Remedial Action Contract
for Remedial Response, Enforcement Oversight, and Non-Time Critical Removal Activities at Sites of Release or Threatened Release of Hazardous Substances in EPA Region VIII

U.S. EPA Contract No. EP-W-05-049

Sampling and Analysis Plan/Quality Assurance Project Plan
Comparative Exposure – Eureka, Helena, Whitefish
Libby Asbestos Site, Operable Unit 4

Revision 1 – July 2012

Work Assignment No.:	**329-RICO-08BC Libby Asbestos Superfund Project, OU4 Remedial Investigation/Feasibility Study**
EPA Work Assignment Manager:	**Victor Ketellapper**
CDM Smith Project Manager:	**Nathan Smith**

Prepared for:
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Revision 1 – July 2012

Approved by: [signature] Date: 7/17/12
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Victor Ketellapper, P.E.
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Sampling and Analysis Plan/Quality Assurance Project Plan Comparative Exposure – Eureka, Helena, Whitefish Libby Asbestos Site, Operable Unit 4

REVISION LOG:

Revision No.	Date	Description
0	6/11/12	---
1	7/9/12	• Revised sampling locations for Helena • Changed tree bark sample to be a 5-point composite (i.e., cores from 5 trees composited into a single sample) • Corrected section numbering in Section B4 • Specify the CDM Smith field team leader • Modified procedure for data management requests; removed Appendix G • Added missing EPA (2008) references • Replaced field ROM form in Appendix F to be OU4-specific • Made editorial changes, corrected typographical errors

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List of Acronyms and Abbreviations

%	percent
ABS	activity-based sampling
Ago	grid opening area
cc	cubic centimeter
CDM Smith	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHISQ	chi-squared
CI	confidence interval
cm^{-2}	per square centimeter
COC	chain-of-custody record
DQO	data quality objective
ED	exposure duration
EDD	electronic data deliverable
EDS	energy dispersive spectroscopy
EDXA	energy dispersive x-ray analysis
EF	exposure frequency
EFA	effective filter area
EPA	U.S. Environmental Protection Agency
ERT	Environmental Response Team
ESAT	Environmental Services Assistance Team
ET	exposure time
f	indirect preparation dilution factor
f/cc	fibers per cubic centimeter
FBAS	fluidized bed asbestos segregator
FSDS	field sample data sheet
ft^2	square foot
FTL	field team leader
g	gram
g^{-1}	per gram
GO_x	number of grid openings
GPS	global positioning system
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
H&S	Health and Safety

HDPE	high density polyethylene
ID	identification
IUR	inhalation unit risk
IDW	investigation-derived waste
IRIS	Integrated Risk Information System
L	liters
L/cc	liters per cubic centimeter
L/min	liters per minute
LA	Libby amphibole
LADT	Libby Asbestos Data Tool
LC	laboratory coordinator
MDEQ	Montana Department of Environmental Quality
mm	millimeter
mm^2	square millimeters
N	number
'N/A'	not applicable
NIST	National Institute of Standards and Technology
NVLAP	National Voluntary Laboratory Accreditation Program
OSHA	Occupational Safety and Health Administration
PCM	phase contrast microscopy
PCME	phase contrast microscopy-equivalent
PE	performance evaluation
PLM	polarized light microscopy
QA	quality assurance
QAM	quality assurance manager
QAPP	quality assurance project plan
QA/QC	quality assurance/quality control
QATS	Quality Assurance Technical Support
QC	quality control
RBC	risk-based concentration
RPM	Regional Project Manager
ROM	Record of Modification
s/cm^2	structures per square centimeter
s/g	structures per gram

SAP	sampling and analysis plan
SAED	selective area electron diffraction
Shaw	Shaw Environmental, Inc.
Site	Libby Asbestos Superfund Site
SOP	standard operating procedure
SPF	sample preparation facility
SRM	standard reference materials
STEL	short-term exposure limit
TAS	target analytical sensitivity
TEM	transmission electron microscopy
TWA	time-weighted average
TWF	time-weighting factor
USGS	United States Geological Survey
V	air sample volume
VWC	volumetric water content
wt%	mass percent
µm	micrometers

A Project Management

A3. Distribution List

Copies of this completed and signed sampling and analysis plan/quality assurance project plan (SAP/QAPP) should be distributed to:

U.S. Environmental Protection Agency, Region VIII
1595 Wynkoop Street
Denver, Colorado 80202-1129

- Victor Ketellapper, Ketellapper.Victor@epa.gov (1 hard copy, electronic copy)
- Elizabeth Fagen, Fagen.Elizabeth@epa.gov (electronic copy)
- Don Goodrich, Goodrich.Donald@epa.gov (electronic copy)
- Jeff Mosal, Mosal.Jeffrey@epa.gov (electronic copy)
- Dania Zinner, Zinner.Dania@epa.gov (electronic copy)
- David Berry, Berry.David@epa.gov (electronic copy)

EPA Information Center – Libby
108 East 9th Street
Libby, Montana 59923

- Mike Cirian, Cirian.Mike@epa.gov (1 hard copy, electronic copy)

Montana Department of Environmental Quality
1100 North Last Chance Gulch
Helena, Montana 59601

- Carolyn Rutland, CRutland@mt.gov (electronic copy)
- John Podolinsky, JPodolinsky@mt.gov (electronic copy)

TechLaw, Inc.
ESAT, Region VIII
16194 West 45th Drive
Golden, Colorado 80403

- Doug Kent, Kent.Doug@epa.gov (electronic copy)

CDM Smith – Helena Office
50 West 14th Street, 2nd Floor
Helena, MT 59601

- Robert Alexander, alexanderRR@cdmsmith.com (5 hard copies, electronic copy)

CDM Smith – Libby Field Office
60 Port Boulevard, Suite 201
Libby, Montana 59923

- Dominic Pisciotta, pisciottaDM@cdmsmith.com (electronic copy)
- Kara McKenzie, mckenzieKE@cdmsmith.com (electronic copy)

CDM Smith – Denver Office
555 17th Street, Suite 1100
Denver, Colorado 80202

- Nathan Smith, smithNT@cdmsmith.com (electronic copy)

Copies of the SAP/QAPP will be distributed to the individuals above by CDM Federal Programs Corporation (CDM Smith), either in hard copy or in electronic format (as indicated above). The CDM Smith Project Manager (or their designate) will distribute updated copies each time a SAP/QAPP revision occurs. An electronic copy of the final, signed SAP/QAPP (and any subsequent revisions) will also be posted to the Libby Field eRoom.

A4. Project Task Organization

Figure A-1 presents an organizational chart that shows lines of authority and reporting responsibilities for this project. The following sections summarize the entities and individuals that will be responsible for providing project management, technical support, and quality assurance for this project.

A4.1 Project Management

The U.S. Environmental Protection Agency (EPA) is the lead regulatory agency for Superfund activities within the Libby Asbestos Superfund Site (Site). The EPA Region VIII Libby Asbestos Project Team Leader is Victor Ketellapper. The EPA Regional Project Manager (RPM) for this sampling effort is Elizabeth Fagen. The EPA Region VIII Onsite Field Team Leader for this sampling effort is Michael Cirian.

The Montana Department of Environmental Quality (MDEQ) is the support regulatory agency for Superfund activities at the Site. The MDEQ Project Manager for this sampling effort is Carolyn Rutland. The EPA will consult with MDEQ as provided for by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the National Contingency Plan, and applicable guidance in conducting Superfund activities.

A4.2 Technical Support

A4.2.1 SAP/QAPP Development

This SAP/QAPP was developed by CDM Smith at the direction of, and with oversight by, the EPA. This SAP/QAPP contains all the elements required for both a SAP and a QAPP and has been developed in general accordance with the *EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5* (EPA 2001) and the *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G4* (EPA 2006).

Copies of the SAP/QAPP will be distributed by the CDM Smith Project Manager (or their designate), either in hard copy or in electronic format, as indicated in Section A3. The CDM Smith Project Manager (or their designate) will distribute updated copies each time a SAP/QAPP revision occurs. An electronic copy of the final, signed SAP/QAPP (and any subsequent revisions) will also be posted to the Libby Field eRoom.

A4.2.2 Field Sampling Activities

CDM Smith will also be responsible for conducting all field sampling activities in support of the sampling program described in this SAP/QAPP. Key CDM Smith personnel that will be involved in this sampling program include:

- Nathan Smith, Project Manager
- Robert Alexander, Field Team Leader
- Tracy Dodge, Sample Coordinator
- Scott Miller, Field Data Manager
- Terry Crowell, Quality Assurance Manager
- Damon Repine, Health and Safety Manager

A4.2.3 Asbestos Analysis

All samples collected as part of this project will be sent for preparation and analysis for asbestos at laboratories selected and approved by the EPA to support the Site. The EPA Environmental Services Assistance Team (ESAT) is responsible for procuring all analytical and preparation laboratory services and providing direction to the analytical laboratories. Don Goodrich (EPA Region 8) is responsible for managing the ESAT laboratory support contract for asbestos. The ESAT Region 8 Team Manager at TechLaw, Inc. is Mark McDaniel. He is also the designated laboratory coordinator (LC) for the Libby project that is responsible for directing the analytical laboratories, prioritizing analysis needs, and managing laboratory capacity.

A4.2.4 Data Management

All data generated as part of this sampling effort will be managed and maintained in Scribe. The EPA Environmental Response Team (ERT) is responsible for the administration of all Scribe data management aspects of this project. Joseph Schafer is responsible for overseeing the ERT data management support contract. ERT is responsible for the development and management of Scribe and the project-specific data reporting requirements for the Libby project.

The CDM Smith field data manager (Scott Miller) is responsible for uploading sample information to the field Scribe project database. ESAT is responsible for uploading new analytical results to the analytical Scribe project database. The ESAT project data manager for the Libby project is Janelle Lohman (TechLaw, Inc.).

Because of the quantity and complexity of the data collected at the Site, the EPA has designated a Libby Data Manager to manage and oversee the various data support contractors. The EPA Region 8 Data Manager for the Libby project is Jeff Mosal.

A4.3 Quality Assurance

There is no individual designated as the EPA Quality Assurance Manager for the Libby project. Rather, the Region 8 QA program has delegated authority to the EPA RPMs. This means that the EPA RPMs have the ability to review and approve governing investigation documents developed by Site contractors. Thus, it is the responsibility of the EPA RPM for this sampling effort (Elizabeth Fagen), who is independent of the entities planning and obtaining the data, to ensure that this SAP/QAPP has been prepared in accordance with the EPA QA guidelines and requirements. The EPA RPM is also responsible for managing and overseeing all aspects of the quality assurance/quality control (QA/QC) program for this sampling effort. In this regard, the RPM is supported by the EPA Quality Assurance Technical Support (QATS) contractor, Shaw Environmental, Inc. (Shaw). The QATS contractor will evaluate and monitor laboratory QA/QC and is responsible for performing annual audits of each analytical laboratory.

Terry Crowell (CDM Smith) is the field Quality Assurance Manager for this project. Ms. Crowell is responsible for evaluating and monitoring field QA/QC, for providing oversight of field sampling and data collection activities, and for designating a qualified individual to conduct the field surveillance (see Section B5.1).

A5. Problem Definition/Background

A5.1 Site Background

Libby is a community in northwestern Montana located 7 miles southwest of a vermiculite mine that operated from the 1920s until 1990. The mine began limited operations in the 1920s and was operated on a larger scale by the W.R. Grace Company from approximately 1963 to 1990. Studies revealed that the vermiculite from the mine contains amphibole-type asbestos, referred to as Libby amphibole (LA).

Epidemiological studies revealed that workers at the mine had an increased risk of developing asbestos-related lung disease (McDonald *et al.* 1986, Amandus and Wheeler 1987, Amandus *et al.* 1987, Sullivan 2007). Additionally, radiographic abnormalities were observed in 17.8 percent of the general population of Libby including former workers, family members of workers, and individuals with no specific pathway of exposure (Peipins *et al.* 2003). Although the mine has ceased operations, historic or continuing releases of LA from mine-related materials could be serving as a source of on-going exposure and risk to current and future residents and workers in the area. The Site was listed on the National Priorities List in October 2002.

A5.2 Reasons for this Project

Previous investigations conducted at the Site have demonstrated that LA is present in environmental source media (e.g., soil, tree bark, duff material) at locations in and around the Site. As a result, individuals may be exposed to LA that is released to air during source disturbance activities. These inhalation exposures may pose a risk of cancer and/or non-cancer effects.

The EPA has also performed several investigations at the Site to evaluate potential exposures to LA released from source materials by measuring the concentration of LA in breathing zone air during various disturbance activities, referred to as "activity-based sampling" (ABS). As part of these ABS studies, LA has been measured in outdoor ABS air, soil, tree bark, and duff material. However, there are no data on LA concentrations in these media from cities/towns near the Site that are not impacted by the mine which can provide a frame of reference for the purposes of making comparisons to exposures in Libby.

A5.3 Applicable Criteria and Action Limits

At the Libby Site, the EPA has developed action levels and cleanup criteria for LA that are applicable to emergency response actions performed at residential/commercial properties (EPA 2003). However, these criteria are not applicable to locations outside of the Site. In addition, final action levels for the Site will not be developed until completion of the remedial investigation/feasibility study and the publication of the record of decision. Thus, there are no LA-specific criteria or action limits that apply to this sampling program.

Personal air monitoring of sampling personnel will be performed in accordance with Occupational Safety and Health Administration (OSHA) requirements. In accordance with these requirements, samples will be analyzed for asbestos by phase contrast microscopy (PCM) and compared to the OSHA limits for workplace exposures. The short-term (15-minute) exposure limit (STEL) is 1.0 fiber per cubic centimeter of air (f/cc), and the long-term time-weighted average (TWA) exposure limit is 0.1 f/cc.

A6. Project/Task Description

A6.1 Task Summary

Basic tasks that are required to implement this SAP/QAPP include collecting ABS air, duff, soil, and tree bark samples in Eureka, Helena, and Whitefish, Montana and analyzing these samples for asbestos. These basic tasks are described in greater detail in subsequent sections of this SAP/QAPP.

A6.2 Work Schedule

The work schedule for performing these tasks begins with collection of ABS air, duff, soil, and tree bark samples from each city in the study. It is anticipated that this task will be completed in August 2012. Sample analysis and data evaluation and interpretation tasks will be performed over the fall of 2012.

A6.3 Locations to be Evaluated

Location selection for the collection of ABS air, duff, soil, and tree bark samples is described in Section B1.1.

A6.4 Resources and Time Constraints

As noted above, the sampling is scheduled to occur in August 2012. The intent is to collect ABS air samples during the most arid time of the year. This will help ensure that the air samples are representative of the worst-case exposure conditions for fiber release from the soil or duff material.

The EPA has introduced both resource and time constraints with the scope of this sampling program. Due to the amount of funding, this sampling program will be limited to approximately nine samples per medium (ABS air is limited to nine samples per activity per actor). Additionally, the EPA has planned for this sampling to be conducted in/around three cities with a maximum of 5 days spent in each city.

A7. Quality Objectives and Criteria

A7.1 Data Quality Objectives

Data quality objectives (DQOs) are statements that define the type, quality, quantity, purpose, and use of data to be collected. The design of a study is closely tied to the DQOs, which serve as the basis for important decisions regarding key design features such as the number and location of samples to be collected and types of analyses to be performed. The EPA has developed a seven-step process for establishing DQOs to help ensure that data collected during a field sampling program will be adequate to support reliable site-specific decision-making (EPA 2001, 2006).

Appendix A provides the detailed implementation of the seven-step DQO process associated with this SAP/QAPP.

A7.2 Performance Criteria

Because the primary goal of this study is to provide data for the purposes of making comparisons to corresponding media collected at the Libby Site, the performance criteria and analytical requirements for this study are based on the requirements specified in other studies of ABS air, soil, duff, and tree bark. These requirements are specified as part of the DQOs (see **Appendix A**). The analytical requirements for LA measurements established in Section B4 ensure that results from this study will be directly comparable to results from historical (and planned future) sampling efforts.

A7.3 Precision

The precision of asbestos measurements is determined mainly by the number (N) of asbestos structures counted in each sample. The coefficient of variation resulting from random Poisson counting error is equal to $1/N^{0.5}$. In general, when good precision is needed, it is desirable to count a minimum of 3-10 structures per sample, with counts of 20-25 structures per sample being optimal.

A7.4 Bias and Representativeness

To the extent feasible, samples should be collected and analyzed in accordance with procedures that have been performed in previous (and planned future) sampling efforts of ABS air, soil, duff, and tree bark. This will ensure that the results of this study are representative and appropriate for comparison to other data sets.

A7.5 Completeness

Target completeness for this project is 100%. If any samples are not collected, or if LA analysis is not completed successfully, this could result in that portion of the study providing no useful information. In this event, additional sampling may be needed to support EPA decision-making.

A7.6 Comparability

The data generated during this study will be obtained using standard analytical methods for LA that have been utilized previously in other studies, and will yield data that are comparable to previous analyses of LA in ABS air, soil, tree bark, and duff material.

A7.7 Method Sensitivity

The method sensitivity (analytical sensitivity) needed for LA analysis of each medium is discussed in Section B4.

A8. Special Training/Certifications

A8.1 Field

Asbestos is a hazardous substance that can increase the risk of cancer and serious non-cancer effects in people who are exposed by inhalation. Therefore, all individuals involved in the collection, packaging, and shipment of samples must have appropriate training. Prior to starting any field work, any new field team member must complete the following, at a minimum:

Training Requirement	Location of Documentation Specifying Training Requirement Completion
Read and understand the governing Health and Safety Plan (HASP)	HASP signature sheet
Attend an orientation session with the field health and safety (H&S) manager	Orientation session attendance sheet
Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) and relevant 8-hour refreshers	OSHA training certificates
Current 40-hour HAZWOPER medical clearance	Physician letter in the field personnel files
Respiratory protection training, as required by 29 CFR 1910.134	Training certificate
Asbestos awareness training, as required by 29 CFR 1910.1001	Training certificate
Sample collection techniques	Orientation session attendance sheet

All training documentation will be stored in the CDM Smith field office. It is the responsibility of the field H&S manager to ensure that all training documentation is up-to-date and on-file for each field team member.

Prior to beginning field sampling activities, a field planning meeting will be conducted to discuss and clarify the following:

- Objectives and scope of the fieldwork
- Equipment and training needs
- Field operating procedures, schedules of events, and individual assignments
- Required quality control (QC) measures
- Health and safety requirements

It is the responsibility of each field team member to review and understand all applicable governing documents associated with this sampling program, including this SAP/QAPP, all associated standard operating procedures (SOPs) (see **Appendix B**), and the applicable HASP.

A8.2 Laboratory

A8.2.1 Certifications

All analytical laboratories participating in the analysis of samples for the Libby project are subject to national, local, and project-specific certifications and requirements. Each laboratory is accredited by the National Institute of Standards and Technology (NIST)/National Voluntary Laboratory Accreditation Program (NVLAP) for the analysis of airborne asbestos by transmission electron microscope (TEM) and/or analysis of bulk asbestos by polarized light microscopy (PLM). This includes the analysis of NIST/NVLAP standard reference materials (SRMs), or other verified quantitative standards, and successful participation in two proficiency rounds per year each of bulk asbestos by PLM and airborne asbestos by TEM supplied by NIST/NVLAP.

Copies of recent proficiency examinations from NVLAP or an equivalent program are maintained by each participating analytical laboratory. Many of the laboratories also maintain certifications from other state and local agencies. Copies of all proficiency examinations and certifications are also maintained by the LC.

Each laboratory working on the Libby project is also required to pass an on-site EPA laboratory audit. The details of this EPA audit are discussed in Section B5.3.3. The LC also reserves the right to conduct any additional investigations deemed necessary to determine the ability of each laboratory to perform the work. Each laboratory also maintains appropriate certifications from the state and possibly other certifying bodies for methods and parameters that may also be of interest to the Libby project. These certifications require that each laboratory has all applicable state licenses and employs only qualified personnel. Laboratory personnel working on the Libby project are reviewed for requisite experience and technical competence to perform asbestos analyses. Copies of personnel resumes are maintained for each participating laboratory by the LC in the Libby project file.

A8.2.2 Laboratory Team Training/Mentoring Program

<u>Initial Mentoring</u>

The orientation program to help new laboratories gain the skills needed to perform reliable analyses at the Site involves successful completion of a training/mentoring program that was developed for new laboratories prior to their analysis of Libby field samples. All new laboratories are required to participate in this program. The training program includes a rigorous 2-3 day period of on-site training provided by senior personnel from those laboratories already under contract on the Libby project, with oversight by the QATS contractor. The tutorial process includes a review of morphological, optical, chemical, and electron diffraction characteristics of LA, as well as training on project-specific analytical methodology, documentation, and administrative procedures used on the Libby site. The mentor will also review the analysis of at least one sample by each type of analytical method with the trainee laboratory.

Site-Specific Reference Materials

Because LA is not a common form of asbestos, U.S. Geological Survey (USGS) prepared Site-specific reference materials using LA collected at the Libby mine site (EPA 2008a). Upon entry into the Libby program, each laboratory is provided samples of these LA reference materials. Each laboratory is required to analyze multiple LA structures present in these samples by TEM in order to become familiar with the physical and chemical appearance of LA and to establish a reference library of LA Energy Dispersive Spectroscopy (EDS) spectra. These laboratory-specific and instrument-specific LA reference spectra (EPA 2008b) serve to guide the classification of asbestos structures observed in Libby field samples during TEM analysis.

Regular Technical Discussions

On-going training and communication is an essential component of QA for the Libby project. To ensure that all laboratories are aware of any technical or procedural issues that may arise, a regular teleconference is held between the EPA, their contractors, and each of the participating laboratories. Other experts (e.g., USGS) are invited to participate when needed. These calls cover all aspects of the analytical process, including sample flow, information processing, technical issues, analytical method procedures and development, documentation issues, project-specific laboratory modifications, and pertinent asbestos publications.

Professional/Technical Meetings

Another important aspect of laboratory team training has been the participation in technical conferences. The first of these technical conferences was hosted by USGS in Denver, Colorado, in February 2001, and was followed by another held in December 2002. The Libby laboratory team has also convened on multiple occasions at the ASTM Johnston Conference in Burlington, Vermont, including in July 2002, July 2005, July 2008, and July 2011, and at the Michael E. Beard Asbestos Conference in San Antonio, Texas in January 2010. In addition, members of the Libby laboratory team attended an EPA workshop to develop a method to determine whether LA is present in a sample of vermiculite attic insulation held in February 2004 in Alexandria, Virginia. These conferences enable the Libby laboratory and technical team members to have an on-going exchange of information regarding all analytical and technical aspects of the project, including the benefits of learning about developments by others.

A8.2.3 Analyst Training

All TEM analysts for the Libby project undergo extensive training to understand TEM theory and the application of standard laboratory procedures and methodologies. The training is typically performed by a combination of personnel, including the laboratory manager, the laboratory quality assurance manager (QAM), and senior TEM analysts.

In addition to the standard TEM training requirements, trainees involved with the Libby project must familiarize themselves with Site-specific method deviations, project-specific documents, and visual references. Standard samples that are often used during TEM training include known pure (traceable) samples of chrysotile, amosite, crocidolite, tremolite, actinolite and anthophyllite, as well as fibrous non-asbestos minerals such as vermiculite, gypsum, antigorite, kaolinite, and sepiolite. New TEM analysts on the Libby project are also required to perform an *EDS Spectra Characterization Study* (EPA 2008b) on the LA-specific reference materials provided during the initial training program to aide in LA mineralogy recognition and definition. Satisfactory completion of each of these tasks must be approved by a senior TEM analyst.
All TEM analysts are also trained in the Site-specific laboratory QA/QC program requirements for TEM (see Section B5.3.4). The entire program is discussed to ensure understanding of requirements and responsibilities. In addition, analysts are trained in the project-specific reporting requirements and data reporting tools utilized in transmitting results. Upon completion of training, the TEM analyst is enrolled as an active participant in the Libby laboratory program.

A training checklist or logbook is used to assure that the analyst has satisfactorily completed each specific training requirement. It is the responsibility of the laboratory QAM to ensure that all TEM analysts have completed the required training requirements.

A9. Documentation and Records

A9.1 Field

Field teams will record sample information on the most current version of the Site-specific field sample data sheets (FSDSs) developed for each medium[1]. Section B3.1.2 provides detailed information on the documentation requirements for FSDS forms. In brief, the FSDS forms document the unique sample identifier assigned to every sample collected as part of this program. In addition, the FSDSs provide information on whether the sample is representative of a field sample or a field-based QC sample (e.g., field blank, field duplicate).

A9.2 Laboratory

All preparation and analytical data for asbestos generated in the laboratory will be documented on Site-specific laboratory bench sheets and entered into a database or spreadsheet electronic data deliverable (EDD) for submittal to the data managers. Section B4.2 provides detailed information on the requirements for laboratory documentation and records.

[1] The most recent version of the FSDS forms are provided in the Libby Field eRoom.

A9.3 Logbooks and Records of Modification/Deviations

It is the also responsibility of the field team, preparation laboratory, and analytical laboratory staff to maintain logbooks and other internal records throughout the sample lifespan as a record of sample handling procedures. Significant deviations (i.e., those that impact or have the potential to impact investigation objectives) from this SAP/QAPP, or any procedures referenced herein governing sample handling, will be discussed with the EPA Project Manager (or their designate) and the CDM Smith Project Manager prior to implementation. Such deviations will be recorded on a Record of Modification (ROM) form. Sections B5.1.2, B5.2.2, and B5.3.2 provide detailed information on the procedures for preparing and submitting ROMs by field, preparation laboratory, and analytical laboratory personnel, respectively.

B Data Generation and Acquisition

B1. Study Design

B1.1 Locations

B1.1.1 Cities/Towns

This study seeks to collect data on LA concentrations in a variety of media from cities/towns near the Site that are not affected by the mine which can provide a frame of reference for Libby. In the past, two cities that have been selected for the purposes of providing reference data associated with ambient air monitoring are Eureka, Montana and Helena, Montana. Thus, these two cities will be included in this investigation. In addition, the town of Whitefish, Montana has been selected for this investigation because it is one of the two nearest towns (Eureka, Montana being the second) in the predominant downwind direction (northeast) of the vermiculite mine (EPA 2008c).

B1.1.2 Sampling Locations

To avoid sampling access issues, sample collection areas near each city/town were selected in locations that are state or federally owned. To minimize potential impacts from anthropogenic sources, locations that were outside of the city limits were preferred. A total of three locations were selected for each city/town. In general, sampling locations were placed such that they were representative of various compass directions around each city/town. Sampling locations were placed in areas that were accessible via forest service roads and that appeared to have adequate tree cover (based on a cursory review of aerial images). **Figure B-1** identifies the selected sampling locations for Eureka, Helena, and Whitefish, respectively. **Appendix C** provides detailed topographic maps of each sampling location, including information on access roads that may be used to access each location.

Should these pre-determined sampling locations become inaccessible at any point during or prior to the sampling event, new locations that meet the same criteria will be identified and presented to the EPA for approval. These changes would be documented on a ROM form as described in Section B5.1.

B1.1.3 ABS Areas

At each location, two different types of ABS scenarios will be evaluated – a digging scenario (simulating a child digging) and a fireline scenario (simulating a fire fighter digging a fireline by hand). **Appendix D** provides a detailed description of the ABS script for each scenario.
A 10-foot by 10-foot square area will be identified at each location and the corners will be marked during sampling to ensure that duff, soil, and ABS digging air samples are collected

entirely within the boundary. Global positioning system (GPS) coordinates will be collected from the approximate center of these locations.

The ABS fireline scenario will be performed in the general vicinity of the 100-square foot (ft^2) area selected for digging ABS, but should not come within 20 feet of the flagged corners. GPS coordinates will be collected from the approximate center of the constructed firebreak after the ABS activity has ended.

For ease of implementation, tree bark will be collected in the same general location as the 100 ft^2 area identified for duff, soil, and ABS air sample collection.

B1.2 Sampling Design

The following provides an overview of the sampling effort that will be conducted. Detailed information on sampling procedures and methods are presented in Section B2.

Sampling will begin with the collection of one tree bark composite sample from the area immediately surrounding each 100 ft^2 digging ABS location. A total of nine tree bark composite samples will be collected (three tree bark composite samples per city for each of three cities).

Following bark collection, one duff composite sample will be collected from each 100-ft^2 digging ABS area. A total of nine duff composite samples will be collected (three duff composite samples per city for each of three cities).

Following duff collection, surficial soil will be collected in a 5-gallon bucket from each 100-ft^2 digging ABS location that will serve as the soil sample and source material for digging ABS air sample collection. A total of nine soil samples will be collected (three soil samples per city for each of three cities).

Following soil collection, the digging ABS air sampling event will be conducted within each 100-ft^2 digging ABS location using the soil from the 5-gallon bucket. Each event will include the collection of two digging ABS air samples – one with a high volume pump and one with a low volume pump. A total of 18 digging ABS air samples will be collected (six ABS air samples per city for each of three cities). However, only one of the two air filters for each ABS sample, either the high volume or the low volume, will be analyzed by TEM (see Section B4).

Following the digging ABS scenario, the fireline ABS air sampling event will be conducted in the general vicinity of the digging ABS location. During the event, two individuals will participate in the ABS scenario. Thus, each event will include the collection of four fireline ABS air samples – two with high volume pumps and two with low volume pumps. A total of 36 fireline ABS air samples will be collected (12 ABS air samples per city for each of three cities). However, only one of the two air filters for each ABS sample, either the high volume or the low volume, will be analyzed by TEM (see Section B4).

All samples will be collected in and around each ABS location prior to mobilizing to other ABS locations in the same city. All sample collection in one city will be completed prior to mobilizing to the next city.

The requirements for field QC sample collection are discussed in Section B5.1.

Table B-1: Number of Samples per Medium

Medium	Number of samples collected per ABS area	Number of samples collected per city	Total number of samples collected	Number of samples analyzed*
Bark	1	3	9	9
Duff	1	3	9	9
Soil	1	3	9	9
Digging ABS Air	2 (1 HV, 1 LV)	6	18	9
Fireline ABS Air	4 (2 HV, 2 LV)	12	36	18

* Either the HV or LV will be selected for analysis, depending upon filter loading.
HV = high volume filter
LV= low volume filter

B1.3 Study Variables

The level of asbestos in outdoor ABS air under source disturbance activities can depend on factors that vary seasonally (e.g., soil moisture, wind speed, humidity, etc.). ABS should be performed under conditions that have a high probability of resulting in measureable ABS air concentrations of LA, if it is present.

It is preferable to conduct ABS sampling when the conditions for release of LA fibers are generally favorable, so outdoor ABS will be restricted to summer months (July-September) when rainfall and soil moisture levels are at their lowest. The exact dates have not yet been set, however it is anticipated that this sampling program will occur in August 2012. ABS sampling will not occur if rainfall in the past 36 hours has exceeded ¼ inch, if there is standing water present, or if the moisture deficiency is less than 50 percent (%).

It is not anticipated that any attempt will be made to directly correlate soil or duff LA concentrations with the resulting ABS air sample LA concentrations. As such, the location and timing of soil and duff collection is not dictated by ABS. However, for ease of implementation, soil and duff samples will be collected from the same 100-ft^2 area that will be used for the soil disturbance ABS.

Similarly, for ease of implementation, tree bark samples will be collected from the same general area where soil, duff, and ABS air samples are collected.

B1.4 Critical Measurements

The critical measurement associated with this project is the measurement of the concentration of LA in ABS air, tree bark, duff, and soil from locations in Eureka, Helena, and Whitefish. The analysis of LA may be achieved using several different types of microscope, but the EPA generally recommends using TEM because this technique has the ability to clearly distinguish asbestos from non-asbestos structures, and to classify different types of asbestos (i.e., LA, chrysotile).

B1.5 Data Reduction and Interpretation

Data collected as part of this study are intended to be used to support comparative evaluations that will provide a frame of reference for levels of LA measured in environmental media at the Libby Site. These comparisons may be made using a variety of methods, ranging from simple visual comparisons using graphical plots to statistical comparisons using the Poisson ratio test (Nelson 1982).

B2. Sampling Methods

B2.1 Sample Collection

The following subsections provide investigation-specific requirements for sample collection. A list of general field equipment that will be used to perform this sampling is provided in each of the field sampling SOPs. A medium- and investigation-specific equipment list is provided in Section B8.1 of this SAP/QAPP.

As part of this investigation, personal air samples will also be collected on the first three events for each scenario for ongoing health and safety monitoring. The health and safety samples will be collected using an additional low volume sampling pump and are not intended for use as ABS air samples. To differentiate these samples from the other personal air samples collected as part of this sampling effort, 'PA-EXC' or 'PA-TWA' will be selected in the Sample Air Type field of the FSDS. These samples will be collected and analyzed in accordance with the *Response Action SAP* (CDM Smith 2011) and will represent both the TWA and STEL sampling periods.

B2.1.1 ABS Air

ABS air samples will be collected, handled, and documented in general accordance with Site-specific standard operating procedure (SOP) EPA-LIBBY-2012-10, *Sampling of Asbestos Fibers in Air* (see **Appendix B**). In addition, the following investigation-specific requirements apply for ABS air samples collected under this SAP/QAPP.

During every event, each actor will wear two different sampling pumps – a high volume pump and a low volume pump – to allow for the collection of two "replicate" filters (i.e., each filter represents the same sample collection duration, but different total sample air volumes). The high volume pump will be an F&J L-15P, or equivalent, and the low volume pump will be an SKC 224-PCXR4, or equivalent. The appropriate flow rate for each sampling pump will be optimized to achieve the highest sample air volume possible without causing the filter to become overloaded. Initially, the high volume pump flow rate will be 5.5 liters per minute (L/min) and the low volume pump flow rate will be 2.0 L/min. Only one of the two resulting air samples from each actor will be selected for analysis (see Section B4).

During the ABS event, pump flow rates will be verified at 30-minute intervals or when participants are relieved from an activity by a backup participant, whichever occurs sooner. See Section B6/B7.1 for details regarding pump calibration.

B2.1.2 Tree Bark

Tree bark samples will be collected, handled, and documented in general accordance with Site-specific SOP EPA-LIBBY-2012-12, *Sampling and Analysis of Tree Bark for Asbestos* (see **Appendix B**), with the following project modifications:

- Bark samples need not be collected from a particular side of the tree. Rather, preference for sample collection will be given to areas of the tree with rough bark approximately 4-5 feet above the ground.
- Trees selected for sampling will be Douglas fir with a diameter of at least 8 inches. If these trees are not available near the selected sample location, the sampling team will preferentially select trees in the area with a large diameter and rough bark.
- Three different trees should be selected for sampling for each ABS area. A bark sample should be collected from each tree and place together in a zip-top bag.
- It is not anticipated that the same trees will need to be located for future sampling activities, so flagging tape/ID tags will not be left on the trees. GPS coordinates will be collected for each bark sample location.
- Bark sample information will be recorded on the soil FSDS (the soil FSDS is designed to accommodate multiple media).
- The collection of tree age cores is not necessary for this project.

In brief, for each ABS area, a hole saw and chisel will be used to collect a circular bark sample from each of 3 trees, which will be composited into a single sample for analysis of LA by TEM.

B2.1.3 Duff

Samples of duff material will be collected, handled, and documented in general accordance with Site-specific SOP EPA-LIBBY-2012-11, *Sampling and Analysis of Duff for Asbestos* (see **Appendix B**), with the following project modifications:

- A 30-point composite sample of duff will be collected from the 10-foot by 10-foot digging ABS area. Enough material will be collected from each sub-location such that the 30-point composite fills a 1-gallon zip-top bag.
- Sample information will be recorded on a soil FSDS (the soil FSDS is designed to accommodate multiple media).

In brief, at each specified sampling point, any fresh or partially decayed organic debris (e.g., twigs, leaves, pine needles) will be collected by hand from the soil surface, taking care to ensure that the top layer of soil beneath the organic debris is not included in the duff material sample.

B2.1.4 Soil

Soil samples will be collected, handled, and documented in general accordance with Site-specific SOP CDM-LIBBY-05, *Site-Specific SOP for Soil Sample Collection* (see **Appendix B**), with the following project modifications:

- Soil samples will be 30-point composite samples.
- Pin flags will not be used to identify composite points within each sampling area.
- Plastic bristle brushes and aluminum foil will not be required for decontamination and storage. Instead, sampling equipment will be rinsed with locally available deionized water before and after each sample is collected.
- Visual Vermiculite Estimation Forms will not be used. The contents of this form have been incorporated into the soil FSDS.
- Prior to collecting soil material, the top 0-1 inches of soil and any vegetation should be carefully removed and set aside.
- Soil will be deposited into a clean 5-gallon bucket as it is collected. Soil should be collected from a depth of 1-6 inches below ground surface at each of the 30 aliquot sub-locations. Enough soil will be collected from each sub-location such that the 30-point composite fills the 5-gallon bucket. Semi-quantitative estimation of vermiculite will performed at each aliquot sub-location as described below.
- Once soil has been collected from the 30 sub-locations, it must be homogenized prior to soil sample collection. This homogenization will occur immediately prior to the digging ABS air sampling when the bucket of soil has been poured onto the ground to allow for thorough mixing. An approximate 1,000 gram (g) soil sample will be collected in a zip-top bag from the pile of homogenized soil for asbestos analysis (see Section B4.1.4).
- During soil sample collection and prior to the start of ABS air sampling, the soil moisture should be determined as described later in this section.

<u>Visible Vermiculite Estimation</u>

As mentioned above, visual estimation of the amount of visible vermiculite in each of the 30 aliquots sub-locations will be performed in general accordance with Site-specific SOP CDM-

LIBBY-06, *Semi-Quantitative Visual Estimation of Vermiculite in Soils at Residential and Commercial Properties* (see **Appendix B**) with the following project modifications:

- 30-point composite soil samples will be collected regardless of the presence of visible vermiculite.
- Location type will be not applicable ('N/A') and Location Description will be 'Undeveloped Area'.
- Remove and visually inspect soil from 1-6 inches below ground surface.
- The approximate location and level of any visible vermiculite will be documented on a field sketch that also details the location of each scenario area. An aerial may be used as the baseline for the field sketch.
- Visual Vermiculite Estimation Forms will not be used. The contents of this form have been incorporated into the soil FSDS.

<u>Soil Moisture Measurement</u>

For the ABS digging scenario, soil moisture will be measured in the 5-gallon bucket of soil immediately prior to its use in the ABS scenario using a soil moisture meter. ABS activities will not be performed if the measured volumetric water content (VWC) is greater than 50%. In addition, soil moisture should also be estimated by the hand squeeze appearance method, which provides results in percent of field capacity. This is performed by firmly squeezing a handful of soil and comparing the results to the table below. ABS activities will not be performed if the soil moisture deficiency is less than 50%. The measured VWC and estimated moisture content should be recorded on the Property Background and Sampling Form.

Table B-2: Interpretation of Field Test for Moisture Content

% Soil Moisture Deficiency	Moderately coarse texture	Medium texture	Fine and very fine texture
0 (field capacity)	Upon squeezing, no free water appears on soil, but wet outline of ball is left on hand.		
0 to 25	Forms weak ball, breaks easily when bounced in hand.*	Forms ball, very pliable, slicks readily.*	Easily ribbons out between thumb and forefinger.*
25 to 50	Will form ball, but falls apart when bounced in hand.*	Forms ball, slicks under pressure.*	Forms ball, will ribbon out between thumb and forefinger.*
50 to 75	Appears dry, will not form ball with pressure.*	Crumbly, holds together from pressure.*	Somewhat pliable, will ball under pressure.*
75 to 100	Dry, loose, flows through fingers.	Powdery, crumbles easily.	Hard, difficult to break into powder.

* Squeeze a handful of soil firmly to make ball test.
% = percent

For the ABS fireline scenario, soil moisture will be measured from a minimum of 10 locations along the fireline between 0 and 3 inches below ground surface using the soil moisture meter. ABS activities will not be performed if the average VWC is greater than 50%, or if the VWC for any of the measurement points is greater than 75%. The 10 soil moisture readings for each area will be recorded in the field logbook and the average VWC will be recorded on the ABS Property Background and Sampling Form. In addition, soil moisture should also be estimated by the hand appearance method described above and recorded on the Property Background and Sampling Form.

B2.2 Global Positioning System Coordinate Collection

GPS location coordinates will be recorded in basic accordance with Site-specific SOP CDM-LIBBY-09, *GPS Coordinate Collection and Handling* (see **Appendix B**). For this investigation, GPS coordinates will be collected as follows:

- Digging ABS air – no GPS coordinates to be collected
- Fireline ABS air – collect GPS coordinates from the mid-point of each firebreak line
- Duff/Soil – collect GPS coordinates from the center of each 100-ft^2 ABS area
- Tree Bark – collect GPS coordinates from a location immediately adjacent to the selected tree

GPS coordinates will be collected as Sample Points, requiring the input of sample identification (ID) (also referred to as index ID) and location ID. Since multiple samples may be attributed to one area, for this sampling program the index ID will be input as 'N/A'.

Field-collected GPS data are converted to a usable geographic information system (GIS) format using the general processes described in SOP CDM-LIBBY-09. After the conversion from GPS points to GIS files, 100% of the data is checked visually to identify any potential data entry errors.

B2.3 Equipment Decontamination

Equipment used to collect, handle, or measure environmental samples will be decontaminated in basic accordance with Site-specific SOP EPA-LIBBY-2012-04, *Field Equipment Decontamination at Nonradioactive Sites* (see **Appendix B**). Materials used in the decontamination process will be disposed of as investigation-derived waste (IDW) as described below. This SOP specifies the minimum procedural requirements for equipment decontamination. Additional equipment decontamination procedures are also specified in the medium-specific collection SOPs.

B2.4 Handling Investigation-derived Waste

Any disposable equipment or other IDW will be handled in general conformance with Site-specific SOP EPA-LIBBY-2012-05, *Guide to Handling of Investigation-Derived Waste* (see **Appendix**

B). In brief, IDW will be double bagged in clear 6-mil poly bags with 'IDW' written, in letters at least 3-inches high, in indelible ink on at least two sides of the outer bag. All IDW generated during this sampling program will remain in the custody of the sampling team until the team returns to Libby where the IDW will enter the waste stream at the local class IV asbestos landfill.

B3. Sample Handling and Custody

B3.1 Sample Identification and Documentation

B3.1.1 Sample Labels

Samples will be labeled with sample ID numbers supplied by field administrative staff and will be signed out by the sampling teams. For air samples, the labels will be affixed to the sample cassette and the inside of the sample bag. For soil, tree bark, and duff samples, the labels will be affixed to the inside of both the inner and outer sample bags and the sample ID number will be written in indelible ink on the outside of each bag.

Sample ID numbers will identify the samples collected during this sampling effort using the following format:

CX-#####

where:

CX = Prefix that designates samples collected under this SAP/QAPP
= A sequential five-digit number

B3.1.2 Field Sample Data Sheets

As noted previously in Section A9, field teams will record sample information on the most current version of the Site-specific FSDS. Use of standardized forms ensures consistent documentation across samplers. Hard copy FSDSs are location-specific and allow for the entry of up to three individual samples from the same location on the same FSDS form. If columns are left incomplete due to fewer than three samples being recorded on a sheet, the blank columns will be crossed out, dated, and signed by the field team member completing the FSDS. Erroneous information recorded on a hard copy FSDS will be corrected with a single line strikeout, initial, and date. The correct information will be entered in close proximity to the erroneous entry.

FSDS information will be completed in the field before field personnel leave the sampling location. To ensure that all applicable data is accurately entered and all fields are complete, a different field team member will check each FSDS. The team member completing the hard copy form and the team member checking the form will initial the FSDS in the proper fields. In addition, the field team leader (FTL) will also complete periodic checks of FSDSs prior to relinquishment of the samples to the field sample coordinator. Once FSDSs and samples are relinquished to the field sample coordination staff, the FSDSs are again checked for accuracy and completeness when data are input into the local Scribe field database.

If a revision is required to the hard copy FSDS during any of these checks, it will be returned to the field team member initially responsible for its completion. The error will be explained to the team member and the FSDS corrected. If the team member is no longer on site, revisions will be made by sample coordination staff or the FTL. It is the responsibility of the field data manager to make the appropriate change in the local Scribe field database.

Each hard copy FSDS is assigned a unique sequential number. This number will be referenced in the field logbook entries related to samples recorded on individual sheets. Field administrative staff will manage the hard copy FSDSs in their respective field office. Original FSDSs will be filed by medium and FSDS number. Hard copies of all FSDS forms will also be sent to the CDM Smith office in Denver, Colorado for archive.

B3.1.3 Field Logbooks

The field logbook is an accounting of activities at the Site and will duly note problems or deviations from the governing documents. Field logbooks will be maintained in general conformance with Site-specific SOP EPA-LIBBY-2012-01, *Field Logbook Content and Control* (see **Appendix B**). In addition to general logbook content requirements outlines in the SOP, the following items will be recorded for each logbook entry:

- Soil moisture deficiency
- Pump calibration and flow rate verification

Separate field logbooks will be kept for each investigation and the cover of each field logbook will clearly indicate the name of the investigation and its sequence number. Field logbooks will be completed for each investigation activity prior to leaving a sampling location. Field logbooks will be checked for completeness and adherence to SOP requirements on a daily basis by the FTL or their designate for the first week of each investigation. When incorrect field logbook completion procedures are discovered during these checks, the errors will be discussed with the author of the entry and corrected. Erroneous information recorded in a field logbook will be corrected with a single line strikeout, initial, and date. The correct information will be entered in close proximity to the erroneous entry.

The field administrative staff will manage the field logbooks by assigning unique identification numbers to each field logbook, tracking to whom and the date each field logbook was assigned, the general investigation activities recorded in each field logbook (e.g., ambient air monitoring), and the date when the field logbook was returned. As field logbooks are completed, originals will be catalogued and maintained by the field administrative staff in their respective field office. Scanned copies of field logbooks will be maintained on the local servers for the CDM Smith offices in Libby and Denver.

B3.1.4 Photographs and Video

Photographic documentation will be collected with a digital camera in general conformance to SOP EPA-LIBBY-2012-02, *Photographic Documentation of Field Activities* (see **Appendix B**). Photographs should be taken to document representative examples of ABS scenarios performed, sampling locations, site conditions during ABS activities, pre-sampling conditions, and at any other special conditions or circumstances that arise during the activity.

Electronic captions will be used to describe the photographs instead of maintaining photographic logs in daily logbook entries.

Photograph file names will be in the format:

Station ID_CX_date

where:

CX indicates Comparative Exposure

The date is formatted as MM-DD-YY

A digital video will be prepared to document a representative example of ABS scenarios at locations and will include any special conditions or circumstances that arise during the activity. File names will be in the same format as photographic documentation listed above.

B3.2 Field Sample Custody

All teams will ensure that samples, while in their possession, are maintained in a secure manner to prevent tampering, damage, or loss. All samples and FSDSs will be stored in a locked location (e.g., vehicle or hotel) at the end of each day. At the conclusion of the sampling program, the team will return to Libby and relinquish all samples and FSDSs to the sample coordinator or designated secure sample storage area. The field team will be responsible for documenting this transfer of sample custody in the logbook.

B3.3 Chain-of-Custody Requirements

The chain-of-custody (COC) is used as physical evidence of sample custody and control. This record system provides the means to identify, track, and monitor each individual sample from the point of collection through final data reporting. A complete COC record is required to accompany each shipment of samples. COC procedures will follow the requirements as stated in Site-specific SOP EPA-LIBBY-2012-06, *Sample Custody* (see **Appendix B**).

At the end of each day, all samples will be relinquished to the field sample coordinator or a designated secure storage location by the sampling team following COC procedures, and an entry will be made into the field logbook indicating the time samples were relinquished and the sample coordinator who received the samples. The field sample coordinator will follow COC procedures to ensure proper sample custody between acceptance of the sample from the field teams to delivery or shipment to the laboratory.

A member of the sample coordination staff will manually enter sample information from the hard copy FSDS into the local Scribe field project database using a series of standardized data entry forms developed in Microsoft Access by ESAT, referred to as the sample Data Entry Tool, or the "DE Tool". The DE Tool has a variety of built-in QC functions that improve accuracy of data entry and help maintain data integrity. After the data entry is checked against the hard copy FSDSs (by a different sample coordination staff member than completed the original data entry), the DE Tool is used to prepare an electronic COC. A three-page carbon copy COC will be generated from the electronic COC. The field sample coordinator will retain one hard copy of the COC for the project file; the other two hard copies of the COC will accompany the sample shipment.

The field sample coordinator will note the analytical priority level for the samples (based on consultation with the LC) at the top of the COC. A copy of the investigation-specific Analytical Requirements Summary Sheet (see **Appendix E**) will also accompany each COC.

If any errors are found on a COC after shipment, the hard copy of the COC retained by the field sample coordinator will be corrected with a single strikeout, initial, and date. A copy of the corrected COC will be provided to the LC for distribution to the appropriate laboratory. It is the responsibility of the field data manager to make any corrections to the local Scribe field project database. Sample and COC information will be published to Scribe.NET regularly from the local Scribe field project database by the field data manager (see Section B10.1 for additional details).

B3.4 Sample Packaging and Shipping

Samples will be packaged and shipped in general accordance with SOP EPA-LIBBY-2012-07, *Packaging and Shipping of Environmental Samples* (see **Appendix B**) with the following additional requirement:

- Custody seals will be placed on all samples collected as part of this sampling program. Zip-top sample bags containing tree bark, duff, or soil will be rolled parallel to the top of the bag. The custody seal will be placed perpendicular to the top of the bag such that the sample ID remains visible and the bag cannot be unrolled without breaking the seal.

A custody seal will be placed over at least two sides of the shipping cooler and then secured by tape. Prior to sealing the shipping container, the sample coordinator will perform a final check of the contents of the shipment with the COC, sign and date the designated spaces at the bottom of the COC. The field sample coordinator will then place the custody seals on the shipping container.

The field sample coordinator will be responsible for sending samples to the appropriate location, as specified by the LC. With the exception of samples that are hand-delivered to the EMSL Mobile Laboratory in Libby, all samples will be sent to the Troy Sample Preparation Facility (SPF) for subsequent shipment to the appropriate analytical laboratory, or archive.

Samples will be hand-delivered, picked up by a courier service, or shipped by a delivery service to the designated location, as applicable. For hand-deliveries and courier pickups, samples will be packaged for transit such that they are contained and secure (i.e., will not be excessively jostled). Clean plastic totes with the lids secured or sample coolers may be used for this purpose. For samples requiring shipment, an established overnight delivery service provider (e.g., Federal Express) will be used.

B3.5 Holding Times

In general, there are no holding time requirements for asbestos. Because sample preparation (see Section B4.1) will include techniques to address any issues related to holding time for the media (i.e., ashing of tree bark and duff samples will address the growth of organic material that may occur between sample collection and sample analysis), there are no holding time requirements for samples collected as part of this sampling program.

B3.6 Archival and Final Disposition

All samples and grids will be maintained in storage at the Troy SPF or analytical laboratory unless otherwise directed by the EPA. When authorized by the EPA, the laboratory will be responsible for proper disposal of any remaining samples, sample containers, shipping containers, and packing materials in accordance with sound environmental practice, based on the sample analytical results. The laboratory will maintain proper records of waste disposal methods, and will have disposal company contracts on file for inspection.

B4. Analytical Methods

B4.1 Analytical Methods and Requirements

This section discusses the analytical methods and requirements for samples collected in support of the comparative exposure sampling program. This section includes detailed information on the analysis of ABS air, duff and soil materials, and tree bark, as well as the data reporting requirements, sample holding times, and custody procedures.

An analytical requirements summary sheet (**COMPEXP-0612**), which details the specific preparation and analytical requirements associated with this sampling program, is provided in **Appendix E**. The analytical requirements summary sheet will be reviewed and approved by all participating laboratories in this sampling program prior to any sample handling. A copy of this analytical requirements summary sheet will be submitted with each COC.

The personal air samples collected for the on-going health and safety monitoring will be analyzed in accordance with the *Response Action SAP* (CDM 2011). In brief, air samples will be prepared and analyzed by PCM in accordance with NIOSH Method 7400, Issue 2.

B4.1.1 ABS Air

The DQOs for the comparative exposure sampling program (see **Appendix A**) provide detailed information on the sample preparation, analysis method, counting rules, and stopping rules for ABS air. Each of these analysis requirements is summarized below.

Sample Preparation

Two filters are collected for each ABS actor during each sampling event – a high volume filter and a low volume filter. The high volume filter will be analyzed in preference to the low volume filter. If the high volume filter is deemed to be overloaded (i.e., > 25% particulate loading on the filter), the low volume filter should be analyzed in preference to performing an indirect preparation on the high volume filter. If the low volume filter is also deemed to be overloaded, an indirect preparation (with ashing) may be performed of the high volume filter in accordance with the procedures in Libby-specific SOP EPA-LIBBY-08, *Indirect Preparation of Air and Dust Samples for Analysis by TEM* (see **Appendix B**). The filter will be used to prepare a minimum of three grids using the grid preparation techniques described in Section 9.3 of ISO 10312:1995(E).

Analysis Method

Grids will be examined by TEM in basic accordance with the recording procedures described in ISO 10312:1995(E), as modified by the most recent versions of Libby Laboratory Modifications[2] LB-000016, LB-000029, LB-000066, LB-000067, and LB-000085.

Counting Rules

Because of the high number of grid openings that are needed to achieve the target analytical sensitivity (see **Appendix A**), all ABS air samples will be examined using counting protocols for

[2] Copies of all Libby Laboratory Modifications are available in the Libby Lab eRoom.

recording phase contrast microscopy-equivalent (PCME) structures only (per ISO 10312 Annex E). That is, filters will be examined at a magnification of about 5,000x, and all amphibole structures (including not only LA but all other amphibole asbestos types as well) that have appropriate selective area electron diffraction (SAED) patterns and energy dispersive x-ray analysis (EDXA) spectra, and having length > 5 micrometers (µm), width ≥ 0.25 µm, and aspect ratio ≥ 3:1 will be recorded on the Libby-specific TEM laboratory bench sheets and EDDs for the recording of air samples. If observed, chrysotile structures should be recorded in accordance with ISO 10312 recording procedures.

Stopping Rules

Appendix A provides detailed information on the derivation of the stopping rules for ABS air field samples analyzed by TEM. The stopping rules are as follows:

1. Count a minimum of two grid openings from each of two grids.
2. Continue counting until one of the following is achieved:
   a. The target analytical sensitivity (see below) is achieved.
   b. 25 PCME LA structures have been observed.
   c. A total filter area of 20 square millimeters (mm^2) has been examined (this is approximately 2,000 grid openings).

When one of these criteria has been satisfied, complete the examination of the final grid opening and stop. The target analytical sensitivity differs between the two types of ABS scenarios. For the digging ABS scenario, the target analytical sensitivity is 0.00022 cubic centimeter $(cc)^{-1}$. For the fireline ABS scenario, the target analytical sensitivity is 0.0025 cc^{-1}. The COC will identify the applicable ABS scenario for all ABS air samples.

For lot blanks and field blanks, the TEM analyst should examine an area of 1.0 mm^2 (approximately 100 grid openings).

B4.1.2 Duff

Sample Preparation

Duff samples will be prepared and analyzed in basic accordance with the procedures specified in SOP EPA-LIBBY-2012-11, *Sampling and Analysis of Duff for Asbestos* (see **Appendix B**). In brief, each sample is dried and ashed, and an aliquot of the resulting ash residue is acidified, suspended in water, and filtered. A total of three replicate filters will be created for each duff sample using additional aliquots of the ash residue. Each filter will be used to prepare a minimum of three grids using the grid preparation techniques described in Section 9.3 of ISO 10312:1995(E).

Analysis Method and Counting Rules

Grids will be examined by TEM using high magnification (~20,000x) in basic accordance with the recording procedures described in ISO 10312:1995(E), as modified by SOP EPA-LIBBY-2012-11 and the most recent versions of Libby Laboratory Modifications LB-000016, LB-000029, LB-000066, LB-000067, and LB-000085. In brief, all fibrous amphibole structures that have appropriate SAED patterns and EDXA spectra, and having length ≥ 0.5 um and an aspect ratio (length: width) ≥ 3:1, will be recorded. If observed, chrysotile structures should be recorded using the same procedures.

Stopping Rules

The stopping rules for the TEM analysis of duff materials are as follows:

1. Count a minimum of two grid openings from each of two grids.
2. Continue counting until one of the following is achieved:
   a. The target analytical sensitivity (1E+07 per gram dry weight [g^{-1}]) is achieved.
   b. 50 LA structures have been observed.
   c. A total filter area of 1.0 mm^2 has been examined (this is approximately 100 grid openings).

When one of these criteria has been satisfied, complete the examination of the final grid opening and stop.

The results for each duff analysis will be expressed in terms of LA structures per gram duff (dry weight).

B4.1.3 Tree Bark

Sample Preparation

Tree bark samples will be prepared and analyzed in basic accordance with the procedures specified in SOP EPA-LIBBY-2012-12, *Sampling and Analysis of Tree Bark for Asbestos* (see **Appendix B**). In brief, each sample is dried and ashed, and the resulting ash residue is acidified, suspended in water, and filtered. A total of three replicate filters will be created for each tree bark sample using equal aliquots of the ash residue suspension. Each filter will be used to prepare a minimum of three grids using the grid preparation techniques described in Section 9.3 of ISO 10312:1995(E).

Analysis Method and Counting Rules

Grids will be examined by TEM using high magnification (~20,000x) in basic accordance with the recording procedures described in ISO 10312:1995(E), as modified by SOP EPA-LIBBY-2012-12. In brief, all fibrous amphibole structures that have appropriate SAED patterns and EDXA spectra, and having length ≥ 0.5 um and an aspect ratio (length: width) ≥ 3:1, will be recorded. If observed, chrysotile structures should be recorded using the same procedures.

Stopping Rules

The stopping rules for the TEM analysis of tree bark are as follows:

1. Count a minimum of two grid openings from each of two grids.
2. Continue counting until one of the following is achieved:
    a. The target analytical sensitivity (100,000 per square centimeter [cm^{-2}]) is achieved.
    b. 50 LA structures have been observed.
    c. A total filter area of 1.0 mm^2 has been examined (this is approximately 100 grid openings).

When one of these criteria has been satisfied, complete the examination of the final grid opening and stop.

The results for each tree bark analysis will be expressed in terms of LA structures per cm^2 of tree bark (i.e., a surface area loading).

B4.1.4 Soil

Sample Preparation

All soil samples collected for asbestos analysis will be transmitted to the Sample Preparation Facility (SPF) located in Troy, MT. Prior to preparation, all soil samples will be dried as detailed in Libby-specific SOP ISSI-LIBBY-01, *Soil Sample Preparation* (see **Appendix B**). Once dried, each sample will be split into two approximately equal portions: 1) archive aliquot; 2) fluidized bed asbestos segregator (FBAS) aliquot. The archive aliquot will be stored in accordance with SOP ISSI-LIBBY-01.

The FBAS aliquot will be prepared for analysis in accordance with SOP ESAT-LIBBY-01, *Fluidized Bed Asbestos Segregator Method for Determination of Releasable Asbestos Fibers in Soil* (see **Appendix B**). In brief, the soil aliquot will be sieved using sieves with two opening sizes (6.3 millimeters [mm] and 0.85 mm). Soil material passing through the 0.85 mm sieve will be retained for use in the FBAS. For each soil sample, a total of three air filter replicates will be generated from the FBAS aliquot. Prior to generating the filter replicates, several test filters will be generated using varying amounts of soil. The particulate loading rates on these filters will be should be determined using PCM, and filter loading optimized such that the resulting filter approaches, but does not exceed, overloading. Replicate air filters for TEM analysis will then be generated using the soil mass that achieves optimum particulate loading on the filter.

Analysis Method

Replicate FBAS air filters will be sent to the analytical laboratory for preparation and analysis of asbestos by TEM. The filter will be used to prepare a minimum of three grids using the grid preparation techniques described in Section 9.3 of ISO 10312:1995(E). Grids will be examined by TEM in basic accordance with the recording procedures described in ISO 10312:1995(E), as modified by the most recent versions of Libby Laboratory Modifications LB-000016, LB-000029, LB-000066, LB-000067, and LB-000085.

The results for each FBAS analysis will be expressed in terms of LA structures per gram soil (dry weight).

Counting and Stopping Rules for Field Samples

To reduce the potential level of effort to complete the TEM analysis, filters will be examined using a tiered TEM magnification approach, as follows:

<u>High Magnification Analysis</u>

The TEM microscopist will begin the analysis utilizing a magnification of 20,000x. All amphibole structures (including not only LA but all other amphibole asbestos types as well) that have appropriate SAED patterns and EDXA spectra, and having length ≥ 0.5 µm and an aspect ratio ≥ 3:1 will be recorded on the FBAS-specific TEM laboratory bench sheets and EDD spreadsheets. If observed, chrysotile structures should be recorded, but chrysotile structure counting may stop after 50 structures have been recorded.

Examine a minimum of two grid openings from each of two grids. Continue examining grid openings until one of the following is achieved:

1. The target analytical sensitivity (6.3E+03 per gram [g^{-1}]) is achieved,
2. 50 LA structures are recorded, or
3. A total area of 1.2 mm^2 of filter has been examined (approximately 120 grid openings).

When one of these criteria is achieved, complete the final grid opening and stop.

Low Magnification Analysis

After completing the initial examination at 20,000x magnification, if fewer than 50 LA structures have been recorded, and the target analytical sensitivity has not yet been achieved, the TEM microscopist will switch to a lower magnification of 5,000x and continue to record only PCME LA structures (i.e., length > 5 µm, width ≥ 0.25 µm, aspect ratio ≥ 3:1) until one of the following is achieved:

1. The target analytical sensitivity (6.3E+03 g^{-1}) is achieved,
2. 50 LA structures are recorded, or
3. A total area of 3.0 mm^2 of filter has been examined (approximately 300 grid openings).

When one of these criteria is achieved, complete the final grid opening and stop.

Counting and Stopping Rules for Blanks

For blanks (lot blanks, preparation blanks, and sand blanks), the TEM analyst should examine an area of 1.0 mm^2 (approximately 100 grid openings) utilizing a magnification of 20,000x and the counting rules described above for the "high magnification analysis".

B4.2 Analytical Data Reports

An analytical data report will be prepared by the laboratory and submitted to the appropriate LC after the completion of all required analyses within a specific laboratory job (or sample delivery group). This analytical data report may vary by laboratory and analytical method but generally includes a case narrative that briefly describes the number of samples, the analyses, and any analytical difficulties or QA/QC issues associated with the submitted samples. The data report will also include copies of the signed COC forms, analytical data summaries, a QC package, and raw data. Raw data is to consist of instrument preparation logs, instrument printouts, and QC sample results including, instrument maintenance records, COC check in and tracking, raw data instrument print outs of sample results, analysis run logs, and sample preparation logs. The laboratory will provide an electronic scanned copy of the analytical data report to the LC and others, as directed by the LC.

B4.3 Laboratory Data Reporting Tools

Standardized data reporting tools (i.e., EDDs) have been developed specifically for the Libby project to ensure consistency between different laboratories in the presentation and submittal of analytical data. In general, unique Libby-specific EDDs have been developed for each analytical method and each medium. Since the beginning of the Libby project, each EDD has undergone continued development and refinement to better accommodate current and anticipated future data needs and requirements. EDD refinement continues based on laboratory and data user input. Electronic copies of all current EDD templates are provided in the Libby Lab eRoom.

For TEM analyses, detailed raw structure data will be recorded and results will be transmitted using the Libby-specific EDDs for TEM. For PLM analyses, optical property details and results will be recorded on the Libby-specific EDDs for PLM. Standard project data reporting requirements will be met for TEM and PLM analyses. EDDs will be transmitted electronically (*via* email) to the following:

- Doug Kent, Kent.Doug@epa.gov
- Janelle Lohman, Lohman.Janelle@epa.gov
- Tracy Dodge, DodgeTA@cdmsmith.com
- Phyllis Haugen, HaugenPJ@cdmsmith.com
- Libby project email address for CDM Smith, libby@cdmsmith.com

Note: ESAT is in the process of developing a new Site-specific analytical results reporting tool, referred to as the Libby Asbestos Data Tool (LADT). This tool is a relational Microsoft® Access database with a series of standard data entry forms specific to each analytical method. The LADT creates a Microsoft® Excel export file that can be directly uploaded into an analytical Scribe project database (see Section B10.4). Laboratories have the option of using LADT as a data reporting method instead of the Libby-specific EDDs.

B4.4 Analytical Turn-around Time

Analytical turn-around time will be negotiated between the EPA laboratory coordinator (LC) and the laboratory. It is anticipated that turn-around times of 2-4 weeks are acceptable, but this may be revised as determined necessary by the EPA.

B4.5 Custody Procedures

Specific laboratory custody procedures are provided in each laboratory's *Quality Assurance Management Plan*, which have been independently reviewed at the time of laboratory procurement. While specific laboratory sample custody procedures may differ between laboratories, the basic laboratory sample custody process is described briefly below.

Upon receipt at the facility, each sample shipment will be inspected to assess the condition of the shipment and the individual samples. This inspection will include verifying sample integrity. The accompanying COC will be cross-referenced with all of the samples in the shipment. The laboratory sample coordinator will sign the COC and maintain a copy for their project files.

Depending upon the laboratory-specific tracking procedures, the laboratory sample coordinator may assign a unique laboratory identification number to each sample on the COC. This number, if assigned, will identify the sample through all further handling at the laboratory. It is the responsibility of the laboratory manager to ensure that internal logbooks and records are maintained throughout sample preparation, analysis, and data reporting.

B5. Quality Assurance/Quality Control

B5.1 Field

Field QA/QC activities include all processes and procedures that have been designed to ensure that field samples are collected and documented properly, and that any issues/deficiencies associated with field data collection or sample processing are quickly identified and rectified. The following sections describe each of the components of the field QA/QC program implemented at the Site.

B5.1.1 Training

Before performing field work in Libby, field personnel are required to read all governing field guidance documents relevant to the work being performed and attend a field planning meeting specific to the Comparative Exposure sampling effort. Additional information on field training requirements is provided in Section A8.1.

B5.1.2 Modification Documentation

All field deviations from and modifications to this SAP/QAPP will be recorded on the Libby field ROM Form (see **Appendix F**). The field ROM forms will be used to document all permanent and temporary changes to procedures contained in guidance documents governing investigation work that have the potential to impact data quality or usability. Any minor deviations (i.e., those that will not impact data quality or usability) will be documented in the field logbooks. ROMs are completed by the FTL overseeing the investigation/activity, or by assigned field or technical staff. As modifications to governing documents are implemented, the FTL will communicate the changes to the field teams conducting activities associated with the modification.

Each completed field ROM is assigned a unique sequential number (e.g., LFO-000026) by the CDM Smith field QAM. A ROM tracking log for all field modifications is maintained by the field QAM. This tracking log briefly describes the ROM being documented, as well as ROM author, the reviewers, and date of approval. Once a form is prepared, it is submitted to the appropriate EPA RPM for review and approval. Copies of approved ROMs are available in the Libby Field eRoom.

B5.1.3 Field Surveillances

Field surveillances consist of periodic observations made to evaluate continued adherence to investigation-specific governing documents. It is not anticipated that a field surveillance will be performed for this investigation. However, field surveillances may be conducted if field processes are revised or other QA/QC procedures indicate potential deficiencies.

B5.1.4 Field Audits

Field audits are broader in scope than field surveillances. Audits are evaluations conducted by qualified technical or QA staff that are independent of the activities audited. Field audits can be conducted by field contractors, internal EPA staff, or EPA contracted auditors. It is the responsibility of the EPA RPM to ensure that field auditing requirements are met for each investigation. Because this sampling design is unique to other sampling efforts that have occurred in the past at the site, one field audit will be conducted during the early stages of this investigation to identify any early deficiencies so that any impact on project data quality is limited.

B5.1.5 Field QC Samples

Field QC samples are collected to help ensure that field samples are not contaminated from exogenous sources during sample collection, and to help evaluate the precision of field sample analytical results. Field QC samples are assigned unique field identifiers and are submitted to the analytical laboratory along with the associated field samples.

Air

Two types of field QC samples will be collected as part of the ABS air sampling portion of this program – lot blanks and field blanks.

<u>Lot Blank</u>

Lot blanks are collected to ensure air samples for asbestos analysis are collected on asbestos-free filters. A lot blank is a randomly selected filter cassette from a manufactured lot. One lot blank is required for every 500 cassettes. It is the responsibility of the FTL to submit the appropriate number of lot blanks prior to cassette use in the field. The lot blanks are analyzed for asbestos by TEM analysis as described above (see Section 5.1.3). Lot blank results will be reviewed by the FTL before any cassette in the lot is used for sample collection. The entire batch of cassettes will be rejected if any asbestos is detected on either lot blank. Only filter lots with acceptable lot blank results are placed into use for the ABS effort.

Field Blank

Field blanks are collected to evaluate potential contamination introduced during sample collection, shipping and handling, or analysis. For this sampling effort, field blanks for ABS air will be collected at a rate of 1 per ABS team per day. It is the responsibility of each field team to collect the appropriate number of field blanks. Field blanks are collected by removing the end cap of the sample cassette to expose the filter in the same area where sample collection occurs for about 30 seconds before re-capping the sample cassette. The field blanks are analyzed for asbestos by TEM analysis as described above (see Section 5.1.3).

If any asbestos is observed on a field blank, the FTL and/or laboratory manager will be notified and will take appropriate measures (e.g., re-training on sample collection and analysis procedures) to ensure staff are employing proper sample handling techniques. In addition, a qualifier of "FB" will be added to the related field sample results in the project database to denote that the associated field blank had asbestos structures detected.

Duff

Only one type of field QC sample will be collected as part of the duff sampling portion of this program –field duplicates. Field blanks for duff are not required for this sampling program.

One field duplicate sample of duff material will be collected as part of this sampling program. The duff field duplicate should be collected at the same approximate locations as the duff sampling points as the parent sample (i.e., within 12 inches of the parent sampling points). It is the responsibility of the FTL to ensure that the field duplicate is collected. The field duplicate is given a unique sample number, and field personnel will record the sample number of the associated co-located sample in the parent sample number field of the FSDS. The same station location is assigned to the field duplicate sample as the parent field sample. Field duplicates will be sent for analysis by the same method as field samples and are blind to the laboratories (i.e., the laboratory cannot distinguish between field samples and field duplicates).

Field duplicate results will be compared to the original parent field sample using the Poisson ratio test using a 90% confidence interval (CI) (Nelson 1982). Because field duplicate samples are expected to have inherent variability that is random and may be either small or large, typically, there is no quantitative requirement for the agreement of field duplicates. Rather, results are used to determine the magnitude of this variability to evaluate data usability.

Soil

One type of field QC samples will be collected as part of the soil sampling portion of this program – field duplicates. Field duplicates for soil are collected from the same area as the parent sample but from different individual sampling points (i.e., a second 5-gallon bucket will be filled with soil from 30 different sub-locations within the same 100-ft^2 digging ABS area).

Both buckets will be poured out and homogenized separately. The parent soil sample will be collected from one of the soil piles and the field duplicate will be collected from the other pile. Only the parent pile of soil will be used for the soil-disturbance activity. The soil from the second bucket (field duplicate) will be redistributed within the area once ABS air sample collection is complete.

One field duplicate sample of soil will be collected as part of this sampling program. It is the responsibility of the FTL to ensure that the appropriate number of field duplicates is collected. Each field duplicate is given a unique sample number, and field personnel record the sample number of the associated co-located sample in the parent sample number field of the FSDS. The same location ID is assigned to the field duplicate sample as the parent field sample. Field duplicates will be sent for analysis by the same method as field samples and are blind to the laboratories (i.e., the laboratory cannot distinguish between field samples and field duplicates).

Field duplicate results for TEM analyses will be compared to the parent sample using the Poisson ratio test using a 90% confidence interval (Nelson 1982). The variability between the field duplicate and the associated parent field sample reflects the combined variation in sample heterogeneity and the variation due to measurement error. Because field duplicate samples are expected to have inherent variability that is random and may be either small or large, typically, there is no quantitative requirement for the agreement of field duplicates. Rather, results are used to determine the magnitude of this variability to evaluate data usability

Tree Bark

Two types of field QC samples may be collected as part of the tree bark sampling portion of this program – equipment rinsates and field duplicates. Field blanks for tree bark are not required for this sampling program.

Equipment Rinsates

Equipment rinsates are collected to evaluate potential contamination that arises to due inadequate decontamination of sampling equipment. Equipment rinsates will only be collected if non-dedicated field sampling equipment (i.e., hole saws, chisels) are utilized. Following decontamination efforts, the decontaminated equipment (i.e., hole saw, chisel) should be rinsed with clean water (e.g., store-bought drinking water), and the resulting rinsate should be collected in a high density polyethylene (HDPE) container. At least one equipment rinsate blank should be collected per equipment decontamination effort; one equipment rinsate per day will be analyzed. It is the responsibility of each field team to collect the appropriate number of equipment rinsate blanks. Equipment rinsate blanks should be labeled with a unique sample number and submitted for analysis by TEM.

If any asbestos structures are observed on an equipment rinsate, the FTL and/or laboratory manager will be notified and will take appropriate measures to ensure staff are employing proper sample handling techniques. In addition, a qualifier of "EB" will be added to the related field sample results in the project database to denote that the associated equipment rinsates had asbestos structures detected.

<u>Field Duplicates</u>

One field duplicate sample of tree bark will be collected as part of this sampling program. Field duplicates for tree bark are collected from the same tree as and in close proximity to (within 6 inches) the parent field sample. The field duplicate is collected using the same collection technique as the parent sample. It is the responsibility of the FTL to ensure that the field duplicate is collected. The field duplicate is given unique sample number, and field personnel will record the sample number of the associated co located sample in the parent sample number field of the FSDS. The same station location is assigned to the field duplicate sample as the parent field sample. Field duplicates will be sent for analysis by the same method as field samples and are blind to the analytical laboratories (i.e., the laboratory cannot distinguish between field samples and field duplicates).

Field duplicate results will be compared to the original parent field sample using the Poisson ratio test using a 90% CI (Nelson 1982). Because field duplicate samples are expected to have inherent variability that is random and may be either small or large, typically, there is no quantitative requirement for the agreement of field duplicates. Rather, results are used to determine the magnitude of this variability to evaluate data usability.

B5.2 Troy SPF

As noted above, prior to preparation by fluidized bed, soil samples will be dried at the Troy SPF. The sections below provide detailed information on QA/QC procedures for the Troy SPF, which is maintained by adherence to standard preparation procedures, submission of preparation QC samples, facilities monitoring, and audits.

B5.2.1 Training/Certifications

Personnel performing sample preparation activities must have read and understood the *Soil Sample Preparation Work Plan*, the *SPF HASP*, and all associated SOPs and governing documents for soil preparation (e.g., SOP ISSI-LIBBY-01). In addition, all personnel must have completed 40-hour OSHA HAZWOPER training, annual updates, annual respirator fit tests, and annual or semi-annual physicals, as required.

Prior to performing activities at the Troy SPF, new personnel will be instructed by an experienced member of the SPF staff and training sessions will be documented in the SPF project files. It is the responsibility of the SPF QAM to ensure that all personnel have completed the required training requirements.

B5.2.2 Modification Documentation

When changes or revisions are needed to improve or document specifics about sample preparation procedures used by the Troy SPF, these changes are documented using an SPF ROM form (see **Appendix F**). The SPF ROM form provides a standardized format for tracking procedural changes in sample preparation and allows project managers to assess potential impacts on the quality of the data being collected. SPF ROMs will be completed by the appropriate SPF or technical staff. Once a form is prepared, it is submitted to the ESAT QAM (or their designate) for review. Final review and approval is provided by the appropriate EPA RPM. Copies of approved SPF ROMs are available in the Libby Lab eRoom.

B5.2.3 Soil Preparation Facility Audits

Internal audits of the SPF are conducted by the SPF QAM periodically to evaluate personnel in their day-to-day activities and to ensure that all processes and procedures are performed in accordance with governing documents and SOPs. All aspects of sample preparation, as well as sample handling, custody, and shipping are evaluated. If any issues are identified, SPF personnel are notified and retrained as appropriate. Audit reports will be completed following each laboratory audit. A copy of the internal audit report, as well as any corrective action reports, will be provided to the LC and the QATS contractor.

Internal audits will be conducted following any significant procedural changes to the soil preparation processes or other SPF governing documents, to ensure the new methods are implemented and followed appropriately.

The Troy SPF is also required to participate in an annual on-site laboratory audit carried out by the EPA through the QATS contract. Audits consist of an evaluation of facility practices and procedures associated with the preparation of soil samples. A checklist of requirements, as derived from the applicable governing documents and SOPs, is prepared by the auditor prior to the audit, and used during the on-site evaluation. Evaluation of the facility is made by reviewing SPF documentation, observing sample processing, and interviewing personnel.

It is the responsibility of the QATS contractor to prepare an On-site Audit Report following the SPF audit. The On-site Audit Report includes both a summary of the audit results and completed checklist(s), as well as recommendations for corrective actions, as appropriate. Responses from each SPF to any deficiencies noted in the On-site Audit Report are also maintained with the respective reports.

It is the responsibility of the QATS contractor to prepare an On-Site Audit Trend Analysis Report on an annual basis. This report shall include a compilation and trend analysis of the on-site audit findings and recommendations. The purpose of this reported is to identify SPF performance problems and isolate the potential causes.

B5.2.4 Preparation QC Samples

Four types of preparation QC samples are collected during the soil preparation process: sand blanks, drying blanks, and preparation duplicates. Each type of preparation QC sample is described in more detail below.

Sand Blank

A sand blank is a sample of store-bought quartz sand that is analyzed to ensure that the quartz sand matrix used for drying and grinding blanks is asbestos-free. Detailed procedures for this certification process are provided in ESAT SOP PLM-02.00, *Blank Sand Certification by Polarized Light Microscopy*. In brief, about 800 grams of sand are split into 40 sand blank aliquots of roughly equal size. Each sand blank is evaluated using stereomicroscopic examination and analyzed by PLM-VE. If a sand blank has detected asbestos, it is re-analyzed by a second PLM analyst to verify the presence of asbestos. The sand is certified as asbestos-free if all 40 sand blanks are non-detect for asbestos. The sand is rejected for use if any asbestos is detected in the sand blanks. Only sand that is certified as asbestos-free will be utilized in the SPF.

Drying Blank

A drying blank consists of approximately 100 to 200 grams of asbestos-free quartz sand that is processed with each batch of field samples that are dried together (usually this is approximately 125 samples per batch). The drying blank is then processed identically to field samples. Drying blanks determine if cross-contamination between samples is occurring during sample drying. One drying blank will be processed with each drying batch per oven. It is the responsibility of the SPF QAM to ensure that the appropriate number of drying blanks is collected. Each drying blank is given unique sample number that is investigation-specific, as provided by the field sample coordinator (i.e., a subset of sample numbers for each investigation will be provided for use by the SPF). SPF personnel will record the sample number of the drying blank on the sample drying log sheet.

It is the responsibility of the QATS contractor to review the drying blank results and notify the SPF QAM immediately if drying blank results do not meet acceptance criteria and if corrective actions are necessary. If asbestos is detected in the drying blank, a qualifier of "DB" will be added to the related field sample results in the project database that were dried at the same time as the detected drying blank to denote that the associated drying blank had detected asbestos. In addition, the drying oven will be thoroughly cleaned. If asbestos continues to be detected in drying blanks after cleaning occurs, sample processing must stop and the drying method and decontamination procedures will be evaluated to rectify any cross-contamination issues.

Preparation Duplicate

Preparation duplicates are splits of field samples submitted for sample preparation. The preparation duplicates are used to evaluate the variability that arises during the soil preparation and analysis steps. After drying, but prior to sieving, a preparation duplicate is prepared by using a riffle splitter to divide the field sample (after an archive split has been created) into two approximately equal portions, creating a parent and duplicate sample.

Preparation duplicate samples are prepared at a rate of 1 per 20 samples (5%) of samples prepared. It is the responsibility of the SPF QAM to ensure that the appropriate number of preparation duplicates is prepared. Each preparation duplicate is given unique sample number that is investigation-specific, as provided by the field sample coordinator. SPF personnel will record the sample number of the preparation duplicate and its associated parent field sample on the sample preparation log sheet. Preparation duplicates are submitted blind to the laboratory for analysis by the same analytical method as the parent sample.

Preparation duplicate results will be compared to the original parent field sample using the Poisson ratio test using a 90% CI (Nelson 1982). Because preparation duplicate samples may have inherent small-scale variability that is random and may be either small or large, there is no quantitative requirement for the agreement of preparation duplicates. Rather, results are used to determine the magnitude of this variability to evaluate data usability. The QATS contractor will notify the SPF QAM when preparation duplicate results are statistically different from the parent results to determine if corrective action is needed.

B5.2.5 Performance Evaluation Standards

The USGS has prepared several Site-specific reference materials of LA in soil that are utilized as performance evaluation (PE) standards to evaluate laboratory accuracy and precision. These PE standards are kept in storage at the Troy SPF and are inserted into the sample train in accordance with SOP ISSI-LIBBY-01, with the following project-specific modification:

- PE standards will not be processed prior to insertion (i.e., no sieving or grinding of the standard should be performed).

PE standards of varying nominal levels will be inserted on a quarterly basis at a rate of at least one PE standard per analytical laboratory.

It is the responsibility of the SPF QAM to ensure that the appropriate number of PE standards is inserted. Each PE standard is given unique sample number that is investigation-specific, as provided by the field sample coordinator. SPF personnel will record the sample number of the PE standard, the nominal level of the PE standard, and whether it was inserted pre- or post-processing on the sample preparation log sheet. PE standards are submitted blind to the laboratory for analysis by the same analytical method as the field samples.

Results for PE standards will be evaluated by the QATS contractor or their designate. PE standard results that are prepared by FBAS and analyzed by TEM will be compared to results by the nominal concentration of the PE standard. The LC should be notified if PE standard results do not meet acceptance criteria. Corrective action will be taken if the PE standards demonstrate issues with accuracy and/or bias in results reporting. Examples of corrective actions that may be taken include reanalysis and/or repreparation, collaboration between and among laboratories to address potential differences in analysis methods, and analyst re-training.

B5.3 Analytical Laboratory

Laboratory QA/QC activities include all processes and procedures that have been designed to ensure that data generated by an analytical laboratory are of high quality and that any problems in sample preparation or analysis that may occur are quickly identified and rectified. The following sections describe each of the components of the analytical laboratory QA/QC program implemented at the Site.

B5.3.1 Training/Certifications

All analytical laboratories participating in the analysis of samples for the Libby project are subject to national, local, and project-specific certifications and requirements. Additional information on laboratory training and certification requirements is provided in Section A8.2.

Laboratories handling samples collected as part of this sampling program will be provided a copy of and will adhere to the requirements of this SAP/QAPP. Samples collected under this SAP/QAPP will be analyzed in accordance with standard EPA and/or nationally-recognized analytical procedures (i.e., Good Laboratory Practices) in order to provide analytical data of known quality and consistency.

B5.3.2 Modification Documentation

All deviations from project-specific and method guidance documents will be recorded on the Laboratory ROM Form (see **Appendix F**). The ROM will be used to document all permanent and temporary changes to analytical procedures. ROMs will be completed by the appropriate laboratory or technical staff. As ROMs are completed, it is the responsibility of the LC to communicate any changes to the project laboratories. When the project management team determines the need, this SAP/QAPP will be revised to incorporate necessary modifications. Copies of approved ROMs for this SAP/QAPP will be made available in the Libby Lab eRoom.

B5.3.3 Laboratory Audits

Each laboratory working on the Libby project is required to participate in an annual on-site laboratory audit carried out by the EPA through the QATS contract. These audits are performed by EPA personnel (and their contractors), that are external to and independent of, the Libby laboratory team members. These audits ensure that each analytical laboratory meets the basic capability and quality standards associated with analytical methods for asbestos used at the Libby site. They also provide information on the availability of sufficient laboratory capacity to meet potential testing needs associated with the Site.

<u>External Audits</u>

Audits consist of several days of technical and evidentiary review of each laboratory. The technical portion of the audit involves an evaluation of laboratory practices and procedures associated with the preparation and analysis of samples for the identification of asbestos. The evidentiary portion of the audit involves an evaluation of data packages, record keeping, SOPs, and the laboratory *QA Management Plan*. A checklist of method-specific requirements for the commonly used methods for asbestos analysis is prepared by the auditor prior to the audit, and used during the on-site laboratory evaluation.

Evaluation of the capability for a laboratory to analyze a sample by a specific method is made by observing analysts performing actual sample analyses and interviewing each analyst responsible for the analyses. Observations and responses to questions concerning items on each method-specific checklist are noted. The determination as to whether the laboratory has the capability to analyze a sample by a specific method depends on how well the analysts follow the protocols detailed in the formal method, how well the analysts follow the laboratory-specific method SOPs, and how the analysts respond to method-specific questions.

Evaluation of the laboratory to be sufficient in the evidentiary aspect of the audit is made by reviewing laboratory documentation and interviewing laboratory personnel responsible for maintaining laboratory documentation. This includes personnel responsible for sample check-in, data review, QA procedures, document control, and record archiving. Certain analysts responsible for method quality control, instrument calibration, and document control are also interviewed in this aspect of the audit. Determination as to the capability to be sufficient in this aspect is made based on staff responses to questions and a review of archived data packages and QC documents.

It is the responsibility of the QATS contractor to prepare an On-site Audit Report for each analytical laboratory participating in the Libby program. These reports are handled as business confidential items. The On-site Audit Report includes both a summary of the audit results and completed checklist(s), as well as recommendations for corrective actions, as appropriate. Responses from each laboratory to any deficiencies noted in the On-site Audit Report are also maintained with the respective reports.

It is the responsibility of the QATS contractor to prepare an On-Site Audit Trend Analysis Report on an annual basis. This report shall include a compilation and trend analysis of the on-site audit findings and recommendations. The purpose of this reported is to identify common asbestos laboratory performance problems and isolate the potential causes.

Internal Audits

Each laboratory will also conduct periodic internal audits of their specific operations. Details on these internal audits are provided in the laboratory *QA Management Plan*. The laboratory QAM should immediately contact the LC and the QATS contractor if any issues are identified during internal audits that may impact data quality.

B5.3.4 Laboratory QC Analyses

General Requirements

The Libby-specific QC requirements for TEM analyses of asbestos are patterned after the requirements set forth by NVLAP. In brief, there are three types of laboratory-based QC analyses for TEM – laboratory blanks, recounts, and repreparations. Detailed information on the Libby-specific requirements for each type of TEM QC analysis, including the minimum frequency rates, selection procedures, acceptance criteria, and corrective actions are provided in the most recent version of Libby Laboratory Modification LB-000029.

With the exception of inter-laboratory analyses, it is the responsibility of the laboratory manager to ensure that the proper number of TEM QC analyses is completed. Inter-laboratory analyses for TEM will be selected *post hoc* by the QATS contractor or their designate in accordance with the selection procedures presented in LB-000029. The LC will provide the list of selected inter-laboratory analyses to the laboratory manager and will facilitate the exchange of samples between the analytical laboratories.

Duff and Tree Bark-specific Requirements

In addition to the laboratory-based QC analyses discussed above, TEM analyses of tree bark and duff have additional QC analyses that are required, including drying blanks and filtration blanks. Because three replicate filters will be prepared and analyzed for each duff and tree bark sample, no laboratory duplicate analyses will be required for this sampling effort. Detailed information on the Libby-specific requirements for each type of TEM QC analysis is provided in the medium-specific SOPs (i.e., EPA-LIBBY-2012-11 and EPA-LIBBY-2012-12). It is the responsibility of the laboratory manager to ensure that the proper number of TEM QC analyses is completed.

B6/B7. Instrument Maintenance and Calibration

B6/B7.1 Field Equipment

B6/B7.1.1 General Maintenance

All field equipment (e.g., soil moisture meters, GPS units) should be maintained in basic accordance with manufacturer specifications. When a piece of equipment is found to be operating incorrectly, the piece of equipment will be labeled "out of order" and placed in a separate area from the rest of the sampling equipment. The person who identified the equipment as "out of order" will notify the FTL overseeing the investigation activities. It is the responsibility of the FLT to facilitate repair of the out-of-order equipment. This may include having appropriately trained field team members complete the repair or shipping the malfunctioning equipment to the manufacturer. Field team members will have access to basic tools required to make field acceptable repairs. This will ensure timely repair of any "out of order" equipment.

B6/B7.1.2 Air Pump Calibration

Air sampling pumps will be calibrated at the start of each day's sampling period using a rotameter that has been calibrated to a primary calibration source. The primary calibration standard used at the Site is a Bios DryCal® DC-Lite. For pre-sampling purposes, calibration will be considered complete when ±5 percent of the desired flow rate is attained, as determined by three measurements with the calibrator using a cassette reserved for calibration (from the same lot as the sample cassettes to be used in the field). Additional calibration may be performed during sample collection as described below.

If at any time the observed flow rates are ±10% of the target rate, the sampling pump should be re-calibrated, if possible. If at any time an air sampling pump is found to have faulted or the observed flow rates are 25% below (due to heavy particulate loading or a pump malfunction) or 50% above the target rate, the pump will be replaced or the activity will be terminated. Collection of air samples will continue, regardless of the amount of particulate loading on the filters, unless the flow rate is affected. At the beginning of the sampling program, flow rates and particulate loading may be checked more frequently as conditions require, establishing expected conditions.

To calculate the percentage of an observed flow to the target flow, the following formula is used:

$$X\% = \frac{Observed\ Flow\ Rate\ (L/min)}{Target\ Flow\ Rate\ (L/min)} \cdot 100$$

For post-sampling calibration, three separate constant flow calibration readings will be obtained with the sampling cassette inline and those flow readings will be averaged. If the flow rate changes by more than 5% during the sampling period, the average of the pre- and post-sampling rates will be used to calculate the total sample volume.

Samples for which there is more than a 30% difference from initial calibration to end calibration will be invalidated. The sample collector will record the pump serial number, sample number, initial flow rate, sample start/end times, sample locations, and final flow rate, as well as mark the sample "void," in the field logbook and FSDS. These samples will not be submitted for analysis.

To prevent potential cross-contamination, each rotameter used for field calibration will be transported to and from each sampling location in a sealed zip-top plastic bag. The cap and calibration cassette used at the end of the rotameter tubing will be replaced each day after it is used.

B6/B7.2 Laboratory Instruments

All laboratory instruments used for this project will be maintained and calibrated in accordance with the manufacturer's instructions. If any deficiencies in instrument function are identified, all analyses shall be halted until the deficiency is corrected. The laboratory shall maintain a log that documents all routine maintenance and calibration activities, as well as any significant repair events, including documentation that the deficiency has been corrected.

B8. Inspection/Acceptance of Supplies and Consumables

B8.1 Field

In advance of field activities, the FTL will check the field equipment/supply inventory and procure any additional equipment and supplies that are needed. The FTL will also ensure any in-house measurement and test equipment used to collect data/samples as part of this SAP/QAPP is in good, working order, and any procured equipment is acceptance tested prior to use. Any items that the FTL determines unacceptable will be removed from inventory and repaired or replaced as necessary.

The following list summarizes the general equipment and supplies required for most investigations:

- Field logbook – Used to document field sampling activities and any problems in sample collection or deviations from the investigation-specific QAPPs. See Section B3.1.3 for standard procedures for field logbooks.

- Field sample data sheets (FSDSs) – FSDSs are medium-specific forms that are used to document sample details (i.e., sampling location, sample number, medium, field QC type, etc.). See Section B3.1.2 for standard procedures for the completion of FSDSs.

- Sample number labels – Sample numbers are sequential numbers with investigation-specific prefixes. Sample number labels are pre-printed and checked out to the field teams by the FTL or their designate. To avoid potential transcription errors in the field, multiple labels of the same sample number are prepared – one label is affixed to the collected sample, one label is affixed to the hard copy FSDS form. Labels may also be affixed to the field logbook.

- Indelible ink pen, permanent marker – Indelible ink pens are used to complete required manual data entry of information on the FSDS and in the field logbook (pencil may not be used). Permanent markers may also be used to write sample numbers on the sample containers.

- PPE - As required by the HASP.

- Land survey map or aerial photo – Used to identify appropriate sampling locations. In some cases, sketches may be added to the map/photo to designate sampling and visual inspection locations and other site features.

- Digital camera – Used to document sampling locations and conditions. See Section B3.1.4 for standard procedures in photographic documentation.

- Global positioning system (GPS) unit, measuring wheel, stakes – Used to identify and mark sampling locations. See B2.2 for standard procedures in GPS documentation.

- Soil moisture meter – Used to measure soil moisture content in the ABS areas.

- Zip-top bags – Zip-top bags are used as sample containers for most types of environmental samples. Sample number labels will be affixed to the bags or the sample number will be hand-written in permanent marker on the bags.

- Decontamination equipment – Used to remove any residual asbestos contamination on reusable sampling equipment between the collection of samples. See Section B2.3 for standard decontamination procedures.

In addition to the generic equipment list, the following equipment will be required for sampling activities as part of this program:

- ABS air sampling equipment: 25-mm diameter mixed cellulose ester filter cassette (0.8 µm pore), high and low flow rate battery-powered air sampling pumps, rotameter, tygon tubing, rotameter, tygon tubing, belt or backpack to attach pumps to sampler

- Soil sampling equipment: trowel/shovel, 5-gallon buckets

- Tree bark sampling equipment: aerosol hairspray, battery-powered drill, 2-inch diameter hole saw, chisel

- Custody seals

B8.2 Laboratory

The laboratory manager is responsible for ensuring that all reagents and disposable equipment used in this project is free of asbestos contamination. This is demonstrated by the collection of blank samples, as described in Section B5.

B9. Non-direct Measurements

The EPA has performed several investigations at the Site to evaluate potential exposures to LA released from source materials by measuring the concentration of LA in breathing zone air during various disturbance activities. As part of these ABS studies, LA has been measured in outdoor ABS air, soil, tree bark, and duff material. The ABS air, soil, tree bark, and duff sample results from this sampling program may be compared to existing and future Libby data sets for these environmental media.

Data users will utilize the appropriate project databases to access data for comparison. See Sections B10.4 and B10.5 for additional information on project databases and data reporting. Only those data that have undergone data verification and validation (see Section D2) and been evaluated with regard to data usability (see Section D3) should be utilized for the purposes of making comparisons.

B10. Data Management

The following subsections describe the field, Troy SPF, and analytical laboratory data management procedures and requirements for this investigation. These subsections also describe the project databases utilized to manage and report data from this investigation. Detailed information regarding data management procedures and requirements can be found in the *EPA Data Management Plan* for the Libby Asbestos Superfund Site (EPA 2012).

B10.1 Field Data Management

Scribe is a software tool developed by ERT to assist in the process of managing environmental data. A Scribe project is a Microsoft Access database. Data for the Site are captured in various Scribe projects. Additional information regarding Scribe and the Libby Scribe project databases is discussed in Section B10.3.

The field data manager utilizes a "local" field Scribe project database (i.e., LibbyCDM_Field.mdb) to maintain field sample information. The term "local" denotes that the database resides on the server or personal computer of the entity that is responsible for the creating/managing the database. It is the responsibility of the field data manager to ensure that all local field Scribe project databases are backed-up nightly to a local server.

Field sample information from the FSDS is manually entered by a member of the field sample coordination staff using a series of standardized data entry forms (i.e., DE Tool). This tool is a Microsoft Access database that was originally developed by ESAT. The DE Tool is currently maintained by CDM Smith and resides on the local server in the Libby field office. This tool is used to prepare an electronic COC. Data in the DE Tool are imported into the local field Scribe project database by the field data manager.

It is the responsibility of the field data manager to "publish" sample and COC information from the local field Scribe database to Scribe.NET on a daily basis. It is not until a database has been published via Scribe.NET that it becomes available to external users.

B10.2 Troy SPF Data Management

The Troy SPF utilizes a local SPF Scribe project database to maintain soil sample preparation information. Soil preparation information from the preparation log sheets is entered into the local SPF Scribe project database by SPF personnel. After the data entry is checked against the original forms, it is the responsibility of the SPF manager (or their designate) to publish soil sample preparation information from the local SPF Scribe database to Scribe.NET.

B10.3 Analytical Laboratory Data Management

The analytical laboratories utilize several standardized data reporting tools developed specifically for the Libby project to ensure consistency between laboratories in the presentation and submittal of analytical data. In general, a unique Libby-specific EDD has been developed for each analytical method and each sampling medium. Electronic copies of all current EDD templates are provided in the Libby Lab eRoom.

Once the analytical laboratory has populated the EDD with results, the spreadsheet(s) are transmitted via email to the ESAT TEM Laboratory Manager, the ESAT project data manager, and the FTL (or their designate). (Other email recipients may also be specified by the ESAT LC).

The ESAT project database manager utilizes a local analytical Scribe project database (i.e., LibbyLab2012.mdb) to maintain analytical results information. The EDDs are uploaded directly into the analytical Scribe project database. It is the responsibility of the ESAT project data manager to publish analytical results information from the local analytical Scribe database to Scribe.NET.

B10.4 Libby Project Database

As noted above, Scribe is a software tool developed by ERT to assist in the process of managing environmental data. A Scribe project is a Microsoft Access database. Multiple Scribe projects can be stored and shared through Scribe.NET, which is a web-based portal that allows multiple data users controlled access to Scribe projects. Local Scribe projects are "published" to Scribe.NET by the entity responsible for managing the local Scribe project. External data users may "subscribe" to the published Scribe projects via Scribe.NET to access data. Subscription requests are managed by ERT.

All data collected for this investigation will be maintained in Scribe. As discussed above, data will be are captured in various Scribe project databases, including a field Scribe project (i.e., LibbyCDM_Field.mdb) and an analytical results Scribe project (i.e., LibbyLab2012.mdb).

B10.5 Data Reporting

Data users can access data for the Libby project through Scribe.NET. To access data, a data user must first download the Scribe application from the EPA ERT website[3]. The data user must then subscribe to each of the published Scribe projects for the Site using login and password information that are specific to each individual Scribe project. Scribe subscriptions for the Libby project are managed by ERT. Using the Scribe application, a data user may download a copy of any published Scribe project database to their local hard drive. It is the responsibility of the data user to regularly update their local copies of the Libby Scribe projects via Scribe.NET.

The Scribe application provides several standard queries that can be used to summarize and view results within an individual Scribe project. However, these standard Scribe queries cannot be used to summarize results across multiple Scribe projects (e.g., it is not possible to query both the "LibbyCDM_Field" project and the "LibbyLab2012" project using these standard Scribe queries).

If data users wish to summarize results across multiple published Scribe projects, there are two potential options. Data users may request the development of a "combined" project from ERT. This combined project compiles tables from multiple published Scribe projects into a single

[3] http://www.ertsupport.org/scribe_home.htm

Scribe project. This allows data users to utilize the standard Scribe queries to summarize and view results.

Alternatively, data users may download copies of multiple published Scribe project databases for the Site and utilize Microsoft Access to create user-defined queries to extract the desired data across Scribe projects. This requires that the data user is proficient in Microsoft Access and has an intimate knowledge of proper querying methods for asbestos data for the Site.

It is the responsibility of the data users to perform a review of results generated by any data queries and standard reports to ensure that they are accurate, complete, and representative. If issues are identified by the data user, they should be reported to the EPA Region 8 data manager for resolution via email (Mosal.Jeffrey@epa.gov). It is the responsibility of the EPA Region 8 data manager to notify the appropriate entity (e.g., field, Troy SPF, analytical laboratory) in order to rectify the issue. A follow-up email will be sent to the party reporting the issue to serve as confirmation that a resolution has been reached and any necessary changes have been made.

C Assessment and Oversight

Assessments and oversight reports to management are necessary to ensure that procedures are followed as required and that deviations from procedures are documented. These reports also serve to keep management current on field activities.

C1. Assessment and Response Actions

C1.1 Assessments

System assessments are qualitative reviews of different aspects of project work to check the use of appropriate QC measures and the general function of the QA system. Field and office system assessments will be performed under the direction of CDM Smith's QA Director, with support from the CDM Smith QA Manager. As noted previously, it is anticipated that a field audit will be performed during this sampling program. The field audit findings will be documented in an audit report. A copy of the report will be provided to the EPA RPM and the QATS contractor. Field surveillances may be conducted if field processes are revised or other QA/QC procedures indicate potential deficiencies.

Laboratory system assessments/audits will be coordinated by the EPA. Performance assessments for the laboratories may be accomplished by submitting blind reference material (i.e., performance evaluation samples). These assessment samples are samples with known concentrations that are submitted to the laboratories without identifying them as such to the laboratories. Performance assessments will be coordinated by the EPA.

C1.2 Response Actions

Corrective response actions will be implemented on a case-by-case basis to address quality problems. Minor actions taken to immediately correct a quality problem will be documented in the applicable field or laboratory logbooks and a verbal report will be provided to the appropriate manager (e.g., the FTL or EPA LC). Major corrective actions will be approved by the EPA Remedial Project Manager and the appropriate manager prior to implementation of the change. Major response actions are those that may affect the quality or objective of the investigation. EPA project management will be notified when quality problems arise that cannot be corrected quickly through routine procedures.

In addition, when modifications to this SAP/QAPP are required, either for field or laboratory activities, a ROM must be completed by field staff and approved by the EPA prior to implementation.

C2. Reports to Management

No regularly-scheduled written reports to management are planned as part of this project. However, QA reports will be provided to management for routine audits and whenever quality problems are encountered. Field staff will note any quality problems on FSDSs or in field logbooks. Further, the CDM Smith project manager will inform EPA project management upon encountering quality issues that cannot be immediately corrected. Weekly reports and change request forms are not required for work performed under this SAP/QAPP.

D Data Validation and Usability

D1. Data Review, Verification and Validation

D1.1 Data Review

Data review of Scribe project data typically occurs at the time of data reporting by the data users and includes cross-checking that sample IDs and sample dates have been reported correctly and that calculated analytical sensitivities or reported values are as expected. If discrepancies are found, the data user will contact the EPA database administrator, who will then notify the appropriate entity (field, preparation facility, or laboratory) in order to correct the issue.

D1.2 Criteria for LA Measurement Acceptability

Several factors are considered in determining the acceptability of LA measurements in samples analyzed by TEM. This includes the following:

1. *Evenness of filter loading.* This is evaluated using a chi-squared (CHISQ) test, as described in International Organization for Standardization 10312 Annex F2. If a filter fails the CHISQ test for evenness, the result may not be representative of the true concentration in the sample, and the result should be given low confidence.
2. *Results of QC samples.* This includes both field and laboratory QC samples, such as field and laboratory blank samples, as well as various types of recount and re-preparation analyses. If significant LA contamination is detected in field or laboratory blanks, all samples prepared on that day should be considered to be potentially biased high. If agreement between original analyses and field or laboratory duplicates (i.e., repreparation or recount analyses) is poor, results for those samples should be given low confidence.

D2. Verification and Validation Methods

D2.1 Data Verification

Data verification includes checking that results have been transferred correctly from the original hand-written, hard copy field and analytical laboratory documentation to the project databases. The goal of data verification is to identify and correct data reporting errors.

For analytical laboratories that utilize the Libby-specific EDD spreadsheets, data checking of reported analytical results begins with automatic QC checks that have been built into the spreadsheets. In addition to these automated checks, because these results will be reported to property owners, a detailed manual data verification effort will be performed for 100% of all samples and TEM analytical results collected as part of this sampling effort. This data verification process utilizes Site-specific SOPs (see **Appendix B**) developed to ensure TEM results and field sample information in the project databases is accurate and reliable:

- EPA-LIBBY-09 – SOP for TEM Data Review and Data Entry Verification – This Site-specific SOP describes the steps for the verification of TEM analyses, based on a review of the laboratory benchsheets, and verification of the transfer of results from the benchsheets into the project database.

- EPA-LIBBY-11 - SOP for FSDS Data Review and Data Entry Verification – This Site-specific SOP describes the steps for the verification of field sample information, based on a review of the FSDS form, and verification of the transfer of results from the FSDS forms into the project database. An FSDS review is performed on all samples selected for TEM or PLM data verification.

The data verification review ensure that any data reporting issues are identified and rectified to limit any impact on overall data quality. If issues are identified during the data verification, the frequency of these checks may be increased as appropriate.

Data verification will be performed by appropriate technical staff that are familiar with project-specific data reporting, analytical methods, and investigation requirements. The data verifier will prepare a data verification report (template reports are included in the SOPs) to summarize any issues identified and necessary corrections. A copy of this report will be provided to the appropriate project data manager, LC, and the EPA RPM. The data verifier will also transmit the results of the data verification, including any electronic files summarizing identified discrepancies, via email to the EPA Region 8 data manager (Mosal.Jeffry@epa.gov) for resolution. A follow-up email will be sent to the data verifier to serve as confirmation that a resolution has been reached on any issues identified.

It is the responsibility of the EPA Region 8 data manager to coordinate with the FTL and/or LC to resolve any project database corrections and address any recommended field or laboratory procedural changes from the data verifier. The EPA Region 8 data manager is also responsible for electronically tracking in the project database which data have been verified, who performed the verification, and when.

D2.2 Data Validation

Unlike data verification, where the goal is to identify and correct data reporting errors, the goal of data validation is to evaluate overall data quality and to assign data qualifiers, as appropriate, to alert data users to any potential data quality issues. Data validation will be performed by the QATS contractor (or their designate), with support from technical support staff that are familiar with project-specific data reporting, analytical methods, and investigation requirements.

Data validation for asbestos should be performed in basic accordance with the draft *National Functional Guidelines (NFG) for Asbestos Data Review* (EPA 2011), and should include an assessment of the following:

- Internal and external field audit/surveillance reports
- Field ROMs
- Field QC sample results
- Internal and external laboratory audit reports
- Laboratory contamination monitoring results
- Laboratory ROMs
- Internal laboratory QC analysis results
- Inter-laboratory analysis results
- Performance evaluation results
- Instrument checks and calibration results
- Data verification results (i.e., in the event that the verification effort identifies a larger data quality issue)

A comprehensive data validation effort should be completed quarterly and results should be reported as a technical memorandum. This technical memorandum shall detail the validation procedures performed and provide a narrative on the quality assessment for each type of asbestos analysis, including the data qualifiers assigned, and the reason(s) for these qualifiers. The technical memorandum shall detail any deficiencies and required corrective actions.

The QATS contractor will also prepare an annual addendum to the *Quality Assurance and Quality Control Summary Report for the Libby Asbestos Superfund Site* (CDM Smith 2011) to summarize results of the quarterly data validation efforts. This addendum should include a summary of any data qualifiers that are to be added to the project database to denote when results do not meet NFG guidelines and/or project-specific acceptance criteria. This addendum should also include recommendations for Site QA/QC program changes to address any data quality issues.

The data validator will transmit the results for each data validation effort via email to the EPA Region 8 data manager (Mosal.Jeffrey@epa.gov). This email should include an electronic summary of the records that have been validated, the date they were validated, any recommended data qualifiers, and their associated reason codes. It is the responsibility of the EPA Region 8 data manager to ensure that the appropriate data qualifiers and reason codes recommended by the data validator are added to the project database, and to electronically track in the project database which data have been validated, who performed the validation, and when.

In addition to performing quarterly data validation efforts, it is the responsibility of the QATS contractor (or their designate) to perform regular evaluations of all field blanks and SPF preparation blanks, to ensure that any potential contamination issues are quickly identified and resolved. If any blank contamination is noted, the QATS contractor should immediately contact the appropriate field QAM or SPF QAM to ensure that corrective actions are made.

D3. Reconciliation with User Requirements

It is the responsibility of data users to perform a data usability assessment to ensure that DQOs have been met, and reported investigation results are adequate and appropriate for their intended use. This data usability assessment should utilize results of the data verification and data validation efforts to provide information on overall data quality specific to each investigation.

The data usability assessment should evaluate results with regard to several data usability indicators. **Table D-1** summarizes several indicators of data usability and presents general evaluation methods for each indicator. Depending upon the nature of the investigation, other evaluation methods may also be appropriate. The data usability assessment results and conclusions should be included in any investigation-specific data summary reports.

Non-attainment of project requirements may result in additional sample collection or field observations in order to achieve project needs.

Table D-1: General Evaluation Methods for Assessing Asbestos Data Usability

Data Usability Indicator	General Evaluation Method
Precision	Sampling – Review results for co-located samples and field duplicates to provide information on variability arising from medium spatial heterogeneity and sampling and analysis methods. Soil Preparation – Review results for preparation duplicates to provide information on variability arising from sample preparation and analysis methods. Analysis – Review results for TEM laboratory duplicates, filter replicates, recounts, and repreparations to provide information on variability arising from analysis methods. Review results for inter-laboratory analyses to provide information on variability and potential bias between laboratories.
Accuracy/Bias	Calculate the background filter loading rate and use results to assign detect/non-detect in basic accordance with ASTM 6620-00. For air samples, determine the frequency of indirect preparation. Review results for LA-specific soil performance evaluation standards to provide information on direction/magnitude of potential bias. Review results for blanks to provide information on potential contamination.
Representativeness	Review relevant field audit report findings and any field/laboratory ROMs for potential data quality issues.
Comparability	Compare the sample collection SOPs, preparation techniques, and analysis methods to previous investigations.
Completeness	Determine the percent of samples that were able to be successfully collected and analyzed (e.g., 99 of 100 samples, 99%).
Sensitivity	Determine the fraction of all analyses that stopped based on the area examined stopping rule (i.e., did not achieve the target sensitivity).

ASTM = American Society of Testing and Materials
LA = Libby amphibole
QATS = Quality Assurance Technical Support
ROM = record of modification
SOP = standard operating procedure
TEM = transmission electron microscopy

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Sampling and Analysis Plan/Quality Assurance Project Plan
Comparative Exposure – Eureka, Helena, Whitefish
Libby Asbestos Site, Operable Unit 4
Revision 1 – July 2012

FIGURES

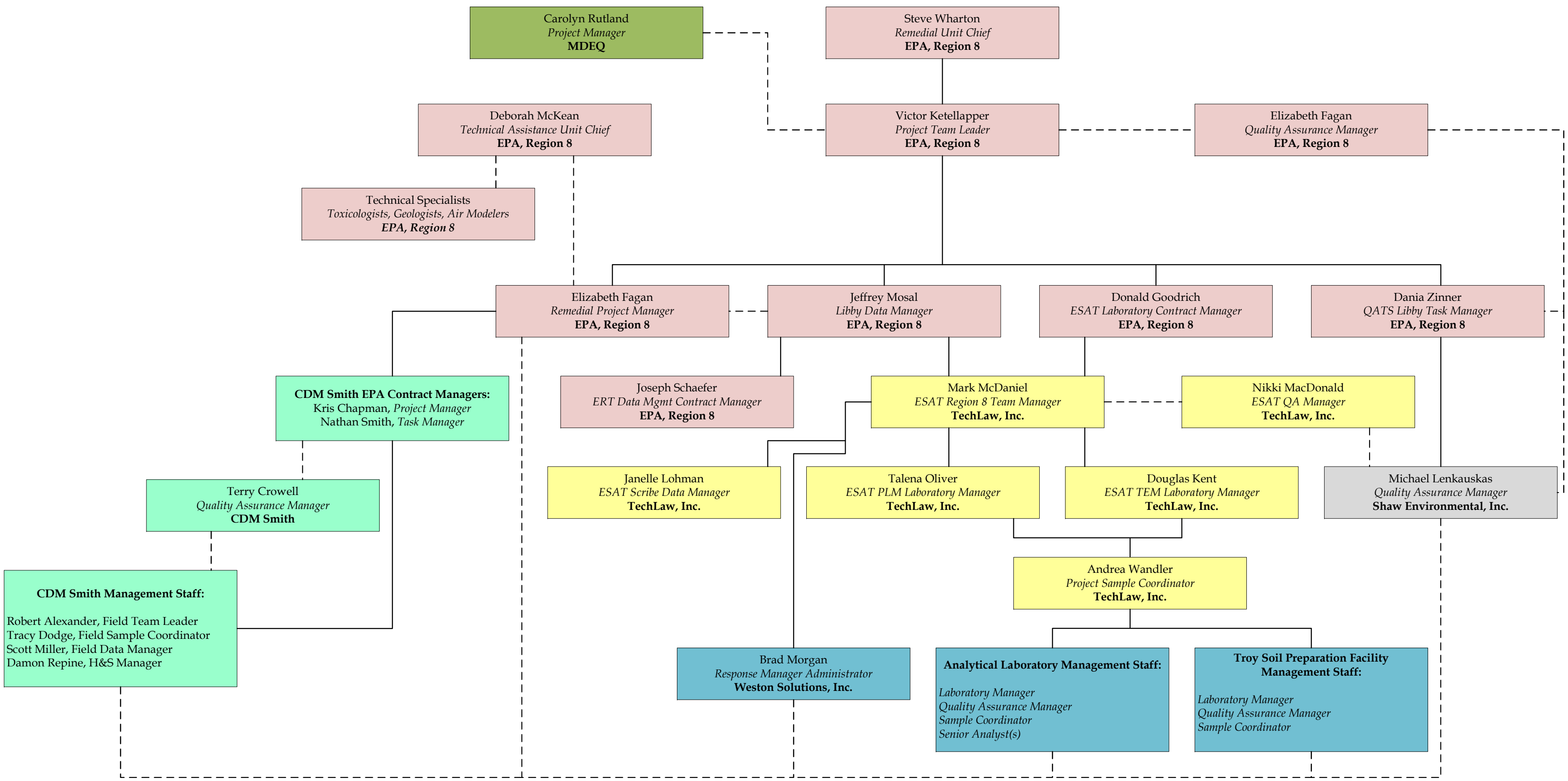

Figure A-1. Organizational Chart for the Comparative Exposure Sampling Program

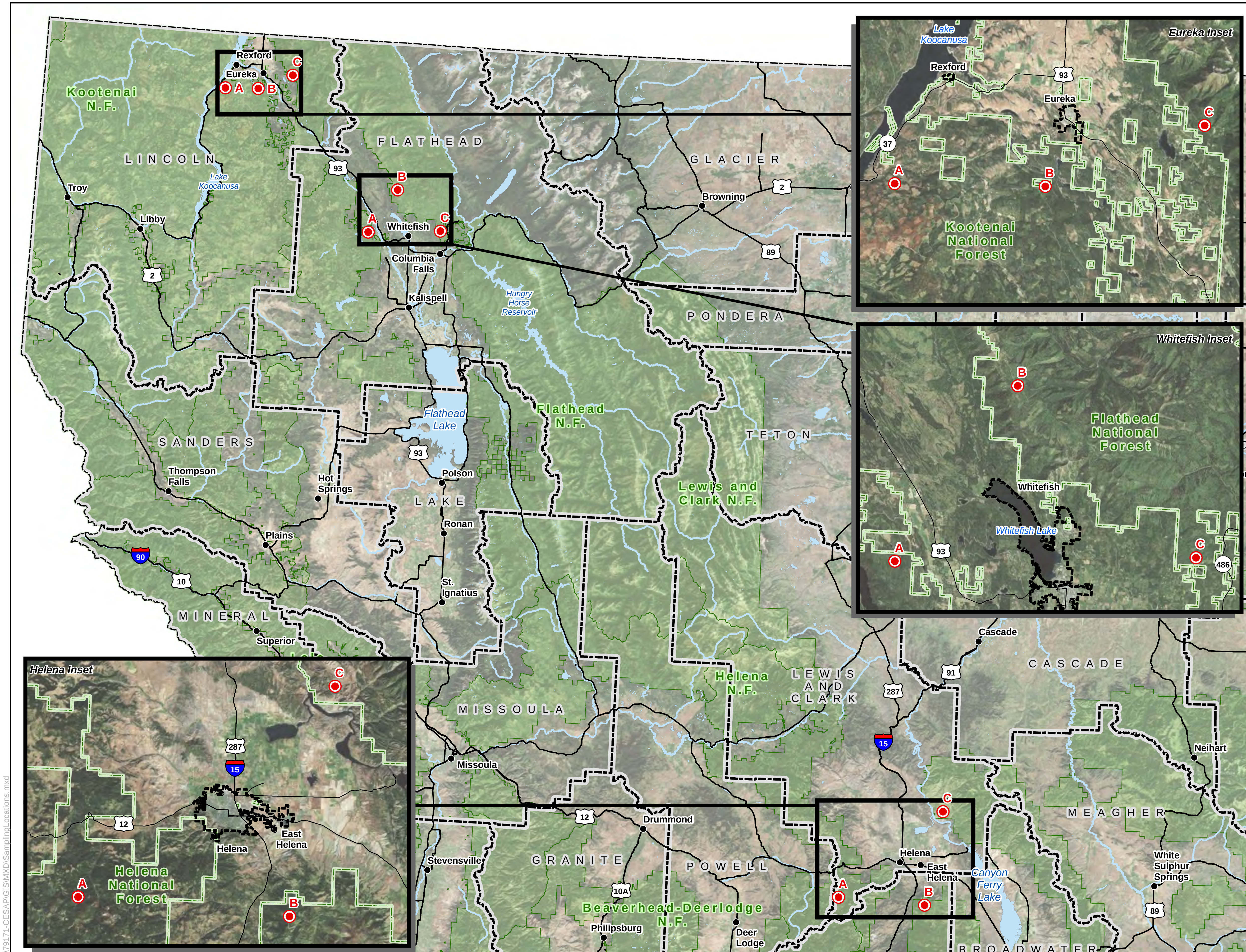

Figure B-1: Sampling Locations for Eureka, Helena, and Whitefish
[Revision 1]

Legend

- Samping Location
- Populated Place
- Primary Road
- Waterbody
- River
- US Administrative Forest
- County Boundary

N W E S

Miles
0 10 20 40

Data Sources:
Bing Maps Aerial Imagery,
US Census, USGS,
USDA, ESRI

CDM Smith

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Sampling and Analysis Plan/Quality Assurance Project Plan
Comparative Exposure – Eureka, Helena, Whitefish
Libby Asbestos Site, Operable Unit 4

Revision 1 – July 2012

Appendix A
Data Quality Objectives (DQOs)

Appendix A

Data Quality Objectives for the Comparative Exposure Study

Data quality objectives are statements that define the type, quality, quantity, purpose, and use of data to be collected. The design of a study is closely tied to the DQOs, which serve as the basis for important decisions regarding key design features such as the number and location of samples to be collected and types of analyses to be performed. The EPA has developed a seven-step process for establishing DQOs to help ensure that data collected during a field sampling program will be adequate to support reliable site-specific risk management decisions (EPA 2001, 2006).

The following sections implement the seven-step DQO process associated with this SAP.

A.1 Step 1: State the Problem

Previous investigations conducted at the Libby Asbestos Superfund Site (Site) have demonstrated that LA is present in environmental source media (e.g., soil, tree bark, duff material) at locations in and around the Site. As a result, individuals may be exposed to LA that is released to air during source disturbance activities. These inhalation exposures may pose a risk of cancer and/or non-cancer effects.

The EPA has also performed several investigations at the Site to evaluate potential exposures to LA released from source materials by measuring the concentration of LA in breathing zone air during various disturbance activities, referred to as "activity-based sampling" (ABS). As part of these ABS studies, LA has been measured in outdoor ABS air, soil, tree bark, and duff material. However, there are no data on LA concentrations in these media from cities/towns near the Site that are not impacted by the mine which can provide a frame of reference for the purposes of making comparisons to exposures in Libby.

A.2 Step 2: Identify the Goal of the Study

The goal of this study is to measure LA concentrations in outdoor ABS air and other environmental source media that can be used to compare to levels measured in Libby. Results will be used by risk managers to provide a frame of reference for the purposes of interpreting estimated exposures and establishing the spatial extent of LA contamination at the Site.

A.3 Step 3: Identify Information Inputs

The following subsections describe the types of information needed to meet the study goals. Each subsection summarizes the information needed for each medium, including outdoor ABS air, soil, duff material, and tree bark.

A.3.1 Outdoor ABS Air Concentrations of LA

The information needed consists of reliable measurements of LA concentrations in air under realistic and representative scenarios that are characteristic of soil-disturbing activities in locations that can provide a frame of reference for levels measured in outdoor ABS air in OU4.

Disturbance Activities

People may disturb soil or other LA-contaminated source materials by a variety of different activities. It is not feasible to evaluate every possible type of disturbance, so ABS should be performed using selected scenarios that are considered to be representative examples of disturbances that have been evaluated in other outdoor ABS programs. In particular, there are two ABS scenarios that are of interest – a digging scenario (simulating a child playing in the dirt) and a fireline scenario (simulating a firefighter digging a fireline by hand).

The digging ABS scenario was evaluated as part of the *2011 Miscellaneous ABS SAP for OU4* (EPA 2011). In brief, at each ABS area, a 5-gallon bucket of soil is collected and brought to a standardized location where the ABS is conducted. ABS personnel will sit on the ground and empty the soil from the 5-gallon container onto the ground. Then, they will use a hand trowel to place the soil back into the container. Once all the soil has been placed back into the container, the process will be repeated.

The fireline ABS scenario was evaluated as part of the *Phase IV Part A SAP for OU3* (EPA 2010). In brief, trees and brush are removed using a chainsaw. Then, a Pulaski tool or other similar device is used to scrape away all combustible material down to mineral soil to establish a fireline approximately 18 inches wide.

Type of Air Sample

Experience at Libby and at other asbestos sites has demonstrated that personal air samples (i.e., samples that collect air in the breathing zone of a person) tend to have higher concentrations of LA than air samples collected by a stationary monitor (EPA 2007a), especially if the person is engaged in an activity that disturbs an asbestos source such as contaminated soil. Because personal air samples are more representative of breathing zone exposures, this study should focus on the collection of personal air samples during ABS. ABS measurements should be obtained by drawing a known volume of air through a filter that is located in the breathing zone of the individual performing the disturbance activity and measuring the number of LA structures that become deposited on the filter surface.

Analysis Method

ABS air samples should be analyzed for LA using TEM. Because the toxicity of asbestos when inhaled may depend on the structure dimensions and asbestos mineral type, results should include the size attributes (length, width) of each asbestos structure observed, along with the mineral classification (LA, other amphibole, chrysotile). Meeker *et al*. (2003) observed that most LA structures from the Libby ore body contain detectable levels of both sodium and potassium, whereas LA originating from other potential sources may not. Thus, information on the sodium and potassium content of each LA structure observed, as determined by energy dispersive spectroscopy (EDS), should also be recorded.

A.3.2 Soil Concentrations of LA

The information needed consists of reliable measurements of LA concentrations in the soils that are being disturbed during the ABS effort in locations that can provide a frame of reference for levels measured in soils at the Site.

Type of Soil Sample

Soil samples should be collected using a sampling design that allows for estimation of the average level of LA in the soil that is being disturbed as part of the digging ABS effort (i.e., a single multi-point composite sample or multiple single-point samples from which a mean can be calculated). Results should provide an estimate of the level (e.g., mass percent [wt%], asbestos structures per gram [s/g] of soil) of LA in soil.

Analysis Method

Polarized light microscopy (PLM) is the typical method that is used to analyze solid media for asbestos. However, PLM is not generally intended for assessing low-level (<1%) asbestos contamination in soil. More recently, a new soil preparation method using FBAS has been utilized to allow for the analysis of soil by TEM. Preliminary method performance evaluations show that TEM analyses of soil prepared using the FBAS method were able to reliably quantify LA concentrations of 0.005 wt% and lower in soil (Januch *et al.* 2012). Results from the TEM analysis provide an estimate of the LA level in soil as asbestos s/g of soil (from which an estimate based on mass percent can be derived). Therefore, soils should be analyzed for asbestos by TEM after preparation using the FBAS method.

Because it is possible that, if present, the asbestos observed in soils from the areas of interest may be different from the type of asbestos derived from the Libby ore body at the mine site, TEM analysis results should include the size attributes (length, width) of each asbestos structure observed, along with the mineral classification (LA, other amphibole, chrysotile). In addition, information on the sodium and potassium content of each LA structure observed, as determined by EDS, should also be recorded.

A.3.3 Duff Material Concentrations of LA

The information needed consists of reliable measurements of LA concentrations in duff materials in locations that can provide a frame of reference for levels in duff material measured at the Site.

Type of Duff Sample

Duff samples should be collected using a sampling design that allows for estimation of the average level of LA in the soil that is being disturbed as part of the fireline ABS effort (i.e., a single multi-point composite sample or multiple single-point samples from which a mean can be calculated). In addition, duff samples should be collected in a manner that is equivalent to the sample collection methods used in previous sampling efforts. Results should provide an estimate of the level (e.g., asbestos structures per gram of dried duff [s/g, dry weight]) of LA in duff.

Analysis Method

Duff samples should be analyzed for LA using TEM. As noted above, because it is possible that, if present, the asbestos observed in duff from the areas of interest may be different from the type of asbestos derived from the Libby ore body at the mine site, TEM analysis results should include the size attributes (length, width) of each asbestos structure observed, along with the mineral classification (LA, other amphibole, chrysotile). In addition, information on the sodium and potassium content of each LA structure observed, as determined by EDS, should also be recorded.

A.3.4 Tree Bark Concentrations of LA

The information needed consists of reliable measurements of LA concentrations in tree bark in locations that can provide a frame of reference for levels in tree bark measured at the Site.

Type of Tree Bark Sample

Tree bark samples should be collected using a sampling design that allows for direct comparison to tree bark samples collected as part of previous sampling efforts (e.g., during Phase I of the OU3 remedial investigation study). Results should provide an estimate of the level of LA loading on the tree bark surface (e.g., asbestos structures per cm^2 of area [s/cm^2]).

Analysis Method

Tree bark samples should be analyzed for LA using TEM. As noted above, because it is possible that, if present, the asbestos observed in tree bark from the areas of interest may be different from the type of asbestos derived from the Libby ore body at the mine site, TEM analysis results should include the size attributes (length, width) of each asbestos structure observed, along with the mineral classification (LA, other amphibole, chrysotile). In addition, information on the sodium and potassium content of each LA structure observed, as determined by EDS, should also be recorded.

A.4 Step 4: Define the Bounds of the Study

The following sections specify the geographic (spatial) and temporal boundaries of this study.

A.4.1 Spatial Bounds

As noted above, this study seeks to collect data on LA concentrations from cities/towns near the Site that are not impacted by the mine, which can provide a frame of reference for Libby. In the past, two cities that have been selected for the purposes of providing reference data in the ambient air monitoring investigations are Eureka, Montana and Helena, Montana. Thus, these two cities should be included in this investigation. In addition, the town of Whitefish, Montana, which is located about 15 miles north of Kalispell, Montana, is in a predominant downwind direction (northeast) from the vermiculite mine and should also be included in this investigation.

To avoid sampling access issues, sample collection areas within each city/town should be selected in locations that are state or federally owned. To minimize potential impacts from anthropogenic sources, locations that are outside of the city limits are preferred. There is no reason that sampling locations for each medium need to be the same (e.g., tree bark does not necessarily need to be collected in the same area as soil); however, to maximize data interpretation across multiple media, to the extent feasible, sampling locations for each medium should be co-located.

A.4.2 Temporal Bounds

Outdoor ABS Air Sampling

The level of asbestos in outdoor ABS air under soil-disturbance activities can depend on factors that vary seasonally (e.g., soil moisture, wind speed, humidity, etc.). As noted above, ABS should be performed under conditions that have a high probability of resulting in measureable ABS air concentrations of LA, if it is present.

In general, it is expected that asbestos releases from outdoor source materials (soil, duff) are more likely to occur when snow cover is limited or absent, and that releases will tend to be higher during drier conditions. Based on this, outdoor ABS should be restricted to summer months (July-September), when conditions for asbestos release are generally favorable. The exact dates of ABS sampling are not important and may be selected at random. Note: ABS sampling should not occur if rainfall in the past 36 hours has exceeded ¼ inch, if there is standing water present, or if the moisture content of the soil is greater than 50%.

Soil, Duff Material, and Tree Bark Sampling

It is not thought that the asbestos levels in soil, duff, or tree bark are likely to be highly time-variable in a static environment. However, source material samples should be collected prior to ABS to ensure that the ABS activity itself does not alter the potential asbestos levels.

A.5 Step 5: Define the Analytic Approach

Data collected as part of this study can be used to support comparative evaluations that will provide a frame of reference for levels of LA measured in environmental media at the Libby Site.

These comparisons may be made using a variety of methods, ranging from simple visual comparisons using graphical plots to statistical comparisons using the Poisson ratio test (Nelson 1982). The Poisson ratio test can only be used in making statistical comparisons between individual samples or pooled concentrations. No statistically valid approach is available for making comparisons of asbestos datasets that cannot be pooled; therefore, these types of comparisons will rely upon graphical presentations.

A.6 Step 6: Specify Acceptance Criteria

When making statistical comparisons between two ABS datasets, the goal is to be able to have adequate power to reject the null hypothesis if the difference between the datasets is greater than some specified level. However, because there is no statistically valid approach for making comparisons of asbestos datasets, it is not possible to calculate the number of samples required to achieve a desired statistical power. Measured LA concentrations from previous sampling efforts show that data can be highly variable as a consequence of inherent sampling variability and analytical measurement error. Because of this, it may be nearly impossible to distinguish small differences (e.g., factor of 2-3) between datasets.

A.7 Step 7: Develop the Plan for Obtaining Data

The following sections present a sampling design that will yield data that will address the DQOs specified in Steps 1-6 above.

A.7.2 Study Design Considerations

Sampling Locations and Events

It is assumed that the sampling variability is likely to be higher across multiple ABS locations within each city relative to the variability within an ABS location across time. Thus, rather than performing multiple sampling events at a single ABS location within each city, this study will select multiple ABS locations within each city and perform a single ABS event. The number of ABS locations to be selected is primarily limited by budgetary constraints. At a minimum, three ABS locations within each city should be selected for evaluation.

ABS Air Sampling Approach

Two key variables that may be adjusted during collection of air samples are sampling duration and pump flow rate. The product of these two variables determines the amount of air drawn through the filter, which in turn is an important factor in the analytical cost and feasibility of achieving the target analytical sensitivity (TAS) (see below). In general, longer sampling times are preferred over shorter sampling times because: a) longer time intervals are more likely to yield representative measures of the average concentration (as opposed to short-term fluctuations); and b) longer collection times are associated with higher volumes, which reduces the number of grid openings that need to be examined to achieve the TAS. Likewise, higher flow rates are generally preferred over lower flow rates because high flow results in high volumes drawn through the filter over shorter sampling times.

When feasible, ABS personnel should wear two different sampling pumps – a high volume pump and a low volume pump. This will allow for the collection of two "replicate" filters (i.e., each filter represents the same sample collection duration, but different total sample air volumes). The appropriate flow rate for each sampling pump should be optimized to achieve the highest sample air volume possible without causing the filter to become overloaded.

The high volume filter will be analyzed in preference to the low volume filter. If the high volume filter is deemed to be overloaded, the low volume filter should be analyzed in preference to performing an indirect preparation on the high volume filter to avoid potential bias associated with indirect preparation[a]. If the low volume filter is deemed to be overloaded, an indirect preparation (with ashing) may be performed (following consultation with and approval from the LC).

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[a] Indirect preparation has the potential to increase the number of LA structures recorded during TEM analysis, which may bias resulting air concentrations high (Berry *et al*. 2012). However, it is expected that this potential bias is lower for amphibole asbestos relative to chrysotile asbestos (Hwang and Wang 1983; HEI-AR 1991; Breysse 1991).

TEM Stopping Rules

In general, three alternative stopping rules are specified for TEM analyses to ensure resulting data are adequate:

1. The TAS to be achieved
2. A maximum number of structures to be counted
3. A maximum area of filter to be examined

Because the goal of this study is to collect data that can be compared to data collected as part of previous studies, with one exception (fireline ABS air), the stopping rules for each medium are set equal to those utilized in previous studies. The following table summarizes the stopping rules for each medium.

Medium	TEM Stopping Rules			Previous Study Source
	Target Analytical Sensitivity	Maximum Structures Observed	Maximum Area Examined	
Digging ABS Air	0.00022 cc^{-1}	25 PCME LA structures	20 mm^2 (2,000 GOs)	2011 OU4 Miscellaneous ABS SAP, Background Soils (EPA 2011)
Fireline ABS Air	***	***	***	OU3 Phase IV Part A SAP (EPA 2010)
Soil	6.3E+03 g^{-1}	50 LA structures^{+}	1.6 mm^2 (160 GOs)	2011 OU4 Miscellaneous ABS SAP, Background Soils (EPA 2011)
Tree Bark	100,000 cm^{-2}	50 total LA structures	1 mm^2 (100 GOs)	OU3 Phase I SAP (EPA 2007b)
Duff	1E+07 g^{-1}	50 total LA structures	1 mm^2 (100 GOs)	OU3 Phase I SAP (EPA 2007b)

***TEM stopping rules were revised from previous study (see below)

$^{+}$ Based on a tiered magnification approach (i.e., initial analysis by high magnification, supplemental PCME only analysis by low magnification)

For the previous fireline ABS program, the stopping rules for ABS air samples were determined based on a risk-based concentration in air that was derived using the inhalation unit risk (IUR) value specified by the Integrated Risk Information System (IRIS). More recently, EPA has developed draft toxicity values that are LA-specific. Thus, the TEM stopping rules were re-calculated based on the LA-specific toxicity values.

Target Analytical Sensitivity

The level of analytical sensitivity needed to ensure that analysis of ABS air samples will be adequate is derived by finding the concentration of LA in ABS air that might be of potential concern, and then ensuring that if an ABS sample were encountered that had a true concentration equal to that level of concern, it would be quantified with reasonable accuracy. This process is implemented below:

Step 1. Calculation of Risk-Based Concentrations

Cancer. The basic equation for calculating the risk-based concentration (RBC) for cancer is:

RBC(cancer) = Maximum Acceptable Cancer Risk / (TWFc * IUR)

For cancer, the maximum acceptable risk is a risk management decision. For the purposes of calculating an adequate TAS, a value of 1E-05 is assumed.

The exposure parameters needed to calculate the time-weighting factor (TWF) are based on information provided by the U.S. Forest Service for firefighters in the Libby Valley, as follows:

Exposure Parameter	Value
Exposure Time (ET)	10 hours/day
Exposure Frequency (EF)	14 days/year
Exposure Duration (ED)	10 years

Based on these exposure parameters, the TWF for cancer is 0.0023 (10/24 * 14/365 * 10/70 = 0.0023). The proposed LA-specific IUR is 0.17 $(PCM\ s/cc)^{-1}$. Based on these values, the RBC for cancer is 0.026 LA PCME s/cc.

Non-Cancer. The basic equation for calculating the RBC for non-cancer effects is:

RBC(non-cancer) = (Maximum Acceptable HQ * RfC) / TWFnc

For non-cancer, the maximum acceptable HQ is 1. Based on the exposure parameters specified above, the TWF for non-cancer is 0.0027 (10/24 * 14/365 * 10/60 = 0.0027). The proposed LA-specific RfC is 0.00002 LA PCM s/cc. Based on these values, the RBC for non-cancer is 0.0075 LA PCME s/cc.

Because the non-cancer RBC is lower than the cancer RBC, the non-cancer RBC is used to derive the TAS, as follows.

Step 2: Determining the TAS

The TAS is determined by dividing the RBC by the target number of structures to be observed during the analysis of a sample with a true concentration equal to the RBC:

TAS = RBC / Target Count

The target count is determined by specifying a minimum detection frequency required during the analysis of samples at the RBC. This probability of detection is given by:

Probability of detection = 1 - Poisson(0,Target Count)

Assuming a minimum detection frequency of 95 percent, the target count is 3 structures. Based on this, the TAS is:

TAS = (0.0075 s/cc) / (3 s) = 0.0025 cc^{-1}

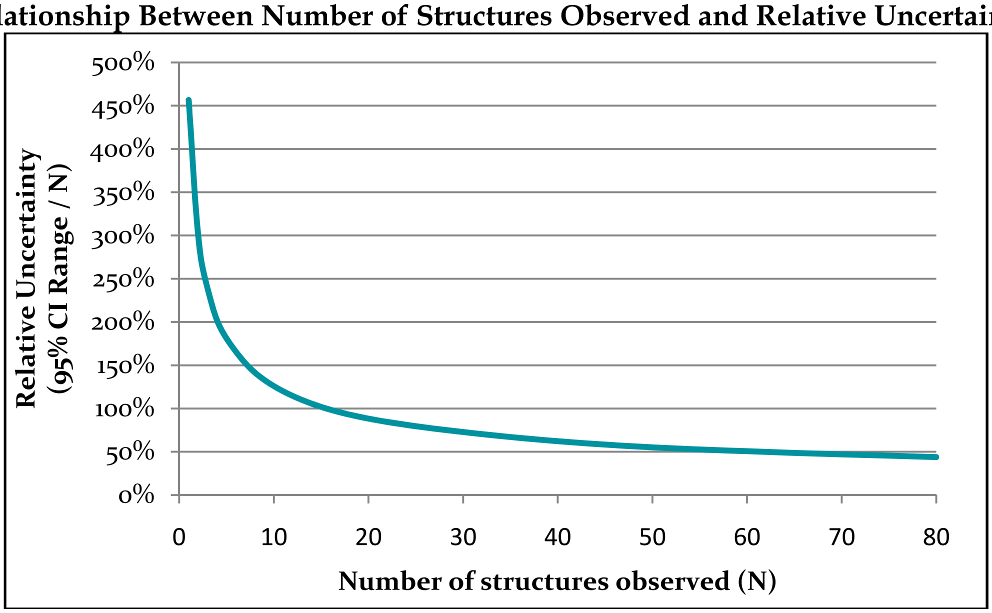
Maximum Number of LA Structures

Ideally, all samples would be examined by TEM until the TAS is achieved. However, for filters that have high asbestos loading, reliable estimates of concentration may be achieved before achieving the TAS. This is because the uncertainty around a TEM estimate of asbestos concentration in a sample is a function of the number of structures observed during the analysis. The confidence interval (CI) around a count of N structures is characterized as a chi-squared (CHISQ) distribution:

Ntrue ~ CHISQ(2 · Nobs + 1) / (2/Sensitivity)

As Nobs increases, the absolute width of the CI range increases, but the relative uncertainty (expressed as the CI range divided by Nobs) decreases. This concept is illustrated in the figure below. The goal is to specify a target N such that the resulting Poisson variability is not a substantial factor in the evaluation of method precision. As shown, above about 25 structures, there is little change in the relative uncertainty. Therefore, the count-based stopping rule for TEM should utilize a maximum structure count of at least 25 LA structures.

Relationship Between Number of Structures Observed and Relative Uncertainty



Maximum Area to be Examined

The number of grid openings that must be examined (GOx) to achieve the TAS is calculated as:

$$GOx = EFA / (TAS \cdot Ago \cdot V \cdot 1000 \cdot f)$$

where:

EFA = Effective filter area (assumed to be 385 square millimeters [mm^2])

TAS = Target analytical sensitivity $(cc)^{-1}$

Ago = Grid opening area (assumed to be 0.01 mm^2)

V = Sample air volume (liters [L])

1000 = L/cc (conversion factor in liters per cubic centimeter)

f = Indirect preparation dilution factor (assumed to be 1 for direct preparation)

Based on a sampling duration of 30 minutes and an assumption that the high flow (5.5 L/minute) filter is able to be prepared directly (i.e., f-factor = 1), , the number of grid openings needed to achieve the TAS of 0.0025 cc^{-1} is about 93 grid openings. In the event an indirect preparation is necessary, the number of grid openings that will need to be examined is inversely proportional to the dilution needed (i.e., an f of 0.1 will increase the number of grid openings by a factor of 10). In this case, it is possible that the number of grid openings that would need to be examined to achieve the target analytical sensitivity may be cost or time prohibitive. In order to limit the maximum effort expended on any one sample, a maximum area examined of 20 mm^2 is identified for this project. Assuming that each grid opening has an area of about 0.01 mm^2, this would correspond to about 2,000 grid openings.

Summary of TEM Stopping Rules

The TEM stopping rules fireline ABS air samples collected as part of this study should be as follows:

1. Count a minimum of two grid openings from each of two grids.
2. Continue counting until one of the following is achieved:
    a. The TAS (0.0025 cc^{-1}) is achieved.
    b. 25 LA structures have been observed.
    c. A total filter area of 5 mm^2 has been examined (this is approximately 500 grid openings).

When one of these criteria has been satisfied, complete the examination of the final grid opening and stop.

A.7.2 Refining the Study Design

In accordance with the EPA's DQO process, it is expected that the sampling program described in this document may be modified as data are obtained. For example, the TAS may be either increased or decreased depending on the detection frequency, mean values, and sample variability observed in the sample results. Sampling durations and pump flow rates may also be modified if a high frequency of filter overloading is reported.

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Sampling and Analysis Plan/Quality Assurance Project Plan
Comparative Exposure – Eureka, Helena, Whitefish
Libby Asbestos Site, Operable Unit 4

Revision 1 – July 2012

Appendix B
Standard Operating Procedures (SOPs)

SOP ID	SOP Description
Field Procedures	
EPA-LIBBY-2012-01	Field Logbook Content and Control
EPA-LIBBY-2012-02	Photographic Documentation of Field Activities
EPA-LIBBY-2012-04	Field Equipment Decontamination
EPA-LIBBY-2012-05	Handling Investigation-Derived Waste
EPA-LIBBY-2012-06	Sample Custody
EPA-LIBBY-2012-07	Packaging and Shipping of Environmental Samples
EPA-LIBBY-2012-10	Sampling of Asbestos Fibers in Air
EPA-LIBBY-2012-11	Sampling and Analysis of Duff for Asbestos
EPA-LIBBY-2012-12	Sampling and Analysis of Tree Bark for Asbestos
CDM-LIBBY-05	Site-Specific SOP for Soil Sample Collection
CDM-LIBBY-06	Semi-Quantitative Visual Estimation of Vermiculite in Soils at Residential and Commercial Properties
CDM-LIBBY-09	GPS Coordinate Collection and Handling
Laboratory Procedures	
EPA-LIBBY-08	Indirect Preparation of Air and Dust Samples for Analysis by TEM
ISSI-LIBBY-01	Soil Sample Preparation
ESAT-LIBBY-01	Fluidized Bed Asbestos Segregator Method for Determination of Releasable Asbestos Fibers in Soil
ESAT SOP PLM-02.00	Blank Sand Certification by Polarized Light Microscopy
Data Verification Procedures	
EPA-LIBBY-09	TEM Data Review and Data Entry Verification
EPA-LIBBY-11	FSDS Data Review and Data Entry Verification

The most recent versions of all field SOPs are provided electronically in the Libby Field eRoom (https://team.cdm.com/eRoom/R8-RAC/Libby).

The most recent version of all laboratory and data verification SOPs are provided electronically in the Libby Lab eRoom (https://team.cdm.com/eRoom/mt/LibbyLab).

Sampling and Analysis Plan/Quality Assurance Project Plan
Comparative Exposure – Eureka, Helena, Whitefish
Libby Asbestos Site, Operable Unit 4

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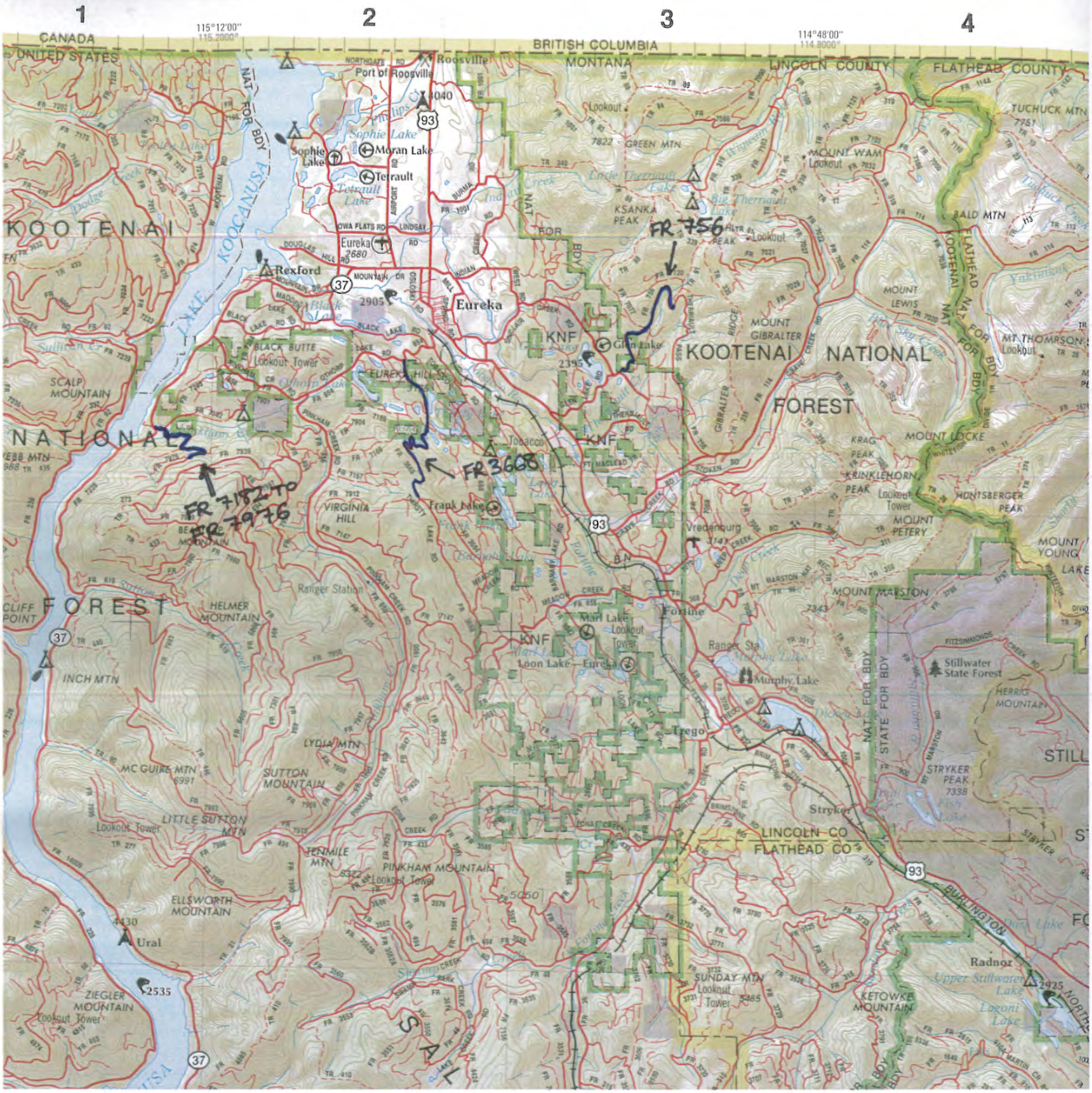
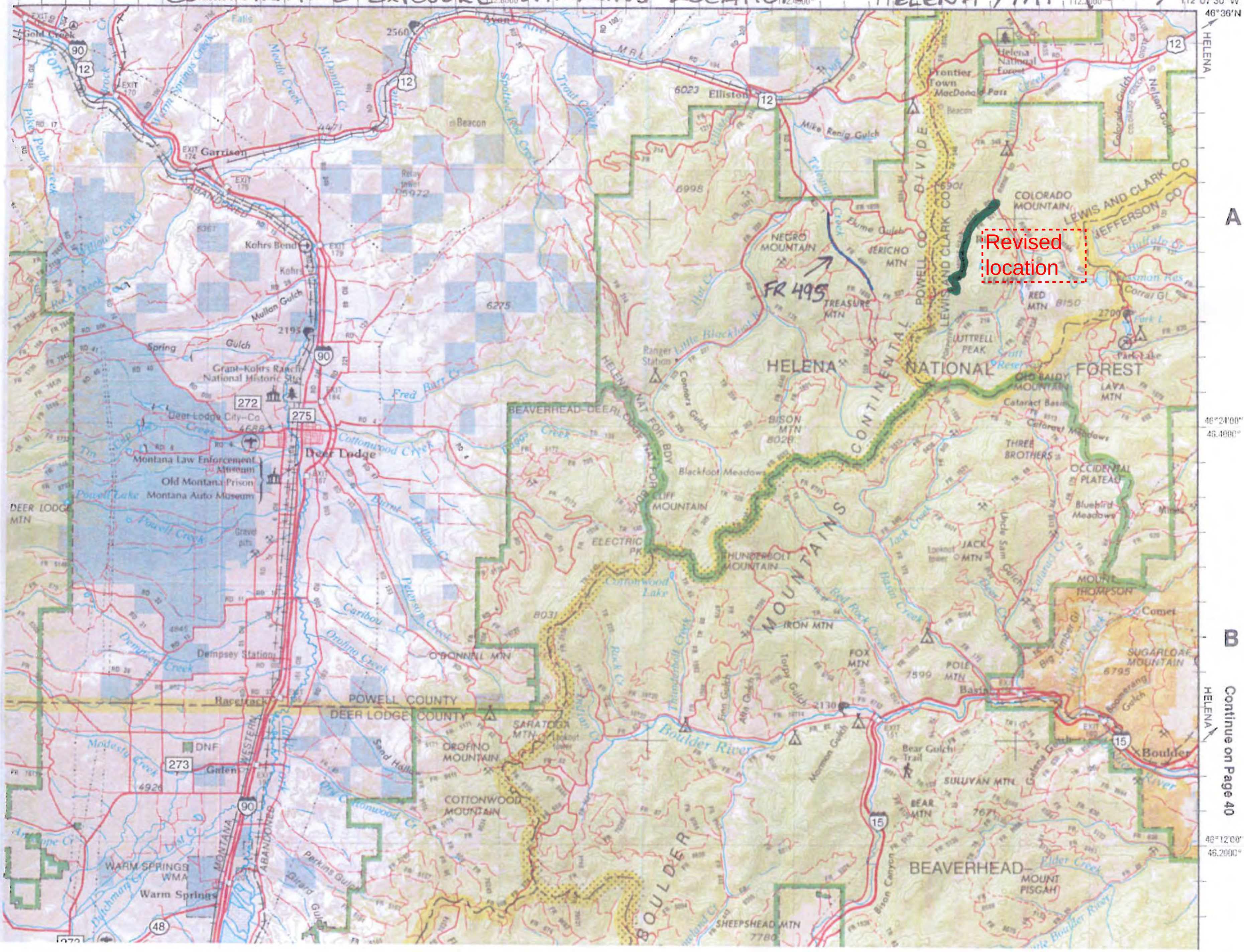
Appendix C
Detailed Map Locations

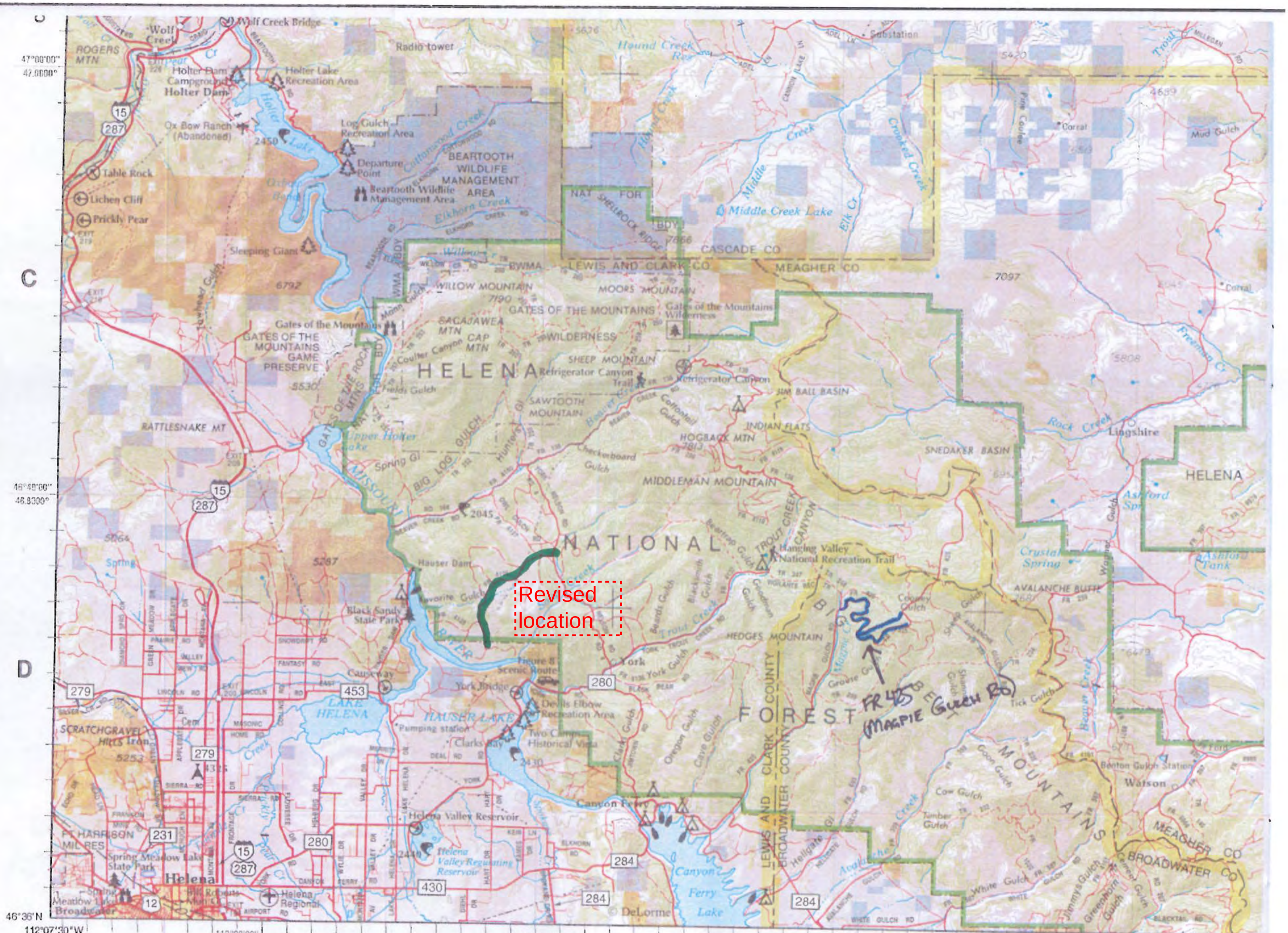


Comparative Exposure Sampling Locations - Eureka, MT

Continue on Page 55

COMPARATIVE EXPOSURE SAMPLING LOCATION - HELENA, MT (SW)





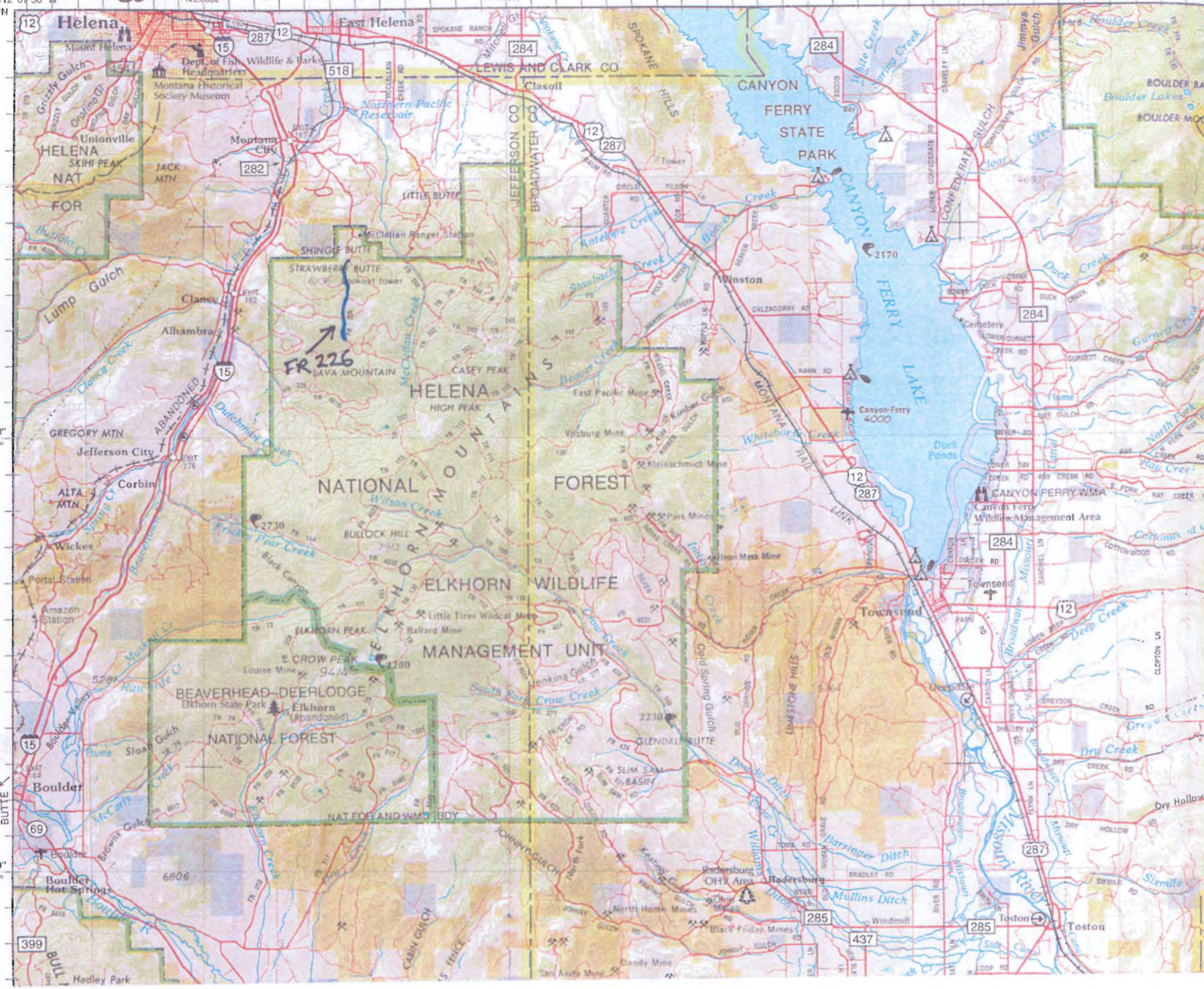
Continue on Page 40

COMPARATIVE EXPOSURE SAMPLING LOCATION - HELENA, MT (NW)

Contour interval
200 feet (61 meters)

COMPARATIVE EXPOSURE SAMPLING LOCATION - HELENA, MT (5)

Continue on Page 56



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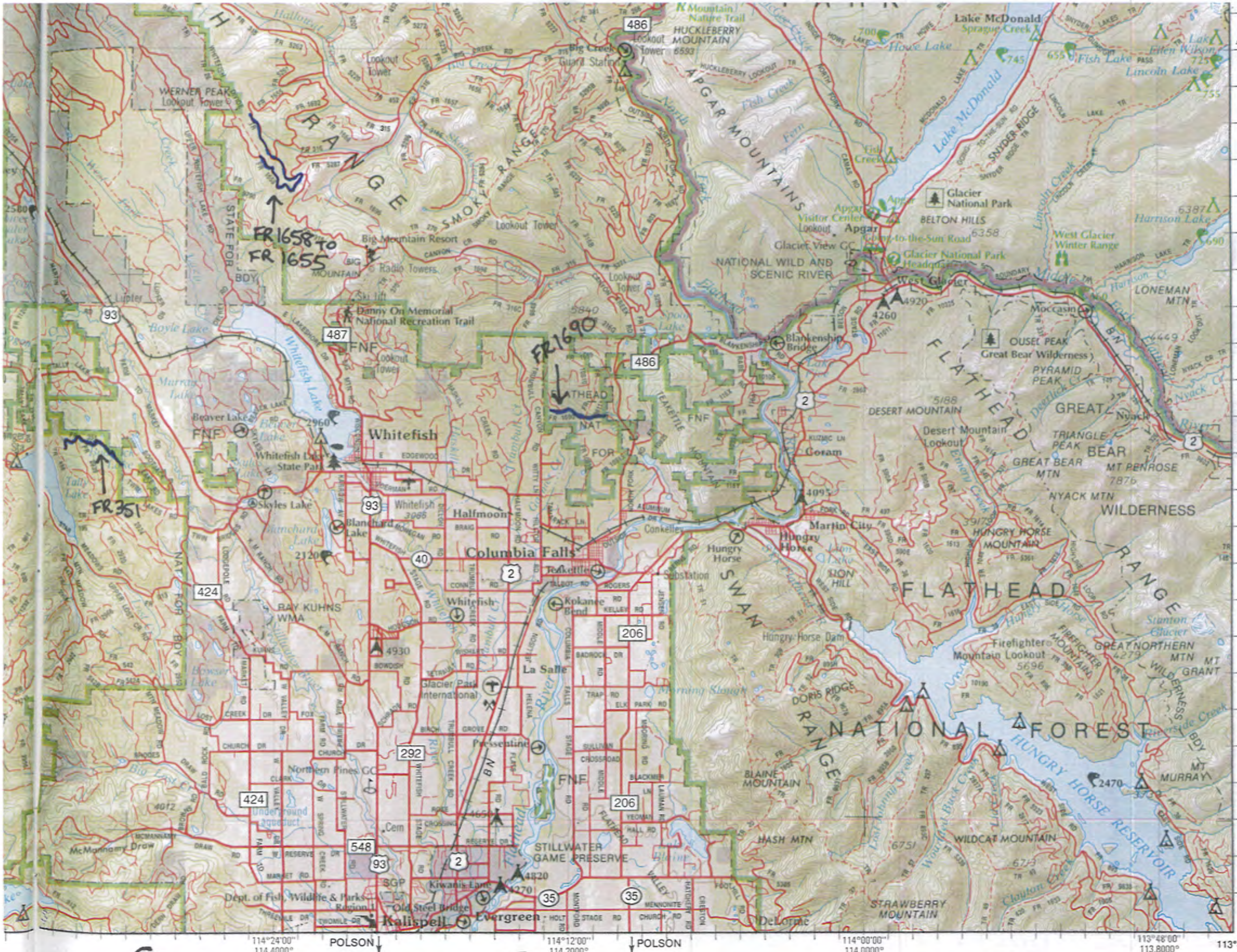
BUTTE



C

D

COMPARATIVE EXPOSURE SAMPLING LOCATIONS - WHITEFISH, MT

Scale 1:250,000

1 inch represents 4 miles

Continue on Page 67

BLM Lands

State Lands

See pages 48–49 for *Statewide Locater Map*

Sampling and Analysis Plan/Quality Assurance Project Plan
Comparative Exposure – Eureka, Helena, Whitefish
Libby Asbestos Site, Operable Unit 4

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Appendix D
ABS Scripts

Appendix D

ABS Scripts for the Comparative Exposure Study

Digging Scenario

The soil-disturbance activity will be a digging scenario that simulates a child digging and playing in the dirt. One ABS participant will sit on the ground and empty the soil from the 5-gallon container onto the ground. Then, they will use a hand trowel to place the soil back into the container. Once all the soil has been placed back into the container, the process will be repeated. Personnel will continue to fill/dump soil for a total sampling duration of 120 minutes. At the end of the sampling duration, the ABS participant will turn off the air sampling pumps and cap the sampling cassettes. This will result in total air sample volumes for the high volume pump and the low volume pump of 660 liters and 240 liters, respectively.

Fireline Scenario

The duff-disturbance activity will be a fireline cutting scenario that simulates firefighters constructing a firebreak by hand. A Pulaski tool or other similar device is used to scrape away all combustible material down to mineral soil to establish a line approximately 18 inches wide. Participants will make an effort to construct a linear firebreak, however they should adjust their path to avoid obstructions such as trees and shrubs. *(Note: The original ABS scenario that was performed in OU3 included the removal of small trees and brush using a chainsaw. Due to safety concerns, this aspect of the script was removed.)*

During an initial attack of a forest fire, these activities are typically done by a crew of four to six fire fighters. For the ABS scenario, two individuals will participate. This activity will be performed for a period of 30 minutes. The two ABS participants will work approximately 10 feet apart. After 15 minutes, the relative positions of the two samplers will be reversed. After 30 minutes, the ABS activity is ended, and both participants will turn off the air sampling pumps and cap the sampling cassettes. For each ABS participant, this will result in total air sample volumes for the high volume pump and the low volume pump of 165 liters and 60 liters, respectively.

Sampling and Analysis Plan/Quality Assurance Project Plan
Comparative Exposure – Eureka, Helena, Whitefish
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Appendix E
Analytical Requirements Summary Sheet
[COMPOU4-0612]

The most recent version of the Analytical Requirements Summary Sheet is provided electronically in the Libby Lab eRoom (https://team.cdm.com/eRoom/mt/LibbyLab).

SAP/QAPP REQUIREMENTS SUMMARY #COMPOU4-0612
SUMMARY OF PREPARATION AND ANALYTICAL REQUIREMENTS FOR ASBESTOS

Title: Sampling and Analysis Plan/Quality Assurance Project Plan, Comparative Exposure in Eureka, Helena, Whitefish, Libby Asbestos Site, Operable Unit 4

SAP Date (Revision): June 2012 (Revision 0)

EPA Technical Advisor: Elizabeth Fagen (303-312-6095, Fagen.Elizabeth@epa.gov)
(contact to advise on DQOs of SAP related to preparation/analytical requirements)

Sampling Program Overview: This program will conduct sampling in Eureka, Helena, and Whitefish. As part of this program, ABS air samples will be collected and analyzed for asbestos by TEM for two different ABS scenarios (digging, firelines). Personal air samples will also be collected for H&S monitoring and analyzed by PCM. Soil samples will be collected and analyzed for asbestos by TEM (following preparation by fluidized bed). Duff material samples will be collected and analyzed for asbestos by TEM. Tree bark samples will be collected and analyzed for asbestos by TEM.

Sample ID Prefix: CX-_ _ _ _ _

Estimated number and timing of field samples:
All samples will be collected in August 2012 timeframe (exact dates have not yet been determined).
>> ABS Air = (3 cities * 3 ABS areas * 2 ABS scenarios) = 18 samples + field QC samples
>> Soil, Duff, Tree Bark = (3 cities * 3 ABS areas) = 9 samples of each media + field QC samples

1. AIR

TEM/PCM Preparation and Analytical Requirements for Air Field Samples:

Medium Code	Medium, Sample Type	Preparation Details				Analysis Details			Applicable Laboratory Modifications (current version of)
		Investi-gative?	Indirect Prep? (b)		Filter Archive?	Method	Recording Rules (c)	Analytical Sensitivity/Prioritized Stopping Rules (d)	
			With Ashing	Without Ashing					
A	Air, ABS Digging	Yes	Yes, if material is overloaded (>25%) or unevenly loaded on filter	No	Yes	TEM – Modified ISO 10312, Annex E *(Low Mag, 5,000X)*	All PCME asbestos; L: > 5 µm W: ≥ 0.25 µm AR: ≥ 3:1	Count a minimum of 2 grid openings in 2 grids, then continue counting until one is achieved: i) the target sensitivity is achieved ii) 25 PCME LA structures are recorded iii) 20 mm^2 of filter has been examined	LB-000016, LB-000029, LB-000066, LB-000067, LB-000085
B	Air, ABS Firelines								

Medium Code	Medium, Sample Type	Preparation Details				Analysis Details			Applicable Laboratory Modifications (current version of)
		Investi-gative?	Indirect Prep? (b)		Filter Archive?	Method	Recording Rules (c)	Analytical Sensitivity/Prioritized Stopping Rules (d)	
			With Ashing	Without Ashing					
C	Air, Health & Safety	No	No	Yes, if material is overloaded (>25%) or unevenly loaded on filter	Yes	PCM – NIOSH 7400, Issue 2 TEM– AHERA (upon request)	For PCM: NIOSH 7400, "A" rules If AHERA is requested: All asbestos; L $\geq$ 0.5 µm AR $\geq$ 5:1	For PCM: Count a minimum of 20 FOVs, then continue counting until one is achieved: i) 100 fibers are recorded ii) 100 FOVs are examined (regardless of count) For AHERA: Examine 0.1 mm^2 of filter	For PCM: LB-000015 For AHERA: LB-000029, LB-000031, LB-000067, LB-000085

(a) The high volume filter will be analyzed in preference to the low volume filter if direct preparation is possible. If the high volume filter is overloaded, use the low volume filter. If the low volume filter is overloaded, prepare indirectly (with ashing), calculate number of grid openings to analyze to reach target analytical sensitivity, and contact EPA project managers or their designate before proceeding with analysis.
(b) See most current version of SOP EPA-LIBBY-08 for preparation details.
(c) If observed, chrysotile and other amphibole asbestos should be recorded.
(d) Target analytical sensitivity for digging scenario is 0.00022 cc^{-1} and for fireline scenario is 0.0025 cc^{-1}.

TEM/PCM Preparation and Analytical Requirements for Air Field Quality Control Samples:

Medium Code	Medium, Sample Type	Preparation Details			Analysis Details			Applicable Laboratory Modifications (current version of)
		Indirect Prep?		Archive?	Method	Recording Rules	Stopping Rules	
		With Ashing	Without Ashing					
D	Air, lot blank and field blank	No	No	Yes	TEM – Modified ISO 10312, Annex E *(Low Mag, 5,000X)*	All PCME asbestos; L: > 5 µm W: $\geq$ 0.25 µm AR: $\geq$ 3:1	Examine 1.0 mm^2 of filter.	LB-000016, LB-000029, LB-000066, LB-000067, LB-000085
E	Air, Health & Safety field blank	No	No	Yes	PCM – NIOSH 7400, Issue 2 TEM–AHERA (upon request)	For PCM: NIOSH 7400, "A" rules If AHERA is requested: All asbestos; L $\geq$ 0.5 µm AR $\geq$ 5:1	For PCM: Count a minimum of 20 FOVs, then continue counting until one is achieved: i) 100 fibers are recorded ii) 100 FOVs are examined (regardless of count) For AHERA: Examine 0.1 mm^2 of filter	For PCM: LB-000015 For AHERA: LB-000029, LB-000031, LB-000067, LB-000085

2. SOIL

Soil Preparation and Analysis Requirements:

Preparation Method	Analysis Method	Applicable Laboratory Modifications (current version of)
Fluidized Bed (ESAT-LIBBY-01 Rev. 0)	TEM – Modified ISO (see below)	(see below)

TEM Analysis Requirements for Soil Samples Prepared by Fluidized Bed:

Medium Code	Medium, Sample Type	Preparation Details				Analysis Details			Applicable Laboratory Modifications (current version of)
		Investi-gative? (e)	Indirect Prep? (e,f) With Ashing	Indirect Prep? (e,f) Without Ashing	Filter Archive?	Method	Recording Rules (g)	Analytical Sensitivity/Prioritized Stopping Rules (h)	
F	Soil, FBAS Filter	Yes	Yes	No	Yes	TEM – Modified ISO 10312	<u>High Mag (20,000x, Initial):</u> All asbestos L: $\geq$ 0.5 µm AR: $\geq$ 3:1 <u>Low Mag (5,000x, Supplemental):</u> All asbestos; L: > 5 µm W: $\geq$ 0.25 µm AR: $\geq$ 3:1	<u>High Mag:</u> Count a minimum of 2 grid openings in 2 grids, then continue counting until one is achieved: i) sensitivity of 6.3E+03 g^{-1} is achieved ii) 50 LA structures are recorded iii) Total area of 1.2 mm^2 of filter has been examined <u>Low Mag:</u> Count until one is achieved: i) sensitivity of 6.3E+03 g^{-1} is achieved ii) 50 LA structures are recorded (including the LA structures counted at high mag) iii) Total area of 3.0 mm^2 of filter has been examined (including the area counted at high mag)	LB-000016, LB-000029, LB-000066, LB-000067, LB-000085

(e) The filter analyzed in the TEM must be from 10 to 30% loaded without uneven loading. If this is not achieved, contact the FBAS preparation laboratory to request a new FBAS filter submittal. Laboratories may elect to not analyze a filter that is 25% to 30% loaded if too many overlapping particles are observed based on professional judgment and request a new filter submittal. EPA (or their designate) will specify which FBAS filter samples are to be prepared directly and which are to be prepared indirectly in accordance with SOP EPA-LIBBY-08.

(f) A total of 3 replicate FBAS filters will be generated for each soil sample.
(g) Data recording for chrysotile is not necessary, but presence of chrysotile should be noted in analysis comments.
(h) Only proceed with low magnification analysis if the high magnification analysis recorded fewer than 50 LA structures and the target analytical sensitivity was not achieved.

TEM Analysis Requirements for Fluidized Bed Preparation Quality Control Samples:

Medium Code	Sample Type	Preparation Details			Analysis Details			Applicable Laboratory Modifications (current versions of)
		Indirect Prep?		Archive?	Method	Recording Rules	Stopping Rules	
		With Ashing	Without Ashing					
G	Preparation Blank, Lot Blank, Sieve Blank	No	No	Yes	TEM – ISO 10312 *(High Mag, 20,000X)*	All asbestos; L ≥ 0.5µm AR ≥ 3:1	Examine 1.0 mm^2 of filter area	LB-000016, LB-000029, LB-000066, LB-000067, LB-000085

3. DUFF MATERIAL

Duff Preparation and Analysis Requirements:

Preparation Method	Analysis Method	Applicable Laboratory Modifications (current version of)
SOP EPA-LIBBY-2012-11 (see Section 6.1 and Section 6.2)	TEM – Modified ISO 10312 (see below)	None

TEM Analysis Requirements for Duff Samples:

Medium Code	Medium, Sample Type	Preparation Details				Analysis Details			Applicable Laboratory Modifications (current version of)
		Investi-gative?	Indirect Prep? (i)		Filter Archive?	Method	Recording Rules	Analytical Sensitivity/ Prioritized Stopping Rules	
			With Ashing	Without Ashing					
H	Duff, Filter	Yes	No	No	Yes	TEM – Modified ISO 10312 (see Section 6.2.3 of SOP EPA-LIBBY-2012-11)	All asbestos; L: ≥ 0.5 µm AR: ≥ 3:1	Count a minimum of 2 grid openings in 2 grids, then continue counting until one is achieved: i) sensitivity of 1E+07 g^{-1} is achieved ii) 50 LA structures are recorded iii) 1.0 mm^2 of filter has been examined	LB-000016, LB-000029, LB-000066, LB-000067, LB-000085

(i) A total of 3 replicate filters will be generated for each duff sample (i.e., 3 different aliquots of the ash residue will be used to create 3 replicate filters).

4. TREE BARK

Tree Bark Preparation and Analysis Requirements:

Preparation Method	Analysis Method	Applicable Laboratory Modifications (current version of)
SOP EPA-LIBBY-2012-12 (see Section 6.1 and Section 6.2)	TEM – Modified ISO 10312 (see below)	None

TEM Analysis Requirements for Tree Bark Samples:

Medium Code	Medium, Sample Type	Preparation Details				Analysis Details			Applicable Laboratory Modifications (current version of)
		Investi-gative?	Indirect Prep? (j) With Ashing	Indirect Prep? (j) Without Ashing	Filter Archive?	Method	Recording Rules	Analytical Sensitivity/ Prioritized Stopping Rules	
I	Tree Bark, Filter	Yes	No	No	Yes	TEM – Modified ISO 10312 (see Section 6.2.3 of SOP EPA-LIBBY-2012-12)	All asbestos; L: $\geq$ 0.5 µm AR: $\geq$ 3:1	Count a minimum of 2 grid openings in 2 grids, then continue counting until one is achieved: i) sensitivity of 100,000 cm^{-2} is achieved ii) 50 LA structures are recorded iii) 1.0 mm^2 of filter has been examined	LB-000016, LB-000029, LB-000066, LB-000067, LB-000085

(j) A total of 3 replicate filters will be generated for each tree bark sample (i.e., 3 equal aliquots of the ash suspension will be used to create 3 replicate filters).

Analytical Laboratory Quality Control Sample Frequencies:

<u>TEM (k):</u>
Lab Blank – 4%
Recount Same – 1%
Recount Different – 2.5%
Verified Analysis – 1%
Interlab – 0.5%
Repreparation – 1%

<u>Addtl TEM, for tree bark:</u>
Filtration Blank – 2%

<u>Addtl TEM, for duff:</u>
Drying Blank – 1 per batch
Filtration Blank – 2%

<u>PCM (l):</u> Blind Recounts – 10%

(k) See LB-000029 for selection procedure and QC acceptance criteria
(l) See NIOSH 7400 for QC acceptance criteria

Requirements Revision:

Revision #:	Effective Date:	Revision Description
0	5/30/2012	N/A
1	6/11/2012	Added additional TEM laboratory QC analyses for tree bark and duff.
2	7/9/2012	Remove analysis of laboratory duplicates for tree bark and duff (requirement of additional laboratory duplicates is not necessary since 3 filter replicates will be prepared for each sample).

Analytical Laboratory Review Sign-off:

All laboratories signed the original version of this analytical summary sheet (Rev0); this revision did not require another signature process.

Sampling and Analysis Plan/Quality Assurance Project Plan
Comparative Exposure – Eureka, Helena, Whitefish
Libby Asbestos Site, Operable Unit 4
Revision 1 – July 2012

Appendix F
Record of Modification (ROM) Forms

[An example of each ROM template is provided.]

The most recent version of the field ROM is provided electronically in the Libby Field eRoom (https://team.cdm.com/eRoom/R8-RAC/Libby).

The most recent version of the SPF and analytical laboratory ROMs are provided electronically in the Libby Lab eRoom (https://team.cdm.com/eRoom/mt/LibbyLab).

Record of Modification to Documents Governing Field Activities Libby Asbestos Project

Form No. LFO-000xxx

Instructions to Requester: Email draft modification form to the contacts at bottom of form for review and approval. File approved copy with the CDM Quality Assurance Coordinator (QAC) at the Libby Field Office (LFO). The QAC will distribute approved copies and maintain the originals at the LFO.

Requester: ______________________________ Title: ________________________

Company: ______________________________ Date: ________________________

Governing document (title and approved date) or SOP (title and SOP number):______________________

____

____

Field logbook and page number where modification is documented (or attach associated correspondence):

____

Description of modification (attach additional sheets if necessary; include revised text for all document or SOP sections that are affected by the modification):______________________________________

____

____

Implication(s) of modification (if applicable, attach a list of affected property addresses or sample IDs):

____

____

____

Duration of modification (cicle one):

Temporary Date(s):______________________

Permanent Effective Date:_________________

Data Quality Indicator (indicate one; reference the definitions below for direction on selecting data quality indicators):

❑ Not Applicable ❑ Low Bias ❑ High Bias

❑ Reject ❑ Estimate ❑ No Bias

CDM Technical Review and Approval: ______________________________ Date:____________
(CDM Project Manager or designate)

EPA Review and Approval: ____________________________________ Date:____________
(USEPA RPM or designate)

DATA QUALITY INDICATOR DEFINITIONS

Reject - Samples associated with this modification form are not useable. The conditions outlined in the modification form adversely effect the associated sample to such a degree that the data are not reliable.

Low Bias - Samples associated with this modification form are useable, but results are likely to be biased low. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimated low.

Estimate - Samples associated with this modification form are useable, but results should be considered approximations. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimates.

High Bias - Samples associated with this modification form are useable, but results are likely to be biased high. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimated high.

No Bias - Samples associated with this modification form are useable as reported. The conditions outlined in the modification form suggest that associated sample data are reliable as reported.

Request for Modification
to
Laboratory Activities
LB-0000XX

Instructions to Requester: E-mail form to contacts at bottom of form for review and approval.
All Labs Applicable Forms – copies to: EPA LC, QATS contractor, All Project Labs
Individual Labs Applicable Forms – copies to: EPA LC, QATS contractor, Initiating Lab

Method (circle all applicable): TEM-AHERA TEM-ISO 10312 PCM-NIOSH 7400
EPA/600/R-93/116 ASTM 5755 TEM 100.2 SRC-LIBBY-03
SRC-LIBBY-01 NIOSH 9002 Other:______________________________

Requester:______________________________ Title: ______________________________
Company: ______________________________ Date: ______________________________

Original Requester: ______________________________ Original Request Date: ______________
[only applicable if modification is a revision of an earlier modification]

Description of Modification:
____

Reason for Modification:
____

Potential Implications of this Modification:
____

Laboratory Applicability (circle one): **All** **Individual(s)** ______________________________

This laboratory modification is (circle one): **NEW** **APPENDS to** ___________ **SUPERCEDES** ___________

Duration of Modification (circle one):
Temporary Date(s): ______________________________
Analytical Batch ID: ______________________________
Temporary Modification Forms – Attach legible copies of approved form with all associated raw data packages

Permanent (Complete Proposed Modification Section) Effective Date: ______________

Permanent Modification Forms – Maintain legible copies of approved form in a binder that can be accessed by analysts.

Proposed Modification to Method (attach additional sheets if necessary; state section and page numbers of method when applicable):
____

REFERENCES

Data Quality Indicator (circle one) – Please reference definitions below for direction on selecting data quality indicators:

Not Applicable **Reject** **Low Bias** **Estimate** **High Bias** **No Bias**

DATA QUALITY INDICATOR DEFINITIONS:

Reject - Samples associated with this modification form are not useable. The conditions outlined in the modification form adversely affect the associated sample to such a degree that the data are not reliable.

Low Bias - Samples associated with this modification form are useable, but results are likely to be biased low. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimated low.

Estimate - Samples associated with this modification form are useable, but results should be considered approximations. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimates.

High Bias - Samples associated with this modification form are useable, but results are likely to be biased high. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimated high.

No Bias - Samples associated with this modification form are useable as reported. The conditions outlined in the modification form suggest that associated sample data are reliable as reported.

Technical Review: ______________________________ Date: ____________
(Laboratory Manager or designate)

Project Review and Approval: ______________________________ Date: ____________
(USEPA: Project Manager or designate)

Approved By: ______________________________ Date: ____________
(USEPA: Technical Assistance Unit Chief or designate)

MOD No.: SPF-__________

Request for Modification
To
Soil Sample Preparation Activities

Instructions to Requester: E-mail form to contacts at bottom of form for review and approval.

File approved copy at the Sample Preparation Facility (SPF).

Requester:______________________________ Title: ______________________

Company: ______________________________ Date: ______________________

Effective Date: __________________

Description of Modification:

____

____

Reason for Modification:

____

____

Potential Implications of this Modification:

____

____

Duration of Modification (circle one):

Temporary Date(s): ____

Preparation Batch ID:____

- Temporary Modification Forms – Attach legible copies of approved form with all associated chain-of-custody forms. Also, maintain legible copies of approved form in a binder that can be accessed by SPF personnel.

Permanent (complete Proposed Modification to Method)

- Permanent Modification Forms – Maintain legible copies of approved form in a binder that can be accessed by CSF personnel.

Proposed Modification to Method (attach additional sheets if necessary; state section and page numbers of Method when applicable):

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Technical Review: ______________________________ Date: __________________

(SPF Manager or designate)

Approved By:________________ Title: _____________ Date: __________________

(USEPA: Project Chemist or designate)