procedure (SOP) describes the protocol for collecting discharge measurements in streams and ditches. Discharge is defined as the volume rate of flow of water, including any substances suspended or dissolved in the water. Discharge will be expressed in cubic feet per second (cfs) or gallons per minute (gpm). This SOP provides a method for describing a current and three methods for measuring discharge: 1) volumetric method, 2) area-velocity method, and 3) flume method. Note that the protocol for collection of surface water samples is included in Libby OU3 SOP-3, Surface Water Sampling.

The procedures presented herein are intended to be general in nature and are applicable when referenced in a monitoring or field sampling plan. As the work progresses, and if warranted, appropriate revisions may be made when approved in writing by the Project Manager. All discharge measurements must be performed following health and safety protocols described in the health and safety plan.

2.0 HEALTH AND SAFETY WARNING

All personnel engaged in surface water discharge measurements must follow health and safety protocols described in the health and safety plan. Asbestos fibers are thin and long fibers so small that they cannot be seen by the naked eye. Asbestos fibers are easily inhaled when disturbed and when embedded in the lung tissue can cause health problems. Significant exposure to asbestos increases the risk of lung cancer, mesothelioma, asbestosis (non-cancerous lung disease), and other respiratory diseases (ATSDR 2006).

3.0 DEFINITIONS

Discharge: The volume of water transported in a certain amount of time through a cross-section of a stream. Discharge is expressed in cfs or gpm.

4.0 RESPONSIBILITIES

This section presents a brief definition of field roles, and the responsibilities generally associated with them. This list is not intended to be comprehensive and often additional personnel may be involved. Project team member information shall be included in project-specific plans (e.g., work plan, field sampling plan, quality assurance plan, etc.), and field personnel shall always consult the appropriate documents to determine project-specific roles and responsibilities. In addition, one person may serve in more than one role on any given project.

Project Manager: Selects site-specific sampling methods, sample locations, and constituents to be analyzed with input from other key project staff.

Quality Control Manager: Overall management and responsibility for quality assurance and quality control (QA/QC). Selects QA/QC procedures for the sampling and analytical methods, performs project audits, and ensures that data quality objectives are fulfilled.

Field Team Leader (FTL) and/or Field Geologist, Hydrogeologist, or Engineer: Implements the sampling program, supervises other sampling personnel, and ensures compliance with SOPs and QA/QC requirements. Prepares daily logs of field activities.

Sampling Technician (or other designated personnel): Assists the FTL, geologist, hydrogeologist, or engineer in the implementation of tasks. Performs the actual sample collection, packaging, and documentation (e.g., sample label and log sheet, chain-of-custody record, etc.).

5.0 DISCHARGE MEASUREMENT PROCEDURES

5.1 Background

The methods and procedures described in this SOP were developed from these sources:

- Rantz, S.E. et al., 1982. *Measurement and Computation of Streamflow: Volume 1, Measurement of Stage and Discharge*, U.S. Geological Survey Water Supply Paper 2175. U.S. Government Printing Office, Washington, D.C.
- U.S. Department of the Interior, 1977. *National Handbook of Recommended Methods for Water-Data Acquisition*. Office of Water Data Coordination, U.S. Geological Survey, Reston, VA.
- U.S. Environmental Protection Agency, 1986. *Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual*. Environmental Services Division, Region IV, Athens, GA.

The selection of an appropriate method for discharge measurement depends on the flow conditions. In some conditions, the flow measurement methods described here may be impossible to implement (e.g., extreme high-flow conditions). If flow conditions cannot be measured at a specific location, then field personnel will attempt to measure flow at a point upstream or downstream of the sample site. The field personnel will also note the conditions that inhibited more accurate measurement at the designated measurement location. All samples should be collected prior to performing the discharge measurements.

5.2 Qualitative Current Description

In cases where a discharge measurement is not required but a description of the direction and relative rate of flow is useful, qualitative measurements are made. Qualitative measurement of current is made by using a strip of soft tape or cloth attached to the end of a pole. The strip will indicate the presence of water flow and direction of flow at the location and depth. The diameter of the pole should be sufficiently small to prevent directional error.

5.3 Discharge Measurement

Quantitative measurements may be made using a current meter, a volumetric method, or flume method. The selection of discharge measurement method depends on streamflow rate and/or specific channel characteristics. For pipes, drain system outfalls and cases where flows are too small or stream gradients are too high, the volumetric method is appropriate. In cases where water depth is

greater than 0.3 feet or the channel cross section is wide, discharge should be measured using the area-velocity method. Where flows are below the practical limit that can be measured with the area-velocity method, the flume method is best. Where the total discharge is conveyed through two channels or differing types, a combination of these methods may be appropriate.

5.3.1 Volumetric Method

The volumetric method is a simple and accurate method for measuring flow from small discharges such as gravity flow discharged from pipe outlets, and is particularly useful for the measurement of small flows. This method involves observing the time required to fill or partly fill a calibrated container to a known volume. Alternatively, in the case of measuring discharge remotely in a sump or standpipe setting, the volumetric method may be performed by capturing flow in a container for a set period of time, no less than 10 seconds. This volume of water is then measured and discharge is determined.

Field personnel will observe and use judgment in approximating the flow volume and will select an appropriately sized volumetric container to use the volumetric method of flow measurement. Equipment required to make this measurement is a calibrated container and a stopwatch. Calibrated containers of varying sizes include: 5-gallon bucket, 2-liter graduated cylinder, 1-liter graduated cylinder, 1-liter bucket, etc. The incremental volume of a 5-gallon bucket can be determined by adding known volumes of water and recording the depth after each addition.

To measure flow, a technician will measure the time required to fill a volumetric container. The technician will time flow into the container for a minimum of 10 seconds. Five consecutive measurements will be made and noted, and the results will be averaged to determine the discharge. If remote measurement is necessary, a container will be attached to an extension rod. The technician will time flow for a minimum of 10 seconds. The volume of water will then be poured into a calibrated container, measured, and recorded. Five such measurements will be made, noted, and the results averaged to determine the discharge.

Calculations will be performed as follows:

- Record each of the five measurements in terms of gallons per second or milliliters per second, depending on the volumetric container.
- If one of the five measurements is 50 percent or more different from the other measurements, then this value will not be used. Instead, five additional measurements will be taken and, provided that none of these measurements differs by greater than 50 percent from the other measurements, these values will be used.
- Average the five values.
- Leakage around the discharge pipe, if any, will also be estimated and noted.
- Convert the averaged value to cfs as follows:
 - to convert ml/s to cfs, multiply by 3.53×10^{-5}
 - to convert gal/s to cfs, multiply by 0.134
- Record discharge in cfs.

5.3.2 Velocity-Area Method

The vertical axis current meter may be used to perform velocity-area method discharge measurements. Common types of vertical axis current meters are the Price meter, type AA, and the Marsh-McBirney. A current meter is an instrument used to measure the velocity of flowing water. Operation of the Price Meter, type AA, is based on the proportionality between the velocity of the water and the resulting angular velocity of the meter rotor. By placing a current meter at a point in a stream and counting the number of revolutions of the rotor during a measured interval of time, the velocity of water at that point is determined. The number of revolutions of the rotor is obtained by an electrical circuit through the contact chamber. Contact points in the chamber are designed to complete an electrical circuit at selected frequencies of revolution. The electrical impulse produces an audible click in a headphone. The intervals during which meter revolutions are counted are timed with a stopwatch. The Marsh-McBirney uses electromagnetic induction to determine the velocity of

water. As water flows over a sensor it changes the voltage within the sensor. The changing voltage is processed by the instrument which presents the output as a linear measurement of velocity.

A Price pygmy meter may be used in shallow depths and low-velocity waters. The pygmy meter is scaled two-fifths as large as the type AA meter. The pygmy meter makes one contact (click) per revolution and the type AA meter can make one click per revolution or one click per five revolutions.

The Marsh-McBirney type meter can be used at any depth greater than 0.15 feet.

The current meter measures velocity at a point. The velocity-area method requires measurement of the mean velocity in selected subsections of the stream cross-section. By dividing the stream width into subsections, discharge becomes the total of discharges measured in each subsection. Velocity (V) is measured at each subsection, and discharge becomes the sum of the products of each velocity point and the cross-sectional area of each subsection:

$$Q = \sum(A_i * V_i)$$

where: Q = Streamflow in cfs,
A = Area of stream subsection in square feet, and
V = velocity in feet per second.

A cross section is defined by the depths at vertical points (i = 1, 2, 3, ...n) where the average velocity is measured.

In general, the person(s) measuring discharge should strive to measure no more than 5 percent of the flow in any one subsection. However, for small streams this is often impossible. Therefore, the person(s) should divide the channel cross-section into as many subsections as possible and make two complete discharge measurements using different sections for each. Subsections do not need to be identical in width. Velocities near banks are generally lower than velocities near the center of streams; therefore, these subsections may be wider than subsections near the center. Subsections will also be more closely spaced if a stream has an unusually deep portion in the cross-section.

Typically, velocities will be measured by current meter for a 40- to 70-second period. It is recognized that 40 to 70 seconds is not long enough to ensure the accuracy of a single-point observation of velocity. However, because pulsations caused by turbulent and eddying effects are random and because velocity observations during a discharge measurement are made at several verticals, there is little likelihood that the pulsations will bias the total measure discharge of a stream.

To make an area-velocity discharge measurement, the following conditions are required:

1. The stream must be channelized or contain relatively straight sections upstream of the measurement location.
2. Depth must be greater than 0.2 foot across most of the cross-section being measured.

The ideal channel cross-section is trapezoidal in shape, completely smooth in boundary materials, and possesses a uniform velocity distribution. Such an ideal condition is rarely observed. Therefore, minor modifications to the stream channels will be used to optimize measurement conditions. These modifications may include removal of aquatic vegetation, ice, and moving small stones that impact velocity upstream or downstream of the cross-section. However, no modifications should be made while measurements are being taken.

If flow conditions permit, current meter measurements will be made by wading. The type AA or pygmy meter and the Marsh-McBirney are used for wading measurements. The table below lists the type of meter and velocity method to be used for wading measurements at various depths. The persons(s) should stand at arm's length to the side of the meter.

Velocity Measurement Point Selection

Stream Depth (ft)	Type of Meter	Velocity Measuring Point(s) (Fraction of Depth)
2.5 or more	Type AA/Marsh-McBirney	0.2 and 0.8
1.5 - 2.5	Optional/Marsh-McBirney	0.6
0.3 - 1.5	Optional/Marsh-McBirney	0.6
< 0.3	Pygmy	0.5

Some departure from these specifications will be permitted. A Marsh-McBirney meter is appropriate for all depths deeper than 0.15 feet. Do not switch from one meter to another in the middle of a discharge measurement.

Under open channel laminar flow conditions, the effect of fluid contact with the bed of a stream channel and the air is a vertical distribution of velocities. Consistent with this velocity distribution, actual observation and mathematical theory has demonstrated that a single measurement of velocity taken at 0.6-depth or the average of two point velocities taken at 0.2 and 0.8 of the depth below the surface accurately results in mean velocity in the vertical (U.S.G.S. Water-Supply Paper 2175, 133-134 pp).

If the stream is generally less than 2.5 feet deep, the six-tenths (0.6) method will be used. If the stream is generally greater than 2.5 feet, the two- and eight-tenths (0.2 and 0.8) method, also known as the two-point method, will be used. A complete discussion concerning how to set the wading rod to place the current meter at proper depths is contained in Section 2.3.5, Field Procedures.

In the 0.6-depth method, an observation of velocity made in the vertical at 0.6 of the depth below the surface is used as the mean velocity in the vertical. In the two-point method of measuring velocities, observations are made in each vertical at 0.2 and 0.8 of the depth below the surface. The average of the two observations is taken as the mean velocity in the vertical.

A depth of 1.25 feet will accommodate the 0.6-depth method without causing the meter to be set closer than 0.5 feet from the stream bed; if the meter is set any closer to the stream bed, it will under-register the velocity. If the technician is at a measurement section that has only a few verticals shallower than 1.25 feet, the technician should use the type AA or Marsh-McBirney meter rather than the pygmy meter.

Mechanical vertical axis current meters do not register velocities accurately when placed close to a vertical wall. A Price meter held close to a right-bank vertical wall will under-register because the slower water velocity near the wall strikes the effective (concave) face of the cups. The converse is true at a left-bank vertical wall. (The terms "left bank" and "right bank" designate direction from the center of a stream for an observer facing downstream.) The Price meter also under-registers when positioned close to the water surface or close to the streambed.

5.3.2.1 Equipment And Techniques

Current meters, timers, depth and width measuring devices, and a means of counting meter revolutions are needed for measurement of discharge. The equipment includes:

- Field notebook, indelible marker
- Global Positioning System (GPS) unit;
- Digital Camera;
- Top-setting wading rod and current meter;
- Width-measuring devices, either engineer's tape or tagline;
- Digital counter or headset and stopwatch;
- Current meter rating tables;
- Stakes for width-measuring devices; and
- Calculator.

Top-Setting Wading Rod. The depth-measuring device that will be used is the wading rod. The current meter is attached to the wading rod. The top-setting wading rod has a 2-inch hexagonal main rod for measuring depth and a d-inch diameter round rod for setting the position of the current meter.

Current Meter. Vertical axis current meter, Marsh-McBirney, type AA meter, or pygmy meter.

Engineer's Tape or Tagline. Tape measures or premarked taglines are used for stream width measurements. Orientation normal to the flow patterns of the stream and elimination of most of the sag, through support or tension, are recommended for improved accuracy.

Digital Revolution Counter or Headset. The digital revolution counter attaches to an electronic connection at the top of the wading rod. The digital display shows the number of seconds of elapsed time. The person(s) stops the counter after 40 or more seconds, and the counter automatically displays the velocity.

If the digital counters are unavailable, the headset will be used as a means for determining the number of revolutions. A headset attaches to an electronic connection at the upper end of the wading rod. The person(s) wears this headset to listen to the audible clicking sounds produced by current meter revolutions. The number of rotations are counted and timed. Velocities as a function of time are listed on a current meter rating chart provided by the manufacturer, which is kept in the current-meter carrying case. When using the Marsh-McBirney meter a revolution counter or a headset will not be needed. This type of meter computes velocity directly. A velocity reading should be taken only after a suitable time has passed allowing the readings to stabilize.

Stopwatch. A stopwatch is used to measure time during which velocity is measured at each point in the cross-section.

5.3.2.2 Maintenance And Calibration

Prior to and following the use of the current meter, spin tests will be conducted to ensure that the unit performs acceptably. The spin test will be performed in an enclosed area, such as in the cab or in the enclosed rear of the trunk, to prevent wind interference. The test is to be performed prior to attaching the current meter to the wading rod. While holding the meter steady in an area sheltered

Libby Superfund Site Operable Unit 3 Standard Operating Procedure

from breezes, the technicians will spin the rotor and then press the start button on the stopwatch. The technician will observe the meter until the rotor ceases to spin.

The duration of the spin for the pygmy meter will be more than 40 seconds, and for the Price AA meter, it will be more than 90 seconds. If the meter fails to meet the time-of-spin criteria, the meter will be cleaned and oiled before use. If the meter continues to spin well beyond these time limits, the record will indicate that the meter spun for 40+ seconds in the case of the pygmy meter, or for 90+ seconds in the case of the Price AA meter.

The Marsh-McBirney will have a zero check performed on the sensor to ensure accurate readings are obtained. First clean the sensor. Then place the sensor in a five gallon bucket of water. Keep it at least three inches away from the sides and bottom of the bucket. To make sure the water is not moving, wait 10 to 15 minutes after you have positioned the sensor and before taking any zero readings. If needed follow the manufactures recommendations to zero adjust the sensor.

To ensure reliable observations of velocity, it is necessary that the current meter be kept in good condition. Before and after each discharge measurement, the meter cups or vanes, pivot and bearing, and shaft will be examined for damage, wear, or faulty alignment. During measurements, the meter will be observed periodically when it is out of the water to be sure that the rotor spins freely and/or the sensor is free of debris.

Meters will be cleaned and oiled daily when in use. If measurements are made in sediment-laden water, the meter will be cleaned immediately after each measurement. After oiling, wipe away any excess oil and spin the rotor to ensure that it operates freely. If the rotor stops abruptly, the cause of the trouble will be determined and corrected before using the meter. The Marsh-McBirney should not be oiled in any way.

In addition to meter maintenance, the entire unit consisting of current meter, wading rod, and digital counter or headset will be checked before departure to the field each day as follows:

- Attach the current meter and digital counter/headset to the wading rod.
- Check the digital counter by ensuring that the readout is visible when the unit is turned on.
- If a headset is being used:
 - Spin the current meter to ensure that audible clicks occur.
 - If audible clicks do not occur, the following steps should be taken:
 - Check that electronic connections are tight.
 - Check that the cat's whisker lightly contacts the upper part of the shaft.
 - Spin again. If audible clicks still do not occur, check that the battery in the headset is properly aligned. Replace the battery, if necessary.

5.3.2.3 Procedures

Upon arrival at the site, the field technicians will evaluate the flow conditions to determine which measurement method is appropriate. Based on flow conditions, the Price AA meter, the pygmy meter, or the Marsh-McBirney meter will be selected to perform an area-velocity measurement.

At each measurement point (or section) across the stream cross-section, depth is measured prior to measurement of velocity. Place the wading rod about 0.5 feet downstream from the tagline. Place the wading rod in the stream so the base plate rests on the streambed. The depth of water is read from the graduated main rod. The main rod is graduated into 0.1-foot increments. These increments are indicated by a single score in the metal. Half-foot increments are marked by two scores in the metal, and each foot is marked by three scores in the metal. A vernier scale on the upper handle of the rod corresponds to 0.1-foot increments, and has 1 through 9 in raised numbers next to raised marks. A sliding, adjustable rod, known as the setting rod, to which the meter is attached, has single scored marks that are aligned with values on the vernier scale.

In high-velocity areas, it is recommended that depth be read as the value between depth on the upstream side of the rod and depth on the downstream side of the rod. Depth is measured to the nearest 0.2 foot. This depth is used to set the vertical location of the current meter.

The setting rod is then adjusted downward so that the scored mark of the setting rod that corresponds to the range of depth in feet (e.g., if depth = 0.46, range in feet = 0; or if depth = 1.72, range in feet = 1) is aligned with the stream depth value transposed to the vernier scale. This automatically positions the meter for use in the 0.6 method as the meter is then six-tenths of the total depth from the surface of the water.

For using the two-point method of velocity measurement, the depth of water is divided by 2. This value is set so that the meter will be at the 0.8-depth position from the water surface. The depth of water is then multiplied by two, and this value is set. The meter will then be at the 0.2-depth position measured down from the water surface. These two positions represent the conventional 0.2- and 0.8-depth positions. If depths are less than 0.30 foot, the 0.5 method may be used. The observation depth recorded will then be 0.5 of the total depth.

If water quality or sediments are sampled in conjunction with discharge measurement, samples will be collected prior to making discharge measurements. The following steps are to be followed in discharge measurement:

- Evaluate the measurement location. Choose a location where flow is least turbulent. If the prescribed location is in a stream reach with highly turbulent flow conditions, try to select a location immediately upstream or downstream. Flow should be visible from bank to bank. Eddies and slack water must not be present. Neither the type AA meter nor the pygmy meter will be used for measuring velocities slower than 0.1 ft/s unless absolutely necessary.
- Remove aquatic vegetation, ice, or other minor flow impediments. When such modifications are made, exercise great care to avoid unnecessary movement of sediments allow flow to stabilize before the current meter measurement begins.

- Position a tape about 1 foot above the surface of the water. Secure the tape so that it remains taut and perpendicular to the channel.
- Select a starting point at either the left bank (left edge of water, LEW) or the right bank (right edge of water, REW). LEW and REW are determined when facing downstream.
- Note the distance in feet, and the stream direction, that this cross-section lies from the prescribed location. For example, the note may read "25 feet downstream" or "15 feet upstream."
- Measure the width of the stream. After selecting the appropriate meter, select the number of subsections in which to measure velocity attempting to measure no more than 10 percent of the total flow in any one section, if possible.
- After determining the distance desired between measuring points, commonly referred to as sections, measurement can begin. Record the time and bank at which measurements start on the discharge measurement notes as "REW Start 0000", using REW or LEW depending upon whether starting at the right or the left edge of the water.
- Note the distance to the beginning edge of water from the initial point. The initial point is an arbitrary point on the tape, preferably zero, which lies on the shoreside of the stream. All station locations are recorded as distances from the initial point.
- Proceed to the first station beyond the edge of water. Record the distance from the initial point on the discharge measurement notes. Place the wading rod into the stream so the base plate rests on the stream bed.
- Stand downstream of the tagline or tape and face upstream. Do not stand behind or close to the meter. Raise the current meter on the wading rod so that it is well above the surface of the water.
- Measure stream depth at the measurement point as indicated on the wading rod. Record the stream depth to the nearest 0.2 foot (for example 0.32 feet or 1.54 feet).
- Lower the meter to the required depth and record the observation depth. The observation depth as a fraction of total depth is 0.6, 0.2, 0.8 or occasionally 0.5.
- The technician will stand in a position that least affects the velocity of the water passing the current meter. That position is usually obtained by facing upstream with the arm fully extended. The technician will stand at about a 45-degree angle downstream from the wading rod. The wading rod is held in a vertical position with

the meter parallel to the direction of flow. Avoid standing in the water when possible.

- Start the digital counter. After 40 seconds, stop the counter. Note that the counter reports velocity.
- If using the headset rather than the digital counter, start the stopwatch on the first click and begin counting clicks. The first click counted after starting the stopwatch is counted as one.
- After at least 40 seconds have passed, stop the stopwatch on a click. Record the number of seconds and the number of revolutions (clicks) on the same line of the notes as the recorded depth.
- Determine velocity as a function of elapsed time and number of revolutions from the velocity chart specific to the flow meter. The manufacturer provides these charts with the instrument. Record velocity in the appropriate column. The flow meter must be aligned parallel to the direction of flow.
- Proceed to the next station. Record the distance from the initial point to the station. Repeat measurements of depth and velocity. Continue in this manner across the stream.
- After recording the distance measurement at the last station, record the time at which the ending edge of water is reached (e.g., LEW [or REW] FINISH 1330).
- Note velocity and depth at the edge of water as zero.
- Evaluate and record flow characteristics, weather conditions, air temperature, water temperature, observer(s), type of meter, and remarks.
- If less than 20 subsections have been used for the measurement, repeat the measurement steps. Begin from the opposite bank from where the previous measurement began.

5.3.2.4 Discharge Calculation

Calculate discharge on the discharge notes as follows:

- Use the distances from initial point to compute width for each subsection. The first width is computed by subtracting the first distance (edge of water) from the second distance and dividing this quantity by two. The second width will be the difference

between the third distance and the first distance divided by two. For each subsequent width, subtract the previous station distance from the following station distance and divide this quantity by two. The final width is calculated as the difference between the final distance and the second-to-last distance divided by two. Sum the width column and check to ensure that the calculated width equals the distance between the REW and LEW.

- Multiply the width by the depth for each station to determine the area of each subsection. Sum the areas to determine total area.
- Multiply the velocity by the area for each station to obtain the discharge for each subsection.
- Sum the discharges for each subsection to determine total discharge and record the value.
- If two sets of discharge measurements beginning at opposite banks were taken, repeat the discharge calculations for the second set of data. Average the total discharges for the two measurements. Record the average value and report it for input into the database.

5.3.3 Control Structures

Control structure such as flumes can be used to determine discharge. These structures have regular dimensions that allow for a consistent relationship between water level and discharge. A calibrated constriction placed in a stream channel changes the level of the water in or near the constriction. Flumes are constructed so that a restriction in the channel causes the water to accelerate, producing a corresponding change (drop) in the water level. When the physical dimensions of the flume constriction are known, discharge through constriction may be determined from measurement of depth. See below for a description of discharge measurement for Parshall flumes.

Typical flumes consist of three sections:

- A converging section to accelerate the approaching flow.
- A throat section, whose width is used to designate flume size.

- A diverging section, designed to ensure that the level downstream is lower than the level in the converging section.

The stage of a stream is the height of the water surface above an established elevation. Stage is usually expressed in feet. The Parshall flume consists of a converging section with a level floor, a throat section with a downward sloping floor, and a diverging section with an upward sloping floor. The principal feature of the Parshall flume (developed by R. Parshall in 1922) is an approach reach having converging sidewalls and a level floor, the downstream end of which is a critical depth cross-section. The primary stage measurement is made in the approach reach at some standard distance upstream from the critical-depth cross-section.

The flumes are designated by the width (w) of the throat. Flumes having throat widths from 3 inches (in.) to 8 feet (ft.) have a rounded entrance whose floor slope is 25 percent. Smaller and larger flumes do not have that feature. Ideally, flow rate through a flume may be determined by measurements at a single point some distance downstream from the inlet and above the throat.

5.3.3.1 Equipment

The following equipment will be needed:

- Field notebook, indelible marker
- GPS unit;
- Marking stakes;
- Digital Camera;
- Calculator;
- Current meter;
- Carpenter's level;
- Framing square;
- Measuring tapes; and
- Staff gauge.

5.3.3.2 Maintenance And Calibration

All flumes will be inspected to determine that entrance conditions provide a uniform influent flow distribution, the converging throat section is level, and that the throat section walls are vertical. The flume will be closely examined to determine that it is discharging freely. Any problems observed during the inspection will be noted and reported to the field manager.

5.3.3.3 Procedures

Steps to be followed in measuring discharge.

- Remove any material that may have accumulated in the flume or on the weir;
- If the station includes a chart recorder, inspect the strip chart on the recorder to verify that it is operating;
- Note any deterioration of the station; report these conditions to the field manager at the conclusion of daily data collection activities;
- Measure and record the throat width (W) to the nearest 1/10 of an inch;
- Use the staff gauge to measure and record the gauge height (H) to the nearest 0.2 foot;
- Calculate discharge as described in Subsection 2.5.6; and
- Record the calculated discharge and the time and date of the site visit.

5.3.3.4 Discharge Calculation

A set of flume tables is necessary for calculating flows. The flume tables are specific to the type and size of flume and are usually supplied by the flume manufacturer. Based on the gage height (head, H, in feet) and the throat width of the flume (size of flume, W), the discharge is read directly from the table provided from the manufacturer. Note that the approximate values of discharge for heads other than those shown may be found by direct interpolation in the table. The following equation and table gives calculation coefficients for discharge calculations with Parshall flumes.

Libby Superfund Site Operable Unit 3 Standard Operating Procedure

The free-flow discharge equations for the standard Parshall flume sizes are of the form:

$$Q = Ch_a^n$$

where:

h_a = measuring head (ft)

Q = discharge (ft³/s)

C and n = coefficients specific to flume size

Coefficients (C) and exponents (n) for Parshall flume discharge calculations are listed in the following table.

Throat width	Coefficient (C)	Exponent (n)
1 in	0.338	1.55
2 in	0.676	1.55
3 in	0.992	1.55
6 in	2.06	1.58
9 in	3.07	1.53
1 ft	3.95	1.55
2 ft	8.00	1.55
3 ft	12.00	1.57
4 ft	16.00	1.58
5 ft	20.00	1.59
6 ft	24.00	1.59
7 ft	28.00	1.60
8 ft	32.00	1.61
10 ft	39.38	1.60
12 ft	46.75	1.60
15 ft	57.81	1.60
20 ft	76.25	1.60
25 ft	94.69	1.60
30 ft	113.13	1.60
40 ft	150.00	1.60
50 ft	186.88	1.60

6.0 DOCUMENTATION

Information required by this SOP, including rationale for changes, will be documented in detail in a bound field notebook and on appropriate field forms (see attached). This information includes the calibration data for flow measurement devices and field discharge measurement data.

Documentation will also include the type of flow measurement device, including a model number and instrument serial number; a detailed description of measurement location and weather conditions during the measurement; and calculations.

7.0 QUALITY ASSURANCE AND QUALITY CONTROL

All data must be documented in the field logbooks and/or field forms, including rationales deviations from this SOP. The Field Team Leader or designated QA reviewer will check and verify that field documentation has been completed per this procedure and other procedures referenced herein. All equipment must be operated according to the manufacturer's specifications, including calibration and maintenance.

7.1 Calculation Check

All calculations will be reviewed for accuracy and conformance with these procedures. The calculation review will be performed by a technically qualified individual before results are reported or interpreted. The calculation check shall be documented by the reviewer's initials and date of review. A copy of the reviewed calculations should be included in the project file.

7.2 Records Review and Management

The project manager or designated reviewer will verify that documentation has been completed and filed per this procedure.

8.0 DECONTAMINATION

All equipment used in the discharge measurement process shall be decontaminated prior to field use and between locations. Decontamination procedures are presented in SOP-7. Personnel shall don appropriate personal protective equipment as specified in the health and safety plan. Any investigation-derived waste generated in the sampling process shall be managed in accordance with the procedures outlined in SOP-12.

9.0 REFERENCES

Agency for Toxic Substances and Disease Registry. 2006. *Asbestos Exposure and Your Health*.

Rantz, S.E. et al., 1982. *Measurement and Computation of Streamflow: Volume 1, Measurement of Stage and Discharge*, U.S. Geological Survey Water Supply Paper 2175. U.S. Government Printing Office, Washington, D.C.

U.S. Department of the Interior, 1977. *National Handbook of Recommended Methods for Water-Data Acquisition*. Office of Water Data Coordination, U.S. Geological Survey, Reston, VA.

U.S. Environmental Protection Agency, 1986. *Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual*. Environmental Services Division, Region IV, Athens, GA.

U.S. Environmental Protection Agency. 2007. *Guidance for Preparing Standard Operating Procedures (SOPs)*. EPA QA/G-6. U.S. Environmental Protection Agency, Office of Environmental Information. EPA/600/B-07/001. April 2007.

Libby Superfund Site Operable Unit 3 Standard Operating Procedure

Date: September 26, 2007

OU3 SOP 5 (Rev. 0)

Title: SEDIMENT SAMPLING

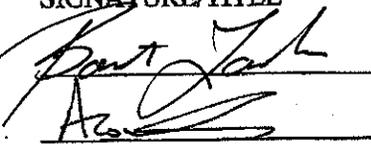
APPROVALS:

TEAM MEMBER

SIGNATURE/TITLE

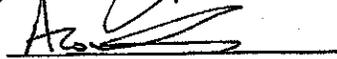
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EPA Remedial Project Manager



9/26/07

SOP Author



9/26/07

Revision Number	Date	Reason for Revision
0	09/26/2007	--



1.0 INTRODUCTION

This Standard Operating Procedure (SOP) describes the protocols to be followed when sediment samples are collected for physical or chemical analysis. The procedures presented herein apply to sediment sampling from surface waters, wetlands, ponds, drainage structures, etc.

This document focuses on methods and equipment that are readily available and typically applied in collecting sediment samples. It is not intended to provide an all-inclusive discussion of sample collection methods. Specific sampling problems may require the adaptation of existing equipment or design of new equipment. Such innovations shall be clearly described in the project-specific sampling plan and approved by the Project Manager and the Quality Manager.

2.0 HEALTH AND SAFETY WARNING

All personnel engaged in sediment sampling must follow health and safety protocols described in the health and safety plan. Asbestos fibers are thin and long fibers so small that they cannot be seen by the naked eye. Asbestos fibers are easily inhaled when disturbed and when embedded in the lung tissue can cause health problems. Significant exposure to asbestos increases the risk of lung cancer, mesothelioma, asbestosis (non-cancerous lung disease), and other respiratory diseases (ATSDR 2006).

3.0 DEFINITIONS

Environmental Sample: A solid sample collected for chemical or geotechnical analysis. These samples are used to support remedial investigation, feasibility studies, treatability studies, remediation design and performance assessment, waste characterization, etc.

Hand Auger: A sampling tool consisting of a stainless steel tube with two sharpened spiral wings at the tip.

Shovel/Trowel: A sampling device consisting of a stainless steel spade attached to a handle.

Core Sampler: A variable diameter stainless steel tube that can be attached to a hammer for

driving into sediment. The tube can also be fitted with retaining liners.

4.0 RESPONSIBILITIES

This section presents a brief definition of field roles, and the responsibilities generally associated with them. This list is not intended to be comprehensive and often additional personnel may be involved. Project team member information shall be included in project-specific plans (e.g., work plan, field sampling plan (FSP), quality assurance plan, etc.), and field personnel shall always consult the appropriate documents to determine project-specific roles and responsibilities. In addition, one person may serve in more than one role on any given project.

Project Manager: Selects site-specific sampling methods, sample locations, and constituents to be analyzed with input from other key project staff.

Quality Control Manager: Overall management and responsibility for quality assurance and quality control (QA/QC). Selects QA/QC procedures for the sampling and analytical methods, performs project audits, and ensures that data quality objectives are fulfilled.

Field Team Leader (FTL) and/or Field Geologist, Hydrogeologist, or Engineer: Implements the sampling program, supervises other sampling personnel, and ensures compliance with SOPs and QA/QC requirements. Prepares daily logs of field activities.

Sampling Technician (or other designated personnel): Assists the FTL, geologist, hydrogeologist, or engineer in the implementation of tasks. Performs the actual sample collection, packaging, and documentation (e.g., sample label and log sheet, chain-of-custody record, etc).

5.0 SEDIMENT SAMPLING PROCEDURES

This section describes sediment sampling from the bottom of a surface water drainage course or pond. The collected samples will be placed in appropriate sample containers, as designated by the FSP or Quality Assurance Project Plan (QAPP), for transfer to a laboratory for the analyses identified in the FSP. Details of sample collection will be described on the attached sediment sampling form.

5.1 Sampling Equipment and Methods

All sediments, including sediment submerged under water, may be sampled by the following methods:

A. Direct Sampling Method -- Fluid sediment may be collected directly using the sample container. If sampled under water, the container will be capped in place to avoid disturbance while surfacing.

B. Manual Core Sampler Method -- A slide-hammer core sampler with stainless steel liners may be used to recover a relatively undisturbed core sample of the sediment. An extension section may be added to reach sediment intervals in deeper waters.

C. Remote Scoop Method -- A sampling cup or container attached to a pole may be used to collect a sediment sample in deeper water or where a longer reach is needed.

D. Bottom Sampling Dredge Method -- A sampling dredge attached to a cable also may be used to recover sediment samples in deeper waters.

The selection of sampling equipment listed above depends on the site conditions and sample type required. In addition, the following equipment is needed to collect sediment samples:

- Field notebook, indelible marker
- Global Positioning System (GPS) unit
- Marking stakes
- Digital Camera
- Compass
- 100 m measuring tapes
- Detergent solution (0.1-0.3 % Alconox)
- Distilled water
- Latex gloves
- Ziploc bags
- Paper Towel
- Chain of custody and sample labels
- Coolers
- Sample bottles
- Plastic sheeting

5.1.1 Stream Sediment Sample Collection

Collect surface water samples according to SOP-3 prior to collecting sediment samples. Stream sediment samples will be composite samples comprised of five subsamples collected from the surface to a depth of 4 inches, which is the most biologically active sediment zone. The five subsamples will be collected from random locations along the creek channel within 200 feet of the specified location. No sediments will be collected from overbank areas, unless specified in the FSP.

For collecting sediment samples, the procedures outlined below shall be followed.

1. Don appropriate health and safety equipment.
2. Setup clean plastic sheeting in area for processing samples.
3. Collect sediment samples using decontaminated equipment from inundated areas beginning at the most downstream location (i.e., no sediments will be collected from overbank areas).
4. Collect approximately 200 grams of sediment from each subsampling location.
5. Composite the five subsamples in a water-tight plastic bag (e.g., Ziploc® bags) and homogenize by hand kneading.
6. Carefully remove twigs, rocks, leaves and other undesirable debris not considered part of the sample.
7. Carefully decant excess water from the sample bag, if necessary, taking care to avoid decanting fine sediment.
8. Double bag the sample. Label outer bag with the Index ID, sample location, and sample analysis information in accordance with the procedures in SOP No. 9. Place in cooler on ice for storage and shipment (refer to SOP-8 for sample handling and shipping information).

9. Complete the appropriate sediment Field Sample Data Sheet (FSDS) form to document the station and sample details (see SOP No. 9, Attachment 1). Document sediment characteristics, sample location as well as any changes to this SOP in the field logbook.
10. Locate the sample using a site map or GPS according to SOP-11.

For duplicates, a second sediment composite sample will be collected (Steps 3-9 above) from the sampling reach and placed into a new sample bag.

5.1.2 Storm Water Detention Pond Sediment Sample Collection

A single composite sediment sample will be collected at each of the storm water detention ponds designated in the FSP according to the steps presented in section 5.1.1. Sediment will be collected from the bottom surface, not from the side slopes, of the pond in areas that would most frequently contain storm water.

If water is present in the detention pond at the time of sampling, then procedures for collecting subaqueous sediment cores from a lake or a pond will be adopted. When cores are collected by wading, the sampler will proceed in a circular direction around the pond to collect the five subsamples and avoid disturbing sediments at the subsampling locations prior to use of the coring device. Core samples will be collected using a Wildco® K-B Corer or similar device with clear plastic liners. The core barrel will be advanced a minimum of 6 inches or to the depth of refusal, but only the shallowest 4 inches will be processed as a sample according to the steps presented in section 5.1.0. Once collected, each sediment core will be capped (with top and bottom marked).

6.0 QUALITY ASSURANCE AND QUALITY CONTROL

Duplicate, equipment rinsate, and matrix spike samples will be collected at the frequencies documented in the field sampling plan. All sampling data must be documented in the field logbooks and/or field forms, including rationales deviations from this SOP. The Field Team Leader or designated QA reviewer will check and verify that field documentation has been completed per this procedure and the other procedures referenced herein. All equipment must be

operated according to the manufacturer's specifications, including calibration and maintenance.

7.0 DECONTAMINATION

All equipment used in the sampling process shall be decontaminated prior to field use and between sample locations. Decontamination procedures are presented in SOP-7. Personnel shall don appropriate personal protective equipment as specified in the health and safety plan. Any investigation-derived waste generated in the sampling process shall be managed in accordance with the procedures outlined in SOP-12.

8.0 REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR). 2006. Asbestos Exposure and Your Health.

U.S. Environmental Protection Agency. 2007. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. U.S. Environmental Protection Agency, Office of Environmental Information. EPA/600/B-07/001. April 2007.

Libby Superfund Site Operable Unit 3 Standard Operating Procedure

Date: September 26, 2007

OU3 SOP 6 (Rev. 0)

Title: GROUNDWATER SAMPLING

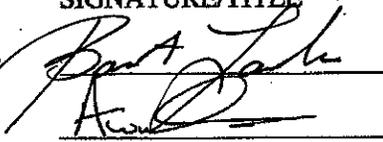
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TEAM MEMBER

SIGNATURE/TITLE

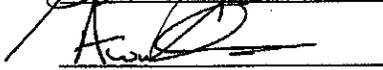
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EPA Remedial Project Manager



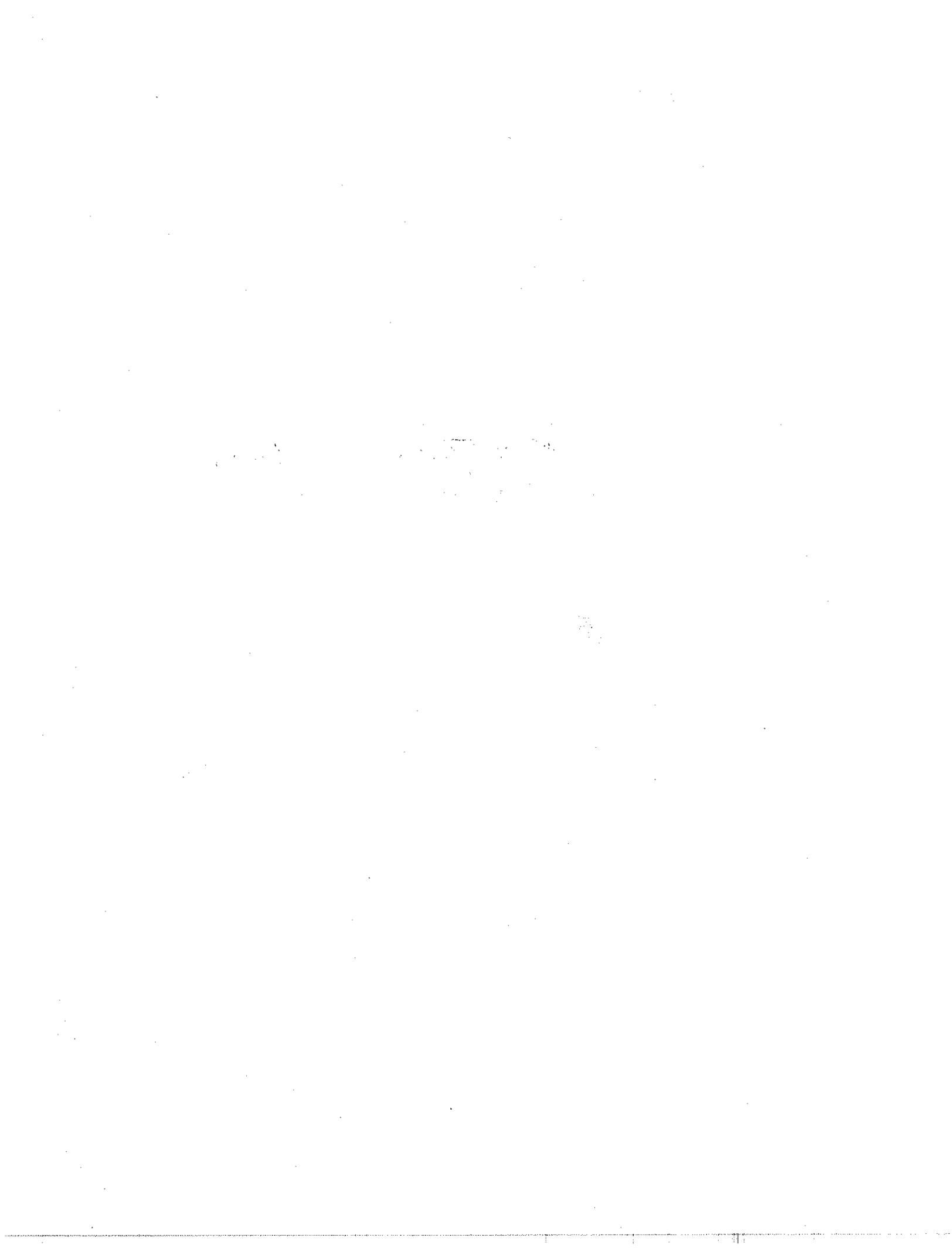
9/26/07

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0	09/26/2007	--



1.0 INTRODUCTION

This standard operating procedure (SOP) is intended to serve as a reference for the proper equipment and techniques for collecting groundwater samples for chemical analysis. The SOP is based on MWH SOP-11, Groundwater Sampling, Revision 1.0, March 2004, modified for use at the Libby Asbestos Superfund Site OU3. The purpose of this SOP is to enable the user to collect representative and defensible groundwater samples, and to plan the field sampling effort. These procedures are applicable when referenced by a monitoring or field sampling plan (FSP).

To be valid, a groundwater sample must represent the water-bearing unit being sampled. The physical, chemical, and bacteriological integrity of the sample must be maintained from collection to analysis in order to minimize changes in water quality. Acceptable equipment for sample collection from completed wells includes bailers, electrical submersible pumps and peristaltic pumps. In order to obtain a representative sample of the groundwater, the sampler must accomplish the following:

- avoid collecting stagnant (standing) water in the well;
- avoid physically or chemically altering the water due to improper sampling techniques, sample handling, or transport; and;
- document that proper sampling procedures have been followed.

This SOP describes groundwater sample collection methods only. Sample handling and shipping procedures are described in SOP-8. Field documentation procedures are presented in SOP-9.

2.0 HEALTH AND SAFETY WARNING

All personnel engaged in groundwater sampling must follow health and safety protocols described in the health and safety plan. Asbestos fibers are thin and long fibers so small that they cannot be seen by the naked eye. Asbestos fibers are easily inhaled when disturbed and when embedded in the lung tissue can cause health problems. Significant exposure to asbestos

increases the risk of lung cancer, mesothelioma, asbestosis (non-cancerous lung disease), and other respiratory diseases (ATSDR 2006).

3.0 DEFINITIONS

Annular Space: The space between the casing or well screen and the wall of the drilled hole, or between the drill pipe and casing, or between two separate strings of casing. The annular space may also be referred to as the annulus.

Aquifer: A geologic formation, group of formations, or part of a formation that is capable of yielding economic quantities of water to a well or spring.

Check Valve: Ball and spring valves on bailers and pumps that are used to allow water to flow in one direction only.

Conductivity: A measure of how well water can conduct an electrical current. It is the reciprocal of resistivity.

Datum: An arbitrary surface (or plane) used in the measurement of heads (i.e., National Geodetic Vertical Datum [NGVD], commonly referred to as mean sea level [msl]).

Dissolved Oxygen (DO): A measure of the quantity of oxygen dissolved in groundwater. DO data is collected in the field using direct measure probes. DO is used to assess the balance between oxygen-consuming and oxygen-producing processes.

Drawdown: The lowering of the potentiometric or piezometric surface in a well and aquifer due to the discharge of water from the well.

Filter-Pack: Sand or gravel that is generally uniform, clean, and well rounded that is placed in the annulus of the well between the borehole wall and the well screen to prevent formation material from entering the well screen, and to stabilize the adjacent formation.

Groundwater Sample: A sample collected from an aquifer for chemical analysis to support remedial investigation, feasibility studies, treatability studies, remediation design and performance assessment, waste characterization, etc.

Head-Space: The empty volume in a sample container between the water level and the cap.

Monitoring Well: A well that is constructed by one of a variety of techniques for the purpose of extracting groundwater for physical, chemical, or biological testing, or for measuring water levels.

Oxidation-Reduction Potential (ORP): A measurement of the reducing or oxidation potential of a given system or medium. ORP data are collected in the field using direct measure probes. Positive potentials indicate the system is oxidizing, while negative potentials indicate the system is reducing.

Packer: A transient or dedicated device placed in a well or borehole that isolates or seals a portion of the well, well annulus, or borehole at a specific level.

Peristaltic Pump: A low-volume pump that operates by suction lift.

Piezometer: A small-diameter well used to measure groundwater elevation and/or to collect periodic groundwater samples.

Static Water Level: The elevation of the top of a column of water in a monitoring well or piezometer that is not influenced by pumping or conditions related to well installation, hydrologic testing, or nearby groundwater extraction.

Turbidity: Cloudiness in water due to suspended and colloidal organic and inorganic material. Units are commonly in Nephelometric Turbidity Units (NTUs).

4.0 RESPONSIBILITIES

This section presents a brief definition of field roles, and the responsibilities generally associated with them. This list is not intended to be comprehensive and often, additional personnel may be involved. Project team member information will be included in project-specific plans (e.g., work plan, field sampling plan, quality assurance plan, etc.), and field personnel will always consult the appropriate documents to determine project-specific roles and responsibilities. In addition, one person may serve in more than one role on any given project.

Project Manager: Selects site-specific groundwater sampling program with input from key project staff and applicable oversight agencies.

Quality Control Manger: Overall management and responsibility for quality assurance and quality control (QA/QC). Selects QA/QC procedures for the sampling and analytical methods, performs project audits, and ensures that data quality objectives are fulfilled.

Field Team Leader (FTL) and/or Geologist, Hydrogeologist, or Engineer: Implements the sampling program, supervises other sampling personnel, and ensures compliance with SOPs and QA/QC requirements. Prepares daily logs of field activities.

Field Sampling Technician (or other designated personnel): Assists the FTL and/or geologist, hydrogeologist, or engineer in the implementation of tasks and is responsible for the proper use, and maintenance of groundwater sampling equipment.

5.0 MONITORING WELL SAMPLE COLLECTION PROCEDURES

5.1 Background

The methods and procedures described in this SOP were developed from these sources:

- U.S. Environmental Protection Agency, Region 9. *Standard Operating Procedure for the Standard/Well-Volume Method for Collecting a Ground-Water Sample from Monitoring Wells for Site Characterization.*

- U.S. Environmental Protection Agency, Region 1, 1996. *Low Stress (low flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells.*
- U.S. Environmental Protection Agency, May 2002. *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers.*
- U.S. Geological Survey, variously dated, National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Chapters A1-A9. Available online at <http://pubs.water.usgs.gov/twri9A>.

5.2 Sampling Equipment

There are several types of equipment available for well purging and sampling. Table 1 provides a summary of the groundwater sampling equipment and their appropriateness for specific parameters or group of parameters. Refer to the field sampling plan (FSP) for the sampling equipment specified. If there are no specifications in the FSP, consult Table 1 based on factors such as depth and diameter of the well, the recharge capacity of the well, and the analytical parameters of interest.

In addition, the following equipment is needed to collect groundwater samples:

- Field notebook and forms, indelible marker
- Global Positioning System (GPS) unit
- Digital Camera
- Water level measuring probes
- Detergent solution (0.1-0.3 % Alconox)
- Distilled water
- Latex gloves
- Ziploc bags
- Paper Towel
- Chain of custody and sample labels

- Coolers
- Sample bottles
- Plastic sheeting
- Filters
- Photo ionization detector

5.3 Sampling Procedures

Wells and piezometers located upgradient of the site will be sampled first and areas downgradient of site thought to contain contamination will be sampled last. Upon arrival at the well or piezometer, prior to groundwater purging or sampling, sampling personnel will perform and document the following procedures.

1. Don appropriate health and safety equipment
2. Setup clean plastic sheeting in area for processing samples
3. Inspect the well or piezometer
4. Measure for organic vapors
5. Measure depth to groundwater (to nearest hundredth of a foot) from marker denoting measuring point (generally a notch cut into the casing on the north side)
6. Measure total depth of well (to nearest hundredth of a foot) from same marker
7. Calculate required purge volume as described below in section 5.3.2
8. Calibrate the water quality measuring instrument according to the manufacture's specifications
9. Measure initial water quality for pH, specific conductivity, temperature, turbidity, ORP, and DO

Document all organic vapor measurement, depth to water, total well depth, and initial water quality information on the monitoring form. Refer to the FSP do determine whether low-flow purging and sampling or volume based purging and sampling is specified. Perform the well purging and sampling according to the procedures specified in the following subsections.

5.3.1 General Criteria for LOW-FLOW Sample Collection

For wells that are sampled for regulatory compliance, a low flow sample collection technique shall be employed to ensure that representative groundwater samples are collected from each well. Additionally, low flow sampling is to be the preferred method for groundwater sampling unless site specific conditions warrant a volume based approach (as discussed in Section 5.3.2). A variable rate submersible centrifugal or positive displacement type pump will be used for purging and sampling; however, if the water table is less than 20 ft a peristaltic pump may be employed as long as the constituents measured are not influenced by negative pressures.

To limit the disturbance to the groundwater and to reduce the large volumes of purged water, monitoring wells can be sampled using low-flow pumping rates. Studies have shown that groundwater in the screened interval of a standard monitoring well can be representative of groundwater in the formation, even though stagnant water lies above in the casing. This occurs when flow is generally horizontal and naturally purges the screened interval. However, the insertion of a sampling device, such as a bailer, can disrupt this equilibrium and cause mixing of the screened and cased interval waters. The mixture of stagnant and screened interval water can even be forced into the aquifer, resulting in chemical effects that may affect data quality. Purging with a bailer increases the turbidity, which can cause adverse impacts on the sample quality. Low-flow sampling technique is an accurate and less invasive method for groundwater sampling.

The objective of low-flow sampling is a more passive approach to sample extraction with the ideal condition being an equilibrium in the intake velocity with the natural groundwater flow velocity. Flow rates from 0.2 to 0.5 liter/minute (l/min) are typical for low-flow sampling. When performed correctly, water sampled using the low-flow technique is produced from the screened interval without disturbing stagnant water in the well casing. By using low flow rates to

stabilize drawdown at less than the goal of 0.30 feet, only screened interval water will be sampled. Drawdown in low yielding formations may be greater than the 0.30 feet.

The following procedures will be used while performing low-flow purging and sampling:

1. Slowly lower pump, or tubing inlet for a peristaltic pump into the well until the intake is at the midpoint of the screened interval.
2. Secure the pump and tubing to avoid shifting during purging
3. Place water level indicator down to the top of the static water table and record the depth to groundwater.
4. Begin purging groundwater at its lowest speed and adjust to a rate between 0.2 to 0.5 liter/minute, making sure to minimize drawdown to less than 0.3 feet as a goal. (Rates up to approximately 0.9 l/min may be feasible only if the drawdown continues to be less than 0.3 feet)
5. Measure and record the discharge rate, drawdown, and water quality parameters at intervals of 30 seconds to five minutes during purging.
6. Purge until three consecutive water quality readings, collected at intervals of at least five minutes, are within:

pH	±0.1 units
Conductivity	±3%
Temperature	±1 degree Celsius
Dissolved Oxygen	±10% difference
Eh-ORP	±10 millivolts
Turbidity	±10 % NTU (when turbidity is greater than 10 NTUs).

It may be difficult to meet all of aforementioned criteria due to the characteristics of the water and the fact these criteria are near the accuracy of the meters themselves. If a minimum of one tubing volume (including the volume of the water in the pump and the flow through cell)

has been met and the parameters have generally stabilized, groundwater samples will be collected.

7. Collect and preserve samples for Volatile Organic Compounds (VOC) first. Unpreserved sample containers should be rinsed with the sample water prior sample collection
8. Label sample containers with the sample location and sample analysis information
9. Pack samples containers to avoid leakage or breakage during shipment
10. Store and ship samples on ice at 4 degrees Celsius. For further details on shipping and handling refer to SOP-12

If the well produces water at an extremely slow rate and excessive drawdown is occurring (> 0.30 feet.) reduce the flow rate or turn the pump off for 15 minutes and allow for recovery. If after pumping is resumed at a slower flow rate (e.g., 0.2 l/min), excessive drawdown continues to occur continue purging until the water level in the well nearly reaches the intake level of the pump. Once the water level reaches this depth, stop pumping and allow the water level to recover to 90 percent of the original static level. Continue purging and monitoring until three consecutive readings meet the stabilization criteria.

If under special circumstances the well does not recover to 90 percent within a normal workday, the well may be allowed to recover overnight and be sampled the following morning.

5.3.2 VOLUME BASED Sample Collection

In instances where low-flow sampling is not possible or necessary based on site-specific conditions samples from wells will be collected using a volume based approach as follows:

7. Calculate the volume of water within the well bore using the following formula (or equivalent): $7.4805 ((D^2\pi)/4) dH = \text{volume (in gallons)}$, where D = casing diameter in feet. (NOTE: This equation is used for grouted wells with short screens. For wells with long screens and/or ungrouted wells, the D = borehole diameter in feet). dH = the distance from well bottom to static water level in feet; and $\pi = 3.1416$

8. Lower pump or bailer intake to a depth just above the screened interval in a manner consistent with that specified for the low-flow sampling above. This is to avoid exposing the screened interval to atmospheric conditions at drawdown and obtain the most representative sample.
9. Measure and record the initial depth to water and water quality
10. Bail or pump the well until at least three casing volumes has been removed AND the water quality parameters have stabilized as described in section (5.3.1). The purge rate must not reach a point where the recharge water is entering the well in an agitated manner and the water level in the well during purging should not be allowed to drop below the pump intake.
11. No more than six well volumes should be removed to prevent the effects of over pumping. If the indicator parameters have not stabilized following six well volumes the field instruments will be recalibrated and checked for possible malfunction. If no problems are found, sampling can be conducted; however, the project manager will be notified and all information will be recorded in the field notebook and/or field purge record.
12. If the yield of the well is low such that it can be bailed or pumped dry, then the recharged groundwater in the well will be considered representative regardless of the number of casing volumes of groundwater removed, since all standing water in the well has been replaced by recharge from the water-yielding zone. If a well is purged dry, the well can be sampled upon 90% recovery or after two hours, whichever occurs first.

5.4 Sample Filtration

Refer to the FSP. When required, a field-filtered water sample will be collected using a disposable, in-line 0.45 μm filter. The water sample will be pumped through the filter attached directly to the discharge tubing. A peristaltic pump and a section of Tygon (polyvinylchloride) tubing or other appropriate method may be used if the sample is collected via bailer. The filter cartridge will be rinsed with an aliquot of 500 ml of sample prior to collection of sample in to the containers or as per the filter manufacturer's recommendations. Both the filter and tubing will be disposed of between samples.

5.4 Sample Preservation and Storage

Refer to the FSP. If required by the project or analytical method, water samples submitted for chemical analysis will be stored at 4 °C in ice-cooled, insulated containers immediately after collection. Preservation and storage methods depend on the chemical constituents to be analyzed and should be performed according to requirements stated in the FSP.

6.0 PURGE WATER HANDLING AND DISPOSAL

Because of the potential for spreading environmental contamination, proper purge water disposal is a necessary part of well monitoring. All purge water will be contained in 55-gallon drums or fixed above-ground storage tank (e.g., Baker Tank) pending analytical results. The collected purge water will be properly disposed of according to the analytical results and any local, state, or federal guidelines.

7.0 QUALITY ASSURANCE AND QUALITY CONTROL

Duplicate, equipment rinsate, and matrix spike samples will be collected at the frequencies documented in the FSP. All sampling data must be documented in the field logbooks and/or field forms, including rationales deviations from this SOP. The Field Team Leader or designated QA reviewer will check and verify that field documentation has been completed per this procedure and other procedures referenced herein. All equipment must be operated according to the manufacturer's specifications, including calibration and maintenance.

8.0 DECONTAMINATION

All equipment used in the groundwater sampling process shall be decontaminated prior to field use and between sample locations. Decontamination procedures are presented in SOP-7. Personnel shall don appropriate personal protective equipment as specified in the health and safety plan. Any investigation-derived waste generated in the sampling process shall be managed in accordance with the procedures outlined in SOP-12.

9.0 REFERENCES

Agency for Toxic Substances and Disease Registry. 2006. Asbestos Exposure and Your Health.

Puls, R.W. and M.S. Barcelona, 1989. Ground Water Sampling for Metals Analyses, Superfund Ground Water Issue, EPA/540/4-89/001, March 1989.

U.S. EPA, Region 9. *Standard Operating Procedure for the Standard/Well-Volume Method for Collecting a Ground-Water Sample from Monitoring Wells for Site Characterization*. Available online at: earth1.epa.gov/region09/qa/pdfs/finalgwsamp_sop.pdf.

U.S. EPA, Region 1, 1996. *Low Stress (low flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells*. July 30, 1996.

U.S. EPA, 2002, *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers*. EPA 542-S-02-001. May 2002.

U.S. Environmental Protection Agency. 2007. *Guidance for Preparing Standard Operating Procedures (SOPs)*. EPA QA/G-6. U.S. Environmental Protection Agency, Office of Environmental Information. EPA/600/B-07/001. April 2007.

U.S. Geological Survey, variously dated. *National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Chapters A1-A9*, available online at <http://pubs.water.usgs.gov/twri9A>.

TABLE 1
GENERALIZED GROUNDWATER SAMPLING DEVICE MATRIX

	GROUNDWATER PARAMETERS																		
	INORGANIC				ORGANIC				RADIOACTIVE			BIOLOGICAL							
	Device	Approx Max Sample Depth	Min Well Diameter	Sample Delivery Rate or Volume*	EC	pH	Redox	Major ions	Trace metals	Nitrate	Fluoride	Dissolved gasses	Non-volatile	Volatile	TOC	TOX	Radium	Gross Alpha & beta	Coliform bacteria
GRAB	Open Bailer	no limit	1/2 in.	variable	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Point-Source Bailer	no limit	1/2 in.	variable	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
POSITIVE DISPLACEMENT (SUBMERSIBLE)	Syringe Sampler	no limit	1 1/2 in.	0.01-0.2 gal	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Gear-drive	200 ft.	2 in.	0-0.5 gpm	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Bladder pump	400 ft.	3/4 in.	0-2 gpm	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Electric Submersible	160 ft.	2 in.	0-1.2 gpm	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
PORTABLE SAMPLING DEVICES	Piston pump (gas-drive)	500 ft.	1 1/2 in.	0-0.5 gpm	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Peristaltic	26 ft.	1/2 in.	0.01-0.3 gpm	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
SUCTIION CONTACT	Gas-lift	variable	1 in.	variable	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Gas-drive	150 ft.	1 in.	0.2 gpm	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
IN SITU SAMPLING DEVICES**	Pneumatic	no limit	no limit	0.01-0.13 gpm	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

** Sampling devices on this chart are divided into two categories: 1. Portable devices for sampling existing monitoring wells, and 2. In situ monitoring devices (often multilevels) that are permanently installed. Sample delivery rates and volumes are average ranges based on typical field conditions. Actual delivery rates are a function of well diameter, size and capacity of sampling device, hydrogeologic conditions, and depth to sampling point.

† Indicates device is generally suitable for application (assuming device is cleaned and operated properly and is constructed of suitable materials. Indicates device may be unsuitable or is untested for application.

○ Source: Modified from Pohlmann and Hess, 1988
Based on Literature Review



Libby Superfund Site Operable Unit 3 Standard Operating Procedure

Date: September 26, 2007

OU3 SOP 7 (Rev. 0)

Title: EQUIPMENT DECONTAMINATION

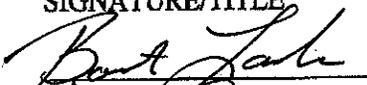
APPROVALS:

TEAM MEMBER

SIGNATURE/TITLE

DATE

EPA Remedial Project Manager




9/26/07
9/26/07

SOP Author

Revision Number	Date	Reason for Revision
0	09/26/2007	--

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1.0 INTRODUCTION

This Standard Operating Procedure (SOP) is based on MWH SOP-02, Equipment Decontamination, Revision 1.0, March 2004, modified for use at the Libby Asbestos Superfund Site OU3. Decontamination of drilling, sampling, and monitoring equipment is a necessary and critical aspect of environmental field investigations. Proper decontamination is a key element in reducing the potential for cross-contamination between samples from different locations, as well as ensuring that samples are representative of the sampled materials. Improper decontamination may result in costly re-collection and re-analysis of samples. All equipment used in the sampling process will be properly decontaminated prior to the collection of each sample and after completion of sampling activities.

The procedures outlined in this SOP will be followed during decontamination of field equipment used in the sampling process, including drilling, soil/water sample collection, and monitoring activities. Any deviations from these procedures will be noted in the field notebooks and approved by the appropriate oversight agency, if significant. Three major categories of field equipment, along with applicable decontamination methods for each, are discussed below.

2.0 HEALTH AND SAFETY WARNING

All personnel engaged in equipment decontamination must follow health and safety protocols described in the health and safety plan. Asbestos fibers are thin and long fibers so small that they cannot be seen by the naked eye. Asbestos fibers are easily inhaled when disturbed and when embedded in the lung tissue can cause health problems. Significant exposure to asbestos increases the risk of lung cancer, mesothelioma, asbestosis (non-cancerous lung disease), and other respiratory diseases (ATSDR 2006).

3.0 DEFINITIONS

Bailer: A cylindrical tool designed to remove material from a well. A valve at the bottom of the bailer retains the contents in the bailer.

Bladder Pump: Groundwater sampling equipment consisting of a flexible bladder, usually made of Teflon[®], contained within a rigid cylindrical body (commonly made of stainless steel). The lower end of the bladder is connected to the intake port through a check valve, while the upper end is connected through a second check valve to a sampling line that leads to the ground surface.

Brass Sleeve: Hollow, cylindrical sleeves made of brass and used as liners in split-spoon samplers for collection of undisturbed samples.

Auger Flight: An individual auger section, usually 5 feet in length.

Continuous Core Barrel: 3-5 foot long steel barrels that can be joined together to allow continuous cores to be collected during a single run.

Drill Pipe: Hollow metal pipe used for drilling, through which soil and groundwater sampling devices can be advanced for sample collection.

Peristaltic Pump: A low-volume suction pump. The compression of a flexible tube by a rotor results in the development of suction.

Source Water: A drilling quality water source identified to be used for steam cleaning. This source should be sampled at the beginning of each field program to set baseline concentrations.

Distilled Water: Commercially available water that has been distilled. Each batch of distilled water should be analyzed to set baseline concentrations.

Hand Auger: A sampling tool consisting of a metal tube with two sharpened spiral wings at the tip.

Split-Spoon Sampler: A sampling tool consisting of a thick-walled steel tube with a removable head and drive shoe. The steel tube splits open lengthwise when the head and drive shoe are removed.

Scoop: A sampling hand tool consisting of a small shovel- or trowel-shaped blade.

Submersible Pump: Groundwater sampling pump that consists of a rotor contained within a chamber and driven by an electric motor.

4.0 RESPONSIBILITIES

This section presents a brief definition of field roles, and the responsibilities generally associated with them. This list is not intended to be comprehensive and often, additional personnel may be involved. Project team member information will be included in project-specific plans (e.g., work plan, field sampling plan, quality assurance plan, etc.), and field personnel will always consult the appropriate documents to determine project-specific roles and responsibilities. In addition, one person may serve in more than one role on any given project.

Project Manager: Responsible for project implementation and coordination, selects project-specific drilling and sampling methods, and associated decontamination procedures with input from other key project staff, and appropriate oversight agencies.

Quality Control Manager: Overall management and responsibility for quality assurance and quality control (QA/QC). Selects QA/QC procedures for the sampling and analytical methods, performs project audits, and ensures that data quality objectives are fulfilled.

Field Team Leader (FTL) and/or Geologist, Hydrogeologist, or Engineer: Implements the field program and supervises other sampling personnel, and ensures that SOPs are properly followed. Prepares daily logs of field activities.

Field Sampling Technician (or other designated personnel): Assists the FTL, geologist, hydrogeologist, or engineer in the implementation of tasks and is responsible for the decontamination of sampling equipment.

5.0 DECONTAMINATION PROCEDURES

Drilling and sampling procedures require that decontaminated tools be employed in order to prevent cross-contamination. The decontamination procedures described below will be followed to ensure that only uncontaminated materials will be introduced to the subsurface during drilling and sampling. The equipment decontamination process will be undertaken before and after each use of the equipment and include either steam cleaning or washing. Steam cleaning of equipment, if used, will be performed at a temporary decontamination site. The flooring of the temporary decontamination site will be impermeable to water and large enough to contain the equipment and the rinsate produced.

If the quantity of water in the pad area exceeds its holding capacity, the water will be drummed temporarily until analytical results are obtained and the water can be properly disposed of. Steam cleaning will not be performed over bare ground, but will always be conducted so that rinsate can be collected and disposed of properly. Wherever applicable, equipment will be disassembled to permit adequate cleaning of the internal portions.

5.1 Drilling and Large Equipment

The following procedure will be used for decontamination of large pieces of equipment. These include well casings, auger flights, drill pipes and rods, and those portions of the drill rig that may stand directly over a boring or well location, or that may come into contact with casing, auger flights, pipes, or rods.

- Establish a decontamination area large enough to contain the equipment and any decontamination waste

- Place equipment on sawhorse or equivalent, if possible.
- Steam clean the external surfaces and internal surfaces, as applicable, on equipment using high-pressure steam cleaner from an approved water source. If necessary, scrub using brushes and a phosphate-free detergent (e.g., Alconox™), or equivalent laboratory-grade detergent until all visible dirt, grime, grease, oil, loose paint, rust, etc., have been removed.
- Rinse with potable water
- Remove equipment from decontamination pad and allow to air dry
- Record date and time of equipment decontamination

5.2 Soil and Groundwater Sampling Equipment

The following procedure will be used to decontaminate sampling equipment such as split-spoon samplers; brass sleeves; continuous core barrels; scoops; hand augers; non-dedicated bailers; submersible pumps, bladder pumps; and other sampling equipment that may come into contact with samples. To minimize decontamination procedures in the field, dedicated equipment will be used wherever feasible:

- Wash and scrub equipment with phosphate-free, laboratory-grade detergent (e.g., Alconox™ or equivalent) and off-site distilled water
- Triple-rinse with distilled water
- Air dry
- Wrap in aluminum foil, or store in clean plastic bag or designated casing.

- Record date and time of equipment decontamination

Personnel involved in decontamination activities will wear appropriate protective clothing as defined in the project-specific health and safety plan.

5.3 Monitoring Equipment

The following procedure will be used to decontaminate monitoring devices such as slug-test equipment, groundwater elevation and free product thickness measuring devices, and water quality checking instruments. Note that organic solvents can not be used to decontaminate free product measuring devices because they will cause damage to the probes. Spray bottles may be used to store and dispense distilled water.

- Wash equipment with laboratory-grade, phosphate-free detergent (e.g., Alconox™ or equivalent) and distilled water
- Triple-rinse with distilled water
- Store in clean plastic bag or storage case.
- Record date and time of equipment decontamination

6.0 QUALITY ASSURANCE AND QUALITY CONTROL

All equipment decontamination must be documented in the field logbooks and/or field forms, including rationales deviations from this SOP. The Field Team Leader or designated QA reviewer will check and verify that field documentation has been completed per this procedure and other procedures referenced herein.

To assess the adequacy of decontamination procedures, field rinsate blanks may be collected. The specific number of rinsate blanks will be defined in a FSP or work plan or by the Project

OU3 SOP 7

Rev. No. 0

Date: September 26, 2007

Page 7 of 8

Manager. In general, at least one field rinsate blank should be collected per sampling event or per day.

Rinsate blanks with elevated or detected contaminants will be evaluated by the Project Manager, who will relay the results to the site workers. Such results may be indicative of inadequate decontamination procedures that require corrective actions (e.g., retaining).

7.0 PROCEDURE FOR WASTE DISPOSAL

All decontamination water that has come into contact with contaminated equipment will be handled, labeled, stored and disposed according to SOP 12. Unless otherwise specified in the FSP, waste generated from other sources and classified as non-hazardous waste (e.g., PPE, plastic sheeting, rope and misc. debris) will be disposed into trash receptacles.

8.0 REFERENCES

Agency for Toxic Substances and Disease Registry. 2006. *Asbestos Exposure and Your Health*.

U.S. Environmental Protection Agency, *RCRA Ground-Water Monitoring: Draft Technical Guidance*, November 1992. Page 7-17.



Libby Superfund Site Operable Unit 3 Standard Operating Procedure

Date: September 26, 2007

OU3 SOP 8 (Rev. 0)

Title: SAMPLE HANDLING AND SHIPPING

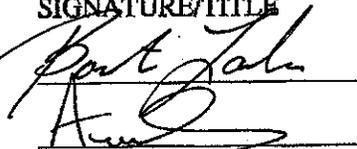
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TEAM MEMBER

SIGNATURE/TITLE

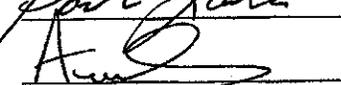
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EPA Remedial Project Manager



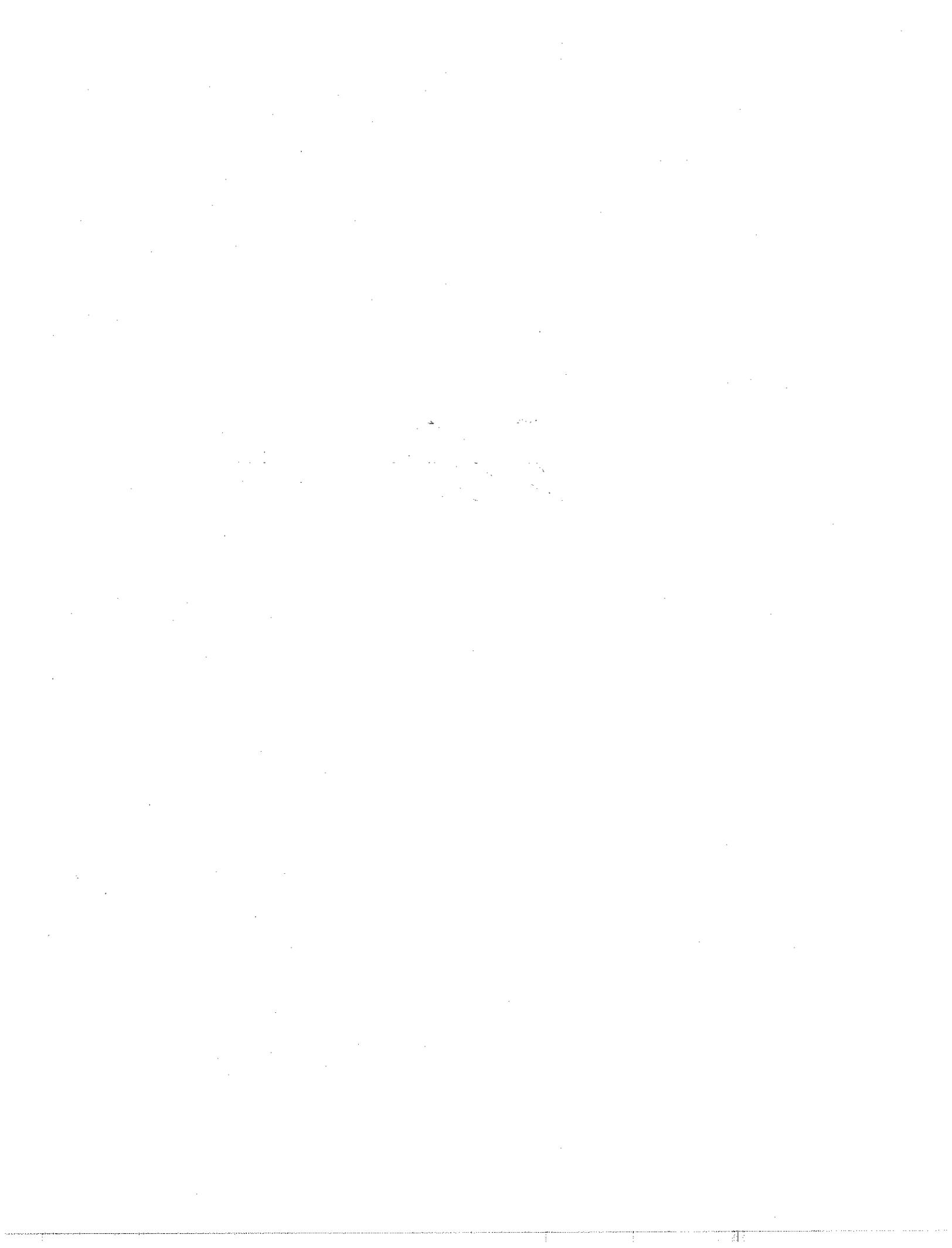
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SOP Author



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Revision Number	Date	Reason for Revision
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1.0 INTRODUCTION

This standard operating procedure (SOP) is based on MWH SOP-09, Sample Handling and Shipping, Revision 1.0, March 2004, modified for use at the Libby Asbestos Superfund Site OU3. This SOP describes the requirements for sample handling, storage and shipping. The purpose of this SOP is to define sample management activities as performed from the time of sample collection to the time they are received by the laboratory.

2.0 HEALTH AND SAFETY WARNING

All personnel engaged in soil sampling must follow health and safety protocols described in the health and safety plan. Asbestos fibers are thin and long fibers so small that they cannot be seen by the naked eye. Asbestos fibers are easily inhaled when disturbed and when embedded in the lung tissue can cause health problems. Significant exposure to asbestos increases the risk of lung cancer, mesothelioma, asbestosis (non-cancerous lung disease), and other respiratory diseases (ATSDR 2006).

3.0 DEFINITIONS

Chain-of-Custody: An accurate written record of the possession of each sample from the time of collection in the field to the time the sample is received by the designated analytical laboratory.

Sample: Physical evidence collected for environmental measuring and monitoring. For the purposes of this SOP, sample is restricted to solid, aqueous, air, or waste matrices. This SOP does not cover samples collected for lithologic description nor does it include remote sensing imagery or photographs (refer to SOP-9 for field documentation procedures).

Sampler: The individual who collects environmental samples during fieldwork.

4.0 RESPONSIBILITIES

This section presents a brief definition of field roles, and the responsibilities generally associated with them. This list is not intended to be comprehensive and often additional personnel may be involved. Project team member information will be included in project-specific plans (e.g., work plan, field sampling plan (FSP), quality assurance plan, and etc.), and field personnel will always consult the appropriate documents to determine project-specific roles and responsibilities. In addition, one person may serve in more than one role on any given project.

Project Manager: The Project Manager is responsible for ensuring that the requirements for sample management are included in the appropriate project plans. The Project Manager is responsible for coordinating sample management efforts with input from other key project staff and applicable government agencies.

Quality Control Manager: Overall management and responsibility for quality assurance and quality control (QA/QC). Selects QA/QC procedures for the sampling and analytical methods, performs project audits, and ensures that data quality objectives are fulfilled.

Field Team Leader and/or Field Hydrogeologist, Geologist or Engineer: Implements the sampling program, supervises other sampling personnel, and ensures compliance with SOPs and QA/QC requirements. Prepares daily logs of field activities.

Field Technician: Responsible for sample collection, documentation, packaging, and shipping. Assists the FTL and/or geologist, hydrogeologist, or engineer in the implementation of tasks.

5.0 PROCEDURES

5.1 Applicability

The information in this SOP may be used by direct reference or incorporated into project-specific plans. Deviations or modifications to procedures addressed herein must be brought to the attention of, and approved by, applicable government agencies.

5.2 Sample Management

Sample Containers: The sample containers to be used will be dependent on the sample matrix and analyses desired, and are specified in the project FSP. Only certified pre-cleaned sample containers will be used. Sample containers will be filled with adequate headspace (approximately 10 percent) for safe handling upon opening, except containers for volatile organic compound (VOC) analyses, which will be filled completely with no headspace. This no-headspace requirement applies to both soil and groundwater samples.

Once opened, the containers will be used immediately. If the container is used for any reason in the field (e.g., screening) and not sent to the laboratory for analysis, it will be discarded. Prior to discarding the contents of the used container and the container, disposal requirements will be evaluated. When storing before and after sampling, the containers will remain separate from solvents and other volatile organic materials. Sample containers with preservatives added by the laboratory will not be used if held for an extended period on the job site or exposed to extreme heat conditions. Containers will be kept in a cool, dry place. For preserved samples (except VOCs), the pH of the sample will be checked following collection of the sample. If the pH is not at the required level, additional preservative (provided by the laboratory) will be added to the sample container.

Numbering and Labeling: Refer to OU3 SOP-9.

Custody Seals. Custody seals with the date and initials of the sampler will be used on each shipping container to ensure custody. The custody seal will be placed on opposite sides of the cooler across the seam of the lid and the cooler body. Alternatively, if the sample containers are all placed inside a liner bag within the cooler, the custody seal may be placed across the seal of the liner bag inside of the cooler.

Chain-of-Custody: COC procedures require a written record of the possession of individual samples from the time of collection through laboratory analyses. A sample is considered to be in custody if it is:

- In a person's possession
- In view after being in physical possession
- In a secured condition after having been in physical custody
- In a designated secure area, restricted to authorized personnel

The COC record will be used to document the samples taken and the analyses requested. Refer to SOP-9 Attachment 2 for the OU3-specific COC form. Information recorded by field personnel on the COC record will include the following:

- Sample identifier (Index ID)
- Date and time of collection
- Sample matrix
- Preservation
- Type of analyses requested
- Unique COC number
- Lab being shipped to
- Signature of individuals involved in custody transfer (including date and time of transfer)
- Airbill number (if appropriate)
- Any comments regarding individual samples (e.g., organic vapor meter readings, special instructions).

COC records will be placed in a waterproof plastic bag (e.g., Ziploc®), taped to the inside lid of the cooler or placed at the top of the cooler, and transported with the samples. Signed airbills will serve as evidence of custody transfer between the field sampler and courier, as well as between the courier and laboratory. If a carrier service is used to ship the samples (e.g., Federal Express, etc.), custody will remain with the courier until it is relinquished to the laboratory. Upon receiving the sample cooler, a laboratory representative should sign in the receiving box of the COC, thus establishing custody. The sampler will retain copies of the COC record and airbill.

Sample Preservation/Storage: The requirements for sample preservation are dependent on the desired analyses and the sample matrix, and are specified in the FSP.

5.3 Sample Shipping

The methods and procedures described in this SOP were developed from these sources:

- 49 CFR 173. Shippers – Shippers – General Requirements for Shipping. United States Code of Federal Regulations available online at <http://www.gpoaccess.gov/cfr/index.html>
- 49 CFR 178. Specifications for Packaging. United States Code of Federal Regulations available online at <http://www.gpoaccess.gov/cfr/index.html>
- ASTM D 4220. Standard Practice for Preserving and Transporting Soil Samples. American Society for Testing and Materials available online at <http://www.astm.org/>
- ASTM D 4840. Standard Practice for Sampling Chain-of-Custody Procedures. American Society for Testing and Materials available online at <http://www.astm.org/>

Procedures for packaging and transporting samples to the laboratory are dependent on the chemical, physical, and hazard properties of the material. The procedures may also be based on an estimation of contaminant concentrations/properties in the samples to be shipped. Samples will be identified as environmental samples, excepted quantities samples, limited quantities samples, or standard hazardous materials. Environmental samples are defined as solid or liquid samples collected for chemical or geotechnical analysis. Excepted quantities involve the shipment of a few milliliters of either an acid or base preservative in an otherwise empty sample container. Limited quantities are restricted amounts of hazardous materials that may be shipped in generic, sturdy containers. Standard hazardous material shipments require the use of stamped/certified containers. All samples will be packaged and shipped or hand delivered to the laboratories the same day of sample collection, unless otherwise specified in the project-specific FSPs.

The following paragraphs describe standard shipping procedures for different types of samples. Any exceptions to these procedures will be defined in the FSP. It is the responsibility of the sampler to refer to the U.S. Department of Transportation (DOT) (<http://hazmat.dot.gov/regs/rules.htm>) regulations when dealing with a substance not addressed in this SOP for requirements and limitations associated with the shipment.

Sample Shipping via Commercial Carrier:

Aqueous or Solid Samples: Samples will be packaged and shipped to the laboratories the same day of sample collection, unless otherwise specified in the FSP and depending on holding time requirements for individual samples. For aqueous or solid samples that are shipped to the laboratory via a commercial carrier the following procedures apply:

- Sample labels will be completed and attached to sample containers.
- The samples will be placed upright in a waterproof metal (or equivalent strength plastic) ice chest or cooler.
- For shipments containing samples for volatile organic analysis, include a trip blank.
- Ice in double Ziploc[®] bags (to prevent leakage) will be placed around, among, and on top of the sample bottles. Enough ice will be used so that the samples will be chilled and maintained at $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$ during transport to the laboratory. Dry ice or blue ice will not be used.
- To prevent the sample containers from shifting inside the cooler, the remaining space in the cooler will be filled with inert cushioning material, such as shipping peanuts, additional bubble pack, or cardboard dividers, such that the sample containers remain upright and do not break.
- Tape shut the cooler's drain plug

Libby Superfund Site Operable Unit 3 Standard Operating Procedure

- The original copy of the completed COC form will be placed in a waterproof plastic bag and taped to the inside of the cooler lid or placed at the top of the cooler.
- The lid will be secured by wrapping strapping tape completely around the cooler in two locations.
- Mark the cooler with arrow labels indicating the proper upright position of the cooler.
- Custody seals consisting of security tape with the date and initials of the sampler will be used on each shipping container to ensure custody. Two signed custody seals will be placed on the cooler, one on the front and one on the back.
- A copy of the COC record and the signed air bill will be retained for the project files.
- Affix a label containing the name and address of the shipper to the outside of the cooler

Hand-Delivered Samples: For aqueous or solid samples that will be hand carried to the laboratory, the same procedures apply.

Excepted Quantities: Usually, corrosive preservatives (e.g., hydrochloric acid, sulfuric acid, nitric acid, or sodium hydroxide) are added to otherwise empty sample bottles by the analytical laboratory prior to shipment to field sites. However, if there is an occasion whereby personnel are required to ship bottles with these undiluted acids or bases, the containers will be shipped in the following manner:

1. Each individual sample container will have not more than 30 milliliters of preservative.

2. Collectively, the preservative in these individual containers will not exceed a volume of 500 milliliters in the same outer box or package.
3. Despite the small quantities, only chemically compatible material may be placed in the same outer box, (e.g., sodium hydroxide, a base, must be packaged separately from the acids).
4. Federal Express will transport nitric acid only in concentrations of 40 percent or less.
5. A "Dangerous Goods in Excepted Quantities" label will be affixed to the outside of the outer box or container. Information required on the label includes:
 - Signature of Shipper
 - Title of Shipper
 - Date
 - Name and Address of Shipper
 - Check of Applicable Hazard Class
 - Listing of UN Numbers for Materials in Hazard Classes

Limited Quantities: Occasionally, it may become necessary to ship known hazardous materials, such as pure or floating product. DOT regulations permit the shipment of many hazardous materials in "sturdy" packages, such as an ice chest or cardboard box (not a specially constructed and certified container), provided the following conditions are met:

1. Each sample bottle is placed in a plastic bag, and the bag is sealed. Each VOC vial will be placed in a sealable bag. As much air as possible is squeezed from the bag before sealing. Bags may be sealed with evidence tape for additional security.
2. Or each bottle is placed in a separate paint can, the paint can is filled with vermiculite, and the lid is affixed to the can. The lid must be sealed with metal clips, filament, or evidence tape. If clips are used, the manufacturer typically recommends six clips.

Libby Superfund Site Operable Unit 3 Standard Operating Procedure

3. The cans are placed upright in a cooler that has had the drain plug taped shut inside and outside, and the cooler is lined with a large plastic bag. Approximately 1 inch of adsorbent material sufficient to retain any liquid that may be spilled, is placed in the bottom of the liner. Only containers having chemically compatible material may be packaged in each cooler or other outer container.
4. The COC record is sealed inside a plastic bag and placed inside the cooler. The sampler retains one copy of the COC record. The laboratory will be notified if the sample is suspected of containing any substance for which the laboratory personnel should take safety precautions.
5. The cooler is shut and sealed with strapping tape (filament type) around both ends. Two signed custody seals will be placed on the cooler, one on the front and one on the back. Additional seals may be used if the sampler and/or shipper consider more seals to be necessary. Wide, clear tape will be placed over the seals to ensure against accidental breakage.
6. The following markings are placed on the side of the cooler:
 - Proper Shipping Name (Column B, List of Dangerous Goods, Section 4, IATA Dangerous Goods Regulations [DGR])
 - UN Number (Column A, List of Dangerous Goods, Section 4, IATA DGR)
 - Shipper's name and address
 - Consignee's name and address
 - The words "LIMITED QUANTITY"
 - Hazard Labels (Column E, List of Dangerous Goods, Section 4, IATA DGR)
 - Two Orientation (Arrow) labels placed on opposite sides.
7. The Airbill/Declaration of Dangerous Goods form is completed as follows:

- Shipper's name and address
 - Consignee's name and address
 - Services, Delivery & Special Handling Instructions
 - Cross out "Cargo Aircraft Only" in the Transport Details Box
 - Cross out "Radioactive" under Shipment Type
 - Nature and Quantity of Dangerous Goods
-
- Proper Shipping Name (Column B, List of Dangerous Goods, Section 4, IATA DGR)
 - Class or Division (Column C, List of Dangerous Goods, Section 4, IATA DGR)
 - UN Number (Column A, List of Dangerous Goods, Section 4, IATA DGR)
 - Packing Group (Column F, List of Dangerous Goods, Section 4, IATA DGR)
 - Subsidiary Risk, if any (Column D, List of Dangerous Goods, Section 4, IATA DGR)
 - Quantity and type of packing (number and type of containers: for example, "3 plastic boxes", and the quantity per container, "2 L", is noted as "3 Plastic boxes X 2 L" This refers to 3 plastic boxes (coolers are referred to as plastic boxes) with 2 liters in each box.
 - Packing Instructions (Column G, List of Dangerous Goods, Section 4, IATA DGR).
 - Note: Only those Packing Instructions in Column G that begin with the letter "Y" may be used. These refer specifically to the Limited Quantity provisions.
 - Authorization (Write in the words Limited Quantity)
 - Emergency Telephone Number (List 800-535-5053. This is the number for INFOTRAC.)
 - Printed Name and Title, Place and Date, Signature.

Standard Hazardous Materials: Shipment of standard hazardous materials presents the most difficulty and expense. However, there may be occasion whereby a hazardous material cannot be shipped under the Limited Quantity provisions, (e.g., where there is no Packing Instruction in Column G, List of Dangerous Goods, IATA Dangerous Goods Regulations, that is preceded by the letter "Y").

In such cases, the general instructions noted above but for non-Limited Quantity materials will apply, with one important difference: standard hazardous materials shipment requires the use of certified outer shipping containers. These containers have undergone rigid testing and are, therefore, designated by a "UN" stamp on the outside, usually along the bottom of a container's side. The UN stamp is also accompanied by codes specifying container type, packing group rating, gross mass, density, test pressure, year of manufacturer, state of manufacturer, and manufacturer code name. The transport of lithium batteries in Hermit Data Loggers is an example of a standard hazardous material where only a designated outer shipping container may be used.

5.4 Holding Times

The holding times for samples will depend on the analysis and the sample matrix. Refer to the FSP for holding times requirements.

6.0 QUALITY ASSURANCE AND QUALITY CONTROL

All sample shipments must be documented in the field logbooks and/or field forms, including rationales deviations from this SOP. The Field Team Leader or designated QA reviewer will check and verify that handling and shipment documentation has been completed per this procedure and other procedures referenced herein.

7.0 DECONTAMINATION

All shipment coolers shall be maintained clean of sampled material to avoid exposure during shipment. Any investigation-derived waste generated in the sampling process shall be managed in accordance with the procedures outlined in SOP-12.

8.0 REFERENCES

Agency for Toxic Substances and Disease Registry. 2006. Asbestos Exposure and Your Health.

Enforcement Considerations for Evaluations of Uncontrolled Hazardous Waste Disposal Sites by Contractors, Draft, Appendix D, April 1980.

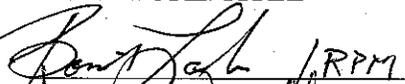
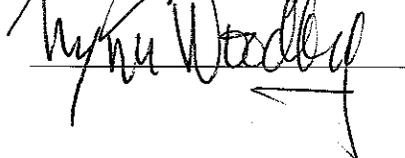
Libby Superfund Site Operable Unit 3 Standard Operating Procedure

Date: October 5, 2007

OU3 SOP 9 (Rev. 1)

Title: FIELD DOCUMENTATION

APPROVALS:

TEAM MEMBER	SIGNATURE/TITLE	DATE
EPA Remedial Project Manager	 /RPM	10/5/07
SOP Author		10/5/07

Revision Number	Date	Reason for Revision
0	09/26/2007	--
1	10/5/2007	<ul style="list-style-type: none"> Add section for "Corrections and Modifications" and Field Modification Approval form (Attachment 3) Update Labeling section and COC (Attachment 2) to reflect non-asbestos analysis and container details Update FSDS forms (Attachment 1) based on field team input



1.0 INTRODUCTION

This Standard Operating Procedure (SOP) is a general guidance document for the required documentation to be completed by field personnel during field investigations. This SOP is based on MWH SOP-04, Field Documentation, Revision 1.0, March 2006, modified for use at the Libby Mine Site. Documentation in the form of field logbooks, reports, and forms shall be completed for every activity in the field. Records shall be maintained on a daily basis as the work progresses. All field documentation shall be accurate and legible because it is deliverable to the client as potentially a legal document.

2.0 HEALTH AND SAFETY WARNING

All personnel engaged in soil sampling must follow health and safety protocols described in the site health and safety plan. Asbestos fibers are thin and long fibers so small that they cannot be seen by the naked eye. Asbestos fibers are easily inhaled when disturbed and when embedded in the lung tissue can cause health problems. Significant exposure to asbestos increases the risk of lung cancer, mesothelioma, asbestosis (non-cancerous lung disease), and other respiratory diseases (ATSDR 2006). All personnel engaged in soil sampling must follow health and safety protocols described in the health and safety plan.

3.0 RESPONSIBILITIES

This section presents a brief definition of field roles, and the responsibilities generally associated with them. This list is not intended to be comprehensive and often, additional personnel may be involved. Project team member information shall be included in project-specific plans (e.g., work plan, field sampling plan, quality assurance plan, etc.), and field personnel shall always consult the appropriate documents to determine project-specific roles and responsibilities. In addition, one person may serve in more than one role on any given project.

Project Manager: Selects project-specific field documentation with input from other key project staff.

Quality Control Manager: Overall management and responsibility for quality assurance and quality control (QA/QC). Selects QA/QC procedures for the sampling and analytical methods, performs project audits, and ensures that data quality objectives are fulfilled.

Field Team Leader (FTL) and/or Field Geologist, Hydrogeologist, or Engineer: Implements the sampling program, supervises other sampling personnel, and ensures compliance with SOPs and QA/QC requirements. Prepares daily logs of field activities.

Field Technician (or other designated personnel): Assists the FTL and/or field geologist, hydrogeologist, or engineer in the implementation of field tasks and field documentation.

Field Sample/Data Manager: Responsible for proper handling and shipping of all samples collected by the field crew, electronic data entry of field sample data sheet (FSDS) and chain-of-custody (COC) forms, and scanning/posting of field documentation PDFs (FSDS, COC, field logbooks, digital photographs) to a dedicated FTP site.

4.0 FIELD DOCUMENTATION PROCEDURES

Field documentation serves as the primary foundation for all field data collected that will be used to evaluate the project site. There are two main forms of field documentation – field logbooks and FSDS forms. All field documentation shall be accurate, legible and written in indelible black or blue ink. Absolutely no pencils or erasures shall be used. Incorrect entries in the FSDS forms or field logbooks will be corrected by crossing out the incorrect entry with one line, the individual making the correction will initial and date next to the correction.

4.1 Field Logbooks

The field logbook shall be a bound, weatherproof book with numbered pages, and shall serve primarily as a daily log of the activities carried out during the fieldwork. All entries shall be

made in indelible black or blue ink. A field logbook shall be completed for each operation undertaken during the field tasks. To further assist in the organization of the field log books, the project name and the date shall be recorded on top of each page along with the significant activity description (e.g., surface sample or soil boring number). All original field documentation shall be retained in the project files.

Skipped pages or blank sections at the end of a field log book page shall be crossed out with an "X" covering the entire page or blank section; "No Further Entries," initials, and date shall be written by the person crossing out the blank section or page. The responsible field team member shall write his/her signature, date, and time after the day's last entry.

Field activities vary from project to project; however, the concept and general information that shall be recorded are similar. The descriptions of field data documentation given below serve as an outline; individual activities may vary in documentation requirements. A detailed description of two basic example logbooks, suitable for documentation of field activities, is given below. These field logbooks include the FTL logbook and the field geologist/sampling team logbook.

FTL Logbook: The FTL's responsibilities include the general supervision, support, assistance, and coordination of the various field activities. As a result, a large portion of the FTL's day is spent rotating between operations in a supervisory mode. Records of the FTL's activities, as well as a summary of the field team(s) activities, shall be maintained in a logbook. The FTL's logbook shall be used to fill out daily/weekly reports and daily quality control reports (DQCRs), and therefore, shall contain all required information. Entries shall be preceded with time in military units for each observation. Items to be documented include:

- Record of tailgate meetings
- Personnel and subcontractors on job site and time spent on the site
- Field operations and personnel assigned to these activities
- Site visitors
- Log of FTL's activities: time spent supervising each operation and summary of daily operations as provided by field team members

- Problems encountered and related corrective actions
- Deviations from the sampling plan and reasons for the deviations
- Records of communications; discussions of job-related activities with the client, subcontractor, field team members, and project manager
- Information on addresses and contacts
- Record of invoices signed and other billing information
- Field observations

Field Geologist/Sampling Team Logbook: The field geologist or sampling team leader shall be responsible for recording the following information in a logbook:

- Health and Safety Activities
 - Calibration records for health and safety equipment (e.g., type of PID, calibration gas used, associated readings, noise dosimeters, etc.)
 - Personnel contamination prevention and decontamination procedures
 - Record of daily tailgate safety meetings
- Weather
- Calibration of field equipment
- Equipment decontamination procedures
- Personnel and subcontractors on job site and time spent on the site
- Station identifier
- Sampling activities
 - Sample location (sketch)
 - Equipment used
 - Names of samplers
 - Date and time of sample collection
 - Sample interval
 - Number of samples collected
 - Analyses to be performed on collected samples
- Disposal of contaminated wastes (e.g., PPE, paper towels, Visqueen, etc.)
- Field observations
- Problems encountered and corrective action taken
- Deviations from the sampling plan and reason for the deviations

- Site visitors

4.2 Field Sample Documentation

Sample Labels: A unique sample identification label shall be affixed to all sample containers. All samples will be labeled in a clear, precise way for proper identification in the field and for tracking in the laboratory. At the time of collection, each sample will be labeled with a unique 5-digit sequential identification (ID) number, referred to as the Index ID. The Index ID for all samples collected as part of OU3 Phase I sampling activities will have a prefix of "P1" (e.g., P1-12345). Index ID labels will be ½ inch x 1 ¾ inch in size and pre-printed for use in the field. For each Index ID, multiple labels will be printed to allow for multiple containers of the same sample (i.e., for different analyses).

Index ID Label Example:

P1-12345

Each collection container will be labeled with a container label that enables the field team member to record the container specific details, such as the method of sample preparation (e.g., filtered/unfiltered), method of preservation, and the analytical methods that will be requested. Container labels will be 2 inch x 4 inch in size and pre-printed for use in the field. Any container-specific information shall be written in indelible ink.

Container Label Example:

Station ID: _____	Date/Time: _____
Index ID: _____	
Media (circle one): AQ SO AA BK DB TC	
For AQ, Filtered? (circle one): Yes No	
Container: _____	
Preservation: _____	
Analyses: _____	
Lab QC: _____	<input type="checkbox"/> Archive

Media acronyms: AQ – aqueous media, SO – solid media, AA – ambient air, BK – tree bark, DB – organic debris, TC – tree age core

After labels have been affixed to the sample container, the labels will be covered with clear packaging tape to ensure permanence during shipping.

Any unused Index ID labels should be crossed out to avoid the possibility of using unused labels for a different sample.

Field Sample Data Sheet (FSDS) Forms: Data regarding each sample collected as part of the OU3 Phase I sampling will be documented using Libby-specific FSDS forms (provided as Attachment 1). These FSDS forms are media-specific and designed to facilitate data entry of station location, sample details, and field measurements needed for the OU3 Phase I investigation. For the purposes of the Phase I OU3 investigation there are five main FSDS forms:

- Stationary Ambient Air Monitor FSDS
- Forest Soil and Tree Bark FSDS
- Mine Waste Materials and Soil FSDS
- Surface Water and Sediment FSDS
- Groundwater FSDS

In the field, one field team member will be responsible for recording all sample details onto the appropriate FSDS form. At the time of sample labeling, one Index ID label will be affixed to the FSDS form in the appropriate field. All written entries on the FSDS form shall be accurate, legible and written in indelible black or blue ink.

Once the FSDS form is complete, written entries will be checked by a second field team member. These two field team members will initial the bottom of the FSDS form in the appropriate field to document who performed the written data entry and who performed the QC check of the FSDS form.

On a weekly basis (or more frequently as conditions permit), information from the hard copy FSDS form will be manually entered into a field-specific OU3 database using electronic data entry screens by the Field Sample/Data Manager. Once electronic data entry is complete, QC of all data entry will be completed by the FTL or their designate. The Field Sample/Data Manager and the FTL will initial in the appropriate field on the paper FSDS form to document who performed the data entry into the database and who performed the QC check.

4.3 Photologs

Photologs are often used in the field to document site conditions and sample location characteristics. While photographs may not always be required, they shall be used wherever applicable to show existing site conditions at a particular time and stage of the investigation or related site activity. Photolog information shall include:

- station location identifier
- Index ID (if applicable)
- date and time of photo
- direction/orientation of the photo
- description of what the photo is intended to show

An engineer's scale or tape shall be included in any photographs where scale is necessary. Any wasted frames or images in a roll of film or sequence of digital images shall be so noted in the field logbook.

4.4 Chain-of-Custody Records

Custody Seals: Custody seals with the date and initials of the sampler will be used on each shipping container to ensure custody. The custody seal will be placed on opposite sides of the cooler across the seam of the lid and the cooler body. Alternatively, if the sample containers are all placed inside a liner bag within the cooler, the custody seal may be placed across the seal of the liner bag inside of the cooler.

Chain-of-Custody Forms: COC procedures allow for the tracking of possession and handling of individual samples from the time of field collection through to laboratory analysis. Documentation of custody is accomplished through a COC form that lists each sample and the individuals responsible for sample collection and shipment, sample preparation, and receipt by the analytical laboratory. The COC form also documents the analyses requested for each sample. Whenever a change of custody takes place, both parties will sign and date the COC form, with the relinquishing party retaining a copy of the form. The party that accepts custody will inspect the COC form and all accompanying documentation to ensure that the information is complete and accurate. Any discrepancies will be noted on the COC form. Shipping receipts shall be signed and filed as evidence of custody transfer between field sampler(s), courier, and laboratory.

Attachment 2 provides an example of the COC form that will be used for all samples collected as part of Phase I OU3 sampling. This form will be printed as a carbonless triplicate form to facilitate retention of COC copies by relinquishing parties. As seen, the COC form includes the following information:

- sample identifier (Index ID)
- date and time of collection
- method of sample preparation and preservation
- number of sample containers
- analyses requested
- shipping arrangements and airbill number, as applicable
- recipient laboratories
- signatures of parties relinquishing and receiving the sample

On a daily basis, the Field Sample/Data Manager will package samples for shipping, complete hard copy COC forms, and ship all samples as outlined in SOP No. 8. On a weekly basis (or more frequently as conditions permit), information from the hard copy COC form necessary for sample tracking will be manually entered into a field-specific OU3 database using electronic data

entry screens by the Field Sample/Data Manager. Once electronic data entry is complete, QC of all data entry will be completed by the FTL or their designate.

5.0 FIELD DATA TRANSMITTAL

Copies of all FSDS forms, COC forms, and field log books will be scanned and posted in portable document format (PDF) to a project-specific file transfer protocol (FTP) site weekly (or more frequently as conditions permit). This FTP site will have controlled access (i.e., user name and password are required) to ensure data access is limited to appropriate project-related personnel. File names for scanned FSDS forms, COC forms, and field log books will include the sample date in the format YYYYMMDD to facilitate document organization (e.g., FSDS_20070831.pdf).

Electronic copies of all digital photographs will also be posted weekly (or more frequently as conditions permit) to the project-specific FTP site. File names for digital photographs will include the station identifier, the sample date, and photograph identifier (e.g., ST-1_20070831_12459.tif).

A copy of the field-specific OU3 database will be posted to the project-specific FTP site on a weekly basis (or more frequently as conditions permit). The field-specific OU3 database posted to the FTP site will include the post date in the file name (e.g., FieldOU3DB_20070831.mdb).

6.0 CORRECTIONS AND MODIFICATIONS

6.1 Field Deviations and Modifications

It is recognized that deviations and modifications from the standard operating procedures may be necessary based on site conditions. Any requested field modifications will be submitted by Robert Marriam (Remedium Group, Inc. - W.R. Grace contractor) to Bonita Lavelle (EPA Region 8 - Remedial Project Manager) for review and approval. All modification requests will be recorded in a Field Modification Approval Form (see Attachment 3).

6.2 Corrections to Hard Copy Forms

If an error is identified on an FSDS or COC form prior to entry into the field-specific OU3 database, the information should be corrected on the hard copy form by crossing out the incorrect entry with one line, the individual making the correction will initial and date next to the correction. Data entry into the field-specific OU3 database and scanning/posting of the hard copy forms should proceed following the data entry procedures described above.

If an error is identified on an FSDS or COC form after entry into the field-specific OU3 database, the information should be corrected on the hard copy form by crossing out the incorrect entry with one line, the individual making the correction will initial and date next to the correction. The corrected form should be scanned and posted to the project-specific FTP site. File names for corrected FSDS forms will include the Index ID of the corrected sample to facilitate document organization (e.g., FSDS_C_P1-12345.pdf). File names for corrected COC forms will include the COC ID of the corrected COC form to facilitate document organization (e.g., COC_C_OU3-36512.pdf). Necessary data corrections will be made to the master OU3 database by the database manager.

If changes are made to a COC form, the analytical laboratory should be provided with a corrected COC form.

7.0 REFERENCES

Agency for Toxic Substances and Disease Registry. 2006. Asbestos Exposure and Your Health.
RCRA Ground-Water Monitoring: Draft Technical Guidance, November 1992.

ATTACHMENT 1

PHASE I OU3 FIELD SAMPLE DATA SHEET (FSDS) FORMS



LIBBY OU3 PHASE 1 FIELD SAMPLE DATA SHEET (FSDS) rev0 STATIONARY AMBIENT AIR MONITOR

Field Logbook No: _____ Page No: _____

Check box if GPS information has been recorded previously

Station ID: A-_____ Station Comments: _____

GPS Coordinate System: UTM Zone 11 North, WGS84 datum, meters

X coord (Easting): _____ m Y coord (Northing): _____ m

Elevation Coordinate System: WGS84, meters Elevation: _____ m

Sampling Team: MWH Sampler Initials: _____

Data Item	Cassette 1	Cassette 2	Cassette 3						
Index ID (place pre-printed label in field provided)									
Sample Height (ft)									
Location Description									
Field QC Type (circle)	FS-(field sample) FB-(field blank) FD-(field dup) For FD, Parent ID:	FS-(field sample) FB-(field blank) FD-(field dup) For FD, Parent ID:	FS-(field sample) FB-(field blank) FD-(field dup) For FD, Parent ID:						
Matrix Type	Outdoor	Outdoor	Outdoor						
Flow Meter Type	Rotameter	Rotameter	Rotameter						
Archive blank (circle)	Yes No	Yes No	Yes No						
Pump ID Number									
Flow Meter ID Number									
Start Date (mm/dd/yy)									
Start Time (hh:mm)									
Start Counter									
Daily Flow Check: Record time (hh:mm) and flow rate (L/min) in fields provided	Check1	Time	Flow	Check1	Time	Flow	Check1	Time	Flow
	Check2			Check2			Check2		
	Check3			Check3			Check3		
	Check4			Check4			Check4		
Stop Date (mm/dd/yy)									
Stop Time (hh:mm)									
Stop Counter									
Pump fault? (circle)	Yes No	Yes No	Yes No						
Stop Flow (L/min)									
Field Comments									
Cassette Lot Number: <u>14635</u>									
Entered By (Provide initials):		Validated By (Provide initials):							



LIBBY OU3 PHASE 1 FIELD SAMPLE DATA SHEET (FSDS) rev1 FOREST SOIL AND TREE BARK

Check box if GPS information has been recorded previously

Field Logbook No: _____ Page No: _____

Station ID: **SL** _____ - _____ Sampling Date: _____

GPS Coordinate System: UTM Zone 11 North, WGS84 datum, meters

X coord (Easting): _____ m Y coord (Northing): _____ m

Elevation Coordinate System: WGS84, meters Elevation: _____ m

Sampling Team: MWH Sampler Initials: _____

Station Comments: _____

TREE BARK SAMPLES

Index ID:	Field QC Type (circle one): FS (field sample) FD (field duplicate) For FD, Parent ID: _____	Sample Area (cm²): 17.03	Tree Species: Douglas Fir	Age Core Collected? (circle one): Y N
Index ID:	Field QC Type (circle one): FS (field sample) FD (field duplicate) For FD, Parent ID: _____	Sample Area (cm²): 17.03	Collection Height (ft): _____	
Diameter* (in): _____				
Field Comments: 				
Entered by (Provide initials):			Validated by (Provide initials):	

*Measured with "D-tape"

FOREST SOIL SAMPLES

Index ID:	Field QC Type (circle one): FS (field sample) FD (field duplicate) For FD, Parent ID: _____	Bulk Soil Description		Organic Debris Collected? (circle one): Y N
		Depth (in) Start: 0 End: 2	Sample Type: Composite # of Comp.: 5	
Index ID:	Field QC Type (circle one): FS (field sample) FD (field duplicate) For FD, Parent ID: _____	Depth (in) Start: 0 End: 2	Sample Type: Composite # of Comp.: 5	Organic Debris Collected? (circle one): Y N
Index ID:	Field QC Type (circle one): FS (field sample) FD (field duplicate) For FD, Parent ID: _____	Depth (in) Start: 0 End: 2	Sample Type: Composite # of Comp.: 5	Organic Debris Collected? (circle one): Y N
Field Comments: 				
Entered by (Provide initials):			Validated by (Provide initials):	



LIBBY OU3 PHASE 1 FIELD SAMPLE DATA SHEET (FSDS) rev0

SURFACE WATER AND SEDIMENT

Check box if GPS information has been recorded previously

Field Logbook No: _____ Page No: _____

Station ID: _____ Station Type (circle one): Stream Pond Seep Sampling Date: _____

GPS Coordinate System: UTM Zone 11 North, WGS84 datum, meters

X coord (Easting): _____ m Y coord (Northing): _____ m

Elevation Coordinate System: WGS84, meters Elevation: _____ m

Sampling Team: MWH Sampler Initials: _____

Station Comments: _____

WATER QUALITY PARAMETERS

Time (hh:mm)	Temp. (°C)	pH	Specific Conductance (umhos/cm)		Diss. O ₂ (mg/L)	Turbidity (NTU)	Sampling Depth (ft)	Total Depth (ft)	Discharge (cfs)
			@ Field Temp	@ 25°C					

Water Quality Comments: _____

SURFACE WATER AND SEDIMENT SAMPLES

Data Item	Sample 1	Sample 2	Sample 3
Index ID (place pre-printed label in field provided)			
Media (circle one):	Surface Water Sediment	Surface Water Sediment	Surface Water Sediment
Field QC Type (circle one):	FS (field sample) FD (field duplicate) For FD, Parent ID: _____ EB (equip blank) FB (field blank) TB (trip blank) Cooler: _____ PE (perf. eval.) ID: _____	FS (field sample) FD (field duplicate) For FD, Parent ID: _____ EB (equip blank) FB (field blank) TB (trip blank) Cooler: _____ PE (perf. eval.) ID: _____	FS (field sample) FD (field duplicate) For FD, Parent ID: _____ EB (equip blank) FB (field blank) TB (trip blank) Cooler: _____ PE (perf. eval.) ID: _____
Archive Blank (circle)	Yes No	Yes No	Yes No
Sample Time (hh:mm)			
For Sediment:			
Sample Type (circle one):	Grab Composite # of Comp: _____	Grab Composite # of Comp: _____	Grab Composite # of Comp: _____
Sample Depth	Start Depth (in): _____ End Depth (in): _____	Start Depth (in): _____ End Depth (in): _____	Start Depth (in): _____ End Depth (in): _____
Field Comments:			
Entered by (Provide initials):		Validated by (Provide initials):	

For Data Entry Completion (Provide Initials)	Completed by	QC by
--	--------------	-------



LIBBY OU3 PHASE 1 FIELD SAMPLE DATA SHEET (FSDS) rev0 MINE WASTE AND SOIL-LIKE MATERIALS

Field Logbook No: _____ Page No: _____

Check box if GPS information has been recorded previously

Station ID: MS- _____ Sampling Date: _____

GPS Coordinate System: UTM Zone 11 North, WGS84 datum, meters Elevation Coordinate System: WGS84, meters

Sampling Team: MWH Sampler Initials: _____

Station Comments: _____

Data Item	Sample 1	Sample 2	Sample 3
Index ID (place pre-printed label in field provided)			
Matrix (circle one):	Surface Soil Tailings Waste Rock Roadway Other _____	Surface Soil Tailings Waste Rock Roadway Other _____	Surface Soil Tailings Waste Rock Roadway Other _____
Sample Time (hh:mm)			
Sample Type (circle one):	Grab Composite # of Comp: _____	Grab Composite # of Comp: _____	Grab Composite # of Comp: _____
Sample Depth	Start Depth (in): _____ End Depth (in): _____	Start Depth (in): _____ End Depth (in): _____	Start Depth (in): _____ End Depth (in): _____
Field QC Type (circle one):	FS (field sample) FD (field duplicate) For FD, Parent ID: _____ PE (perf. eval.) ID: _____	FS (field sample) FD (field duplicate) For FD, Parent ID: _____ PE (perf. eval.) ID: _____	FS (field sample) FD (field duplicate) For FD, Parent ID: _____ PE (perf. eval.) ID: _____
Transect Start Location or Grab Sample Location	X coord: _____ m Y coord: _____ m Elevation: _____ m	X coord: _____ m Y coord: _____ m Elevation: _____ m	X coord: _____ m Y coord: _____ m Elevation: _____ m
Transect End Location	X coord: _____ m Y coord: _____ m Elevation: _____ m	X coord: _____ m Y coord: _____ m Elevation: _____ m	X coord: _____ m Y coord: _____ m Elevation: _____ m
Field Comments:			
Entered by (Provide initials):		Validated by (Provide initials):	



LIBBY OU3 PHASE 1 FIELD SAMPLE DATA SHEET (FSDS) rev1 GROUNDWATER

Field Logbook No: _____ Page No: _____
Station ID: _____ **Station Alias:** _____ **Sampling Date:** _____
 GPS Coordinate System: UTM Zone 11 North, WGS84 datum, meters X coord: _____ Y coord: _____
 Elevation Coordinate System: WGS84, meters Elevation (meters): _____
 Sampling Team: MWH Sampler Initials: _____
 Station Comments: _____

Well: Measuring Point (MP) of Well: _____ MP Units: _____ Screened Interval (ft BGL): _____ Filter Pack Interval (ft BGL): _____ Casing Stickup (ft) _____ Sample Intake Depth (ft BMP): _____	Calibration: <input type="checkbox"/> Daily Verification Weekly Date: _____ VOA Vial pH: _____ Other pH: _____
---	---

Purge Method:
 Dedicated Submersible (SP) Portable Bladder (BP) Peristaltic (PP)
 Portable Submersible (SP) Dedicated Bailer (B) Grab (G)
 Dedicated Bladder (SP) Disposable Bailer (B) Other: _____

Multiplication Factors:
 1" = 0.04 2" = 0.16
 3" = 0.37 4" = 0.65
 6" = 1.47

Purge:
 Starting Water Level (ft BMP): _____ Total Depth (ft BGL): _____ Water Column Height (ft): _____
 Casing Diameter (in ID): _____ Multiplication Factor: _____ Casing Volume (gal): _____ 2X: _____ 3X: _____ 4X: _____
 Water Level (ft BMP) at End of Purge: _____ Total Depth (ft BMP) at End of Purge: _____

Time (hh:mm)	Temp. (°C)	pH	Specific Conductance (umhos/cm)		Diss. O ₂ (mg/L)	Turbidity (NTU)	Vol Evac (gal)	Flow Rate (gal/min)	Comments
			@ Field Temp	@ 25°C					

Final Parameters

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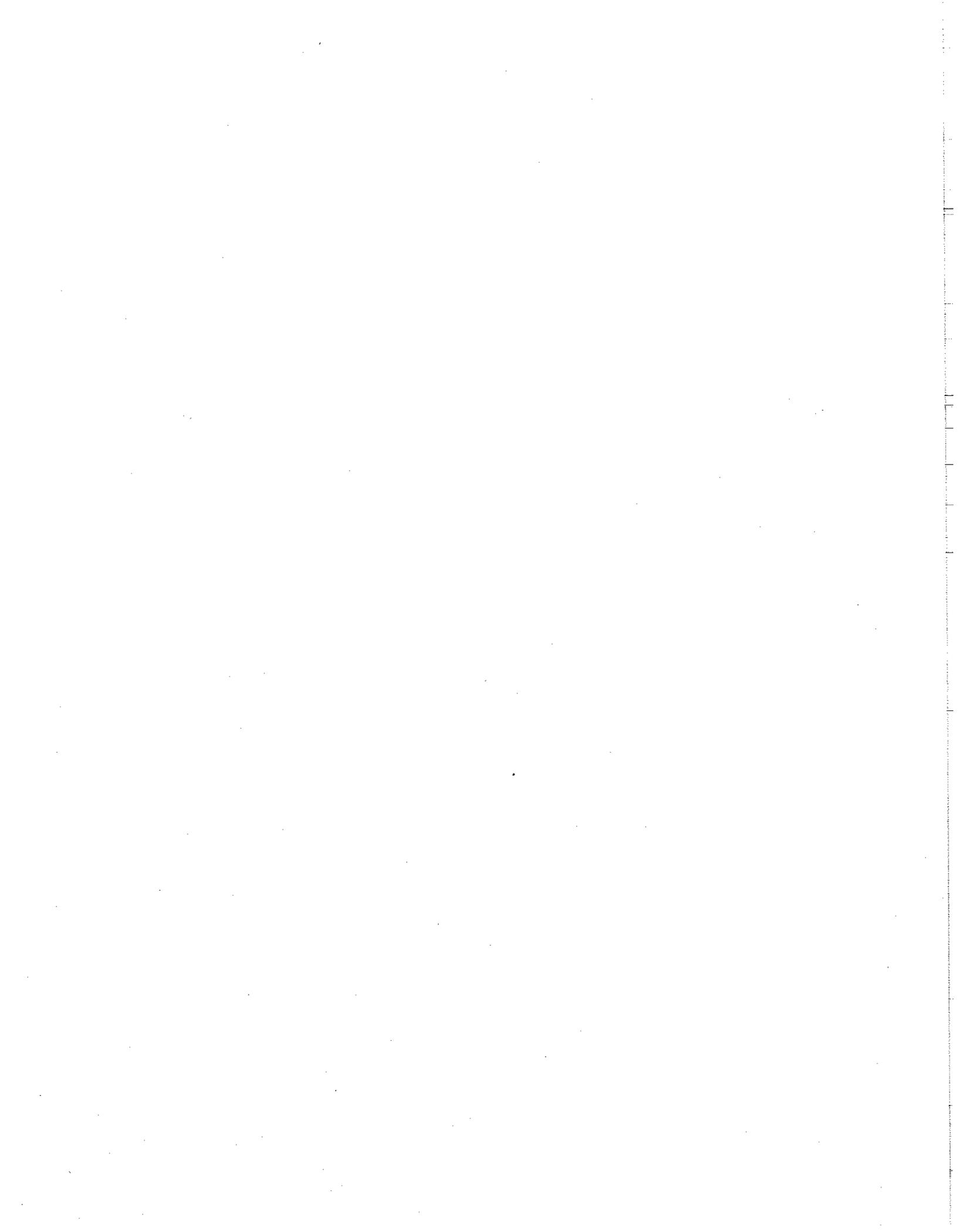
Data Item	Sample 1	Sample 2	Sample 3
Index ID (place pre-printed label in field provided)			
Field QC Type (circle one):	FS (field sample) FD (field duplicate) For FD, Parent ID: _____ Equipment Blank Field Blank Trip Blank Cooler ID: _____	FS (field sample) FD (field duplicate) For FD, Parent ID: _____ Equipment Blank Field Blank Trip Blank Cooler ID: _____	FS (field sample) FD (field duplicate) For FD, Parent ID: _____ Equipment Blank Field Blank Trip Blank Cooler ID: _____
Field Comments:			
Entered by (Provide initials):	Validated by (Provide initials):		



ATTACHMENT 2

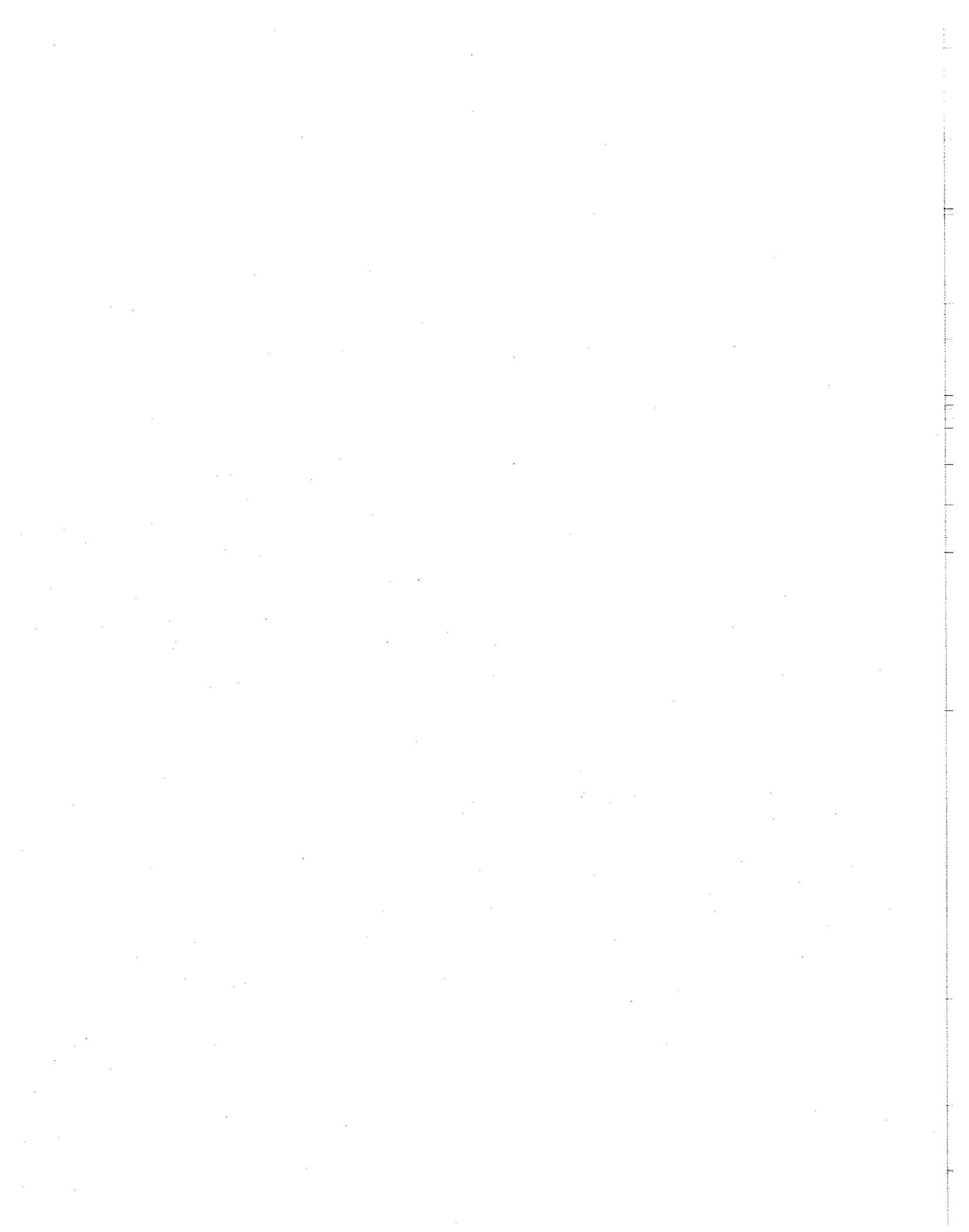
PHASE I OU3 CHAIN OF CUSTODY FORM





ATTACHMENT 3

PHASE I OU3 FIELD MODIFICATION APPROVAL FORM



FIELD MODIFICATION APPROVAL FORM

LFM-OU3-_____

Libby OU3 Phase I Sampling & Analysis Plan

Requested by: _____ Date: _____

Description of Deviation:

EPA Region 8 has reviewed this field modification approves as proposed.

EPA Region 8 has reviewed this field modification and approves with the following exceptions:

EPA Region 8 has reviewed this field modification and does not agree with the proposed approach for the following reasons:

Bonita Lavelle, EPA RPM

Date



Libby Superfund Site Operable Unit 3 Standard Operating Procedure

Date: September 26, 2007

OU3 SOP 10 (Rev. 0)

Title: FIELD EQUIPMENT CALIBRATION

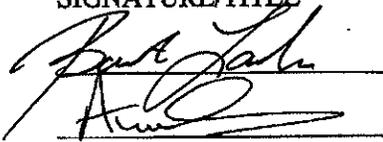
APPROVALS:

TEAM MEMBER

SIGNATURE/TITLE

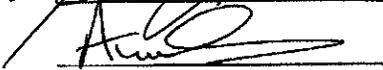
DATE

EPA Remedial Project Manager



9/26/07

SOP Author



9/26/07

Revision Number	Date	Reason for Revision
0	09/26/2007	-



1.0 INTRODUCTION

This standard operating procedure (SOP) provides general guidelines on calibration and operating procedures for typical field equipment. This SOP is based on MWH SOP-01, Field Equipment Calibration, Revision 1.0, March 2004, modified for use at the Libby Asbestos Superfund Site OU3. Field monitoring instruments are used when data quality objectives specify screening level analytical support. These data are collected for on site, real-time measurements, evaluation of existing conditions, refinement of sampling locations, and health and safety evaluations. Field measurements are generally used to refine sampling programs and to estimate the extent of contamination at the site. This type of support also provides real-time data for health and safety purposes.

The purpose of this SOP is to define the calibration and operating procedures for equipment used for field monitoring.

2.0 DEFINITIONS

Conductivity: Is a measure of the quantity of electricity transferred across a unit area, per unit potential gradient, per unit time. Conductivity is measured by dipping a probe directly into the water source or into a separate sample aliquot.

Dissolved Oxygen (DO): Is a measure of the quantity of oxygen dissolved in water. DO data is collected in the field using direct measurement probes.

pH: Is measured directly using a probe and is the acidity or alkalinity of a solution; numerically equal to 7 for neutral solutions, increasing with increasing alkalinity and decreasing with increasing acidity.

Temperature: An indicator of the thermal energy contained in a solid or fluid. Units are degrees Centigrade (°C) or degrees Fahrenheit (°F). Temperature measurements are made with a mercury-filled thermometer, bimetallic-element thermometer, or electrical thermistor.

Turbidity: a measure of cloudiness in water due to suspended and colloidal organic and inorganic material. Turbidity is measured by using a field portable nephelometer capable of reading down to 0.1 Nephelometric Turbidity Units (NTU).

3.0 RESPONSIBILITIES

This section presents a brief definition of field roles, and the responsibilities generally associated with them. This list is not intended to be comprehensive and often, additional personnel may be involved. Project team member information will be included in project-specific plans (e.g., work plan, field sampling plan, quality assurance plan, etc.), and field personnel will always consult the appropriate documents to determine project-specific roles and responsibilities. In addition, one person may serve in more than one role on any given project.

Project Manager: Responsible for identifying the appropriate equipment necessary for adequate site characterization and the requirements for the project-specific tasks.

Quality Control Manager: Performs field program audits and ensures project data quality objectives are fulfilled.

Field Team Leader (FTL) and/or Field Geologist, Hydrogeologist, or Engineer: Implements the field program, and supervises other field staff to ensure proper calibration and use of field equipment through the duration of the project.

Field Technician (or other designated personnel): Responsible for providing requested instrumentation and basic instructions on its calibration and use. Assists the FTL with the implementation of tasks and is responsible for regular equipment maintenance and calibration.

4.0 GUIDELINES

This SOP provides a summary of the calibration and operating procedures in accordance with the various manufacturers' instruction manuals, which accompany each piece of equipment. This

SOP will be reviewed and used in conjunction with the manufacturer's instruction manual by field team members when using field equipment.

4.1 Applicability

Field equipment must be kept in designated cases, packaged properly, and secured during transport. This will prevent equipment damage, which may result in inaccurate readings. All equipment will be decontaminated and calibrated prior to use. As part of the calibration process, standard laboratory procedures of decontamination are to be followed; prior to calibration and between calibration buffers, solution vessels and probes are to be rinsed a minimum of three times with distilled/deionized water and a minimum of one time with the calibration buffer solution or sample solution.

The meters will always be calibrated according to the manufacturer's instructions before the start of each workday and whenever equipment drift is suspected. Consult the specific instruments' instruction manual for further calibration details. The manufacturer's instruction on operation and maintenance will be followed.

4.2 pH Meters

Determining pH is critical for predicting and interpreting the reactions and migration of dissolved chemical constituents in groundwater or surface water. Whenever groundwater or surface water samples are collected, pH may be measured using a flow-through type meter or another type of pH probe. Meters used will have temperature and slope adjustments and a repeatability of ± 0.01 standard pH units.

Calibration: Calibration standard buffers will not be used beyond the date specified by the manufacturer and calibration standard buffers will be stored in a manner that protects the integrity and precision of the solution. Prior to calibrating the instrument, proper

decontamination of the equipment will be performed following standard lab practices (refer to section 4.1).

Two pH standard buffers will be used for calibration of the electrode and are to bracket the anticipated pH of the groundwater or surface water samples. For example, if the anticipated pH of sample water is 6, calibration will be conducted with pH 4 and pH 7 buffer solutions; for an anticipated pH of 8, calibrate with pH 7 and pH 10 buffers. Buffers and samples will be kept at similar temperature. This action will eliminate the need to correct values for temperature effects. Theoretically, buffer solutions are stable indefinitely; however, they are susceptible to contamination. Therefore, old, partially full bottles will be replaced and solutions will not be used past the manufacturer's recommended expiration date. The instrument calibration will be checked periodically against a standard solution.

4.3 Specific Conductance Meters

Specific conductance is used as an indicator of water quality. It is a simple indicator of the change within a system and provides useful information for site characterization. Any meter used to collect field specific conductance measurements will be equipped with a temperature compensator, and read directly in micromhos per centimeter ($\mu\text{mhos/cm}$) corrected to 25°C. The meter will be calibrated to record values over the anticipated range of conductivity values during measurement.

Calibration: Reagent-grade potassium chloride (KCl) will be used for the calibration of specific conductance equipment. Calibration standards will not be used beyond the date specified by the manufacturer. Consult the manufacturer's instruction manual for further details. Specific conductance readings will be reported on the field logs in micromhos/centimeter ($\mu\text{m/cm}$) or millimhos/cm. The instrument calibration will be checked periodically against a standard solution of KCl.

4.4 Turbidity Meters

Turbidity meters measure the amount of light scattered at right angles from a beam of light passing through the test sample. Turbidity readings are the measure of the interaction of light with suspended solid particles in the sample. Test results are read directly in Nephelometric Turbidity Units (NTUs) on an LCD digital readout.

Calibration: The turbidity meter is pre-calibrated in the factory, and a simple standardization is the only step required prior to testing.

4.5 Dissolved Oxygen Meters

Dissolved oxygen (DO) meters measure the quantity of oxygen dissolved in water. In a typical DO meter, the tip of the probe consists of a cell enclosed by a selective membrane in a protective holder containing the electrolyte and electrodes.

Calibration: Always calibrate the instrument according to the manufacturer's specifications. For an accurate calibration, the probe may require immersion in water in an airtight container. If an open container is used for calibration, the margin of error is approximately 0.1 ppm. If the calibration is performed above sea level, a correction will be made for the difference in altitude. Certain table listings are available for oxygen solubility as a function of temperature and salinity. Refer to the manufacturer's specifications regarding slope calibration.

5.0 QUALITY ASSURANCE AND QUALITY CONTROL

All equipment calibration data must be documented in the field logbooks and/or field forms, including rationales deviations from this SOP or manufacturer's recommendations. The Field Team Leader or designated QA reviewer will check and verify that field documentation has been completed per this procedure and other procedures referenced herein. All equipment must be operated according to the manufacturer's specifications, including calibration and maintenance.

6.0 DECONTAMINATION

All equipment used in the sampling process shall be decontaminated prior to field use and between sample locations. Decontamination procedures are presented in SOP-7. Personnel shall don appropriate personal protective equipment as specified in the health and safety plan. Any investigation-derived waste generated in the calibration process shall be managed in accordance with the procedures outlined in SOP-12.

7.0 REFERENCES

Beta Technology Incorporated. Hydac Instruction Manual for the Hydac Conductivity Temperature pH Tester, Beta Technology Incorporated, 545 Moose Lodge Road, Cambridge, MD 21613-0265.

Orion, 1984. Research, Incorporated, Laboratory Products Group, Model SA 250 pH Meter Instruction Manual, 840 Memorial Drive, Cambridge, MA 02139.

YSI, Incorporated (YSI), 1988. YSI Models 33 and 33M S-C-T Meters Instructions, YSI Incorporated, Yellow Springs Instrument Co., Yellow Springs, Ohio, 45387, July, 1988.

YSI, 1989. Instructions YSI Model 3000 and 3000M T-L-C Meter, YSI Incorporated, Yellow Springs Instrument Co., Yellow Springs, Ohio, 45387, May, 1989.

LaMotte Company, (LaMotte). Operator's Manual, Turbidity Model 2008, LaMotte Company, PO Box 329, Chestertown, Maryland, 21620.

Solinst. Solinst Water Level Meter Operating Instructions, Model 101 & 102, Solinst Canada Ltd., 2440 Industrial Street, Burlington, Ontario, L7P 1A5.

Libby Superfund Site Operable Unit 3 Standard Operating Procedure

Date: September 26, 2007

OU3 SOP 11 (Rev. 0)

Title: GPS (Global Positioning System) DATA COLLECTION

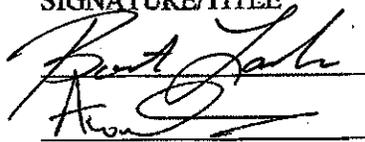
APPROVALS:

TEAM MEMBER

SIGNATURE/TITLE

DATE

EPA Remedial Project Manager



9/26/07

SOP Author

9/26/07

Revision Number	Date	Reason for Revision
0	09/26/2007	--



1.0 INTRODUCTION

This Standard Operating Procedure (SOP) is a general guidance document for the collection of coordinates of point locations using a Global Positioning System (GPS) unit. The GPS is a worldwide, satellite-based system with location positioning capabilities. The system is administered and managed by the Department of Defense. It is comprised of:

- a space segment of approximately 24 operational satellites in complimentary orbit,
- a ground control segment made up of a network of control stations around the globe, and
- a user segment, which includes anyone who uses GPS to collect locational information.

The system utilizes precise time and radio signals to determine distances from satellites to user GPS receivers. Distances are most commonly calculated by using the time it takes for a radio signal code to be transmitted from the satellite and received by the GPS unit. Precise time is critical to the successful operation of the system. The control stations ensure that the satellites employ synchronized, atomic clock-derived universal time coordinates (UTC), commonly known as Greenwich Mean Time (GMT). Receiver units collecting four satellite signals can determine the geodetic (x, y, z) location through a process of mathematical triangulation. The satellite signals contain precise time and satellite position information.

GPS technology is used as a method of accurately determining the coordinates of point locations. The three-dimensional position, or the x, y, and z geodetic coordinates, are determined for the point locations; however, only the x and y values are primarily used. This is due to the processes involved in the system; the vertical GPS coordinates are approximately half as accurate as the horizontal GPS coordinates. The position reported by the GPS unit is based on the geodetic model selected. The vertical, or z coordinate, value is not as accurate as the reported position due to the geometry of the satellite constellation relative to the receivers position on the earth.

GPS is one of the arrays of tools for accurately determining location in the field. The collection of x, y, and z coordinates (for gross data collection) for locations in the field using GPS is useful

for a variety of purposes, including accurate sample locations, locational correlation of remotely sensed data with ground truth locations, and efficiently collecting better spatial data.

2.0 RESPONSIBILITIES

This section presents a brief definition of field roles, and the responsibilities generally associated with them. This list is not intended to be comprehensive and often, additional personnel may be involved. Project team member information will be included in project-specific plans (e.g., work plan, field sampling plan, quality assurance plan, etc.), and field personnel will always consult the appropriate documents to determine project-specific roles and responsibilities. In addition, one person may serve in more than one role on any given project.

Project Manager: Selects project-specific field documentation with input from other key project staff, and appropriate oversight agencies.

Quality Control Manager: Overall management and responsibility for quality assurance and quality control (QA/QC). Selects QA/QC procedures for the sampling and analytical methods, performs project audits, and ensures that data quality objectives are fulfilled.

Field Team Leader (FTL) and/or Field Geologist, Hydrogeologist, or Engineer: Implements the sampling program, supervises other sampling personnel, and ensures compliance with SOPs and QA/QC requirements. Prepares daily logs of field activities.

Field Technician (or other designated personnel): Assists the FTL and/or field geologist, hydrogeologist, or engineer in the implementation of field tasks and field documentation.

3.0 PROCEDURES

There has been, and will continue to be, a considerable and rapid evolution in GPS techniques and technologies. The procedures described here are to be general in nature and geared towards hand-held recreational GPS units. Consult the specific instruments' instruction manual for details on operation.

Method

- Turn GPS unit on by pressing and releasing the power key.
- Following the Welcome Page the Satellite Page will be next.
- After sufficient satellites have been acquired, change to Setup
- Set GPS to report coordinates in UTM Zone 11 North, meters, with WGS84 datum
- Change to Position Page.
- When locating a sample location, use the sample identification as described in the field sampling plan
- To record a location press the Mark key; the X Coordinate (Easting), Y Coordinate (Northing), time, and date will be saved. Record the information into a field log book and field data sheets, and save the information in the GPS unit with a unique identification name and/or number to be downloaded later. Coordinates, in meters, should be recorded with 2 decimal places.
- Then enter OK to return to the Position Page.
- To turn off the GPS unit press and hold down the power key.

4.0 QUALITY ASSURANCE AND QUALITY CONTROL

Only data with high geometrical strength or low percent dilution of position (PDOP) will be used to ensure high accuracy. The Field Team Leader or designated QA reviewer will check and verify that the GPS coordinates are collected using the appropriate Datum, are entered into a field logbook or electronic database on a daily basis and that coordinates entered into project records match those recorded in the GPS-unit memory. If any corrections are necessary, the field team

lead or other field personnel will make those corrections before coordinates are transmitted to data users.

All GPS equipment must be operated according to the manufacturer's specifications, including calibration and maintenance.

5.0 REFERENCES

U.S Environmental Protection Office of Environmental Information. *Global Positioning Systems-Technical Implementation Guidance*. September 2003. Available online at <http://www.epa.gov/OEI/pdf/GPS-TIG.pdf>

Garmin GPSmap 60CSx Operators Manual.

Libby Superfund Site Operable Unit 3 Standard Operating Procedure

Date: September 26, 2007

OU3 SOP 12 (Rev. 0)

Title: INVESTIGATION DERIVED WASTE (IDW) MANAGEMENT

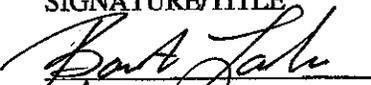
APPROVALS:

TEAM MEMBER

SIGNATURE/TITLE

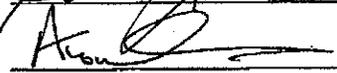
DATE

EPA Remedial Project Manager



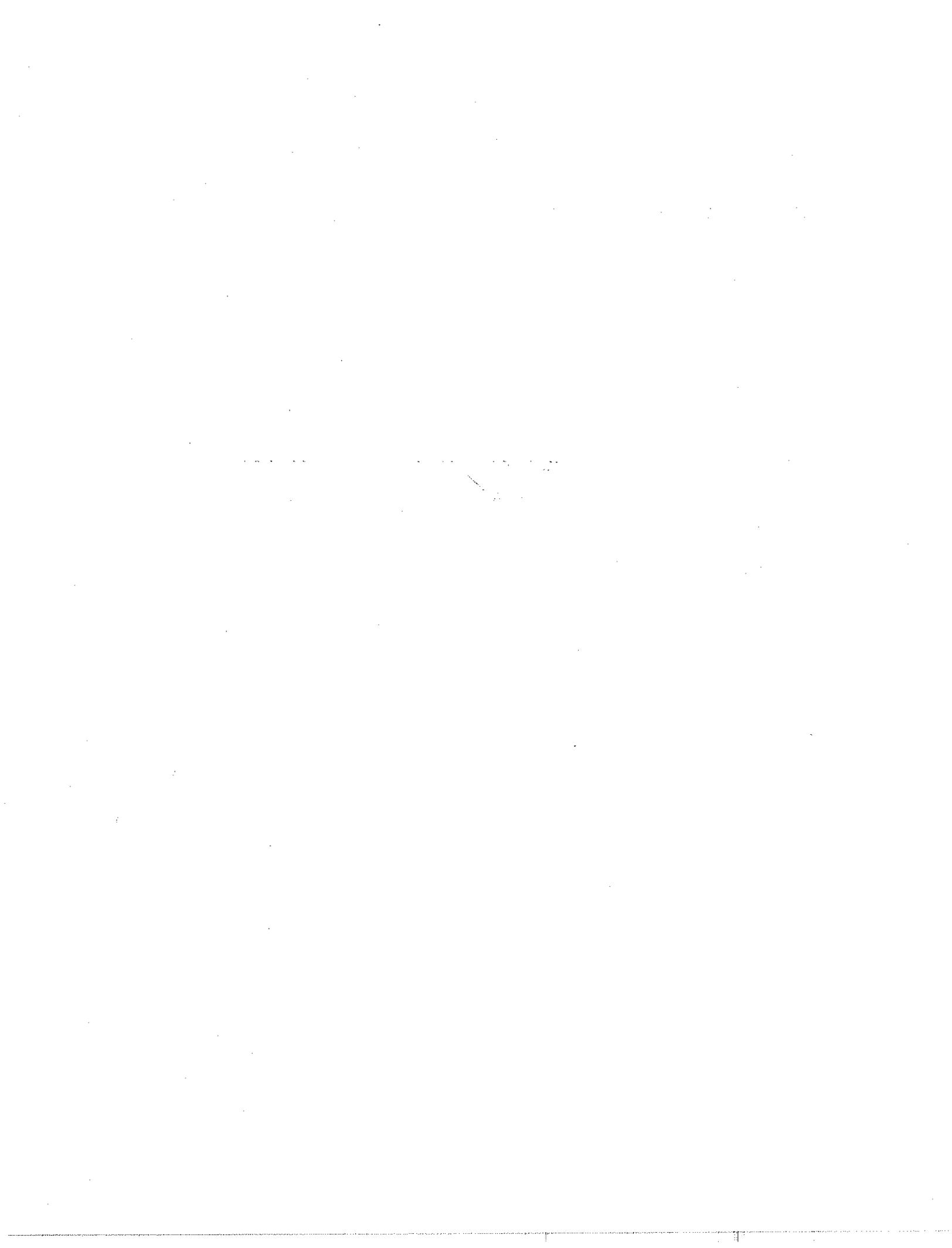
9/26/07

SOP Author



9/26/07

Revision Number	Date	Reason for Revision
0	09/26/2007	--



1.0 INTRODUCTION

This SOP is based on MWH SOP-07, Investigation-Derived Waste (IDW) Management, Revision 1.0, April 2007, modified for use at the Libby Asbestos Superfund Site OU3. IDW may be generated during field investigations at the Libby Asbestos Superfund Site OU3. The National Contingency Plan (NCP), codified in 40 Code of Federal Regulations (CFR) 300, requires that IDW be handled to attain all the applicable or relevant and appropriate requirements (ARARs) to the extent practicable, considering the urgency of the situation. The purpose of this SOP is to present procedures to be followed in the management of IDW generated during the field investigations.

Typical IDW generated during field activities are solid wastes and may include (but are not limited to) the following media and waste types:

Fluids	Solids
Purge water and groundwater	Soils and soil cuttings
Drilling mud	Plastic tarps or sheeting
Grout	Drill pipe and well casing/screen
Decontamination fluids and wastewater	Decontamination solids
	Disposable equipment (i.e., rope, bailers, sampling equipment, & other consumables)
	Spent personal protective equipment (PPE)
	Used containers, sample bottles
	Packaging materials

The above wastes may or may not be encountered, generated or managed while performing field investigations. However, all solid waste streams will be characterized to determine if they are hazardous wastes per 40 CFR § 262.11 for the purposes of handling and disposal. Guidance from this document shall be used as part of project planning to estimate total volumes of IDW likely to be generated as well as how the IDW will be managed and disposed.

2.0 HEALTH AND SAFETY WARNING

All personnel engaged in IDW handling must follow health and safety protocols described in the health and safety plan. Asbestos fibers are thin and long fibers so small that they cannot be seen by the naked eye. Asbestos fibers are easily inhaled when disturbed and when embedded in the lung tissue can cause health problems. Significant exposure to asbestos increases the risk of lung cancer, mesothelioma, asbestosis (non-cancerous lung disease), and other respiratory diseases (ATSDR 2006).

3.0 DEFINITIONS

Area of Contamination (AOC) unit: The AOC unit concept is critical to the IDW management at a CERCLA investigation site. Although EPA has not promulgated a definition of an AOC unit, an AOC unit is generally an area within a CERCLA investigation site with similar characteristics with respect to contamination and the associated risks to human health and the environment. A CERCLA investigation site may contain one or more AOC units.

Decontamination fluids: Any fluids, including aqueous wash water, solvents, and contaminants that are used or generated during decontamination procedures.

Decontamination solids: Any solids, including soils and soil cuttings, fill materials, and contaminants that are generated during decontamination procedures.

Grout: A fluid mixture of cement and water (neat cement) of a consistency that can be forced through a pipe and placed as required.

Hazardous waste: A solid waste that meets the definition of a hazardous waste under RCRA as defined in 40 CFR § 261.3.

Investigation-derived waste (IDW): Solid wastes, as defined in 40 CFR § 261.2, directly generated as result of performing the field activities.

Nonhazardous waste: A solid waste that does not meet the definition of a hazardous waste as defined in 40 CFR § 261.3 or is excluded from hazardous waste regulation per 40 CFR § 261.4(b).

Soils and soil cuttings: Solid material generated from excavation or drilling processes. Soils may include native soils, fill materials, and/or other historical plant waste streams used as fill materials on the site.

Solid waste: Any waste stream (solid, liquid or containerized gas) that meets the definition of solid waste under RCRA as defined in 40 CFR § 261.2.

4.0 RESPONSIBILITIES

This section presents a brief definition of the field team roles and responsibilities for management of IDW generated while conducting field investigations. This list is not intended to be a comprehensive list as additional personnel may be involved. Project team member information shall be included in project-specific plans (e.g., work plan, field sampling plan (FSP), quality assurance plan, etc.), and field personnel shall always consult the appropriate documents to determine project-specific roles and responsibilities. In addition, one person may serve in more than one role on any given project.

Project Manager: Responsible to ensure that all field team members are properly trained per their responsibilities associated with IDW and that appropriate equipment and facilities are available for appropriate IDW management.

Field Team Leader (FTL): Implements the field program and supervises all field team members in the appropriate management of IDW. Ensures that only properly trained personnel are managing IDW on the site.

Environmental, Health and Safety (EHS) Officer: Assists the Team Leader in the supervision of all IDW management on site. The EHS officer shall be responsible for all IDW identification and characterization, on site disposal, off site shipment and disposal, waste accumulation, emergency response and contingency planning, IDW training, and IDW reporting and recordkeeping.

Project Team Members: Ensure that they are properly trained prior to any IDW management as well as follow the appropriate IDW procedures and training.

5.0 REGULATORY BASIS AND GUIDANCE

IDW encountered, generated, or managed during the field investigations may contain hazardous substances as defined by CERCLA. Some IDW may be hazardous wastes under RCRA while others may be regulated under other federal laws such as TSCA. These regulatory requirements may be applicable or relevant and appropriate requirements (ARARs) which impact how the IDW is managed.

5.1 EPA Guidance on IDW Management

The management of IDW shall be in accordance with EPA Guidance "Management of Investigation-Derived Wastes During Site Inspections", May 1991 (EPA, 1991). The specific elements of EPA's guidance for IDW management are as follows:

- Characterizing IDW through the use of existing information (manifests, MSDSs, previous test results, knowledge of the waste generation process, and other relevant records) and best professional judgement.
- Delineating an AOC unit for leaving RCRA hazardous soil cuttings within the unit.

Libby Superfund Site Operable Unit 3 Standard Operating Procedure

- Containerizing and disposing of RCRA hazardous groundwater, decontamination fluids, PPE, and disposable equipment at RCRA Subtitle C facilities.
- Leaving on-site RCRA nonhazardous soil cuttings, groundwater, and decontamination fluids preferably without containerization and testing.

In general, EPA does not recommend removal of wastes from sites, in particular, from those sites where IDW do not pose any immediate threat to human health or the environment. Actions taken during field investigations with respect to IDW that leave conditions essentially unchanged should not require a detailed analysis of ARARs or assurance that conditions at the site after field investigations will comply with the ARARs. At the same time, field personnel ensure that their handling of IDW does not create additional hazards at the site.

In brief, compliance with the NCP can generally be assured by:

- 1) Identifying contaminants, if any, present in the IDW based upon existing information and best professional judgement; testing is not required in most circumstances.
- 2) Determining ARARs and the extent to which it is practicable to comply with them.
- 3) Delineating an AOC unit based upon existing information and visual observation if soil cuttings are RCRA hazardous.
- 4) Burying RCRA hazardous soil cuttings within the AOC unit, so long as no increased hazard to human health and the environment will be created. Containerization and testing are not required.
- 5) Containerizing RCRA hazardous groundwater and other RCRA hazardous IDW such as PPE, disposable sampling equipment, and decontamination fluids for off-site disposal.

5.2 Hazardous Waste Regulation

The RCRA hazardous waste regulations are clearly ARARs for hazardous IDW generated and managed during field investigations. However, with the application of EPA IDW guidance, RCRA requirements apply to management of IDW in the following manner:

- If RCRA hazardous IDW is stored or disposed off-site, then comply with all RCRA (and other ARAR) requirements.
- If RCRA hazardous IDW is stored on-site, then comply with RCRA (and other ARAR) requirements to the extent practicable.

For these field investigations, the following general guidance is expected to be practicable and therefore followed, recognizing that each situation will be evaluated against EPA IDW guidance (EPA, 1991) as well as RCRA hazardous waste requirements and other ARARs:

- IDW may be assumed not to be a “listed” hazardous waste under RCRA 40 CFR 261 Subpart D, unless available information about the site suggests otherwise.
- IDW characterization to determine if the IDW exhibits RCRA hazardous waste characteristics do not typically require testing if the characterization can be made by “applying knowledge of the hazardous characteristics in light of the materials or processes used” or by historical testing consistent with 40 CFR § 262.11(c).
- Compliance with the RCRA hazardous waste generator requirements of 40 CFR Part 262 for all RCRA hazardous IDW generated and/or managed (with exception of soil cuttings managed in accordance with the EPA IDW guidance). It is presumed that the RCRA hazardous IDW generated will fall within the large quantity generator (LQG) requirements.

- Land disposal does not occur (and thus the Land Disposal Restrictions [LDR] of 40 CFR Part 268 are not applicable) when IDW soil cutting wastes are:
 - Moved, stored or left in place within a single AOC unit;
 - Capped in place;
 - Treated in situ (without moving the IDW to another AOC unit for treatment);
or
 - Processed within the AOC unit to improve structural stability (without placing the IDW into another AOC unit for processing).

- Conversely, land disposal does occur (and the LDR of 40 CFR Part 268 are applicable) when IDW soil cutting wastes are:
 - Moved from one AOC unit to another AOC unit for disposal;
 - Moved outside an AOC unit for treatment or storage and returned to the same AOC unit for disposal;
 - Excavated from an AOC unit and placed in a container, tank, surface impoundment, etc. and then re-deposited back into the same AOC.

5.3 TSCA PCB Regulation

IDW containing PCBs at detectable levels may be generated, although the concentration of PCBs in any IDW generated is expected to be far below 50 ppm. However, IDW generated will be evaluated for PCBs and managed according to the following per the requirements of 40 CFR Part 761 Subpart D:

- Liquid IDW at concentrations greater than or equal to 50 ppm PCBs will be incinerated off-site at a TSCA-approved incinerator site.

- Nonliquid IDW at concentration greater than or equal to 50 ppm PCBs may be incinerated, treated by an equivalent TSCA-approved method, or disposed in a TSCA chemical landfill off-site.

- IDW at concentrations less than 50 ppm are generally not regulated under TSCA, and may be disposed in an acceptable Subtitle D facility.

6.0 DESCRIPTION OF ANTICIPATED IDW MANAGEMENT

The following subsections provide a description of the anticipated IDW to be encountered, generated, and/or managed at the Libby Asbestos Superfund Site OU3 during field activities and the anticipated management of each. It should be noted that this information is provided for planning purposes, and will be evaluated and may need to be revised based upon actual experience while on site.

6.1 Soil and Soil Cuttings

During field investigations, surface soil samples, samples of mine waste rock, and samples of fine tailings will be collected. Only a small portion of material will be collected for analysis. While the soil and soil cuttings IDW generated will be evaluated on a case-by-case basis, the general approach will follow the EPA guidance for IDW (EPA, 1991) which includes:

- Characterizing the IDW through the use of existing information (previous test results, previous waste characterization, knowledge of the waste generation process, and other relevant records) and best professional judgement.
- Soil and soil cuttings which are not used directly for sample makeup will not be taken outside of the AOC unit in which they were generated.
- Soil and soil cuttings within the AOC where they are generated will be placed back into the same investigation pit, trench, or bore hole and in the same order from which the material was removed, to the extent practicable and unless noted otherwise in the FSP.

- Soil cuttings potentially requiring RCRA disposal will be handled per the procedures presented in Section 7.0 below and disposed in an off-site RCRA facility.

6.2 Spent Sampling-Related Equipment

During field investigations, spent sampling-related equipment will be generated. This may include (but not limited to) plastic sheeting/tarps, rope, bailers, sampling equipment, spent PPE, sample bottles, used containers, packaging materials, and other consumables. Although the vast majority of the spent sampling-related equipment is expected to be nonhazardous, these IDW may contain a listed hazardous waste (e.g., spent solvents) or may exhibit a hazardous waste characteristic (e.g., toxicity from metals).

While the spent sampling-related equipment will be evaluated on a case-by-case basis, the general approach to be followed for spent sampling-related equipment IDW will follow the EPA guidance for IDW (EPA, 1991) which includes:

- Containerizing the spent sampling-related equipment, typically in a satellite accumulation station.
- Characterizing the spent sampling-related equipment IDW through the use of existing information (previous test results, previous waste characterization, knowledge of the contaminants present, and other relevant records) and best professional judgement. This characterization will be documented and maintained as part of the solid/hazardous waste determination records.
- Those spent sampling-related equipment IDW that are determined to be nonhazardous will be disposed of onsite or as municipal waste.

- Those spent sampling-related equipment IDW that are determined to be hazardous will be managed per the procedures presented in Section 7.0 below and disposed in an off-site RCRA facility.

6.3 Decontamination Fluids and Solids

During field investigations, decontamination fluids and solids will be generated. Typically, these will be generated at a common decon area, although there may be more than one decon area. Typically, the decontamination IDW will include (but not limited to) washwater from vehicles/equipment, and cleaning agents. Although the vast majority of decontamination IDW is expected to be nonhazardous, this IDW may contain a listed hazardous waste (e.g., spent solvents) or may exhibit a hazardous waste characteristic (e.g., toxicity from metals).

While the decontamination IDW will be evaluated on a case-by-case basis, the general approach to be followed for decontamination IDW will follow the EPA guidance for IDW (EPA, 1991) which includes:

- Containment of decontamination fluids (typically washwater) as generated. The washwater will be segregated from solids to the extent practicable (i.e., solids will be allowed to settle out of the washwater on the decontamination containment pad). Washwater will then be containerized to await waste determination. Solids will also be containerized in a separate container to await waste determination.
- Other decontamination solids such as cleaning utensils and PPE will also be containerized to await waste determination.
- Characterizing the decontamination IDW through the use of existing information (previous test results, previous waste characterization, knowledge of the contaminants present, and other relevant records) and best professional judgement. This

characterization will be documented and maintained as part of the solid/hazardous waste determination records.

- The decontamination solids IDW that are determined to be nonhazardous will be disposed of onsite.
- The decontamination liquids IDW that are determined to be nonhazardous will be disposed as a nonhazardous solid waste, preferably on-site.
- The decontamination IDW (either liquid or solid) that are determined to be hazardous will be managed per the procedures presented in Section 7.0 below and disposed in an off-site RCRA facility.

6.4 Drilling, Well Purging, and Development Water

Generally, water at the Site that is extracted from boreholes, wells or piezometers for the purpose of drilling, development, sampling, or hydraulic testing is considered non-hazardous and will be discharged to designated shallow sumps away from the boreholes or wells at the site. If the water generated is determined to be hazardous will be managed per the procedures presented in Section 7.0 below and disposed in an off-site RCRA facility.

7.0 PROCEDURES FOR HAZARDOUS IDW MANAGEMENT

The following procedures apply to all IDW that have been determined to be hazardous except for soil cuttings IDW that remain with the AOC unit.

7.1 Introduction

Once an IDW has been determined to be hazardous, the federal RCRA Subtitle C waste management requirements apply to that waste. The scope of this procedure covers the

requirements for large quantity generators (LQG) of hazardous IDW which manage the hazardous IDW on site such that RCRA permitting is not required.

7.2 Determine Land Disposal Restrictions

The 1984 amendments to the RCRA law included a prohibition of land disposal of certain hazardous wastes without first meeting some treatment standards. For the most part, all listed and characteristic hazardous wastes must be treated according to the treatment levels and technologies outlined in 40 CFR Part 268 to reduce the toxicity and/or mobility of hazardous constituents prior to being disposed of on the land, i.e., landfilled. Therefore, a generator must determine if the waste is a "restricted waste" under the land ban rules, and if so, off site treatment and disposal is limited. Note that these rules apply only to wastes destined for land disposal which is defined as: placement in or on the land including a landfill, surface impoundment, waste pile, injection well, land treatment facility, salt dome formation, salt bed formation, underground mine or cave, or concrete vault or bunker. Wastes which are shipped off site for disposal other than land disposal are not regulated under the land disposal restriction regulations of 40 CFR Part 268.

Generators of hazardous wastes must determine if the waste is restricted from land disposal under 40 CFR Part 268. The following reporting and recordkeeping requirements apply.

- If a generator determines that he is managing a restricted waste and the waste does not meet the applicable treatment standards, with each shipment of waste, the generator must notify the treatment or storage facility in writing of the appropriate treatment standards;
- If the generator determines that he is managing a restricted waste and the waste can be disposed without further treatment, with each shipment of waste, the generator must submit to the treatment, storage or disposal facility a notice and certification stating that the waste meets the applicable treatment standards;

- If the generator determines that he is managing a waste subject to an exemption from a prohibition on the type of land disposal method utilized for the waste, with each shipment of waste, the generator must submit to the receiving facility a notice stating that the waste is not prohibited from land disposal;
- If the generator is managing prohibited waste in tanks, containers, or containment buildings regulated under 40 CFR 262.34, and is treating such waste in such tanks, containers, or containment buildings to meet applicable treatment standards, the generator must develop a waste analysis plan which describes the procedures the generator will carry out to comply with the treatment standards; and
- If the generator determines whether the waste is restricted based solely on his knowledge of the waste, all supporting data used to make this determination must be retained on-site in the generator's files.

The generator must retain on-site a copy of all notices, certifications, demonstrations, waste analysis data, and other documentation produced pursuant to these requirements for at least three years from the date the waste was last shipped from the site. It should also be noted that it is prohibited to dilute a hazardous waste in order to circumvent the land disposal prohibitions (40 CFR 268.3). Once a waste is determined to be a "restricted waste", an appropriate Treatment, Storage, and Disposal Facility (TSDF) can be selected to properly treat and dispose of the waste.

7.3 On-Site Accumulation

As discussed in Section 5.0 above for each IDW generated, a large quantity generator (LQG) must make the appropriate hazardous waste determination per 40 CFR Part 262.11. If the IDW is determined to be hazardous, then the IDW will typically be stored on-site prior to shipment off-site for disposal. The following requirements apply to all hazardous IDW being stored on-site prior to shipment.

7.3.1 EPA Identification Number (40 CFR Part 262.12)

Any facility which is a LQG of hazardous wastes must not treat, store, dispose, transport or offer for transportation any hazardous waste without first obtaining a EPA identification number from EPA (or the authorized state). Hazardous wastes cannot be offered to transporters or to treatment, storage or disposal facilities that have not received a EPA identification number.

7.3.2 On-Site Hazardous Waste Accumulation (Storage) (40 CFR 262.34(d))

Two types of accumulation areas for hazardous waste are permissible for a LQG without RCRA interim status or a Part B permit. These are the "90-day storage area" and the "satellite accumulation station" (SAS). The SAS requirements are discussed below. With regards to a "90-day storage area", a LQG may store hazardous wastes on-site for up to 90 days or less in a storage area, provided that the following conditions are met:

- If the waste is placed in containers, the requirements of 40 CFR Part 265 Subpart I (container requirements) are met. See below for container requirements;
- If the waste is placed in tanks, the requirements of 40 CFR 265 Subpart J (tank requirements) are met. See below for the tank requirements.
- At closure, the generator closes the storage area per the requirements of 40 CFR 265.111 and 40 CFR 265.114;
- The date which the hazardous waste is placed in the storage area is clearly marked on the container, and the container is clearly marked as "Hazardous Waste";
- The facility complies with 40 CFR Part 265 Subpart C, Preparedness and Prevention (See Section 6.3.3 below);
- The facility complies with 40 CFR Part 265 Subpart D, Contingency Plan and Emergency Procedures (See Section 6.3.4);
- The facility complies with 40 CFR Part 265.16 training requirements (See Section 6.6 below);

- Any hazardous wastes which are stored longer than 90 days must first be granted an extension by EPA (or authorized state).

90-Day Storage Area Container Requirements (40 CFR Part 265 Subpart I)

Hazardous waste stored in containers must meet the following requirements:

- Containers must be in good condition, free of leaks;
- Hazardous wastes must be compatible with container (or liner) material;
- Containers must always be kept closed except to add or remove wastes;
- Containers must be handled in a manner to avoid ruptures;
- The storage area must be inspected at least weekly to check for container deterioration; and
- Incompatible wastes must be stored separately with separate secondary containment.

Incompatible wastes are wastes that are unsuitable for co-mingling because the co-mingling could result in any of the following:

- Extreme heat or pressure generation;
- Fire;
- Explosion or violent reaction;
- Formation of substances that have the potential to react violently;
- Formation of toxic dusts, mists, fumes, gases, or other chemicals; and/or
- Volatization of ignitable or toxic chemicals due to heat generation.

90-Day Storage Area Tank Requirements (40 CFR Subpart J)

LQGs that accumulate or store hazardous wastes in tanks or tank systems must meet the following requirements:

- For tanks existing prior to July 14, 1986, an assessment of tank must be performed and certified by an independent, qualified, licensed engineer. The written certification must be kept on file at the facility (40 CFR 265.191);
- New tank systems (those built after July 14, 1986) must meet tank technical standards and have been certified by an independent, qualified, licensed engineer. The written certification must be kept on file at the facility (40 CFR 265.192);
- New tank systems must have adequate secondary containment and leak detection systems. Existing tanks must be upgraded to meet these standards by the time the tank is 15 years of age (40 CFR 265.193);
- Tanks must be operated to prevent system failure, overflow and spills. Tanks must be operated with sufficient freeboard to prevent overtopping (40 CFR 265.194);
- Inspect the tanks at least once each operating day for the following:
 - Discharge control equipment;
 - Monitoring equipment and controls;
 - Tank level; and
 - Evidence of leaks or spills. (40 CFR 265.195)
- Inspect the tanks at least weekly for corrosion, erosion or leaks;
 - The tank must meet the closure and post-closure care provisions of 40 CFR 265.197; and
 - Store incompatible wastes separately (40 CFR 265.199).

Satellite Accumulation Station (SAS) Requirements (40 CFR 262.34(c))

A SAS is a container placed at or near the point of waste generation for the purpose of collecting the waste as it is being generated. For example, a container may be placed in the quality control laboratory for collection of hazardous wastes generated in the laboratory. This SAS may collect up to 55 gallons of hazardous waste or 1 quart of acute hazardous waste. The SAS does not need to meet the requirements of a storage area, provided the following conditions are met:

- The amount of hazardous waste accumulated at the SAS does not exceed 55 gallons (or 1 quart of acute hazardous waste);
- The SAS is located at or near the point of generation where the waste is initially accumulated and is under the control of the operator of the process generating the waste;
- The container used is in good condition, is compatible with the wastes being accumulated, and is kept closed except to add or remove wastes;
- The container is marked with the words "Hazardous Waste" or other words to identify the contents; and
- Once the 55-gallon limit is reached, the date is marked on the container and the container is moved from the SAS within three days to a proper location. For example, the wastes must either be moved to the storage area or be picked up by a waste transporter and moved off-site.

7.3.3 Preparedness and Prevention (40 CFR Part 265 Subpart C)

The following preparedness and prevention steps must be taken concerning the hazardous waste storage area:

- The storage area must be operated and maintained to minimize the possibility of fire, explosions or releases of hazardous waste;
- The facility must have appropriate communication systems, fire-fighting equipment, spill control equipment and decontamination equipment;

- All emergency response systems and equipment must be tested monthly with documentation and maintained to assure proper operation;
- Persons handling hazardous wastes must have immediate access to alarms and/or communication systems;
- The storage area shall have adequate aisle space for emergency response activities; and
- The facility must attempt to make arrangements with the local police, fire departments, emergency response teams, and local hospitals to assure readiness for potential emergencies associated with the storage area.

7.3.4 Contingency Plan and Emergency Procedures (40 CFR Subpart D)

A LQG that accumulates or stores hazardous waste on site in a 90-day storage area must develop and keep current a contingency plan for the facility. The purpose of the contingency plan is to provide an organized plan of action and delegation of responsibilities and authority to specific facility personnel to respond to emergency situations that may require both the facility and/or outside resources. The contingency plan is designed to minimize hazards to humans or the environment from fires, explosion or any unplanned sudden or non-sudden release of hazardous waste/hazardous waste constituent to air, soil or surface water in compliance with the requirements of 40 CFR 265 Subpart D. A Contingency Plan will be maintained on the site if hazardous IDW are accumulated on-site.

The key components of the contingency plan include the following (40 CFR 265.52):

- A description of the emergency response organization, including designation of the Emergency Coordinator and alternates;
- Response procedures;
- Emergency notification;

Libby Superfund Site Operable Unit 3 Standard Operating Procedure

- Arrangements with local authorities;
- List of names, addresses and phone numbers of designated emergency personnel and alternates;
- List of emergency response communication equipment and locations;
- Evacuation procedures, routes and alternates; and
- Procedures for amending the plan.

Copies of the plan must be sent to (40 CFR 265.53):

- The Project Manager;
- Lincoln County Sheriff's department;
- Libby fire department; and
- Other agencies as deemed appropriate.

The emergency coordinator (EC) is the key person facilitating emergency preparedness and response. The EC or designated alternate shall be on-site or on-call at all times. The EC and alternates must be trained and thoroughly familiar with the contingency plan, emergency response activities and operation of the facility. The EC must know the locations and characteristics of all waste generated, location of all records within the facility and the facility layout. The EC must have the authority to commit the resources needed to carry out the spill response plan. Any person or department who first discovers any spill of a hazardous waste/material is responsible for notifying the spill response/emergency response coordinator. The EC for the Libby Mine Site field investigations will be the EHS Officer with the Field Team Leader and the Project Manager as alternates.

The contingency plan should be reviewed and immediately amended when:

- Changes in applicable regulations occur;
- The plan fails in an emergency;
- Changes are made to emergency procedures;
- Changes occur in emergency personnel list; or
- Changes occur in emergency equipment list.

7.4 Pre-Transportation Requirements

Prior to transporting hazardous wastes or offering hazardous wastes for transportation off-site, the generator must comply with the following:

- Package the hazardous wastes in DOT-approved containers per 49 CFR Parts 173, 178 and 179. DOT-approved containers (such as drums) are usually marked as being DOT-approved);
- Label the hazardous wastes according to DOT labeling requirements per 49 CFR Part 172;
- Mark each container (of 110 gallons or less) used in transportation with the following:
HAZARDOUS WASTE - Federal Law Prohibits Improper Disposal. If found, contact the nearest police or public safety authority or the EPA.
 - Generator's Name and Address
 - Manifest Document Number
- Ensure that the initial transporter placards the transport vehicle with the appropriate placard in accordance with 49 CFR Part 172 Subpart F.

7.5 Manifesting Off-Site Shipments of Hazardous IDW

Any generator which transports or offers for transportation hazardous waste for off-site treatment, storage or disposal must prepare a manifest according to manifest instructions for each shipment of similar hazardous wastes. The manifest must be carefully filled out with each

shipment. Take care to follow the instructions and use the terms as listed in the instructions. A generator must designate on the manifest one facility (designated facility) which is permitted to handle the waste described on the manifest (40 CFR 262.20).

The generator must determine if the state to which the wastes are destined (consignment state) requires use of its own manifest. If so, then the consignment state's manifest must be used. If the consignment state does not require use of its manifest, and the state in which the waste shipment originates (generator state) does, then the manifest from the generator state must be used. If both states have manifests, use the consignment state manifest, making sure that there are sufficient copies to meet the generator state distribution requirements. If neither state requires use of its manifest, then any uniform hazardous waste manifest may be used (40 CFR 262.21).

The manifest must contain at least enough copies such that the generator gets two copies, the transporter gets one copy and the designated facility gets one copy. Some states require additional copies to be sent to the state. At the time of shipment, the generator must keep one copy (the generator copy) of the completed, signed manifest and give the remaining copies to the transporter. Each copy must have the signature of the generator and the transporter at the time of shipment. The original manifest shall be returned to the generator once the shipment reaches the designated facility and the manifest is signed by the designated facility (40 CFR 262.21).

If the original, signed manifest is not received by the generator within a certain number of days, action by the generator is required. These requirements are discussed in the following sections:

- If, after 35 days from the date of shipment, the original manifest copy is not yet received by the LQG, the LQG must contact the transporter and/or the designated disposal facility to determine the status of the hazardous waste (40 CFR 262.42(a)(1)).
- If after 45 days from the date of shipment, the original manifest copy is not yet received by the LQG, the LQG must submit an exception report to the U.S. EPA (or authorized state). The exception report must include a copy of the manifest along

with an explanation of efforts to locate the hazardous wastes and the result of these efforts (40 CFR 262.42(a)(2)).

7.6 Personnel Training

Any person, and their immediate supervisor(s), involved in waste management at a LQG facility which stores hazardous waste in a 90-day storage area must undergo initial and annual training for hazardous waste management (40 CFR 262.34(a)(4) and 40 CFR 265.16). Facility personnel are required to successfully complete a program of classroom instruction or on-the-job training that teaches them to perform hazardous waste management duties relevant to their jobs. The program must be directed by a person trained in hazardous waste management procedures.

The training must be designed to enable personnel to effectively respond to emergencies by becoming familiar with emergency procedures, emergency equipment and emergency systems, including the following;

- Procedures for using, inspecting, repairing and replacing facility emergency and monitoring equipment;
- Communications or alarm systems;
- Response to fires or explosions; and
- Off-site communication.

Employee training is to be held at regular intervals. Emergency planning information, e.g., the Contingency Plan, also should be provided to state and local emergency response agencies at regular intervals (40 CFR 265.37 and 265.53). Employees required to receive the training cannot work unsupervised until they have completed the training requirements (either classroom or on-the-job training). In addition, facility personnel must take part in an annual review of the initial training.

The following records must be maintained at the facility for employees affected by this training:

OU3 SOP 12
Rev. No. 0
Date: September 26, 2007
Page 23 of 25

Libby Superfund Site Operable Unit 3 Standard Operating Procedure

- Job title for each position and name of employee filling each job;
- Job descriptions for each position related to hazardous waste management;
- Written description of type and amount of initial and continuing training that will be given to each person filling the various job positions; and
- Documentation that necessary training has been given and completed by each affected personnel.

Training records are required to be kept on current personnel until closure of the facility. For former employees, training records must be kept for at least three years from the date the employee last worked at the facility and may be transferred if the employee stays within the same company (40 CFR 265.16(e)).

7.7 Reporting and Recordkeeping

The following reports are required of a LQG:

- Manifest exception reports as discussed in Section 6.5 above.
- A LQG must submit a Biennial Report to the EPA (or authorized state) every even numbered year by March 1, e.g., March 1, 2008 for the 2007 reporting year. The Biennial Report is to be submitted on EPA form 8700-13A.

The following records are required to be kept for a minimum of three years by the LQG:

- The signed original manifests;
- Biennial reports;
- Exception reports;
- All records pertaining to hazardous waste determinations; and

- Land disposal determination records, notification and certification records.

8.0 QUALITY ASSURANCE AND QUALITY CONTROL

All IDW data must be documented in the field logbooks, field forms, manifests, including rationales deviations from this SOP. The Field Team Leader or designated QA reviewer will check and verify that IDW documentation has been completed per this procedure and other procedures referenced herein.

9.0 REFERENCES

Agency for Toxic Substances and Disease Registry. 2006. Asbestos Exposure and Your Health.

EPA, 1991. Management of Investigation-Derived Wastes During Site Inspections, EPA May 1991, EPA/540/G-91/009

Libby Superfund Site Operable Unit 3 Standard Operating Procedure

Date: September 26, 2007

OU3 SOP 13 (Rev. 0)

Title: GROUNDWATER ELEVATION MEASUREMENTS

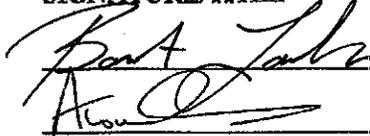
APPROVALS:

TEAM MEMBER

SIGNATURE/TITLE

DATE

EPA Remedial Project Manager



9/26/07

SOP Author

9/26/07

Revision Number	Date	Reason for Revision
0	09/26/2007	-



1.0 INTRODUCTION

This Standard Operating Procedure (SOP) is based on MWH SOP-13, Groundwater Elevation Measurements, Revision 1.0, March 2004, modified for use at the Libby Asbestos Superfund Site OU3. Field measurements of static water levels or depth to groundwater are necessary for the determination of purge volumes, groundwater elevations, direction of groundwater flow, and non-aqueous phase liquid (NAPL) thickness. The accuracy, precision, and reliability of these measurements are dependent on the proper use and care of the field instruments. Consistent methods and practices of data collection (in accordance with recommended manufacturer instructions) must be followed to obtain valid and useful data. Common instruments used to collect groundwater elevation and NAPL thickness data include electric water level indicators and dual-phase probes, and chalked tape. Due to decontamination difficulties, dual-phase probes will only be used in wells containing or suspected of containing NAPL. Use of these probes in "clean" wells may result in cross-contamination. All groundwater elevation measuring equipment will be decontaminated prior to field use and between wells.

This SOP provides a standard reference for selection of the proper equipment and use of the proper techniques for measurement of groundwater elevation and NAPL thickness. The purpose of these procedures is to enable the user to collect representative and defensible groundwater elevation and NAPL thickness data.

2.0 HEALTH AND SAFETY WARNING

All personnel engaged in groundwater elevations measurements must follow health and safety protocols described in the health and safety plan. Asbestos fibers are thin and long fibers so small that they cannot be seen by the naked eye. Asbestos fibers are easily inhaled when disturbed and when embedded in the lung tissue can cause health problems. Significant exposure to asbestos increases the risk of lung cancer, mesothelioma, asbestosis (non-cancerous lung disease), and other respiratory diseases (ATSDR 2006).

3.0 DEFINITIONS

Dual-Phase Probe: A device consisting of a spool of small-diameter graduated cable or tape and a weighted probe attached to one end, used to measure NAPL thickness. A buzzer emits an intermittent signal when the probe contacts water and a steady signal upon contact with NAPL.

Electric Water Level Indicator: A device consisting of a spool of small-diameter graduated cable or tape and a weighted probe attached to one end, used to measure static water levels. A buzzer emits a steady signal when the probe contacts water.

Static Water Level: The elevation of the top of a column of water in a monitoring well or piezometer that is not influenced by pumping or conditions related to well installation, hydrologic testing, or nearby groundwater extraction.

NAPL: NAPL may be lighter than groundwater (e.g., gasoline), or heavier/denser than groundwater (e.g., chlorinated solvents). Light non-aqueous phase liquid (LNAPL) is commonly encountered at the water table surface. Dense non-aqueous phase liquid (DNAPL) is encountered at the interface between impermeable and permeable materials below the water table.

4.0 RESPONSIBILITIES

This section presents a brief definition of field roles, and the responsibilities generally associated with them. This list is not intended to be comprehensive and often, additional personnel may be involved. Project team member information will be included in project-specific plans (e.g., work plan, field sampling plan, quality assurance plan, etc.), and field personnel will always consult the appropriate documents to determine project-specific roles and responsibilities. In addition, one person may serve in more than one role on any given project.

Project Manager: Selects site-specific measurement methods and locations for groundwater elevation measurements with input from other key project staff, and applicable oversight agencies.

Quality Control Manager: Overall management and responsibility for quality assurance and quality control (QA/QC). Selects QA/QC procedures for the sampling and analytical methods, performs project audits, and ensures that data quality objectives are fulfilled.

Field Team Leader (FTL) and/or Field Geologist, Hydrogeologist, or Engineer: Implements the sampling program, supervises other sampling personnel, and ensures compliance with SOPs and QA/QC requirements. Prepares daily logs of field activities.

Field Technician (or other designated personnel): Assists the FTL, project geologist/hydrogeologist, or engineer in the completion of tasks and is responsible for the proper use and maintenance of groundwater elevation measuring equipment.

5.0 STATIC GROUNDWATER LEVEL MEASUREMENTS

Introduction

Unless otherwise specified, electric water level indicators will be used to measure depth to water. Depth to water measurements will be converted to groundwater elevations.

A water-level measurement will be obtained prior to purging the well and also immediately following sampling. The total depth of the well will also be measured and recorded before purging the well.

Measuring Point

A measuring point (MP) shall be selected and marked for each monitoring well and piezometer in which water level measurements will be made. Generally, the MP will be the top of the well casing on the north side. The MP will be permanently marked using an indelible marker or a notch cut into the PVC casing. When the top-of-casing elevation of a monitoring well or piezometer is surveyed, the licensed surveyor shall measure the

MP elevation and reference this measurement to an appropriate datum (such as feet above mean sea level).

Water Level Measurements

When water levels are measured to describe the groundwater potentiometric surface, the water level will be measured prior to purging. All wells to be gauged during a monitoring event and used to construct the potentiometric surface should have water levels taken within the same 24 hour period.

Water levels will be measured to the nearest 0.01 foot using an electronic water-level indicator. The measurement will be made to the measuring point reference mark placed on the top of the PVC well casing.

Prior to use for each measurement, the water level indicator will be decontaminated with an Alconox® solution followed by a distilled water rinse.

An electronic probe consists of a contact electrode attached to the end of an insulated electrical cable, and a reel which houses an ammeter, a buzzer, or other closed circuit indicator. The indicator shows a closed circuit and flow of current when the electrode touches the water surface. The electronic probes used shall be calibrated periodically by comparing the depth-to-water readings between the electronic probe and a steel surveyors' tape.

The procedure for measuring water levels with an electric probe is as follows:

1. Switch on and test that the battery is charged.
2. Lower the probe into the well until the ammeter or buzzer indicates a closed circuit. Raise and lower the probe slightly until the shortest length of cable that gives the maximum response on the indicator is found.

3. With the cable in this fixed position, note the depth to water from the Measuring Point (MP).
4. Repeat as necessary until at least two identical duplicate measurements are obtained. Record the final measurement with time and day of the measurement.

Calibration of the electronic probe will be checked at regular intervals as part of regular maintenance measuring the position of the electrode to check that the calibration marks on the electronic probe correspond to those on the steel surveyors tape.

Well Depth Measurements

The total depth of a well shall be measured by sounding with a weighted steel surveyors' tape or other steel or fiberglass measuring tape, weighted as needed. For shallow wells, the electronic water-level probe may also be used as a measuring device. Procedures to be followed are specified below.

1. For calibration, measure the distance between the zero mark on the end of the measuring tape and the bottom of the weight to the nearest 0.1 foot at the beginning of each well depth measurement activity day, and whenever the apparatus is altered.
2. Lower a weighted tape into the well until the tape becomes slack or there is a noticeable decrease in weight, which indicates the bottom of the well. Care should be taken to lower the tape slowly to avoid damage to the bottom of the well by the weight.
3. Raise the tape slowly until it just becomes taut, and with the tape in this fixed position, note the tape reading opposite the MP to the nearest 0.1 foot.
4. Add the values from the distance from the end of the tape to the end of the weight together, round this number to nearest 0.1 foot, and record the resulting value as "well depth below MP" in the "Remarks" column of the Water Level Monitoring Record form.

Calibration of the electronic probe will be checked at regular intervals as part of regular maintenance measuring the position of the electrode to check that the calibration marks on the electronic probe correspond to those on the steel surveyors tape.

6.0 NAPL THICKNESS MEASUREMENT

Free product, or NAPL, thickness measurements will be made using a dual-phase probe. This instrument is equipped with a sensor capable of detecting NAPL. The probe emits a steady signal when in contact with NAPL and an intermittent signal when in contact with water. The procedures outlined below will be followed in obtaining field measurements of NAPL thickness.

1. Caution will be exercised while opening and working around wells with known NAPL contamination as explosive atmospheres may exist. Monitoring of the well atmosphere will be conducted in accordance with the project-specific health and safety plan.
2. Verify the well identification (ID) number. Check and ensure proper operation of measuring equipment above ground. Prior to opening the well, don personal protective equipment as required. Use caution when opening well cap.
3. If measuring LNAPL lower the probe slowly into the well. Upon contact with LNAPL, the probe should emit a steady sound signal. Raise and lower the probe slightly about the NAPL level a few times to accurately determine the point of contact. Record the value determined to the nearest 0.01 foot from the surveyed reference point on the well casing. If no reference is available, record in the logbook or on the field form where the measurement was taken from (e.g., north side of inner casing).
4. With the buzzer still sounding advance the probe further down the well until the sound signal changes from steady to intermittent. This should indicate the probe has come into contact with water. Raise and lower the probe slightly about the LNAPL-water

interface a few times to accurately determine the depth of the interface. Record the depth measurement from the tape. Values will be recorded to the nearest 0.01 feet from the MP. If no reference mark is present, record in the logbook or in the field form where the measurement was taken from (e.g., from the north side of the inner casing). The difference between the two measured values is the LNAPL thickness.

5. If determining DNAPL presence, lower the probe slowly into the well until an intermittent signal is emitted. Raise and lower the probe slightly above the water level a few times to determine the accurate point of contact. Record the measured depth to the nearest 0.01 feet from the surveyed reference point in the field logbook or on the field form. If no reference is available, record in the logbook or on the field form where the measurement was taken from (e.g., north side of inner casing).
6. Lower the probe slowly through the water column until a steady signal is emitted. Raise and lower the probe slightly about the DNAPL-water interface level a few times to accurately determine the depth of the interface. Record the DNAPL-water interface level to the nearest 0.01 feet from the surveyed reference point. If no reference is available, record in the logbook or on the field form where the measurement was taken from (e.g., north side of inner casing). The difference between the two values is the water thickness.
7. Record well number, top of casing elevation, and surface elevation if available.
8. Record the time and day of the measurement.
9. Some water-level measuring devices have marked metal or plastic bands clamped at intervals along the measuring line used for reference points to obtain depth measurements. The spacing and accuracy of these bands will be checked before each round of measurements because they may loosen and slide up or down the line, resulting in inaccurate reference points.

7.0 QUALITY ASSURANCE AND QUALITY CONTROL

All groundwater elevation measurements must be documented in the field logbooks and/or field forms, including rationales deviations from this SOP. The Field Team Leader or designated QA reviewer will check and verify that field documentation has been completed per this procedure and other procedures referenced herein.

All equipment must be operated according to the manufacturer's specifications, including calibration and maintenance. Calibration of the electronic probe will be checked at regular intervals as part of regular maintenance measuring the position of the electrode to check that the calibration marks on the electronic probe correspond to those on the steel surveyors tape.

8.0 DECONTAMINATION

All equipment used in the sampling process shall be decontaminated prior to field use and between sample locations. Decontamination procedures are presented in SOP-7. Personnel shall don appropriate personal protective equipment as specified in the health and safety plan. Any investigation-derived waste generated in the sampling process shall be managed in accordance with the procedures outlined in SOP-12.

9.0 REFERENCES

Agency for Toxic Substances and Disease Registry. 2006. Asbestos Exposure and Your Health.

Nielson, D.M., 1991. Practical Handbook of Ground-Water Monitoring, Lewis Publishers, Inc., Chelsea, MI.

U.S. Environmental Protection Agency (USEPA), 1986. RCRA Ground-Water Monitoring Technical Enforcement Guidance Document, OSWER-9950.1, September 1986.

Libby Superfund Site Operable Unit 3 Standard Operating Procedure

Date: September 26, 2007

SOP AMB-LIBBY-OU3 (Rev. 0)

Title: SAMPLING OF OUTDOOR AMBIENT AIR (Adapted from CDM-LIBBY-12 Rev1)

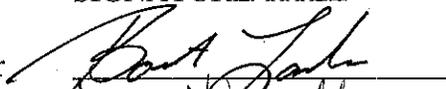
APPROVALS:

TEAM MEMBER

SIGNATURE/TITLE

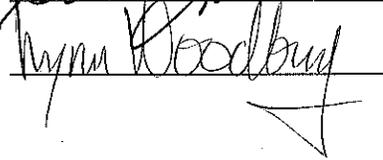
DATE

EPA Remedial Project Manager



9/26/07

SOP Author



9/26/07

Revision Number	Date	Reason for Revision
0	09/26/2007	--



1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to establish the baseline requirements, procedures, and responsibilities inherent to the collection of outdoor ambient air samples. Air samples will be collected as part of the outdoor ambient air program conducted in accordance with the *Libby Operable Unit 3 (OU3) Phase I Sampling and Analysis Plan (SAP) for Libby, Montana (EPA 2007)*.

2.0 RESPONSIBILITIES

All staff with responsibility for the collection of outdoor ambient air samples are responsible for understanding and implementing the requirements contained herein as well as other related project-specific requirements.

Team Leader – The team leader is responsible for communication with EPA regarding status and progress of the sampling event and providing support to field team staff to ensure all necessary resources are available for implementation of the ambient air program.

Field Team Leader (FTL) – The FTL is responsible for ensuring that the specifics related to the collection of outdoor ambient air sampling described in this procedure are followed by all staff and that all quality assurance/quality control procedures related to this program are implemented.

Field Team Members – The field team members are responsible collection and documentation of samples as described in the SAP and this SOP.

3.0 REQUIRED EQUIPMENT

The following is a general list of equipment that may be used:

- Sampling pump – The selected sampling pump will be capable of a flow-rate and pumping times sufficient to achieve the desired air sample volume. The sampling pump will provide a non-fluctuating air-flow through the filter, and will maintain the initial volume flow-rate to within $\pm 10\%$ throughout the sampling period.
- Transmission electron microscopy (TEM) sample cassettes – commercially available, 25-millimeter (mm), three-piece cassette with a 50mm electronically conductive extension cowl loaded with a 0.8 micrometer (μm) mixed cellulous ester (MCE) filter.
- Pump housings – Weatherproof enclosure to house pump and batteries.
- Stands – metal fenceposts to hold sample cassettes at the desired height (6 feet) will be used to support the sample cassette in order to isolate the sample from the vibrations of the sampling pump.
- Inert tubing – Tygon tubing used in the sampling train to connect the outflow end of the sample cassette to the sampling pump. Tubing has a 1/4" inner diameter and 7/16" outer diameter.

- Rotameter – A rotameter calibrated such that the operator can measure flow rates to $\pm 5\%$ accuracy at the expected sampling flow rate.
- Field sample data sheets (FSDS) – specific data related to the collection of each sample will be recorded on a Phase I OU3 stationary ambient air FSDS. This sheet will contain all relevant information regarding equipment used, flow rates, and collection times.
- Field logbook
- Plastic bags
- Sample labels
- Clear packaging tape
- Ink pen

4.0 PROCEDURES

4.1 Selection of Air Volumes and Flow Rates

Samples collected as part of the outdoor ambient air monitoring program are to be collected over a 5-day sampling period. This represents collection duration of 120 hours or 7,200 minutes. The target volume of air to be collected for each sample will be 14,000 liters for the collection period. As a result, samples will be collected at a flow rate of 2.0 liters/minute, which will result in a sample volume of approximately 14,400 liters.

In no event shall a sample be collected at a flow rate lower than 0.92 L/min, since the linear flow velocity would fall below 4 cm/sec, which is the minimum velocity specified by International Organization for Standardization (ISO) method 10312.

As samples are initially collected during this program and analyzed, flow rates and sample times may be adjusted to ensure the sample filter has proper loading for the required analytical analysis and sensitivity goals.

4.2 Calibration Procedures and Flow Rate Adjustments

Each sampling pump will be calibrated before the start of each ambient air sample collection cycle. This is to ensure that each sampling pump is measuring the flow rate or volume of air correctly.

Calibration of Rotameter with an Electronic Calibrator

Rotameters used for pump calibration are calibrated to a primary flow standard. Procedures for rotameter calibration with the primary flow standard meter are as follows:

1. If the electronic calibrator does not automatically adjust to account for temperature and pressure changes, obtain the actual temperature and pressure in Libby, MT from the local National Oceanic and Atmospheric Administration (NOAA) weather station or

from temperature and weather reference centers. Record actual temperature and pressure in the fields provided on the Precision Rotameter Calibration Data Sheet (Attachment 1).

2. Set up the calibration train as shown in EPA SOP #2015 Figure 4 (Attachment 2) with the sampling pump, rotameter, and primary flow meter.
3. Hold the rotameter as vertical as possible.
4. Turn the primary flow standard and sampling pump on.
5. Adjust the pump until the desired flow rate is attained.
6. Calibrate rotameter to desired ball reading, as read from the middle of the flow ball. Record value in the Ball Reading column on the rotameter calibration data sheet.
7. Check adjusted flow rate of sample pump to the primary flow standard. Ten repetitive flow measurements will be averaged and that result recorded in the flow rate column for the selected interval.
8. Repeat this process at 10 intervals over the range of the precision rotameter.
9. Input data into rotameter calculation sheet to generate the corrected flow rate.

Calibration of Sampling Pump with a Rotameter

Prior to sample collection, each sampling pump will be calibrated with a rotameter that has been calibrated as described in Section 4.2.1. The procedures used for sampling pump calibration are as follows:

1. Set up the calibration chain as shown in EPA SOP #2015, Figure 5 (Attachment 2) using a rotameter, sampling pump and a representative sample cassette. The sample cassette to be used for sampling is installed between the pump and the calibrator.
2. To set up the calibration train, attach one end of tubing to the sample cassette base; attach the other end of the tubing to the inlet plug on the pump. Another piece of tubing is attached from the sample cassette cap to the rotameter.
3. Hold the rotameter as vertical as possible.
4. Turn the sampling pump on.
5. Adjust the sampling pump until the middle of the float ball on the rotameter is lined up with the pre-calibrated flow rate value.

Each rotameter used for field calibration will be transported to and from each sampling location in a sealed zip-top plastic bag. The sample cassette cap and attached tubing for rotameter checks will be stored in the site enclosure in a plastic bag.

Adjustment of Flow Rates During Flow Checks

Flow checks will be performed daily. During these checks, flow rates will be adjusted back to the target rate of 2.0 L/min. Adjustment of flow rates during flow checks will be performed as described below and as the last action before leaving a sampling location anytime the sampling pump is moved. Should the flow rate change from the target flow rate, the following procedure will be used to make the adjustment:

1. Connect the rotameter as described in Section 4.2.2 steps 1 to 3.
2. Record the observed flow rate and time of observation.
3. Adjust the flow rate to the target flow of 2.0 L/min.

Attachment 3 illustrates the volume tracking spreadsheet that will be used in the field to determine the time required for sample collection. To track the scheduling of calibration checks, the field teams will use the Calibration Check Schedule Worksheet. An example of this worksheet is included as Attachment 4. Copies of all volume tracking spreadsheets and Calibration Check Schedule Worksheets will be provided to the project data manager at the conclusion of each sampling event. Electronic copies are suitable and will be placed in the project-specific FTP site within one week from completion of each sampling event.

4.3 Outdoor Ambient Air Sample Collection Procedures

Selection of Outdoor Ambient Air Sampling Locations

The position of each sampling location will be fixed; the sample will be collected from the same location for the duration of the outdoor ambient air sampling program. GPS points will be collected for the location of each station. The location should be placed to minimize interference from large trees and road dust.

Sampling Protocol

Each outdoor ambient air sample will be collected, after pump calibration, according to the following procedures:

1. Place a sample label on the sample cassette indicating a unique Index ID.
2. Set up the sampling train; attach the air intake hose to the sample cassette base. The sample cassette will be positioned such that it is held facing downwards at an angle equal to or less than 45° from horizontal. Set the sample cassette to a height of 6 feet above ground surface. Remove the sample cassette cap.
3. Complete the upper portion of the FSDS form including: station information, Index ID, collection height, location description, QC type, cassette lot number, pump number, flow meter number, pump start date and time, and starting counter.
4. Turn the sampling pump on.
5. Check the sampling pump daily and adjust the flow rate, as needed.

6. At the end of the sampling period, orient the sample cassette up, do not remove the sampling cassette from the sampling train. Record the ending flow rate.
7. Turn the pump off. Record the pump stop date and time.
8. Remove the tubing from the sample cassette. Still holding the sample cassette upright, replace the inlet plug on the sample cassette cap and the outlet plug on the sample cassette base. Note: Do not put sample cassettes in shirt or coat pockets as the filter can pick up fibers.
9. Place each sample cassette in a plastic sample bag. Each bag should be marked with the same Index ID as the sample cassette. Place clear packaging tape over the sample identification label.
10. Transport the sample cassettes to the sample coordination area and provide the sample coordinator with the appropriate documentation with the samples.

Pump Failure Procedures

If a sampling pump faults prior to the total desired run time, the following procedures should be used:

1. Record the time of the observed pump fault in the field notes.
2. Record the stop time as the time of the last field flow check.
3. Record the ending flow rate as the rate observed at the time of the last field flow check.
4. Turn the sampling pump back on and calibrate as required (Section 4.2.2).
5. Restart sample collection.
6. Note the pump fault on the FSDS form.
7. Use pump fault time and flow information, if it can be retrieved.

If a pump fault occurs a second time, sampling shall be terminated, and the sample will be archived.

4.4 Quality Assurance/Quality Control

Equipment Maintenance

The manufacturers' instructions regarding operating procedures and maintenance will be reviewed prior to equipment use. Equipment and instrumentation will be utilized in accordance with manufactures instructions.

Collection of Field Quality Control Samples

Field quality control (QC) samples will consist of three types: lot blanks, field blanks, and co-located samples. Field QC samples will be collected at the frequency specified in the *Phase I OU3 SAP*.

4.5 Documentation

Documentation of outdoor ambient air sampling will be recorded in three main locations: field logbooks, field sample data sheets, and the Daily Observation/Impact memorandum. Each of these is discussed below.

Logbooks

Documentation of field activities conducted as part of this program will be recorded in logbooks maintained specifically for this sampling program. The procedures specified in OU3 SOP No. 9 will be followed for logbook records.

Field Sample Data Sheets

Detailed sampling information will be recorded for each sample on an OU3-specific stationary ambient air FSDS (provided in SOP No. 9, Attachment 1).

Daily Observation/Impact Memorandum

For each day that outdoor ambient air samples are collected a Daily Observation/Impact Memorandum (DOI) will be completed. An example of the DOI is included in Attachment 5.

Information to be recorded will include the following: general weather conditions (including if there is any visible frost on the ground/sample cassette and if there is existing snow cover on the ground), location of all removal and remedial actions being conducted, other observations that could affect sample results, and any equipment issues.

5.0 REFERENCES

International Organization of Standardization (ISO). 1995. Ambient Air – Determination of Asbestos Fibers – Direct Transfer Transmission Electron Microscopy Method. ISO 10312:1995(E).

U.S. Environmental Protection Agency (EPA). 2007. Phase I Sampling and Analysis Plan for Operable Unit 3, Libby Asbestos Site, Libby, Montana. September 26, 2007.

SOP AMB-LIBBY-OU3

ATTACHMENT 1

PRECISION ROTAMETER CALIBRATION DATA SHEET



LIBBY OU3 PHASE 1 Precision Rotometer Calibration Data Sheet

Calibration Date: _____
 Rotometer ID: _____
 Actual Temp (°F): _____

Calibration By: _____
 Primary Standard ID: _____
 Actual Pressure (in. Hg): _____

Ball Reading = Y (mid-ball)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Flow Rate = X_1 (L/min)

- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

Rotometer Calibration Procedure:

1. Obtain the actual temperature and actual pressure in Libby, MT from the MET station. Record the actual temperature and actual pressure in the fields provided above.
2. Calibrated rotometer to desired ball reading with a sampling pump and cassette in-line. Cassette must be the same type and from the same lot of cassettes that will be used for sampling. Record value in Ball Reading column.
3. Check adjusted flowrate of sample pump to the Dry Cal flow calibrator primary flow standard. 10 repetitive flow measurements will be averaged and that result recorded in the Flow Rate column for the selected interval.
4. Repeat this process at 10 intervals over the range of the precision rotometer.
5. Input data into rotometer calculation sheet to generate the corrected flow rate.





SOP AMB-LIBBY-OU3

ATTACHMENT 2

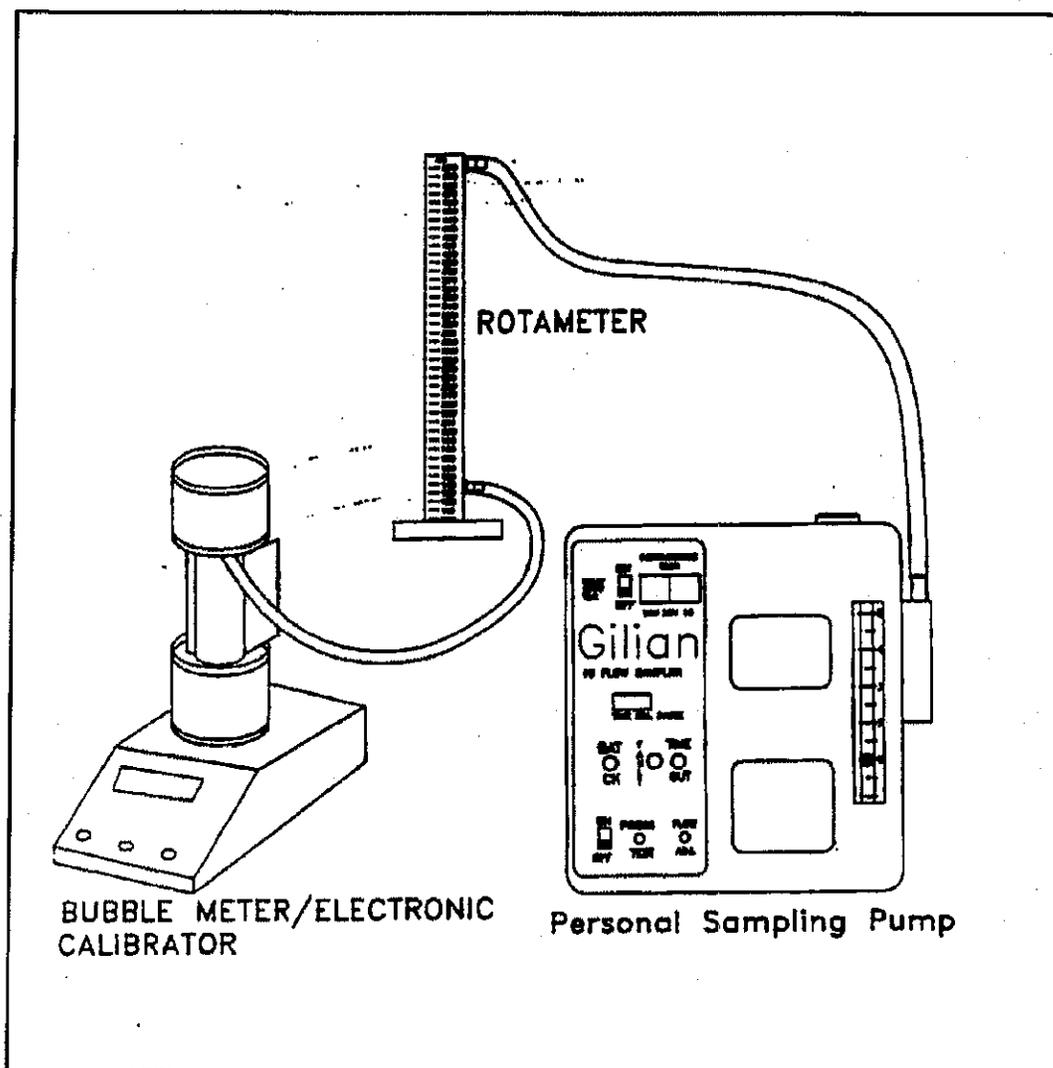
CALIBRATION TRAIN FIGURES
(from EPA SOP #2015)



APPENDIX B

Figures

FIGURE 4. Calibrating a Rotameter with a Bubble Meter

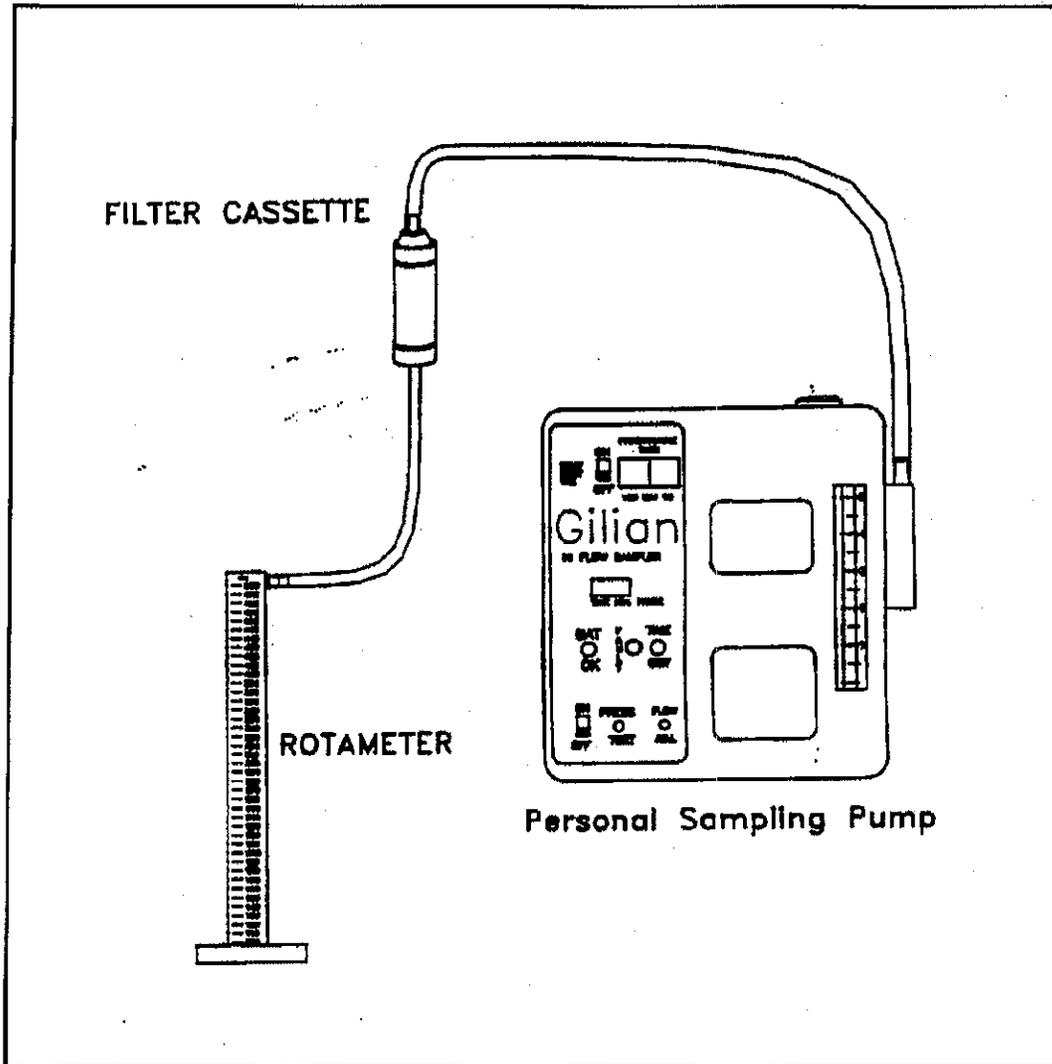




APPENDIX B

Figures

FIGURE 5. Calibrating a Sampling Pump with a Rotameter

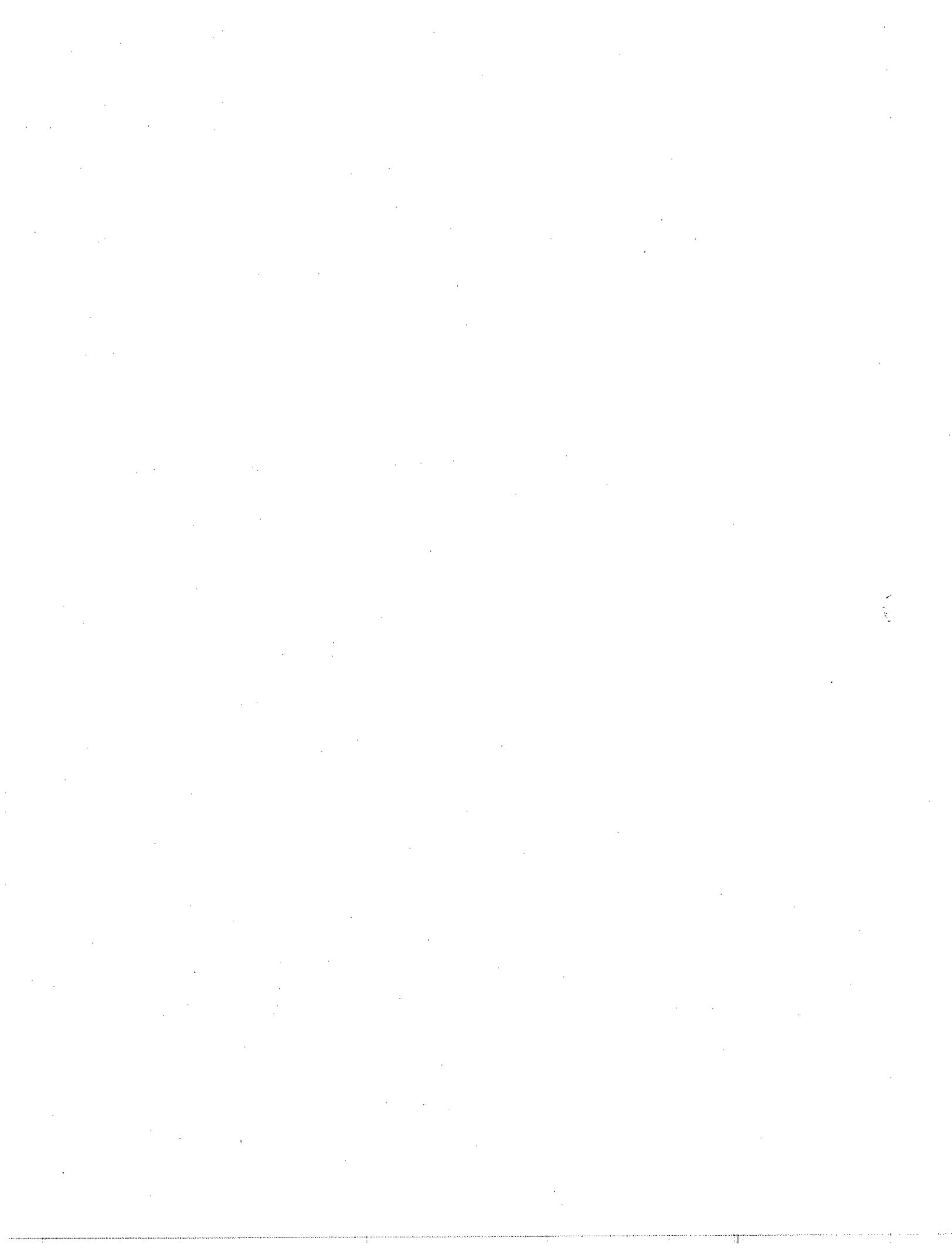




SOP AMB-LIBBY-OU3

ATTACHMENT 3

VOLUME TRACKING SPREADSHEET EXAMPLE





SOP AMB-LIBBY-OU3

ATTACHMENT 4

CALIBRATION CHECK SCHEDULE SPREADSHEET EXAMPLE





SOP AMB-LIBBY-OU3

ATTACHMENT 5

DAILY OBSERVATION/IMPACT MEMORANDUM SPREADSHEET EXAMPLE





Libby Superfund Site Operable Unit 3 Standard Operating Procedure

Date: November 20, 2007

SOP TREE-LIBBY-OU3 (Rev. 1)

Title: SAMPLING AND ANALYSIS OF TREE BARK FOR ASBESTOS

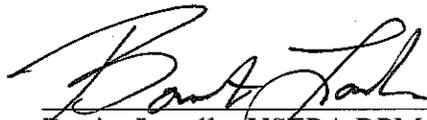
APPROVALS:

TEAM MEMBER

SIGNATURE/TITLE

DATE

EPA Remedial Project Manager


Bonita Lavelle, USEPA RPM

11/20/07

SOP Author


William Brattin, SRC

11/20/07

Revision Number	Date	Reason for Revision
0	09/26/2007	--
1	11/20/2007	Modify procedure for sample preparation based on results of pilot-scale laboratory tests

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide a standardized method for collection and analysis of tree bark samples for asbestos. This procedure will be used by USEPA Region 8 for the Remedial Investigation work for Operable Unit 3 performed at the Libby Asbestos Superfund site.

2.0 RESPONSIBILITIES

The Field Sampling Team Leader is responsible for ensuring that all bark samples are collected in accord with this SOP. The Laboratory Director is responsible for ensuring that bark samples provided to the laboratory for evaluation by this SOP are prepared and analyzed in accord with the requirements of this SOP. It is the responsibility of the Field Sampling Team Leader and the Laboratory Director to communicate the need for any deviations from the SOP with the appropriate USEPA Region 8 Remedial Project Manager or Regional Chemist.

3.0 EQUIPMENT

3.1 Field Equipment

- hole saw (2-inch diameter)
- battery-powered drill
- ½ inch chisel
- flathead screwdriver
- aerosol hair spray
- Ziploc plastic bags
- sample identification tags
- decontamination supplies
- trash bag
- GPS unit
- digital camera
- flagging tape or metal identification tag
- field log book
- field sample data sheet(s) for tree bark
- increment boring device (e.g., Hagloff)
- plastic sheath for age core
- ink pen
- clear packaging tape

3.2 Laboratory Equipment /Reagents

- Disposable Filter funnels with Straight sides. VWR # 145-0020
- Culture Dishes. VWR # 25388-581 (case of 500)
- 47 mm 0.45 micron mixed cellulose ester (MCE) filters
- Glass Petri Dishes

- Glass microscope slides
- Low Temperature Plasma Asher
- Vacuum Evaporator (Carbon Coater)
- Graphite or Carbon rods
- HEPA Laminar Flow Hood
- Acetone Vapor Generator
- Grids
- Fine Forceps
- Grid Clips and Grid Storage Boxes
- Jaffe Wick or Sponge
- Kim wipes or alternative paper
- Transmission Electron Microscope with the following capabilities:
 - 100 Kev
 - fine probe size <250 nm
 - elemental Chemistry via X-Ray Detector
- Large ceramic crucibles (approx. 50 ml capacity or greater)
- Glass stirring rods
- Fumehood
- HEPA filtered Hood
- Ultrasonic Bath producing a rate of energy deposition in the range of 0.08-0.12 MW/m³
- Disposable plastic filter funnel apparatus
- Reagent Grade or better Acetone
- Reagent Grade or better HCl

4.0 METHOD SUMMARY

One or more tree bark samples are obtained from selected trees by using a 2-inch hole saw to cut a circular ring in the bark, following by cutting/prying the circular piece of bark from the tree using a sharp chisel. The area to be sampled is sprayed with hair spray prior to sample collection in order to minimize the potential for loss of fibers from the tree bark. In some cases, a core may be obtained from the tree in order to allow verification of the age of the tree.

Tree bark samples are prepared for analysis by high temperature ashing to remove organic matter. The residue is then treated with HCl to dissolve any salts or carbonate component that may be present and applied to a filter which is examined for asbestos using transmission electron microscopy (TEM).

5.0 SAMPLE COLLECTION

Bark samples should be collected from the sampling stations specified in the Sampling and Analysis Plan (SAP). At each specified sampling station, sample collection should be performed as follows:

5.1 Select Tree

The species and size of tree selected for sampling should be specified in the project-specific sampling and analysis plan. In the absence of specification, the tree selected for sampling should be a Douglas fir (*Pseudotsuga menziesii*) with a diameter (caliper) of about 8-10 inches. If there are multiple trees that meet these requirements in the vicinity of the sampling station, preference should be given to trees with rough bark, and trees that are in open areas.

5.2 Bark Collection

Collect the bark sample from the side of tree facing the mine and from a height of 4-5 feet above the ground.

Steps:

1. Spray the bark collection area with aerosol hairspray and allow to dry.
2. Use a 2-inch diameter hole saw and a battery-powered electric drill to cut a circle in the tree bark. Continue cutting until sawdust changes from red to cream, which indicates that the cambium has been reached (about ½ inch deep).
3. Using a sharp ½-inch metal chisel or flathead screwdriver, cut or pry the circular bark sample off the tree, attempting to maintain the sample in one piece.
4. Place the bark sample in a plastic Ziploc bag.
5. Label the bag with a unique sample identifier.
6. Place clear packaging tape over the sample identifier label.

5.3 Tree Age Core Collection

At locations where an age core is to be collected (as specified in the project-specific sampling and analysis plan), collect a core from the tree using a Hagloff manual increment borer or similar device. Place the core in a plastic straw. Crimp and tape the ends of the straw, and label the straw with the same sample identifier as the bark field sample. Place the straw into a Ziploc bag. Label the bag with the same sample identifier as the bark field sample, and place clear packaging tape over the sample identifier label.

5.4 Field Documentation

Complete the Tree Bark Field Sample Data Sheet (FSDS) form. Measure and record the diameter of the tree. Obtain and record the GPS coordinates of the tree on the Tree Bark FSDS. Mark the tree with flagging tape or a metal identification tag.

5.5 Equipment Decontamination

If dedicated sample equipment is not used, after each sample collection, manually remove any fibrous debris from the hole saw teeth. If resin or pitch is present, use WD40 to clear saw of any residue. Thoroughly clean all collection equipment with isopropyl alcohol wipes. Dry sampling equipment using paper towels. Any spent wipes, paper towels, or other decontamination waste materials must be disposed or stored properly as investigation-derived waste.

6.0 SAMPLE PREPARATION AND ANALYSIS

6.1 Tree Bark Preparation

Drying and Ashing

Measure and record the diameter and the thickness of the tree bark sample to an accuracy of ± 2 mm (about 1/16 of an inch).

Weigh and record the tare weight of a clean crucible. Add the entire tree bark core to the crucible. Place the crucible with bark sample in a drying oven. Heat to 80°C and hold at this temperature until weight stabilizes (at least 6 hours). Record the final weight and calculate the mass of the dried tree bark sample by difference.

Place a lid on the crucible and transfer to a muffle furnace. Ramp up the furnace from a cold start to 450°C. Hold at this temperature for 18 hours or until all organic matter is removed. Allow the crucible to cool. Remove crucible lid and weigh and record the mass of the crucible plus ashed residue. Calculate the mass of the ashed residue by difference.

Acid Treatment

To the ashed residue, add just enough filtered and deionized (FDI) water (approximately 1-2 mL) to cover the surface of the residue. Slowly add approximately 10-20 mL concentrated HCl to the wetted ash. Typically a visible effervescing is observed. Add the HCl slowly to keep this reaction controlled. A small glass stirring rod is useful at this point to gently stir the ash and expose all material to the acid.

If after 3-5 minutes there is no further visible reaction, proceed to the next step. If bubbling is still occurring, continue observation and gentle stirring for up to an additional 5 minutes.

Dilute the sample by adding FDI water directly to the crucible (approximately 20 mL) using a squirt bottle. Pour the sample into an unused disposable 100 mL specimen container with lid. Rinse out any remaining residue from the crucible into the specimen container. Do not exceed 100 mL total volume. Bring the total volume to 100 ml with FDI water.

Cap the specimen jar and agitate the sample by inversion 5 or 6 times. Loosen the cap slightly and sonicate for 2 minutes. After sonication, tighten the cap and then dry the exterior of the specimen container with kim wipe or equivalent.

Filtration

Agitate the sample by inversion 5 or 6 times. Withdraw an initial aliquot of 5 to 20 mL of sonicated sample. Transfer this aliquot into a new disposable specimen container with lid. Bring the volume up to approximately 100 mL with FDI water. Cap and agitate by inversion (5 or 6 times).

Filter this entire volume onto a 47 mm mixed cellulose ester (MCE) filter with 0.4 um pore size.

If the filter appears overloaded (overall particulate level > 20%), repeat the process above, selecting a smaller aliquot volume, as suggested by the degree of overloading. Likewise, if the filter looks too lightly loaded, remove and filter a larger aliquot.

Transfer the filter membranes to individual disposable labeled Petri dishes with lids. With the Petri dish covers ajar, dry the filters by air drying.

6.2 TEM Examination

Prepare 3 grids for TEM analysis as detailed in International Organization for Standardization (ISO) TEM method 10312, also known as ISO 10312:1995(E). Utilize 2 grids for analysis, and archive 1 grid.

Counting rules

Examine the grids using TEM in accord with ISO 10312, with all relevant Libby site-specific modifications, including utilizing the most recent version of all relevant project specific modifications, including LB-000016, LB-000019, LB-000028, LB-000029, LB-000030, LB-000053, and LB-000066. All fibrous amphibole structures that have appropriate Selective Area Electron Diffraction (SAED) patterns and Energy Dispersive X-Ray Analysis (EDXA) spectra, and having length greater than or equal to 0.5 um and an aspect ratio (length:width) $\geq 3:1$, will be recorded on the Libby site-specific laboratory bench sheets. Data recording for chrysotile (if observed) is not required.

Stopping rules

The target analytical sensitivity for sample analysis should be specified in the SAP. In the absence of such specification, the target sensitivity should be no higher than 100,000 cm⁻². The analytical sensitivity is calculated using the following equation:

$$S = \frac{EFA}{GO \cdot Ago \cdot A \cdot F}$$

where:

S	=	Sensitivity (cm ⁻²)
EFA	=	Effective filter area (mm ²)
GO	=	Number of grid openings counted
Ago	=	Area of one grid opening (mm ²)
A	=	Area of tree bark sample being analyzed (cm ²)
F	=	Fraction of original sample deposited on the filter

Count the sample until one of the following occurs:

- The target sensitivity is achieved.
- A total of 50 or more LA structures are observed. In this case, counting may cease after completion of the grid opening that contains the 50th LA structure.
- A total of 100 grid openings are counted without reaching the target sensitivity or observing 50 LA structures. In this event, the laboratory should contact EPA asking for direction.

6.3 Electronic Data Deliverable

All data on the number, type and size of LA fibers collected in the laboratory will be provided as an electronic data deliverable (EDD) using the most recent version of the spreadsheet developed for this purpose ("TEM Tree Bark.xls").

6.4 Analysis of Core Sample

The age of the tree will be determined from the core sample in accord with the method of Phipps (1985).

7.0 QUALITY ASSURANCE

7.1 Field-Based Quality Assurance

Field Duplicates

Field duplicate tree bark samples will be collected at a frequency specified in the SAP. Each field duplicate should be collected from the same tree at a location no further than 6 inches away from the original bark sample. In the absence of such specification, the rate should be no less than 5%. Field duplicate samples should be labeled with a unique identifier. Sample details should be recorded on the Tree Bark FSDS, including the unique identifier of the "parent" field sample.

Equipment Rinsates

If dedicated sampling equipment is not utilized, equipment rinsates should be collected after decontamination of field equipment as described above. The decontaminated equipment (hole saw, chisel) should be rinsed with about 25 mL filtered and deionized water into a glass container. The frequency of rinsate collection should be specified in the SAP. In the absence of such specification, one rinsate sample should be collected per sampling team per day. Equipment rinsate samples should be labeled with a unique identifier. Sample details should be recorded on the Surface Water FSDS.

7.2 Laboratory-Based Quality Assurance

Laboratory Blanks

A laboratory blank is a filter that is prepared by processing a clean crucible in the same way that a bark sample is prepared. That is, a clean crucible is placed in the oven (with the sample set) at the

same time that tree-bark samples are undergoing ashing. After ashing, the blank crucible is treated by addition of water and HCl, as described above. The contents of the crucible are then rinsed out, diluted to 100 mL, and an aliquot at least as large as the highest volume aliquot for the sample set is removed and used to prepare a filter for TEM examination. This type of blank is intended to indicate if contamination is occurring at any stage of the sample preparation procedure.

Laboratory blanks should be prepared at a rate specified in the project-specific sampling and analysis plan. In the absence of a project-specific specification, laboratory blanks should be prepared at a rate of 3%.

Filtration Blanks

A filtration blank is a clean filter that is prepared by passing 100 mL of laboratory FDI water through it. The purpose of this type of blank is to ensure that the filters are not contaminated in the laboratory, and that fluids used for diluting and processing samples are fiber-free.

Filtration blanks should be prepared at a rate specified in the project-specific sampling and analysis plan. In the absence of a project-specific specification, filtration blanks should be prepared at a rate of 2%.

Laboratory Duplicates

Laboratory duplicates will be prepared by applying a second aliquot of ashed residue suspension to a new filter, which is then prepared and analyzed in the same fashion as the original filter. The frequency of laboratory duplicates should be specified in the SAP. In the absence of such specification, the rate should be no less than 5%. Laboratory duplicates should be recorded using the appropriate laboratory quality control field in the TEM EDD spreadsheet.

Recounts

The precision of TEM sample results should be evaluated by recounting selected grid openings in accord with the requirements specified in the most recent version of LB-000029.

8.0 REFERENCES

International Organization for Standardization. 1995. Ambient Air – Determination of asbestos fibres – Direct-transfer transmission electron microscopy method. ISO 10312:1995(E).

Phipps, R.L. 1985. Collecting, Preparing, Cross-dating and Measuring Tree Increment Cores. U.S. Geological Survey Water Resources Investigations Report 85-4148

Ward TJ, T Spear, J Hart, C Noonan, A Holman, M Getman, and JS Webber. 2006. Trees as Reservoirs for Amphibole Fibers in Libby, Montana. Science of the Total Environment 367: 460-465.



SOP DEBRIS-LIBBY-OU3 (Rev. 0)

PREPARATION AND ANALYSIS OF ORGANIC DEBRIS FOR ASBESTOS

(in preparation)



NOTE: This SOP was designed for use on Libby Project Soils. For any other use the SOP needs to be re-evaluated based on specific project objectives

Date: May 6, 2004

SOP No. ISSI-LIBBY-01 (Rev. 8)

Title: SOIL SAMPLE PREPARATION

Author: William Brattin

Syracuse Research Corporation(a)

SYNOPSIS: A standardized method for preparation of soil samples for asbestos analysis is described.

Received by QA Unit:

APPROVALS:

TEAM MEMBER

SIGNATURE/TITLE

DATE

EPA Region 8

W. J. Brattin

5/16/04

Syracuse Research Corp.

WJ Brattin

5/6/04

Revision Number	Revision Date	Reason for Revision
1	1/7/00	Incorporation of sieving to the sample preparation.
2	7/12/00	Revision in sieve size, other minor edits.
3	5/7/02	Incorporate minor edits
4	8/1/02	Modify sieving procedure, add grinding step
5	3/6/03	Incorporate modifications to the procedure and documentation requirements

NOTE: This SOP was designed for use on Libby Project Soils. For any other use the SOP needs to be re-evaluated based on specific project objectives

Revision Number	Revision Date	Reason for Revision
6	3/24/03	Incorporate modifications to the logsheets to conform with electronic data storage requirements and add grinder blank requirements.
7	8/5/03	Incorporate modifications to drying and sample storage procedures
8	5/4/04	Incorporate modifications to drying batch size and recording of preparation information

(a) This SOP was originally prepared by ISSI Consulting Group. ISSI is no longer in existence, and finalization of the SOP was performed by Syracuse Research Corporation (SRC).

TECHNICAL STANDARD OPERATING PROCEDURE

ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

NOTE: This SOP was designed for use on Libby Project Soils. For any other use the SOP needs to be re-evaluated based on specific project objectives

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide a standardized method for preparation of soil samples for asbestos analysis. This procedure will be used by employees of United States Environmental Protection Agency (USEPA) Region 8 and by contractors/subcontractors supporting USEPA Region 8 projects and tasks for the Remedial Investigation work performed at the Libby, Montana site. Site-specific deviations from the procedures outlined in this document must be reviewed and approved within a Request for Modification by the Volpe Center Technical Lead or Libby Project Manager and the USEPA Region 8 Remedial Project Manager or Regional Chemist.

The contents of this SOP have been specifically designed for the Libby Asbestos site. For example, the particle size of 250 μm was selected in an attempt to balance two opposing goals: 1) grinding the sample to a small enough particle size to obtain homogeneous soil samples; and 2) keep the particle size distribution of sufficient size to accommodate analyses by several methods including polarized light microscopy-visual area estimation (PLM-VE), scanning electron microscopy (SEM) and transmission electron microscopy (TEM). It is possible that for methods such as the TEM, further preparation at the laboratory may be necessary. If so, these additional steps will be addressed at the level of the TEM SOP.

Procedures outlined in this SOP have been designed with the intent to prepare soil samples having a target concentration greater or equal to approximately 0.1-0.2% (weight percent) total Libby amphibole (LA) material.

2.0 RESPONSIBILITIES

The Preparation Laboratory Project Leader (PL²) may be an USEPA employee or contractor who is responsible for overseeing the soil sample preparation activities. The PL² is also responsible for checking all work performed and verifying that the work satisfies the specific tasks outlined by this SOP and the Close Support Facility Soil Preparation Plan, Libby Asbestos Site, Operable Unit 4, Libby, Montana (CSF SPP). It is the responsibility of the PL² to communicate with the Preparation Laboratory personnel regarding specific collection objectives and anticipated situations that require any deviation from the respective Project Plans. It is also the

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TECHNICAL STANDARD OPERATING PROCEDURE
ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

NOTE: This SOP was designed for use on Libby Project Soils. For any other use the SOP needs to be re-evaluated based on specific project objectives

responsibility of the PL² to communicate and document the need for any deviations from the Project Plans with the appropriate USEPA Region 8 Remedial Project Manager or Regional Chemist.

Personnel preparing Libby soil samples are responsible for adhering to the applicable tasks outlined in this procedure and conducting all sample handling and preparation activities in the ventilation hood.

3.0 EQUIPMENT

- General purpose laboratory oven - must be capable of maintaining a constant temperature of approximately 89-91°C.
- Analytical balance - calibrated and accurate to tolerance limits indicated on Attachment 2, range of 0.1 g to at least 2000 g
- Riffle splitter - with 3/4 inch chutes to split samples
- Plate Grinder - capable of accepting soil particles of approximately 1/4 inch diameter and grinding to produce particle of approximately 250 µm
- Metal (other than plastic) scoop or spoon - for transferring samples
- 1/4 inch metal (other than plastic) sieve and catch pan - for coarse sieving samples
- 60 mesh (250 µm) and 200 mesh (74 µm) metal (other than plastic) sieves - for verification of the plate grinder settings
- Clean quartz sand - required for preparation of grinding and drying blank samples (Sections 6.2, 9.2, 12.1 and 12.3) and for decontamination of grinder (Section 9.4)
- Clean soil - sufficient aliquot required for calibration of grinder (Section 9.1)
- Drying Pans - pans used during the sample drying process

TECHNICAL STANDARD OPERATING PROCEDURE

ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

NOTE: This SOP was designed for use on Libby Project Soils. For any other use the SOP needs to be re-evaluated based on specific project objectives

- Sample containers - plastic ziplock bags (pint and gallon size)
- Gloves - for personal protection and to prevent cross-contamination of samples. May be plastic or latex. Disposable, powderless
- Field clothing and Personal Protective Equipment - as specified in the Health and Safety Plan (Appendix E of the CSF SPP, December 2003)
- Field notebook -used to record progress, any problems or observations and deviations
- Sample Drying Log Sheets - (Attachment 1) - used to record all sample drying information
- Sample Preparation Log Sheets (Attachment 1)- used to record all sample preparation information (splitting, sieving and grinding)
- Three-ring binder books - binders will contain:
 - Analytical Balance Calibration and Maintenance Log (Attachment 2)
 - Grinder Calibration and Maintenance Log (Attachment 3)
 - Ventilation Hood Calibration and Maintenance Log (Attachment 4)
 - Vacuum Maintenance Log (Attachment 5)
 - Oven Temperature Calibration and Maintenance Log (Attachment 6)
 - Sample labels
- Trash Bags - used to dispose of gloves, wipes and other investigation derived waste
- Indelible Marking Pen - used to record sample information onto plastic ziplock bags and to record logbook information
- Ballpoint Pen - used to record field logsheet information

TECHNICAL STANDARD OPERATING PROCEDURE
ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

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4.0 METHOD SUMMARY

Figure 1 provides an overview of the steps in this procedure. Soil samples are dried in a standard laboratory oven and split into a preparation sample and an archive sample. The preparation sample is sieved to separate coarse material (> 1/4 inch) from fine material (< 1/4 inch). The fine material is ground to a standard particle size of about 250 µm for subsequent asbestos analysis. The coarse material is examined by stereomicroscopy to determine if any large particles of asbestos are present (EPA SOP SRC-LIBBY-01).

5.0 SOIL STORAGE

Upon receipt of samples, samples will be grouped in an inventory batch of approximately 120 samples. Samples will be archived according to the inventory batch they are assigned to and filed by the inventory ID noted on the Sample Drying Log Sheet and Sample Preparation Log Sheet (Attachment 1). This box number will be automatically assigned by the electronic Libby Asbestos Sample Tracking Information System (eLASTIC) when the inventory batch is created in the database.

6.0 BULK SOIL DRYING

Prior to drying, samples will be grouped in a drying batch and assigned a drying batch number. The following sections detail all activities and procedures related to drying samples.

6.1 Calibration

Samples will be weighed prior to and following drying activities. The analytical balance used for drying activities will be calibrated on days when samples are loaded into, or unloaded from, the oven. Before weighing samples, calibrate the balance using S-1 class weights and record all measurements, any required maintenance, and the balance number on the Analytical Balance Calibration and Maintenance Log (Attachment 2).

All drying activities will be performed under a negative pressure HEPA filtered hood. Prior to loading the oven, the ventilation hood will be calibrated to ensure that the ventilation system is operating properly. Ventilation hood calibration and any required maintenance will be

TECHNICAL STANDARD OPERATING PROCEDURE

ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

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documented on the Ventilation Hood Calibration and Maintenance Log (Attachment 4).

A HEPA vacuum will be used to decontaminate the oven following the removal of dried samples. Vacuum calibration will be performed daily, prior to drying activities. All system checks, required maintenance and the vacuum number will be recorded on the Vacuum Maintenance Log (Attachment 5).

Oven temperature calibration will be performed on a weekly basis. Oven temperature calibration and any required maintenance will be documented on the Oven Temperature Calibration and Maintenance Log (Attachment 6).

6.2 Drying Blanks

A drying blank will be created and associated with each drying batch prior to loading samples into the oven. A drying batch will consist of approximately 15 samples. The drying blank will consist of approximately 100-200 grams of clean quartz sand, placed in a drying pan and assigned an index ID (see Section 6.1). Each drying blank will be identified in the notes section of the Sample Drying Log Sheet (Attachment 1) and will be prepared using the same methodology as other soil samples. Following preparation, whenever possible, each blank will be shipped with its associated batch samples. See Section 12.1 for more details regarding drying blanks.

6.3 Drying Procedure

Samples will be loaded into the drying oven using the following steps:

- Record the SOP and Revision Number used to prepare the samples on the Sample Drying Log Sheet (Attachment 1). Record the oven number used to dry the samples on the Sample Drying Log Sheet (Attachment 1).
- Prior to unsealing and drying each sample, record the sample mass to the nearest 0.1 g on the Sample Drying Log Sheet (Attachment 1), the technicians initials and the date. See Section 6.1 for calibration details.

TECHNICAL STANDARD OPERATING PROCEDURE

ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

NOTE: This SOP was designed for use on Libby Project Soils. For any other use the SOP needs to be re-evaluated based on specific project objectives

- Set the oven temperature to $90 \pm 1^\circ\text{C}$. For every sample drying batch, check the oven temperature to verify that proper temperature has been reached and document the start date/time and temperature on the Sample Drying Log Sheet (Attachment 1).
- Transfer each sample to be dried from its zip top storage bag into a clean drying pan. Each sample should be transferred to its respective drying pan under the negative pressure HEPA filtered hood. Label each drying pan with its respective Index ID. Place each sample in the oven.
- Leave the samples in the oven for approximately 24-48 hours or until completely dry. Verify that each sample is dry, by squeezing a portion of the soil with a freshly gloved thumb and forefinger to test the cohesiveness. Once it is confirmed that samples are dry, record the technician's initials, and the date and time of completion, on the Sample Drying Log Sheet (Attachment 1).
- Turn off the oven and allow the samples to cool in the oven. Once the samples are cooled, unload each sample and transfer each sample volume to a clean zip top bag, re-bag the sample with another clean zip top bag and identify the dried sample with the index ID. All samples should be transferred to zip top bags under the negative pressure HEPA filtered hood to prevent potential exposure to fibers that might be released from the sample.
- Record the sample mass of each bagged sample to the nearest 0.1 g on the Sample Drying Log Sheet (Attachment 1), the technician's initials and the date.

6.4 Decontamination

Decontaminate the inside of the hood and the inside of the oven by HEPA vacuuming and wet wiping all surfaces before loading a new batch for drying.

Decontaminate all sample drying pans under the ventilation hood using compressed air or a HEPA vacuum to remove any residual organic material left on the pans. Wet wipe or brush off any visible material that is not removed from the air blast or vacuum. All pans will be decontaminated between samples.

TECHNICAL STANDARD OPERATING PROCEDURE

ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

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7.0 DIVISION OF ARCHIVE AND PREPARATION SAMPLES

Prior to sieving and grinding, samples will be divided into a portion for archive and a portion for preparation. The sections below describe the sample splitting procedure.

7.1 Calibration

Prior to any splitting, sieving, or grinding activities, calibrate the ventilation hood to ensure that the ventilation system is operating properly. Document ventilation hood calibration and any required maintenance on the Ventilation Hood Calibration and Maintenance Log (Attachment 4).

7.2 Procedure for Sample Division

Samples will be divided using the following steps:

- Place the cooled, re-bagged samples in the hood, and knead the contents of the bag to break up any soil clumps.
- Splitting must be performed in the hood to prevent potential exposure to fibers that might be released from the sample. Place one pan on each side of the riffle splitter. Divide the sample into two equal sub-parts by removing the sample from its original plastic bag and loading the dry material into the splitter.
- After splitting, set aside one part for sample preparation as described below (if the volume of the portion left for preparation is still too large for processing, split the sample again so that 3/4 of the original sample will be archived and 1/4 will be set aside for processing).
- Place the remaining split portion into a clean, zip top bag, re-bag the sample in another clean zip top bag, and store as an archive sample in the event additional analyses are required in the future. Identify the archive sample with the index ID and the suffix "A" (for archive fraction). Record the technician's initials and date on the Sample Preparation Log Sheet. Store the archive portion in the numbered inventory box noted on the Sample Preparation Log Sheet (Attachment 1).

TECHNICAL STANDARD OPERATING PROCEDURE
ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

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7.3 Duplicate Samples

One preparation duplicate sample will be processed for every 20 field samples prepared. A preparation duplicate is a sample split of material that is prepared in the same fashion as the parent sample (preparation split) and will be submitted to the laboratory blind. The preparation duplicate will be assigned a unique and random index identification number. For both samples, the corresponding index ID will be indicated in the notes section of the Sample Preparation Log Sheet (Attachment 1). If a preparation duplicate is not being prepared for a particular sample, proceed to Section 7.4.

Following the division of a sample for preparation and archive. Divide the designated sample into two equal sub-parts using a riffle splitter (as described in section 7.2). Retain one portion as the parent sample and assign the other portion the duplicate index ID. Record the technician's initials, and the date of creation on the Sample Preparation Log Sheet (Attachment 1), when the duplicate sample is prepared. Prepare each portion according to the processes outlined below. For further information on preparation duplicates, refer to Section 12.2.

7.4 Decontamination

The splitter will not be decontaminated following this step provided the fine ground sample will be split again into four fractions in Section 10.0. If for any reason the same sample is not immediately split further, the riffle splitter must be decontaminated as follows.

Use a HEPA vacuum and compressed air to decontaminate the splitter and brush or wipe off any visible material that is not removed by the air blast. The splitter is now ready to process the next sample.

8.0 PREPARATION SAMPLE SIEVING

All samples will be sieved prior to grinding to separate out the coarse and fine fractions. The sample sieving procedure is described in the sections below.

TECHNICAL STANDARD OPERATING PROCEDURE

ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

NOTE: This SOP was designed for use on Libby Project Soils. For any other use the SOP needs to be re-evaluated based on specific project objectives

8.1 Calibration

All sieving activities will take place in the hood. Refer to Section 6.1 for details regarding the frequency of ventilation hood calibration.

Samples will be weighed during sieving activities. The analytical balance will be calibrated daily with S-1 class weights before processing begins. All measurements, any required maintenance, and the analytical balance number will be recorded on the Analytical Balance Calibration and Maintenance Log (Attachment 2).

8.2 Sample Sieving Procedure

Conceptually, sample sieving may generate a coarse and a fine fraction sample. Samples will be sieved using the procedure outlined below.

Coarse Fraction

A 1/4 inch stainless steel screen with catch pan will be used to divide the fine and coarse fractions using the following procedure:

- Pour the sample through the 1/4 inch stainless steel sieve and give the screen a shake to ensure all particles < 1/4 inch in size are allowed to pass through the screen. In addition, a pestle may be used to break up any remaining soil clumps to ensure all particles < 1/4 in size pass through the screen.
- Pour all material which does not pass through the screen (> 1/4 inch) into a new, tared, sample bag and identify the coarse sample with the index ID and the suffix "C" (for "coarse fraction").
- Record the mass of the coarse fraction to the nearest 0.1 g on the Sample Preparation Log Sheet (Attachment 1) and record the technician's initials and the date.
- Double-bag the coarse sample portion and identify the sample with the index ID and "C" suffix on the sample bag. Coarse fraction samples are now ready to be packaged for

TECHNICAL STANDARD OPERATING PROCEDURE
ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

NOTE: This SOP was designed for use on Libby Project Soils. For any other use the SOP needs to be re-evaluated based on specific project objectives

shipment to the analytical laboratory or archived as directed.

Fine Fraction

Tare an empty sieve pan, to account for the weight of the pan containing the fine sample, and weigh the fine material that passed through the sieve. Record the mass of the fine fraction to the nearest 0.1 g on the Sample Preparation Log Sheet (Attachment 1). If all of the material passes through the screen, such that there is no coarse fraction, record a mass of zero for the coarse fraction on the Sample Preparation Log Sheet.

Whenever possible, immediately process the fine material that passes through the screen in accord with the approach described in Section 9.3 (below). If processing cannot occur immediately, pour the fine material which passed through the sieve into a new plastic ziplock bag and identify the fine sample material with the index ID and the suffix "F" (for "fine fraction"). Double-bag the sample and identify the sample with the index ID and suffix on the outside of the bag.

8.3 Decontamination

Decontaminate all sieves, pans and the pestle under the ventilation hood using compressed air. Wipe or brush off any visible material that is not removed from the air blast. A HEPA vacuum may also be used to remove any residual organic material left on the sieve pans. All pans and sieves will be decontaminated between samples.

9.0 FINE SAMPLE GRINDING

The fine sieved sample will be ground to produce a material of about 250 μm . The final sample will be packaged and shipped to the laboratory for asbestos analysis. The procedure for grinding the fine sieved sample is outlined below.

9.1 Calibration

All grinding activities will take place in the hood. Refer to Section 7.1 for details regarding the frequency of ventilation hood calibration.

TECHNICAL STANDARD OPERATING PROCEDURE

ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

NOTE: This SOP was designed for use on Libby Project Soils. For any other use the SOP needs to be re-evaluated based on specific project objectives

A HEPA vacuum will be used to decontaminate the hood and processing equipment, following the preparation of each sample. Vacuum calibration will be performed daily, prior to grinding activities. All system checks, required maintenance and the vacuum number will be recorded on the Vacuum Maintenance Log (Attachment 5).

A standard BICO vertical plate grinder will be used to process samples. The grinder will be calibrated daily or after any adjustments are made to the plates. To verify proper particle size (approximately 250 μm), and demonstrate that samples will not be over-processed, grind a sample of clean soil (rather than quartz sand) and sieve using stacked sieves. Clean soil will be provided by the United States Geological Survey (USGS). Unlike the coarseness of quartz sand, soil will more accurately approximate the typical grain size and texture of the Libby samples being processed and will reduce the chance of over-processing. Note that the particle size is cited as "approximately 250 μm ". This is due to the nature of grinding asbestos material. Some material that is longer than 250 μm may pass through the grinder if its longest side is parallel with the vertical grinder plates. The material that comes in contact more nearly perpendicular to the vertical grinder plates will be ground to <250 μm .

The grinder is adjusted acceptably if all material passes through a 60-mesh (250 μm) screen and is substantially retained by a 200-mesh (74 μm) sieve. If the appropriate amount of material does not pass through the stacked sieves, adjust the plates of the vertical grinder until all material processed passes through the aforementioned sieve sizes. Document the grinder number, verification of acceptable adjustment and any observations in the Grinder Calibration and Maintenance Log (Attachment 3).

Following the calibration activities, the stacked sieves will be decontaminated using a HEPA vacuum, compressed air and an aliquot of approximately 20 g of quartz sand will be passed through the grinder before the next sample is processed.

Samples will be weighed following grinding activities. The analytical balance will be calibrated daily with S-1 class weights before processing begins. All measurements, any required maintenance, and the analytical balance number will be recorded on the Analytical Balance Calibration and Maintenance Log (Attachment 2).

TECHNICAL STANDARD OPERATING PROCEDURE
ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

NOTE: This SOP was designed for use on Libby Project Soils. For any other use the SOP needs to be re-evaluated based on specific project objectives

9.2 Grinding Blanks

A grinding blank will be prepared daily, per grinder used, and will be associated with all samples prepared per day, per grinder. The grinding blank will consist of approximately 100-200 grams of clean quartz sand, and will be processed on days that field samples are ground. Each grinding blank will be identified in the notes section of the Sample Preparation Log Sheet (Attachment 1) and will be processed according to the direction of Section 9.3. Grinding blanks will be included with daily shipments to the laboratory. For further information on grinding blanks refer to Section 12.3.

9.3 Grinding of Fine Field Samples

The sample portion that was sieved to < 1/4 inch will be ground to a particle size of approximately 250 μm . Set up a catch pan under the grinder to collect all the ground material. Take the fine sample set aside in Section 8.2, load the grinder hopper, and allow the fine sample to pass through the plate grinder into the catch pan. Note the technician's initials, date of grinding, and grinder number on the Sample Preparation Log Sheet (Attachment 1).

9.4 Decontamination

When grinding is complete, do not move the plates for decontamination (this would require re-calibration). Decontaminate the hopper and catch pan by using a HEPA vacuum, followed by a blast of high pressure air. Set the catch pan aside and clean the grinder with several blasts of compressed air. Pay special attention to areas where dust from the grinding process is known to accumulate (e.g., between the plates and areas adjacent to the catch pan clamps). Reattach the catch pan to the grinder. Pass an aliquot of approximately 20 g of quartz sand through the grinder to clean out any residual soil. Discard the quartz sand and re-clean the grinder with the vacuum and another round of high pressure air blasts. After this decontamination procedure, the grinder is ready to process the next sample.

10.0 SPLITTING OF THE FINE GROUND SAMPLE

The fine ground soil sample should be distributed into four approximately equal subsamples using a splitter. All splitting activities will be performed in the hood. Refer to Section 7.1 for details regarding the frequency of ventilation hood calibration.

TECHNICAL STANDARD OPERATING PROCEDURE
ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

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10.1 Splitting Procedure for Fine Ground Sample

The following method for splitting a soil sample was adapted from EPA 540-R-97-028 (USEPA, 1997):

- Set up one receiving pan on each side of the splitter. Load the soil from the grinder catch pan (Section 9.3) into the splitter, collecting the sample in two receiving pans.
- Tap the catch pan vigorously several times to free any remaining material. Tap the splitter to facilitate the flow of all material through the chutes into the receiving pans.
- Empty each receiving pan into the grinder catch pan and sieve catch pan, respectively. Set the sieve pan aside; this portion of fine ground sample will be split again later.
- Replace the receiving pans under the splitter. Take the grinder catch pan, containing half of the fine ground sample and re-load the contents into the splitter as detailed above. Repeat the process of dispersing the sample material by shaking the catch pan and tapping the splitter to uniformly distribute the sample. The resulting splits are the "FG1" and "FG2" portions on the Sample Preparation Log Sheet (Attachment 1).
- Take these two portions and carefully transfer each into a clean, tared, zip top sample bag. Re-bag one sample portion in another clean zip top sample bag and identify this fine ground sample with the index ID, the suffix "FG" (for "fine fraction, ground") and the fraction number 1, (ex. CS-12345-FG1 for fine ground fraction #1). Identify the bagged second portion with the Index ID, the suffix "FG" and the fraction number 2 and set aside to be re-bagged with the following fine ground portions:
- Place the two empty receiving pans from the "FG1" and "FG2" portion next to the splitter. Repeat the splitting procedure using the other fine ground portion set aside in the sieve pan and split the remaining sample material to create the "FG3" and "FG4" portions.

TECHNICAL STANDARD OPERATING PROCEDURE

ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

NOTE: This SOP was designed for use on Libby Project Soils. For any other use the SOP needs to be re-evaluated based on specific project objectives

- Take the remaining "FG3" and "FG4" portions and carefully transfer each into a clean, tared, ziplock sample bag, identify each remaining fine ground sample with the index ID as noted above.
- Weigh each sample portion (FG1 through FG4), and record each mass along with the technician's initials and date on the Sample Preparation Log Sheet (Attachment 1).
- Combine all bagged portions (archive, coarse and fine) into one large clean, zip top sample bag.

Fine ground samples are now ready to be packaged for shipment to the analytical laboratory or archived as directed. When samples are requested for shipment, the "FG1" fraction will be sent first. If further analyses are required for the fine ground portion, the subsequent fractions will be double bagged and sent (i.e., FG-2 then FG-3, etc.). All archived fine ground portions will be filed in the appropriate inventory archive box noted on the Sample Preparation Log Sheet (Attachment 1).

10.2 Decontamination

Use the vacuum and compressed air to decontaminate the splitter and brush or wipe off any visible material that is not removed by the vacuum or air blast. The splitter is now ready to process the next sample.

11.0 DOCUMENTATION

Index ID numbers are recorded on the Sample Drying Sheet, Sample Preparation Log Sheet (Attachment 1) and on all sample containers. Sample Drying Sheets and Sample Preparation Log Sheets will be filed under their associated dry batch and preparation batch number. If revisions to the Sample Drying Sheet and/or Sample Preparation Log Sheet are necessary, the appropriate parties will be notified of the changes, however, these changes will not necessitate revision to the current standard operating procedure, a modification form will be filled out to document the revisions.

TECHNICAL STANDARD OPERATING PROCEDURE

ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

NOTE: This SOP was designed for use on Libby Project Soils. For any other use the SOP needs to be re-evaluated based on specific project objectives

As mentioned above, the following equipment calibration and maintenance logs will also be maintained:

- daily analytical balance calibration using S-1 class weights (Attachment 2)
- daily grinder setting verification for calibration check and/or post-adjustment verification, grinder maintenance as necessary (Attachment 3)
- daily ventilation hood operating condition verification (i.e., inline filter checks, changes) (Attachment 4)
- HEPA vacuum maintenance and bag changes (Attachment 5)
- weekly oven temperature calibration, oven maintenance as necessary (Attachment 6)

In addition, a field notebook will be maintained by each individual or team that is preparing samples. For each day that samples are processed, the following information should be collected:

- date
- time
- personnel
- PPE
- Governing Plan (CSF SPP, February 2004) and TSOP including revision number
- descriptions of any deviations to the SOP, the reason for the deviation and/or any modification forms being followed
- summary of laboratory activities (including number of samples prepared, and equipment calibrated and used)

12.0 QUALITY ASSURANCE

All quality control sample results will be monitored for potential contamination. If samples results indicate cross-contamination, the PL² will be notified. The PL² will then identify the affected samples and notify the appropriate parties of these samples. Laboratory procedures will also be re-assessed and appropriate changes will be made and documented accordingly by the PL².

TECHNICAL STANDARD OPERATING PROCEDURE
ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

NOTE: This SOP was designed for use on Libby Project Soils. For any other use the SOP needs to be re-evaluated based on specific project objectives

12.1 Drying Blanks

At least one drying blank will be processed with each batch (per oven) of approximately 15 field samples (Section 6.2). Results from each drying blank will determine if cross-contamination occurred during the drying process. The drying blank, consisting of clean quartz sand, will be assigned a random and unique index identification number and will be submitted to the laboratory blind. Detection of asbestos fibers in any drying blank (at the practical quantitation limit of about 0.1-0.2% LA) should be taken as a sign of potential cross-contamination, and steps should be taken to identify and address the source of the cross contamination.

12.2 Preparation Duplicates

One preparation duplicate sample (Section 7.3) will be processed for every 20 field samples prepared. Results from duplicate samples serve to evaluate the precision of the sample preparation process and of the laboratory analysis. A preparation duplicate is prepared by using a riffle splitter to divide the sample into two approximately equal portions, creating a parent and duplicate sample. Both samples are prepared in the same fashion. The preparation duplicate is assigned a unique and random index identification number, and is submitted to the laboratory blind. Inconsistent sample results should be taken as an indication of variability in sample preparation, and steps should be taken to identify and address the source of the variability in sample preparation.

12.3 Grinding Blanks

One grinding blank (Section 9.2), consisting of clean quartz sand, will be processed once per day, per grinder, on days that field samples are ground. Each grinder used in the lab will be assigned a number and all samples processed will be associated with the grinder used for preparation. The grinder number used for each sample will be noted on the Sample Preparation Log Sheet (Attachment 1). Grinding blanks will not be dried, split for archive, or sieved, a grinding blank will only be ground and split into four fine ground samples. Results from the grinding blank will determine if decontamination procedures of laboratory equipment are adequate in preventing cross-contamination of samples during sample grinding and fine ground sample splitting processes only. The grinding blank is assigned a random and unique index identification number and is submitted to the laboratory blind. If asbestos fibers are detected in

TECHNICAL STANDARD OPERATING PROCEDURE

ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

NOTE: This SOP was designed for use on Libby Project Soils. For any other use the SOP needs to be re-evaluated based on specific project objectives

any grinding blank the PL² will be notified. The PL² will identify all samples that were processed on the day the grinding blank was prepared, and the grinder that was used to process the grinding blank. Detection of asbestos fibers in any drying blank (at the practical quantitation limit of about 0.1-0.2% LA) should be taken as a sign of potential cross-contamination, and steps should be taken to identify and address the source of the cross contamination.

13.0 DECONTAMINATION

All non-disposable equipment used during sample preparation must be decontaminated prior to use. Scoops or spoons, splitters, sieves and drying pans that are re-used must be decontaminated with a HEPA vacuum, compressed air, wet-wiping and/or by brushing off any residual material. If soil particles are visible on any of the equipment, repeat the decontamination procedure until the equipment is clean.

Detailed decontamination procedures for specific equipment are noted in Sections 6.4, 7.4, 8.3, 9.4, and 10.2.

14.0 GLOSSARY

HEPA - High Efficiency Particulate Air

Project Plan - The written document that spells out the detailed site-specific procedures to be followed by the Project Leader and the Preparation Lab Personnel.

15.0 REFERENCES

American Society for Testing and Materials. 1998. Standard Practice for Reducing Samples of Aggregate to Testing Size, ASTM Designation: C 702 - 98, 4 p.

CDM. 2004. Close Support Facility Soil Preparation Plan, Libby Asbestos Site, Operable Unit 4, Libby, Montana. February.

TECHNICAL STANDARD OPERATING PROCEDURE
ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

NOTE: This SOP was designed for use on Libby Project Soils. For any other use the SOP needs to be re-evaluated based on specific project objectives

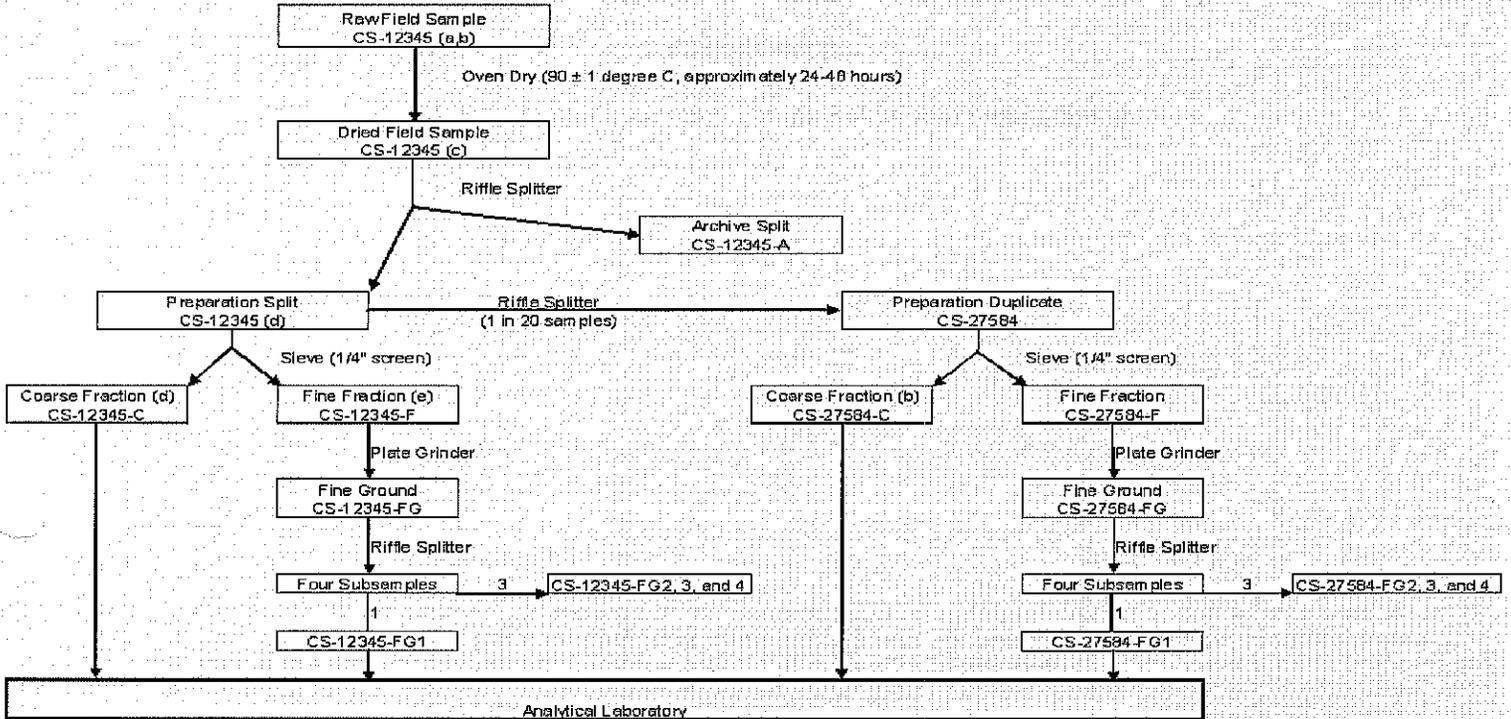
USEPA. 1997. Superfund Method for the Determination of Releasable Asbestos in Soils and Bulk Materials. EPA 540-R-97-028.

TECHNICAL STANDARD OPERATING PROCEDURE

ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

NOTE: This SOP was designed for use on Libby Project Soils. For any other use the SOP needs to be re-evaluated based on specific project objectives

Figure 1 Soil Sample Preparation Flow Diagram



- (a) Example sample number shown to illustrate naming conventions
- (b) Drying blanks, created with clean quartz sand (Section 5.2) will be processed with each batch using the same sample processing procedures outlined in ISSI-Libby-01 (Rev 7)
- (c) If the sample is designated as a duplicate, the sample will follow the duplicate splitting process defined below. If the sample is not a designated duplicate, it will proceed to the sieving step defined below.
- (d) Coarse sample will be returned to CDM CSF for archive after laboratory analysis
- (e) Grinding blanks (Section 8.3), created with clean quartz sand, will be ground and split into four fine ground samples using the same procedures outlined in ISSI-Libby-01 (Rev 7)

TECHNICAL STANDARD OPERATING PROCEDURE
ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

NOTE: This SOP was designed for use on Libby Project Soils. For any other use the SOP needs to be re-evaluated based on specific project objectives

ATTACHMENT 1

SAMPLE DRYING AND SAMPLE PREPARATION LOG SHEETS

TECHNICAL STANDARD OPERATING PROCEDURE
ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

NOTE: This SOP was designed for use on Libby Project Soils. For any other use the SOP needs to be re-evaluated based on specific project objectives

ATTACHMENT 2

ANALYTICAL BALANCE CALIBRATION AND MAINTENANCE LOG

TECHNICAL STANDARD OPERATING PROCEDURE
 ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

NOTE: This SOP was designed for use on Libby Project Soils. For any other use the SOP needs to be re-evaluated based on specific project objectives

Balance # = _____

Measurement Number	Calibration Weights	S - 1 Class Weight Measurements				Measurement within range? Yes or No	if "No" Recalibrate	Technician Initials	QC check initials
		0.1 g	1 g	10 g	100 g				
	Tolerance Limit Range	0.05 - 0.15 g	0.90 - 1.10 g	9.75 - 10.25 g	99.00 - 101.00 g				
Date									
1									
2									
3									
4									
5									
6									
7									
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9									
10									
11									
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25									

The analytical balance calibration will be verified daily.
 All tolerance limits are standard tolerance limits for Class S-1 weights.
 After 20 measurements, the tolerance range will be evaluated for reasonableness.
 Weights falling outside the range require that the balance be recalibrated using all S-class weights

Sheet No.: Balance - _____

TECHNICAL STANDARD OPERATING PROCEDURE

ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

NOTE: This SOP was designed for use on Libby Project Soils. For any other use the SOP needs to be re-evaluated based on specific project objectives

ATTACHMENT 3

GRINDER CALIBRATION AND MAINTENANCE LOG

TECHNICAL STANDARD OPERATING PROCEDURE

ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

NOTE: This SOP was designed for use on Libby Project Soils. For any other use the SOP needs to be re-evaluated based on specific project objectives

ATTACHMENT 4

VENTILATION HOOD CALIBRATION AND MAINTENANCE LOG

TECHNICAL STANDARD OPERATING PROCEDURE
ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

NOTE: This SOP was designed for use on Libby Project Soils. For any other use the SOP needs to be re-evaluated based on specific project objectives

ATTACHMENT 5
VACUUM MAINTENANCE LOG

TECHNICAL STANDARD OPERATING PROCEDURE
ISSI-LIBBY-01, Revision 8: SOIL SAMPLE PREPARATION

NOTE: This SOP was designed for use on Libby Project Soils. For any other use the SOP needs to be re-evaluated based on specific project objectives

ATTACHMENT 6

OVEN TEMPERATURE CALIBRATION AND MAINTENANCE LOG

LIBBY SUPERFUND SITE STANDARD OPERATING PROCEDURE
APPROVED FOR USE IN LIBBY SUPERFUND SITE ONLY

Date: April 21, 2004

SOP No. SRC-LIBBY-01 (Rev. 2)

Title: QUALITATIVE ESTIMATION OF ASBESTOS IN COARSE SOIL BY VISUAL EXAMINATION USING STEREO MICROSCOPY AND POLARIZED LIGHT MICROSCOPY

Author Sally M. L. Gibson

Syracuse Research Corporation

SYNOPSIS: A standardized method is described for the examination of the coarse fraction (>1/4") of soil samples using stereomicroscopy and polarized light microscopy (PLM) to identify, segregate, and estimate the mass percent of asbestos in the sample matrix.

Received by QA Unit:

APPROVALS:

TEAM MEMBER	SIGNATURE/TITLE	DATE
EPA Region 8	<u>[Signature]</u>	<u>4/21/04</u>
Syracuse Research Corp.	<u>[Signature]</u>	<u>4/26/04</u>

Revision	Date	Reason for Revision
0	11/12/02	--
1	5/20/03	Provided clarification on dealing with very small particles.
2	4/21/04	Included statements on limitations of intended use

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide a standardized screening method for the visual examination of the coarse fraction of previously sieved soil samples for evidence of asbestos mineral content using stereomicroscopy with confirmation of asbestos content by polarized light microscopy (PLM). This SOP incorporates salient components of EPA Test Method 600/R-93/116 *Method for Determination of Asbestos in Bulk Building Materials* and National Institute of Occupational Safety and Health (NIOSH) Method 9002 *Asbestos (bulk) by PLM*, Issue 2.

This procedure will be used by employees of contractors/subcontractors supporting USEPA Region 8 projects and tasks for the Libby, Montana, site. Deviations from the procedure outlined in this document must be approved by the USEPA Region 8 Remedial Project Manager or Regional Chemist prior to initiation of sample analysis.

2.0 PREREQUISITE TRAINING

Visual examination will be performed according to this SOP by a laboratory accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) and by analysts proficient either by education or experience in asbestos mineral identification by stereomicroscopy and PLM. Analyst familiarity with the procedural applications prescribed in EPA Test Method 600/R-93/116 and NIOSH Method 9002 is required.

Training as described in the Sampling and Analysis Plan, Remedial Investigation, Contaminant Screening Study, Libby Asbestos Site, Operable Unit 4, (CSS SQAPP [CDM 2002]) will be provided to laboratory personnel or laboratories with less than one year of project-specific experience by "mentors" from either Reservoir Environmental Services, Inc. or EMSL.

3.0 RESPONSIBILITIES

The CDM Laboratory Coordinator (LC) is responsible for overseeing the activities of the CDM Soil Preparation Laboratory and subcontracted laboratories performing sample analysis for the Libby, Montana, project. The LC is also responsible for checking all work performed and verifying that the work satisfies the specific tasks outlined by this SOP and the CSS SQAPP. It

LIBBY SUPERFUND SITE STANDARD OPERATING PROCEDURE
APPROVED FOR USE IN LIBBY SUPERFUND SITE ONLY

is the responsibility of the LC to communicate with the project personnel and subcontracted laboratory regarding specific analysis objectives and anticipated situations that require any deviation from the CSS SQAPP SOPs. In addition, it is the responsibility of the LC to communicate the need for any deviations from this SOP with the CDM Project Manager, USEPA Region 8 personnel (Remedial Project Manager or Regional Chemist.)

Subcontracted laboratory analysts performing the visual examination are responsible for adhering to the applicable tasks outlined in this SOP and substantiating components of the reference procedures (EPA 1993; NIOSH 1994) with the modifications contained herein.

4.0 EQUIPMENT

- Analytical balance - accurate to 0.01 g, range of 0.01 g to 1000 g (for weighing total sample)
- Analytical balance - accurate to 1 mg (for weighing asbestos)
- Traceable standards - major asbestos types
- Microscope - binocular stereomicroscope, 5-60X approximate magnification
- Microscope - polarized light, binocular or monocular with a cross hair reticle (or functional equivalent) and magnification of at least 8X
 - 10X, 20X, and 40X objectives
 - 360 degree rotatable stage
 - substage condenser with iris diaphragm
 - polarizer and analyzer which can be placed at 90 degrees to one another and calibrated relative to the cross-line reticle in the ocular
 - port for wave plates and compensators
 - wave retardation plate (Red I Compensator) with ~550 nanometer retardation and known slow and fast vibration directions
- Light Sources - incandescent or fluorescent

LIBBY SUPERFUND SITE STANDARD OPERATING PROCEDURE
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- Tweezers, dissecting needles, scalpels, probes, razor knives, etc. - standard sample manipulation instruments/tools

- Microscope slides and cover slips

- Refractive index liquids

- Pre-tared glassine paper, glass plates, weigh boats, petri dishes, watchglasses, etc. - laboratory sample containers

- HEPA-filtered or Class 1 biohazard hood negative pressure

- Three-ring binder book- binders will contain Microscopic Examination Logbook Sheets (Attachment 1)

5.0 METHOD

Soils from the Libby, Montana site will be dried, sieved, and prepared according to the most recent revision of SOP ISSI-LIBBY-01, Soil Sample Preparation. The coarse fraction of the soil sample is defined as that portion of the sample which does not pass through a 1/4" sieve. The coarse fraction will be weighed, placed in a zip-top plastic bag, and labeled as described in Camp, Dresser, and McKee (CDM) SOP 1-3 (with project-specific modifications). The samples will be packaged and shipped by the soil preparation laboratory as described in CDM SOP 2-1 (with project-specific modifications) and transferred to the laboratory via chain-of-custody procedures described in CDM SOP 1-2 (with project-specific modifications).

The following sections describe the stereomicroscopic and PLM examination. Materials tentatively characterized as asbestos by stereomicroscopy will be isolated and subjected to confirmation by PLM. The mass % of Libby amphibole asbestos, other amphibole asbestos, and chrysotile asbestos in the coarse soil fraction will be calculated from the mass of each asbestos type positively identified by PLM and the original sample weight. Figure 1 provides an overview of the process.

5.1 Stereomicroscopic Examination

The laboratory will receive the coarse fraction soil samples from the CDM Soil Preparation Laboratory. The entire sample will be weighed and placed in an appropriate container. The weight of each coarse sample will be recorded, along with the sample identification, on the Microscope Examination Logbook Sheet. The sample will be subject to stereomicroscopic examination and particle segregation as depicted Figure 1. The stereomicroscopic examination to identify and segregate asbestos includes:

- using multiple fields of view over the entire sample
- probing the sample by turning pieces over and breaking clumps where possible
- manipulating the sample using appropriate instruments/tools
- observing homogeneity, texture, friability, color and extent of any observed asbestos in the sample(s)

NOTE: Although the coarse fraction is prepared by sieving with a 1/4" screen, particles smaller than 1/4" may be present in the fraction due to adherence between coarse and fine particles. This may even include some very fine asbestos fibers. Because of the technical difficulty, the analyst should not attempt to physically segregate and weigh particles smaller than about 2-3 mm (1/10 inch). A particle this size is expected to have a mass of about 10-20 mg, which is less than 0.1% of a sample whose total mass is 25 grams. If no particles larger than 2-3 mm are present, this should be noted in the data sheet for each category of asbestos using the following code system:

- ND = No asbestos observed
- Tr = Trace levels of asbestos observed but not quantified

The weight fraction for any asbestos type marked "ND" or "Tr" in a given sample is not calculated and is left blank.

As the sample is examined, the analyst will continue segregation of the sample until the entire coarse soil fraction has been characterized as either "non-asbestos" or "tentatively identified asbestos." The tentatively identified asbestos particles will be examined by PLM, as described below. The stereomicroscopist will initial and date the Microscopy Examination Logbook Sheet.

5.2 PLM

The coarse material tentatively identified as asbestos by stereomicroscopic examination will be subject to confirmation using PLM, as described in SOP SRC-LIBBY-03 (Revision 0) (“Analysis of Asbestos Fibers in Soil by Polarized Light Microscopy”). The PLM examination will be used to confirm that the particles tentatively classified as asbestos are actually asbestos, and will be assign each particles to one of three categories:

LA = Libby amphibole
OA = Other amphibole
C = Chrysotile

If OA is observed, the type of OA observed should be noted in the data sheet using the following code system:

- AMOS = Amosite
- ANTH = Anthophyllite
- CROC = Crocidolite
- UNK = Unknown

The total weight of each type of positively identified asbestos (LA, OA, C) will be determined and recorded on the Microscopic Examination Logbook Sheet, along with the analyst’s initials and the date of the examination.

6.0 QUALITY ASSURANCE

Laboratories performing the examination must be accredited by NVLAP. “Calibration” should be verifiable for each microscopist in terms of project-specific training and the successful analysis of materials of known asbestos content (NVLAP test samples, in-house standards) similar to those anticipated to be observed in Libby, Montana soils. Additionally, references such as photographs of the asbestos minerals illustrating distinguishing properties should be available benchside during characterization.

Quality control samples as described in ISSI-LIBBY-01 (i.e., preparation duplicates) will not submitted for the coarse materials samples. The entire coarse fraction will be subject to examination.

LIBBY SUPERFUND SITE STANDARD OPERATING PROCEDURE
APPROVED FOR USE IN LIBBY SUPERFUND SITE ONLY

7.0 REFERENCES

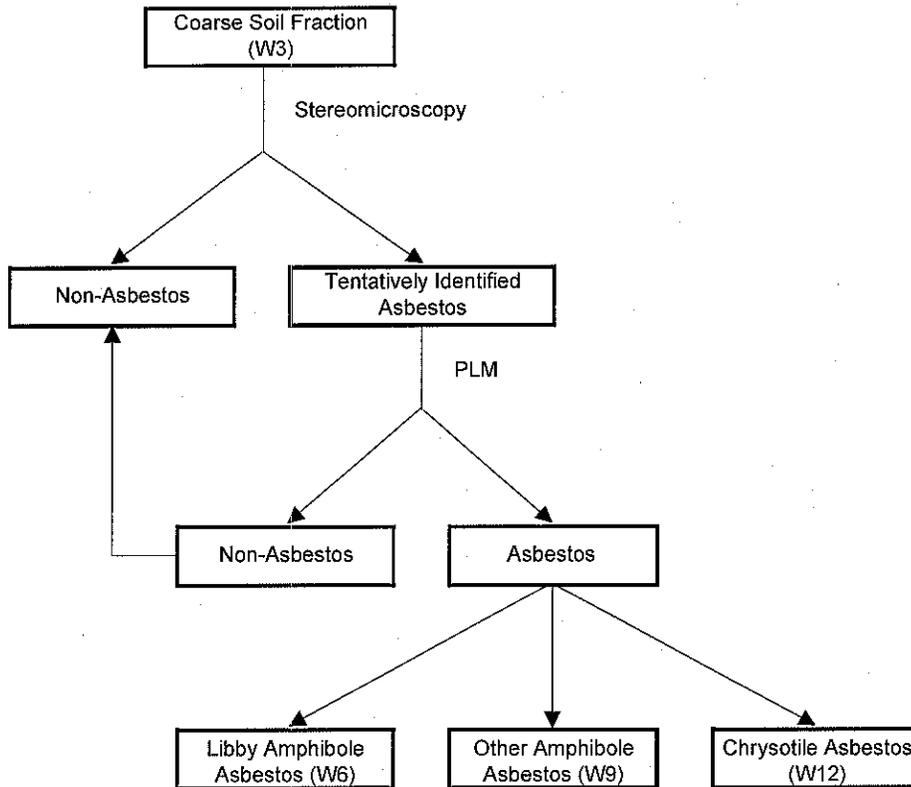
CDM 2002. *Sampling and Analysis Plan, Remedial Investigation, Contaminant Screening Study, Libby Asbestos Site, Operable Unit 4*. 3282-116-PP-SAMP-14187. Camp, Dresser and McKee Denver, Colorado. April.

NIOSH 1994. National Institute of Occupational Safety and Health (NIOSH) Method 9002 *Asbestos (bulk) by PLM*, Issue 2.

USEPA 1993. *Method for Determination of Asbestos in Bulk Building Materials*. 600/R-93/116.

LIBBY SUPERFUND SITE STANDARD OPERATING PROCEDURE
APPROVED FOR USE IN LIBBY SUPERFUND SITE ONLY

Figure 1. Overview of Sample Examination Process



W3 = Original coarse soil fraction mass (g)

W6 = If present in measurable quantities, mass (mg) of Libby amphibole

W9 = If present in measurable quantities, mass (mg) of other amphibole

W12 = If present in measurable quantities, mass (mg) of chrysotile

Codes used in the illustration (e.g., W3) correspond to Data Log Sheet

LIBBY SUPERFUND SITE STANDARD OPERATING PROCEDURE
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ATTACHMENT 1

MICROSCOPIC EXAMINATION LOGBOOK SHEET

SRC-LIBBY-01 Data sheet and EDD.xls

(Check with Volpe or SRC to determine the latest version number)

Example hard copy of data entry sheet shown on next page (for illustration purposes only).

LIBBY SUPERFUND SITE STANDARD OPERATING PROCEDURE
APPROVED FOR USE IN LIBBY PE STUDY ONLY

ANALYSIS OF SOIL-LIKE MEDIA FOR ASBESTOS BY POLARIZED LIGHT MICROSCOPY

Date: July 21, 2005

SOP No. SRC-LIBBY-03 (Revision 2)

Title: **ANALYSIS OF ASBESTOS FIBERS IN SOIL BY POLARIZED LIGHT
MICROSCOPY**

Author: William Brattin

SYNOPSIS: A semi-quantitative method for identifying and quantifying asbestos fibers in soil using polarized light microscopy (PLM) is provided. This method is based on NIOSH Method 9002, EPA Method 600/R-93/116, and CARB Method 435, with project-specific modifications intended specifically for use at the Libby Superfund Site.

APPROVALS:

TEAM MEMBER	SIGNATURE/TITLE	DATE
USEPA Region 8	_____	_____
Syracuse Research Corp.	_____	_____

Revision	Date	Principal Changes
0	03/03/03	--
1	12/11/03	Clarify binning assignment of samples at 0.2%
2	07/21/05	Provided more detail on refractive index for oils

LIBBY SUPERFUND SITE STANDARD OPERATING PROCEDURE
APPROVED FOR USE IN LIBBY PE STUDY ONLY

ANALYSIS OF SOIL-LIKE MEDIA FOR ASBESTOS BY POLARIZED LIGHT MICROSCOPY

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide a standard approach for semi-quantitative analysis of asbestos in samples of soil or other soil-like materials using polarized light microscopy (PLM). This SOP is specifically intended for application at the Libby Superfund site.

2.0 SCOPE AND APPLICATION

This method is intended mainly for analysis of asbestos in soil or other similar soil-like media. This method is appropriate for the analysis of all types of asbestos fibers, including both chrysotile and amphiboles, including those that are characteristic of the Libby site.

3.0 RESPONSIBILITIES

It is the responsibility of the laboratory supervisor to ensure that all analyses and quality assurance procedures are performed in accord with this SOP, and to identify and take appropriate corrective action to address any deviations that may occur during sample preparation or analysis.

The laboratory supervisor should also communicate with project managers at EPA or their oversight contractors any situations where a change from the SOP may be useful, and must receive approval from EPA for any deviation or modification from the SOP before proceeding with sample preparation and analysis.

4.0 METHOD DESCRIPTION

The soil sample to be evaluated for asbestos content by PLM is examined under stereomicroscopy and under PLM (3-5 slides per sample) to estimate the amount of asbestos present. Quantification of the amount of asbestos present may be done either using a visual estimation approach or by a point counting approach, as specified in the Chain of Custody request. In either case, the concentration of Libby amphibole asbestos in the sample is estimated in terms of mass fraction (i.e., percent asbestos by weight) based on the use of project-specific reference materials (calibration standards).

LIBBY SUPERFUND SITE STANDARD OPERATING PROCEDURE
APPROVED FOR USE IN LIBBY PE STUDY ONLY

ANALYSIS OF SOIL-LIKE MEDIA FOR ASBESTOS BY POLARIZED LIGHT MICROSCOPY

5.0 DETAILED METHOD

5.1 Basic Methods

All qualitative and quantitative analyses are to be performed in general accordance with the methods and techniques specified in NIOSH 9002, EPA 600/R-93/116, and CARB Method 435. Project-specific modification, clarifications, and requirements are provided below.

5.2 Visual Estimation Approach

5.2.1 Classification of Asbestos Mineral Type

Based on fiber attributes (morphology, refractive index, color, birefringence, etc.), asbestos in the sample is classified into one of three categories:

Code	Description	Notes
LA	Libby Amphibole	Refractive index values for LA span the standard values for tremolite/actinolite (EPA 1993), but may include values for other similar amphiboles (e.g., winchite, richterite) characteristic of the mine at Libby. Based on analysis of 4 different samples from the mine (Wylie and Verkouteren 2000; USGS, unpublished data; Verkouteren, personal communication), observed refractive indices of Libby amphiboles range from about 1.629-1.640 γ and 1.614-1.623 α , with a birefringence of about 0.017. The full range of refractive indices of samples from the mine may be somewhat greater. Based on these data, when confirming the identity of LA, the target refractive index (RI) for oil is about 1.620-1.630. See Attachment 2 for details on preparing oils of a specified RI.
OA	Other amphibole	Includes amphibole forms (e.g., amosite, crocidolite, anthophyllite) that are not thought to occur in significant amount at the mine in Libby
C	Chrysotile	

LIBBY SUPERFUND SITE STANDARD OPERATING PROCEDURE
APPROVED FOR USE IN LIBBY PE STUDY ONLY

ANALYSIS OF SOIL-LIKE MEDIA FOR ASBESTOS BY POLARIZED LIGHT MICROSCOPY

5.2.2 *Estimation of LA Mass Percent*

The visual area estimation is a semi-quantitative approach that requires the microscopist to estimate the area fraction of the total material present in a field of view that consists of asbestos material. Because this estimation may be difficult, especially at low concentration values, and because the desired output is an estimate of mass fraction (rather than area fraction), all visual estimates of Libby amphibole content will be performed using a set of site-specific reference materials (calibration standards) as a frame of reference. These reference material will contain either 0.2 % or 1.0% Libby amphibole by weight¹, and have been prepared for analysis using the same approach as for field samples. Using the two reference concentrations (0.2% and 1.0%) as a visual guide, the microscopist will evaluate the field sample and report the results as follows:

PLM Laboratory Report			Description
Qual	Conc (wt.%)	Bin	
ND		A	Asbestos was not observed in the field sample
Tr		B1	Asbestos was observed in the field sample at a level that appeared to be lower than the 0.2% reference material
<	1	B2	Asbestos was observed in the field sample at a level that appeared to be approximately equal to or greater than the 0.2% reference material but was less than the 1% reference material.
	1, 2, 3, etc	C	Asbestos was observed in the field sample at a level that appeared to equal or exceed the 1% standard. In this case, the mass percent is estimated quantitatively.

¹ The nominal mass fraction of the reference materials (calibration standards) is based on the gravimetric fraction of the material that is soil and the amount that is spiking material, adjusted for the fraction of the spiking material that is LA. For example, if the spiking material were estimated to contain 85% LA by mass, then the 1.0% calibration standard would contain 1.18 grams of spiking material (1.00 grams of LA) per 100 grams of calibration standard. Because the estimate of LA content of the spiking material is approximate, the true concentration of a calibration material may not be precisely equal to the nominal value.

LIBBY SUPERFUND SITE STANDARD OPERATING PROCEDURE
APPROVED FOR USE IN LIBBY PE STUDY ONLY

ANALYSIS OF SOIL-LIKE MEDIA FOR ASBESTOS BY POLARIZED LIGHT MICROSCOPY

"ND" (not detected) in the Qualifier column is used for all samples in which asbestos is not observed under stereomicroscopy and is also not detected in five (5) different PLM slides prepared using representative sub-samples of the test material. These samples are assigned to **Bin A**.

"Tr" (trace) in the Qualifier column is used for all samples in which asbestos is observed either under stereomicroscopy or in at least one out of 3-5 PLM slides prepared from representative sub-samples of the test material, and in which the amount of asbestos present appears to be less than the 0.2 % reference material. These samples are assigned to **Bin B1**.

"<" (less than) in the Qualifier column and 1 in the Concentration column is used for all samples in which asbestos is observed either under stereomicroscopy or in PLM slides prepared from representative sub-samples of the test material, and in which the amount of asbestos present appears to be equal to or greater than the 0.2 % reference material but less than the 1% reference material. These samples are assigned to **Bin B2**.

A numeric value (1, 2, 3, etc) in the Concentration column without an entry in the Qualifier column is used for all samples in which asbestos is observed either under stereomicroscopy or in PLM slides prepared from representative sub-samples of the test material, and in which the amount of asbestos present appears to be similar to or greater than the 1 % reference material. These samples are assigned to **Bin C**.

Note that because these reference materials are based on Libby amphibole, they are not appropriate for estimating the mass percent of other types of asbestos (chrysotile, other types of asbestos). Therefore, if any asbestos types besides Libby amphibole are observed, the reported values for those samples should be in units of area percent.

5.3 Point Counting Approach

5.3.1 Counting Procedure

Any analysis in which evaluation by point counting is requested will be performed in general accordance with the descriptions provided in EPA/600/R-93/116 and CARB Method 435. The

LIBBY SUPERFUND SITE STANDARD OPERATING PROCEDURE
APPROVED FOR USE IN LIBBY PE STUDY ONLY

ANALYSIS OF SOIL-LIKE MEDIA FOR ASBESTOS BY POLARIZED LIGHT MICROSCOPY

total number of particles to be counted (generally 400 or 1000) will be specified in the Chain of Custody request.

Take eight sub-samples of the soil sample and mount each separately with the appropriate refractive index liquid. The preparations should not be heavily loaded. Each sample should be uniformly dispersed to avoid overlapping particles and allow 25-50% empty area within the fields of view.

An ocular reticule (point array) or cross-hair is used to visually superimpose points on the microscope field of view. Count 1/8 of the total points required on each of the 8 slides (e.g., 50 non-empty points per slide for a 400 point count and 125 non-empty points per slide for a 1000 point count). For each non-empty point counted, assign the particle that is present at the point into one of four bins:

- Not asbestos
- Libby asbestos (LA)
- Other asbestos (OA)
- Chrysotile asbestos (C)

In order for a particle to be counted as asbestos, the aspect ratio must be $\geq 3:1$.

After the required total number of non-empty points have been counted, record the total number of points in the LA, OA and C bins on the point counting data sheet.

5.3.2 *Estimation of Mass Percent*

Like visual estimation, the output of the point counting approach is an estimate of area fraction, not mass fraction. For this site, point-count estimates of area fraction for Libby amphibole particles will be converted into estimates of mass fraction using a standard curve approach.

The standard curve will be prepared using a series of site-specific reference materials (calibration standards) containing 0%, 0.2%, 0.5%, 1%, or 2% Libby amphibole. The area fraction of each reference material will be estimated by the point counting approach in quadruplicate. The standard curve will be prepared by plotting the mean area fraction

LIBBY SUPERFUND SITE STANDARD OPERATING PROCEDURE
APPROVED FOR USE IN LIBBY PE STUDY ONLY

ANALYSIS OF SOIL-LIKE MEDIA FOR ASBESTOS BY POLARIZED LIGHT MICROSCOPY

determined by point counting versus the mass percent in the reference material. The mass fraction of a field sample will be determined by measuring the area fraction of the field sample and locating the mass fraction that corresponds to that area fraction on the standard curve.

Because the standard curve is based on Libby amphibole, it is not appropriate to utilize this standard curve for other types of asbestos. Therefore, if any asbestos types besides Libby amphibole are observed, the reported values for those samples should be in units of area percent.

6.0 APPARATUS AND MATERIALS

Polarized light microscope, with lens and filters
Stereomicroscope (approximately 10-45x)
Petri dish for stereomicroscopic sample examination
Spatula and forceps
Glass slides and cover slips
Refractive Index (RI) oils
Reference Materials (Calibration Standards)

- Soil containing 0.2% LA by mass
- Soil containing 0.5% LA by mass
- Soil containing 1.0% LA by mass
- Soil containing 2.0% LA by mass

Laboratory log book
Data recording sheet (Attachment 1)
Liquid calibration conversion table (Attachment 2)

7.0 QUALITY ASSURANCE/QUALITY CONTROL

7.1 Precision and Accuracy

PLM by visual estimation and point counting are both semi-quantitative methods. For the purposes of this project, the accuracy and precision of the method are evaluated by measuring the frequency with which samples are assigned to the correct "bins". Data on precision and accuracy of bin assignment will be collected in the future and used to establish performance criteria for this project.

LIBBY SUPERFUND SITE STANDARD OPERATING PROCEDURE
APPROVED FOR USE IN LIBBY PE STUDY ONLY

ANALYSIS OF SOIL-LIKE MEDIA FOR ASBESTOS BY POLARIZED LIGHT MICROSCOPY

7.2 Method Proficiency

At present, sufficient data are not available to establish a quantitative procedure for method proficiency demonstration. As results become available, a procedure will be established and applied, based on the analysis of a set of blind Performance Evaluation materials and assessing the frequency of correct bin assignments. If the assignments reported by a laboratory are within acceptance criteria bounds (see Section 7.1), then that laboratory will be deemed proficient. If not, remedial actions must be taken to address the errors before work may begin by that laboratory.

8.0 RECORDS

8.1 PLM Data Forms

Analysts will record analytical results using the electronic data sheets developed for the Libby project, as presented in Attachment 1. Note that there are two different electronic forms; one is for use in visual area estimation, and the other is for use in point counting. Once completed and checked, these spreadsheets are submitted to EPA for upload into the database. The laboratory should retain all original records for use in resolving any questions until otherwise instructed by EPA.

8.2 Instrument Maintenance Logbook

An individual instrument maintenance logbook should be kept for each piece of equipment in use at the laboratory. All maintenance activities must be recorded in the appropriate logbook.

8.3 Data Storage and Archival

Electronic Data. Each day of data acquisition, all electronic files will be saved onto two separate media. For example, the data may be saved onto a computer hard drive, but must also be backed up onto a type of portable media such as CD-ROM, floppy disc, or tape. Portable media will be maintained in a single location with limited access.

LIBBY SUPERFUND SITE STANDARD OPERATING PROCEDURE
APPROVED FOR USE IN LIBBY PE STUDY ONLY

ANALYSIS OF SOIL-LIKE MEDIA FOR ASBESTOS BY POLARIZED LIGHT MICROSCOPY

Hardcopy Data. All data sheets and micrographs must be stored in a secured location with limited access (e.g., locking file cabinet) when not in use.

Copies (hardcopy and electronic) of the raw analytical data will be submitted to USEPA for archival.

LIBBY SUPERFUND SITE STANDARD OPERATING PROCEDURE
APPROVED FOR USE IN LIBBY PE STUDY ONLY

ANALYSIS OF SOIL-LIKE MEDIA FOR ASBESTOS BY POLARIZED LIGHT MICROSCOPY

9.0 REFERENCES

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LIBBY SUPERFUND SITE STANDARD OPERATING PROCEDURE
APPROVED FOR USE IN LIBBY PE STUDY ONLY

ANALYSIS OF SOIL-LIKE MEDIA FOR ASBESTOS BY POLARIZED LIGHT MICROSCOPY

ATTACHMENT 1

PLM DATA RECORDING SHEETS

PLM (VE and PC) Data Sheet and ED.xls

(Check with Volpe or SRC to determine the latest version number)

LIBBY SUPERFUND SITE STANDARD OPERATING PROCEDURE
APPROVED FOR USE IN LIBBY PE STUDY ONLY

ANALYSIS OF SOIL-LIKE MEDIA FOR ASBESTOS BY POLARIZED LIGHT MICROSCOPY

ATTACHMENT 2

RI Liquid Calibration Conversion Tables
Prepared by Dr. Shu-Chun Su, Hercules, Inc.

See attached Excel spreadsheet entitled
"Create RI Liquid Calibration Conversion Tables.xls"