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
OU4 Commercial Logging Activity-based Sampling
Libby Asbestos Site, Operable Unit 4

Revision 0 – September 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:
U.S. Environmental Protection Agency
Region VIII
1595 Wynkoop Street
Denver, Colorado 80202

Prepared by:
CDM Federal Programs Corporation
555 17th Street, Suite 1100
Denver, Colorado 80202

A1. TITLE AND APPROVAL SHEET

Sampling and Analysis Plan/Quality Assurance Project Plan: Libby OU4 2012 Commercial Logging Activity-Based Sampling

REVISION LOG:

Revision #	Revision Date	Description
0	9/17/12	---

Approved by:_______________ Date: 9/17/12
Nathan Smith
CDM Smith, Project Manager

Approved by:_______________ Date: 9/17/12
Terry Crowell
CDM Smith, Quality Assurance Manager

Approved by:_______________ Date: 9/17/12
Elizabeth Fagen, P.E.
EPA, Region VIII, Remedial Project Manager

Approved by:_______________ Date: 9/17/2012
David Berry
EPA, Region VIII, Quality Assurance Reviewer

Approved by:_______________ Date: 9/17/12
for Victor Ketellapper, P.E.
EPA, Region VIII, Libby Asbestos Project Team Leader

Approved by:_______________ Date: 9/18/12
Mary N. Darling, PMP
USACE Project Manager

A2. TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

95UCL	95% upper confidence limit
ABS	activity-based sampling
ACM	asbestos-containing material
cc	cubic centimeters
CDM Smith	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHISQ	chi-squared
CI	confidence interval
COC	chain-of-custody
DQO	data quality objective
EDD	electronic data deliverable
EDS	energy dispersive spectroscopy
EDXA	energy-dispersive x-ray
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERT	EPA Environmental Response Team
ESAT	EPA Environmental Services Assistance Team
f/cc	fibers per cubic centimeter
FS	feasibility study
FSDS	field sample data sheets
FTL	field team leader
GPS	global positioning system
H & S	health and safety
HASP	health and safety plan
HQ	hazard quotient
ID	identification
IDW	investigative-derived waste
ISO	International Organization for Standardization
IUR	inhalation unit risk
L/min	liters per minute
LA	Libby amphibole
LC	laboratory coordinator
MCE	mixed cellulose ester
MDEQ	Montana Department of Environmental Quality
MDNRC	Montana Department of Natural Resources and Conservation
mm	millimeter
N	number of asbestos fibers
NIST	National Institute of Standards and Technology

NVLAP	National Voluntary Laboratory Accreditation Program
OSHA	Occupational Safety and Health Administration
OU	operable unit
OU4	operable unit 4
PCM	phase contrast microscopy
PCME	phase contrast microscopy-equivalent
pdf	portable document format
PLM	polarized light microscopy
QA	quality assurance
QA/QC	quality assurance/quality control
QAM	quality assurance manager
QAPP	quality assurance project plan
QATS	quality assurance technical support
QC	quality control
RBC	risk-based concentration
RfC	reference concentration
RI	remedial investigation
RME	reasonable maximum exposure
ROM	record of modification
RPM	Remedial Project Manager
SAED	selected area electron diffraction
SAP	sampling and analysis plan
Shaw	Shaw Environmental, Incorporated
Site	Libby Asbestos Superfund Site
SOP	standard operating procedure
SRM	standard reference material
STEL	short-term exposure limit
TAS	target analytical sensitivity
TEM	transmission electron microscopy
TWA	time-weighted average
TWF	time-weighting factor
µm	micrometer
USACE	U.S. Army Corps of Engineers
USFS	U.S. Forest Service
USGS	U.S. Geological Survey

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, Ketellaper.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)

U.S. Army Corps of Engineers
Rapid Response Program Office
Offutt AFB, Nebraska 68113

- Mary Darling, Mary.N.Darling@usace.army.mil (1 electronic copy)
- Mark Buss, Mark.E.Buss@usace.army.mil (1 electronic copy)
- Jeff Hubbard, Jeffrey.W.Hubbard@usace.army.mil (1 electronic copy)
- Jeremy Ayala, Jeremy.A.Ayala@usace.army.mil (1 electronic copy)

Montana Department of Natural Resources and Conservation, Libby Unit Office
177 State Lands Office Road
Libby, MT 59923

- Mark Peck, Mpeck@mt.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)

Chapman Construction, Inc.
P.O. Box 516
Libby, Montana 59923

- Mike Chapman, chapman@montanasky.net (1 hard copy, electronic copy)

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

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

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

- Dominic Pisciotta, pisciottaDM@cdmsmith.com (3 hard copies, electronic copy)
- Terry Crowell, crowellTL@cdmsmith.com (electronic copy)
- Damon Repine, repineDL@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, SAP/QAPP development, field sampling support, on-site field coordination, analytical support, data management, 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 U.S. Army Corps of Engineers (USACE), Omaha District, provides project management, environmental engineering, and remediation support to EPA at the Site. The USACE Program Manager is Mary Darling. The USACE Construction Control Representatives are Jeremy Ayala, Jeff Hubbard, and Mark Buss.

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.

The Montana Department of Natural Resources and Conservation (MDNRC) is the regulatory agency responsible for the parcel of land where activities are to occur as part of this SAP/QAPP. The EPA will consult the MDNRC for all activities being performed on the parcel of land as part of this SAP/QAPP. The Unit Manger for the Libby Unit Office of the MDNRC is Mark Peck. The Management Forester for the Libby Unit Office is Jeremy Rank.

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

Chapman Construction, Inc. will be responsible for implementation of the commercial logging activities. Mike Chapman will be the field team leader responsible for conducting this commercial logging effort.

CDM Smith will be responsible for providing field logistical support (e.g., preparing sampling pumps, completing necessary field documentation) for the sampling program described in this SAP/QAPP. Field support will be provided under a contract agreement with USACE (Contract No. W9128F-11-D-0023). Key CDM Smith personnel that will be involved in this sampling program include:

- Nathan Smith, Project Manager
- Dominic Pisciotta, 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 C1.1).

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 commercial logging operations. These inhalation exposures may pose a risk of cancer and/or non-cancer effects.

In the event logging operations were to occur in OU4, it is possible that LA structures in duff and tree bark may be released into the air, which could result in inhalation exposures to commercial logging crews. In addition, it is also possible that workers operating mill sites which process trees harvested from OU4 could also be exposed to LA due to contamination of the tree bark of harvested trees. Available data are not adequate to support reliable quantitative estimation of the air concentrations of asbestos fibers that may occur as a result of commercial logging operations in OU4. Thus, measured data are needed to provide information on potential inhalation exposures of LA to workers engaging in commercial logging activities in OU4.

A5.3 Applicable Criteria and Action Limits

At present, there are no criteria or action limits that apply specifically to exposure of workers or other individuals to LA conducting logging and timber manufacturing operations. However, criteria for exposure of workers to asbestos in workplace air have been established by the Occupational Safety and Health Administration (OSHA). 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. Both exposure limits are expressed in terms of phase contrast microscopy (PCM) fibers (OSHA 2002), which does not distinguish between asbestos and non-asbestos fibers.

A6. PROJECT DESCRIPTION

A6.1 Project Summary

The purpose of this investigation is to collect air samples during commercial logging activities, referred to as "activity-based sampling" (ABS), which will provide measured data on potential exposures to LA. Basic tasks that are required to implement this investigation are described in greater detail in subsequent sections of this SAP/QAPP.

A6.2 Work Schedule

The timing of the ABS event has not yet been determined, but ABS should occur in the August-September 2012 timeframe in order to conduct activities in the driest part of the year. Once data are evaluated by the EPA risk assessment and project management teams, additional commercial logging ABS efforts may be conducted in the winter of 2012-2013, if it is deemed necessary to support risk management decision-making.

Based on the results of the commercial logging sampling effort in OU4 and other areas (e.g., OU3), the EPA risk assessment and project management teams will make a determination if additional sampling efforts are necessary to support risk-management decision-making. If additional sampling efforts are needed, investigation-specific SAP/QAPPs for these additional sampling efforts will be generated prior to sample collection.

A6.3 Location to be Studied

The location in OU4 where commercial logging activities will be performed is described in Section B1.1.

A6.4 Resources and Time Constraints

The greatest time constraint is that commercial logging activities must be conducted when conditions are dry and warm, and before rain and snow begin to occur in the fall. In addition, because commercial logging activities utilize specialized equipment, the timing of the sampling effort will be dictated by availability of commercial logging equipment and staff.

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 the 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 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

The range of LA concentrations that will occur in ABS air during commercial logging activities in OU4 is not known. However, it is possible to estimate the concentration levels that correspond to a level of human health concern. These calculations are provided in Section B4. The analytical requirements for LA measurements in ABS air as established in Section B4 ensure concentrations will be reliably detected and quantified if present at levels of concern.

A7.3 Precision

The precision of asbestos measurements is determined mainly by the number (N) of asbestos fibers 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 fibers per sample, with counts of 20-25 fibers per sample being optimal.

A7.4 Bias/Accuracy and Representativeness

It is expected that LA levels in ABS air may vary widely as a function of location, activities performed, and meteorological conditions. The ABS location selected for evaluation in this study is intended to represent actual locations where logging activities may occur in OU4. ABS activities will be performed during the dry, summer months when the potential for LA release is likely to be highest, thus measured LA concentrations in ABS air may be biased high. The ABS air sample collection will be performed under authentic commercial logging activities, not a set of scripted simulation scenarios, which ensures that results are representative of commercial logging exposures in OU4.

A7.5 Completeness

Target completeness for this project is 100%. If any samples of ABS air 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 risk management decision-making.

A7.6 Comparability

The data generated during this study will be obtained using sample collection, preparation, and analysis methods for measuring LA in air, tree bark, and duff material used previously on other studies. The use of consistent methods will yield data that are comparable to previous results of LA analyses in air, tree bark, and duff material.

A7.7 Method Sensitivity

The method sensitivity (analytical sensitivity) needed for the analysis of LA in ABS air, tree bark, and duff material 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 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

*P*ersonnel contracted to perform authentic logging operations for this study will not be required to have successfully completed OSHA 40-Hour HAZWOPER or medical clearance. However, those personnel will be required to be medically fit and tested to wear respiratory protection.*

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 C**), 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) and National Voluntary Laboratory Accreditation Program (NVLAP) for the analysis of airborne asbestos by transmission electron microscopy (TEM). 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 of airborne asbestos by TEM supplied by NIST/NVLAP.

Copies of recent proficiency examinations from NVLAP or an equivalent program, as well as certifications from other state and local agencies, are maintained by each participating analytical laboratory. Copies of all proficiency examinations and certifications are also maintained by the laboratory coordinator (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 C1.1.2. 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

Initial Mentoring

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, the 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.

<u>Regular Technical Discussions</u>

Ongoing 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.

<u>Professional/Technical Meetings</u>

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 Johnson 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 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 evaluation (similar to 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 B5.2.3). 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 Documentation

Field teams will record sample information on the most current version of the Site-specific field sample data sheets (FSDSs)[1]. Section B3.1 provides detailed information on the sample documentation requirements for samples collected as part of this study. In brief, the FSDS forms document the unique sample identification (ID) number 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). The field teams will also record information related to sample collection in a field logbook.

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.

A9.3 Record of Modification

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

---

[1] The most recent versions of these FSDS form templates are available in the Libby Field eRoom.

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 and B5.2.2 provide detailed information on the procedures for preparing and submitting ROMs by field and analytical laboratory personnel, respectively.

B Data Generation and Acquisition

B1. STUDY DESIGN

B1.1 Sampling Location

Available data indicate that detectable levels of LA in tree bark and duff are present within an area of OU4 referred to as the Upper Flower Creek timber sale site (Tetra Tech 2011). Therefore, the approach that will be taken at OU4 for the commercial logging effort is to collect ABS samples in this area under authentic commercial logging activities to provide information on potential exposures in locations that may be used for timber. **Figure B-1** presents the general area identified for conducting commercial logging activities (see red polygon). The actual location selected within this area will depend upon the ease of access and availability of trees for harvesting. In general, 100 trees of appropriate size will be selected for harvest to conduct hand-felling operations. The selected logging area should be large enough such that it would take 1-2 days to complete hand-felling operations.

As noted previously, if deemed to be needed to support risk management decisions, additional ABS at locations may be evaluated in the future. If any additional sampling efforts are needed, investigation-specific SAP/QAPPs for these efforts will be generated prior to sample collection.

B1.2 Tree Bark and Duff Material Sample Collection

Once a logging ABS area has been identified, samples of tree bark and duff material within the area will be collected and analyzed for LA by TEM to ensure that measured concentrations are similar levels measured during the earlier duff/tree bark sampling efforts in 2011 (Tetra Tech 2011).

A total of 25 different trees from within the ABS area will be selected for sampling. The selected trees should be spatially representative of the entire ABS area, and selected from standing trees that are from the lot of trees that will be felled as part of the hand-felling ABS scenario. From the 25 selected trees, 5 composite bark samples will be collected (with each composite consisting of cores collected from 5 different trees).

In addition, 5 multi-point composite samples of duff material will be collected, with duff materials collected near each of the 25 trees selected for tree bark sampling.

B1.3 ABS Activity Scripts

Commercial logging operations can encompass a variety of different activities. Unlike other ABS investigations, which tend to utilize precise scripts that dictate the types and durations of each activity, for this effort, the scripts will be flexible, and ABS will be performed under authentic conditions by actual commercial logging workers.

The following types of activities are expected to be evaluated as part of this sampling effort:

Hand-Felling - The felling of timber is the process of severing the tree from the stump and placing it on the ground. Hand-felling is the traditional method of skilled personnel, herein referred to as a sawyer, utilizing a handheld chain saw to cut the timber. This method employs techniques and skills to complete a face cut and undercut to control the direction and rate of fall to the tree.

Skidding of Timber - The skidding of timber is the process of moving trees which have been felled to a centralized location for further processing or transportation. A skidder transports trees by dragging them on the ground. Skidders can be open or closed cab machines and can utilize cables (which are attached to felled trees) or grapples (which grab felled trees) to move trees to a processing area. The cable skidder, which requires an operator to get off the machine to manually attach trees with cables (or chokers), has been identified as being the most practical method for the skidding scenario. The activity of attaching chokers to logs is commonly referred to as "hooking". Utilizing the cable skidder scenario for this investigation allows for data to be captured during both skidding and hooking operations.

Mechanical Processing - Timber processing is the act of cutting limbs from the tree and cutting the tree into the desired length and width. Although mechanical processors vary, most utilize an excavator-type machine that mechanically strips limbs from the tree and cuts the tree into desired lengths. Mechanical processors most often have enclosed cabs in which the operator is stationed through the duration of processing activities. Mechanical processing has been identified as being the most commonly utilized method to process timber within the Libby Valley. For this scenario, an enclosed cab mechanical processor will be utilized.

Milling Process – The milling process is the act of removing bark from cut timber and cutting logs to appropriate size and shape for sale. This activity is commonly done at a mill site; however, for this event logs will be cut into slabs and run through a chipper to simulate de-barking activities.

Site Restoration - Due to the select harvesting technique utilized for this event, natural site restoration activities will be monitored, rather than site preparation for replanting. For this scenario, site restoration will be done utilizing a bulldozer, excavator, or backhoe to remove brush and tree litter from the landing area. This process will continue until the landing area has been cleared and the road restored to its original condition.

Appendix B provides the ABS script for each type of activity that will be evaluated in this commercial logging study. In brief, personal air monitoring samples will be collected for sawyers and skidder operators, with sampling pumps placed near the breathing zone of the individual (i.e., on shoulder). For individuals that operate mechanical processing machinery or bulldozers/excavators, sampling pumps may either be worn by the individual or placed in the machine cab. In addition, stationary monitors will be placed near the milling location and on the perimeter of the logging area to provide information on air concentrations near milling activities (e.g., to nearby workers), as well as the potential for contamination migration outside of the logging area.

There is no pre-established study duration or air sample numbers for this study. Rather, the number of ABS air samples collected will depend upon the number of individual workers participating in the types of commercial logging operations described above and how long it takes to complete logging operations for the selected ABS area. ABS air samples will be collected for each individual worker over the entire duration of logging operations.

B1.4 Study Variables

The level of LA in 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.

To ensure that sampling conditions are generally favorable towards the release of LA fibers, ABS will be restricted to summer months (August-September) when rainfall and soil moisture levels are at their lowest. ABS will not occur if rainfall in the past 36 hours has exceeded ¼ inch, or if there is standing water present.

B1.5 Critical Measurements

The critical measurements for this project are measurements of the concentration of LA in ABS air during commercial logging operations in OU4 at a location that is representative of an area that may be used for timber during commercial logging. The analysis of LA may be achieved using several different types of microscopes, but the EPA generally recommends using TEM because this analytical method has the ability to clearly distinguish asbestos from non-asbestos structures, and to classify different types of asbestos (i.e., LA, chrysotile). In addition, analysis by TEM provides structure-specific dimensions that allow for the estimation of PCM-equivalent[2] (PCME) concentrations, which is the concentration metric necessary to estimate exposure and risks.

---

[2] PCME structures have a length greater than 5 micrometers (µm), width greater than or equal to 0.25 µm, and aspect ratio greater than or equal to 3:1.

B1.6 Data Reduction and Interpretation

ABS air samples collected in the field will be used to prepare grids for TEM examination (see Section B4). From this examination, the total number of PCME LA structures observed is recorded and the ABS air concentration is calculated as follows:

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

where:

Cair	= Air concentration (structures per cubic centimeter [s/cc])
N	= Number of PCME LA structures observed (structures)
EFA	= Effective filter area (mm^2)
GOx	= Number of grid openings examined
Ago	= Area of a grid opening (mm^2)
V	= Sample air volume (L)
1000	= L/cc (conversion factor in liters per cubic centimeter)
f	= Indirect preparation dilution factor (assumed to be 1 for direct preparation)

Data for PCME LA concentrations in ABS air will be used to evaluate potential human health risks from commercial logging exposures in OU4.

B2. SAMPLING METHODS

B2.1 Tree Bark Sample Collection

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

- Trees selected for sampling will be Douglas fir with a diameter (caliper) of at least 8 inches. If these trees are not available within the ABS area, trees with a large diameter and rough bark will be selected preferentially.
- It is not anticipated that the same tree will need to be located for future sampling activities, so flagging tape/ID tags will not be left on the tree. Global positioning system (GPS) coordinates will be collected for each tree location.
- Tree bark samples will consist of a 5-tree composite; therefore, decontamination or use of new equipment will not be necessary between collection of the 5-tree composite sample.

In brief, a hole saw will be used to collect a circular bark sample for analysis of LA by TEM. The collection of tree age cores is not necessary for this project.

B2.2 Duff Material Sample Collection

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

- One grab sample from a 5-foot radius surrounding the tree selected for bark sampling will be collected to make up a 5-point composite sample of duff material. Enough duff material will be collected from each sub-location such that the composite sample fills a one-gallon zip-top bag.

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.

B2.3 ABS Air Sample Collection

ABS air samples will be collected, handled, and documented in basic accordance with the procedures specified in Site-specific SOP EPA-LIBBY-2012-10, *Sampling of Asbestos Fibers in Air*, (see **Appendix C**). In brief, a battery-powered air sampling pump (SKC model AirChek XR5000 ™ [0.005-5.0 L/min] or similar) will be worn by the ABS participant, affixed to the interior cab of the logging equipment, or set on stationary stands around perimeter of activities. The monitoring cassette will be attached to the pump via a plastic tube, and affixed such that the cassette is within the breathing zone. All air samples will be collected using cassettes that contain a 25-mm diameter mixed cellulose ester (MCE) filter with a pore size of 0.8 µm.

During the ABS activity, two different sampling pumps will be worn by the worker (or placed in the machine cab or on stationary stands) – 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). Only one of the two resulting air filters will be selected for analysis (see Section B4). Initially, the low flow pumps will be set to a flow rate of 2 liters per minute (L/min) and the high flow pumps will be set to a flow rate of 4 L/min. These flow rates may be revised as experience is gained on the degree of particulate loading on the filters during the activity. *Note: Flow rates should only be adjusted if the amount of particulate loading on the filter is impacting the flow rate. No adjustment is necessary if flow rates are able to be maintained, even if the filters appear to be visually overloaded. Due to the nature of the ABS activities, it is anticipated that most filters will likely require indirect preparation (with ashing) prior to TEM analysis.*

Each air sampling pump will be calibrated at the start of each ABS sampling period. Section B6/B7.1 provides detailed information on calibrating the sampling pump.

At the beginning of the sampling program, flow rates may be checked more frequently as conditions permit to establish expected conditions. To limit the amount of particulate loading on the filter, air cassettes should be replaced every 2 hours throughout the duration of the ABS activity. Set sampling durations have not been established for this ABS effort, rather air samples will be collected for as long as the activity takes to complete.

B2.4 Global Positioning System Coordinate Collection

GPS coordinates will be recorded for each tree where tree bark is collected and for each stationary monitor. (Because duff will be collocated with the sampled trees, no GPS coordinates are needed for duff samples.) In addition, GPS coordinates should be obtained to provide the spatial extent of the ABS area evaluated in the commercial logging activity. GPS location coordinates will be collected in general accordance with Site-specific SOP CDM-LIBBY-09, *GPS Coordinate Collection and Handling* (see **Appendix C**).

B2.5 Equipment Decontamination

B2.5.1Sampling Equipment

Decontamination of non-disposable sampling equipment will be conducted in basic accordance with the procedures specified with Site-specific SOP EPA-LIBBY-2012-04, *Field Equipment Decontamination at Nonradioactive Sites* (see **Appendix C**). Materials used in the decontamination process will be disposed of as investigation-derived waste (IDW) as described below.

B2.5.2Commercial Logging Equipment

Before use on the site, commercial logging equipment will be thoroughly cleaned to reduce the level of effort and water needed for post-ABS decontamination. Field personnel will utilize pressurized water to wash and decontaminate all heavy equipment to remove any visible soil or debris before leaving the site. A competent person will inspect decontaminated vehicles prior to leaving the decontamination pad.

Before being taken off use from the project, all heavy equipment must undergo a full interior and exterior decontamination by the designated personnel. Full decontamination includes removing protective plating (skid plates), pressurized washing of all surfaces, cleaning the interior of the engine compartment, cleaning of the undercarriage, cleaning of the track adjusters, removing floor mats, and an extensive cleaning and wipe-down of the cab. In addition, designated personnel will remove, replace, and dispose of any air filters (air-intake, cab, etc.) from equipment and vehicles that have been utilized for ABS activities. All filters from equipment that has been utilized for ABS activities will be disposed of as asbestos-containing material (ACM).

An inspector will evaluate and document the decontamination before moving or using the equipment. The inspector will fill out a Decontamination Checklist (see **Appendix D**). A copy of this form will be posted to the eRoom along with the field sample documentation.

B2.6 Handling Investigation-derived Waste

Any disposable equipment or other IDW will be handled in basic accordance with the procedures specified in SOP EPA-LIBBY-2012-05, *Guide to Handling of Investigation-Derived Waste* (see **Appendix C**). In brief, IDW will be double-bagged, with the outer bag being a clear heavy-weight trash bag that has been pre-printed with 'IDW' on the outside. If pre-printed IDW bags are not available, the outer bag needs to be clearly labeled (once) in large letters at least 3 inches high using an indelible marker or a taped label. All IDW generated during this sampling program will enter the waste stream at the local class IV asbestos landfill.

B3. SAMPLE HANDLING AND CUSTODY

B3.1 Sample Documentation

B3.1.1 Field Sample Data Sheets and Logbooks

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.

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 C**). In addition to general logbook content requirements outlines in the SOP, the logbooks should also include information on 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 server for the CDM Smith office in Libby.

B3.1.2 Photographic and Video Documentation

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 C**). 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:

CLOU4_date_##

where:

CLOU4 indicates OU4 Commercial Logging

The date is formatted as MM-DD-YY

indicates the photo number

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 Sample Labeling and Identification

Samples will be labeled with sample ID numbers using self-adhesive labels (as supplied by CDM Smith). For air samples, one sample label will be placed on the sampling cassette, one sample label will be affixed to the inside of the plastic bag used to hold the sampling cassette during transport. In addition, the sample ID number will also be written on the outside of the plastic bag. For duff and bark samples, the labels will be affixed to the outside of both the inner and outer sample bags and the sample ID number will be written on the outside of each bag.

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

CL-4####

where:

CL-4 = A sample ID number prefix to identify samples collected under this SAP/QAPP

= A sequential four-digit number

B3.3 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 relinquished by field staff to the field sample coordinator or a designated secure sample storage location at the end of each day.

B3.4 Chain of Custody

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 C**).

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).

B3.5 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 C**) 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.

B3.6 Holding Times

In general, there are no holding time requirements for asbestos. Because sample preparation of the medium will address any issues due to elapsed time between collection and analysis (e.g., ashing of tree bark and duff material will address any organic growth that occurs), there are no holding time requirements for ABS air, duff material, or tree bark samples collected as part of this sampling investigation.

B3.7 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

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

An analytical requirements summary sheet (**LOGOU4-0912**), 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.

B4.1 Analysis of LA in ABS Air

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

B4.1.1 Sample Preparation

For the purposes of this study, despite the fact that samples were changed out every two hours, due to the nature of the activities being performed, it is assumed that all filters will require indirect preparation with ashing due to filter overloading (i.e., > 25% particulate loading). In order to limit the analytic level of effort, filters for a given individual for a given ABS activity may be composited together at the time of the filter preparation. That is, 3-4 filters may be ashed together in accordance with the procedures in Libby-specific SOP EPA-LIBBY-08, or the resulting ash residue for 3-4 filters may be combined, prior to the preparation of the grids for TEM analysis. The combined ashed residue will be used to prepare a minimum of three grids using the grid preparation techniques described in Section 9.3 of International Organization for Standardization (ISO) 10312:1995(E) (ISO 1995). It is anticipated that the TEM analysis will be performed on the high volume filters and that all low volume filters will be archived for possible future analysis.

The LC will provide the analytical laboratory with specific direction in a supplemental technical direction memorandum as to which filters may be composited and how the resulting sample identifier and sample volume should be recorded on the analysis benchsheets. Until this memorandum has been received by the analytical laboratory, the original filters should be held in archive.

B4.1.2 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 LB-000016, LB-000029, LB-000066, LB-000067, and LB-000085.

B4.1.3 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 recording 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.

B4.1.4 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 (0.0018 cc^{-1}) is achieved.
    b. 25 PCME LA structures have been observed.
    c. A total filter area of 20 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.

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

B4.2 Analysis of LA in Duff Material

B4.2.1 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 C**). In brief, each sample is dried and ashed, and an aliquot of the resulting ash residue is acidified, suspended in water, and filtered. 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). Any remaining ash material will be archived for possible future analysis.

B4.2.2 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. In brief, all fibrous amphibole structures that have appropriate SAED patterns and EDXA spectra, and having length ≥ 0.5 µm and an aspect ratio (length: width) ≥ 3:1, will be recorded.

B4.2.3 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 grams, dry weight^{-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 sample will be expressed in terms of LA structures per gram duff (dry weight).

B4.3 Analysis of LA in Tree Bark

B4.3.1 Sample Preparation

Tree bark samples will be prepared and analyzed in basic accordance with the procedures specified in EPA-LIBBY-2012-12, *Sampling and Analysis of Tree Bark for Asbestos* (see **Appendix C**), with the following project modifications:

- Only an aliquot of the resulting ash residue (rather than the total mass) will be filtered.

In brief, each sample is dried and ashed, and an aliquot of the resulting ash residue is acidified, suspended in water, and filtered. 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). Any remaining ash material will be archived for possible future analysis.

B4.3.2 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 µm and an aspect ratio (length: width) ≥ 3:1, will be recorded.

B4.3.3 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 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 sample will be expressed in terms of LA structures per cm^2 of tree bark (i.e., a surface area loading).

B4.4 Data Reporting

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.

B4.5 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.

B4.6 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 record will be cross-referenced with all of the samples in the shipment. The laboratory sample coordinator will sign the COC record 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 commercial logging 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[3]. 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 maintained on the CDM Smith server in Libby.

B5.1.3 Field QC Samples

<u>Air</u>

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.

Lot Blanks

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. For this sampling effort, two lot blanks will be selected at random from the lot of cassettes to be used for the collection of ABS air samples. It is the responsibility of the FTL to submit the appropriate number of lot blanks to the laboratory prior to cassette use in the field. The lot blanks are analyzed for asbestos by TEM analysis as described above (see Section B4.1). 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 Blanks

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

[3] The most recent version of the field ROM form is provided in the Libby Field eRoom.

will be collected at a rate of 1 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 B4.1).

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 Material

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 location as the 5 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.

Tree Bark

Two types of field QC samples may be collected as part of the tree bark sampling portion of this program – equipment rinsates (if necessary) 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 dedicated field sampling equipment (i.e., hole saws, chisels) is not 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 an HDPE container. At least one equipment rinsate blank should be collected per equipment decontamination effort. 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.

Field Duplicates

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 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.

B5.2.1 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.

B5.2.2 Modification Documentation

All deviations from project-specific and method guidance documents will be recorded on the laboratory ROM form[4]. 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.

B5.2.3 Laboratory QC Analyses

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 that are performed 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 following investigation-specific modifications:

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 are completed. Inter-laboratory analyses for TEM will 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-

---

[4] The most recent version of the laboratory ROM form is available on the Libby Lab eRoom.

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, filtration blanks, and laboratory duplicates. 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. EQUIPMENT MAINTENANCE AND INSTRUMENT CALIBRATION

B6/B7.1 Field Equipment

B6/B7.1.1 Field Equipment Maintenance

All field equipment should be maintained and calibrated 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 FTL 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 Sampling 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

The laboratory manager is responsible for ensuring that all laboratory instruments used for this project are 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 Supplies

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.

- 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:

- Commercial logging equipment: to be provided by Chapman Construction, Inc. (see **Appendix B** for a list of equipment)

- 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

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

- Custody seals

B8.2 Laboratory Supplies

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 laboratory blank samples (see Section B5).

B9. NON-DIRECT MEASUREMENTS

There are no non-direct measurements that are anticipated for use in this project.

B10. DATA MANAGEMENT

The following subsections describe the field 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 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.

B10.3 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).

B10.4 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[5]. 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 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

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

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, 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

C1. ASSESSMENT AND RESPONSE ACTIONS

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.

C1.1 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 Manager, with support from the CDM Smith QA Coordinators. Field surveillances may be conducted if field processes are revised or other QA/QC procedures indicate potential deficiencies. A copy of the report will be provided to the EPA RPM and the QATS contractor.

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 field and laboratory managers will inform the EPA RPM upon encountering quality issues that cannot be immediately corrected.

D Data Validation and Usability

D1. DATA REVIEW, VERIFICATION AND VALIDATION

D1.1 Data Review

Data review of 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-square (CHISQ) test, as described in ISO 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 re-preparation 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 C**) 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 laboratory 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 QAM to ensure that corrective actions are made.

D3. RECONCILIATION WITH USER REQUIREMENTS

Once all samples have been collected and analytical data has been generated, data will be evaluated to determine if study objectives were achieved. 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, including precision, accuracy/ bias, representativeness, comparability, completeness, and whether specified analytic requirements (e.g., sensitivity) were achieved. **Table D-1** provides detailed information for how each of these indicators may be evaluated for the reported asbestos data. 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.

REFERENCES

Amandus HE, Wheeler R. 1987. The Morbidity and Mortality of Vermiculite Miners and Millers Exposed to Tremolite-Actinolite: Part II. Mortality. *Am. J. Ind. Med*. 11:15-26.

Berry, D, et al. 2012. Comparison of Amphibole Air Concentrations Resulting from Direct and Indirect Filter Preparation and Transmission Electron Microscopy Analysis. *Journal of Occupational & Environmental Hygiene [in preparation].*

Bishop K, Ring S, Suchanek R, Gray D. 1978. Preparation Losses and Size Alterations for Fibrous Mineral Samples. *Scanning Electron Microsc.* I:207.

Breysse PN. 1991. Electron Microscopic Analysis of Airborne Asbestos Fibers. *Crit. Rev. Analyt. Chem.* 22:201-227.

CDM Smith. 2011. Libby Asbestos Superfund Site Operable Unit 3 Soil Disposal Plan, Libby Asbestos Project, Libby, Montana.

EPA. 1991. Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions. Washington, DC. OSWER Directive 9355.0-30.

_____. 1992. United States Environmental Protection Agency, Office of Solid Waste and Emergency Response. Supplemental Guidance to RAGS: Calculating the Concentration Term. Publication 9285.7-081.

_____. 2001. EPA Requirements for Quality Assurance Project Plans, QA/R-5. Final. March.

_____. 2006. Guidance on Systematic Planning Using the Data Quality Objective Process, QA/G-4. February.

_____ 2007. Summary Report for Data Collected under the Supplemental Remedial Investigation Quality Assurance Project Plan Libby, Montana Superfund Site. U.S. Environmental Protection Agency, Region 8. October.

_____. 2008a. Performance Evaluation of Laboratory Methods for the Analysis of Asbestos in Soil at the Libby, Montana Superfund Site. Produced by Syracuse Research Corporation for EPA, Region 8. Draft – October 7, 2008.

_____. 2008b. Characteristic EDS Spectra for Libby-Type Amphiboles. Produced by Syracuse Research Corporation for EPA, Region 8. Final – March 18, 2008.

_____. 2008c. Framework for Investigating Asbestos-Contaminated Sites. Report prepared by the Asbestos Committee of the Technical Review Workgroup of the Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency. OSWER Directive #9200.0-68.

____. 2010a. Activity-Based Sampling Summary Report, Operable Unit 4, Libby, Montana, Superfund Site. U.S. Environmental Protection Agency, Region 8. June 2.

____. 2010b. ProUCL Version 4.00.05 Technical Guide (Draft). U.S. Environmental Protection Agency, Office of Research and Development. EPA/600/R-07/041. May 2010. http://www.epa.gov/esd/tsc/ProUCL_v4.00.05/ProUCL_v4.00.05_tech_guide(draft).pdf

_____. 2011. Remedial Investigation for Operable Unit 3, Libby Asbestos Superfund Site. Phase IV Sampling And Analysis Plan Part A – Data to Support Human Health Risk Assessment. Addendum: Opportunistic Sampling During Authentic Wildfires. Prepared for, and with oversight by U.S. Environmental Protection Agency, Region 8, Denver, CO, by CDM, Denver, CO and SRC, Inc, Denver, CO. August 20, 2011

HEI-AR. 1991. Asbestos in Public and Commercial Buildings: A Literature Review and Synthesis of Current Knowledge. Health Effects Institute – Asbestos Research. Cambridge, Massachusetts.

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

Meeker GP, Bern AM, Brownfield IK, Lowers HA, Sutley SJ, Hoeffen TM, Vance JS. 2003. The Composition and Morphology of Amphiboles from the Rainy Creek Complex, Near Libby, Montana. *American Mineralogist* 88:1955-1969.

McDonald JC, Harris J, Armstrong B. 2004. Mortality in a cohort of vermiculite miners exposed to fibrous Amphibole in Libby, Montana. *Occup. Environ. Med.* 61:363-366.

McDonald JC, McDonald AD, Armstrong B, Sebastien P. 1986. Cohort study of mortality of vermiculite miners exposed to tremolite. *Brit. J. Ind. Med.* 43:436-444.

Nelson W. 1982. *Applied Life Data Analysis.* John Wiley & Sons, New York. pp 438-446.

OSHA. 2002. OSHA 3096: Asbestos Standard for the Construction Industry (Revised). U.S. Department of Labor, Occupational Safety and Health Administration. http://www.osha.gov/Publications/OSHA3096/3096.html

Peipins LA, Lewin M, Campolucci S, Lybarger JA, Miller A, Middleton D, et al. 2003. Radiographic abnormalities and exposure to asbestos-contaminated vermiculite in the community of Libby, Montana, USA. *Environ. Health Perspect.* 111:1753-1759.

Rohs AM, Lockey JE, Dunning KK, Shulka R, Fan H, Hilbert T, Borton E, Wiot J, Meyer C, Shipley RT, LeMasters GK, Kapol V. 2007. Low level Fiber Induced Radiographic Changes Caused by Libby Vermiculite: A 25 year Follow-up Study. *Am J Respiratory and Critical Care Medicine.* Published online December 6, 2007 as doi:10.1164/rccm.200706-814OC.

Sahle W, Laszlo I. 1996. Airborne Inorganic Fibre Monitoring by Transmission Electron Microscope (TEM): Comparison of Direct and Indirect Sample Transfer Methods. *Ann. Occup. Hyg.* 40:29-44.

Sullivan PA. 2007. Vermiculite, Respiratory Disease and Asbestos Exposure in Libby, Montana: Update of a Cohort Mortality Study. *Environmental Health Perspectives* doi:10.1289/ehp.9481 Available online at http://dx.doi.org.

Tetra Tech. 2011. Libby Amphibole (LA) Asbestos in Tree Bark and Duff in the Upper Flower Creek Timber Sale Site, Libby, Montana. Prepared for the Montana Department of Environmental Quality and the Montana Department of Natural Resources and Conservation. Draft – December.

This page intentionally left blank to facilitate double-sided printing

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. Analysis – Review results for TEM laboratory duplicates, 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.
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

This page intentionally left blank to facilitate double-sided printing

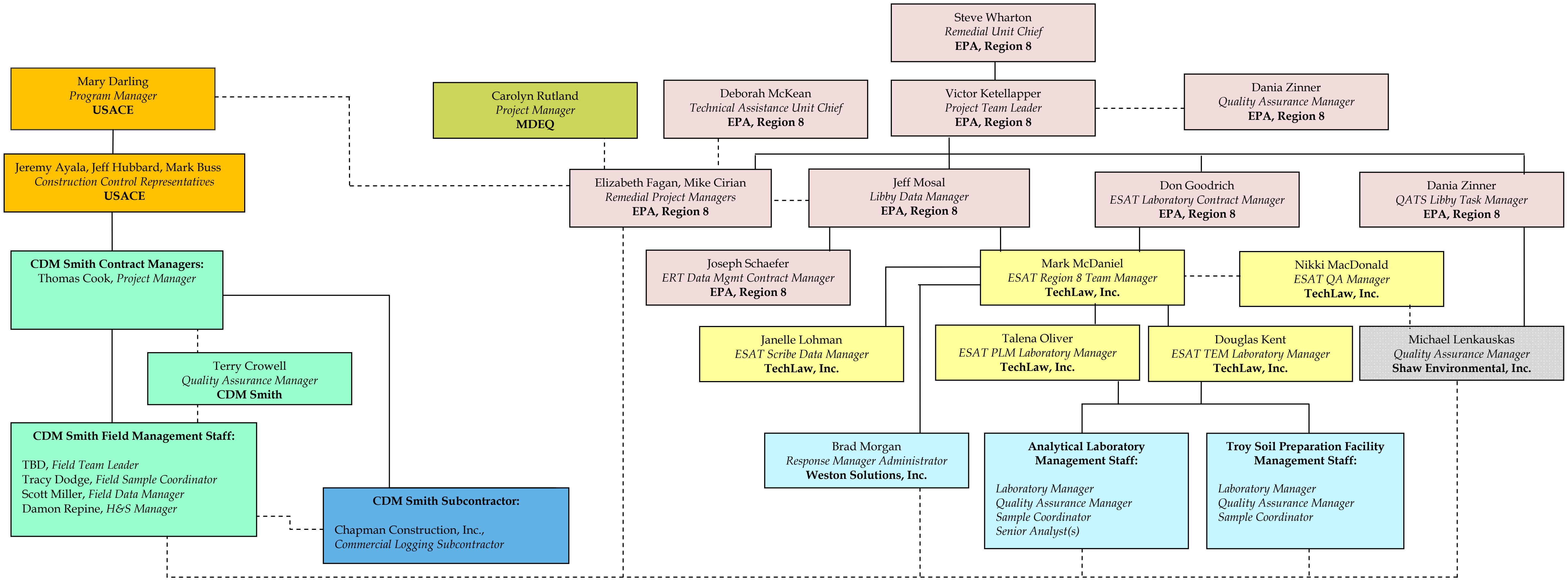


Figure A-1. Organizational Chart for OU4 Commercial Logging ABS

EPA Region 8 Staff

USACE Staff

MDEQ Staff

CDM Smith Staff

CDM Smith Subcontractor

TechLaw Staff

TechLaw Subcontractors

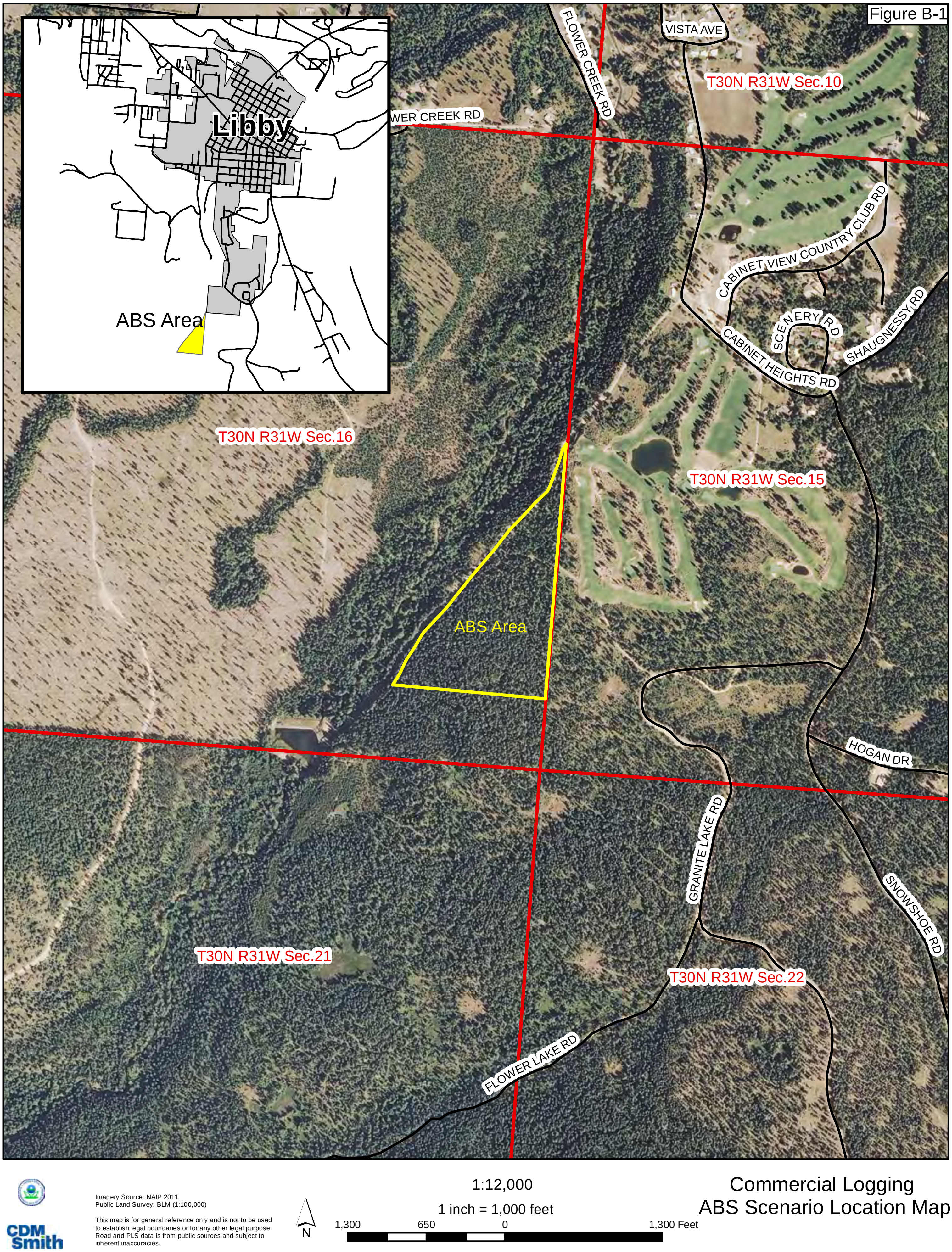
Shaw Staff

Lines of authority

Lines of communication

This page intentionally left blank to facilitate double-sided printing

Figure B-1



Imagery Source: NAIP 2011
Public Land Survey: BLM (1:100,000)

This map is for general reference only and is not to be used to establish legal boundaries or for any other legal purpose. Road and PLS data is from public sources and subject to inherent inaccuracies.

CDM Smith

Commercial Logging
ABS Scenario Location Map

This page intentionally left blank to facilitate double-sided printing

APPENDIX A

DATA QUALITY OBJECTIVES FOR THE COMMERICAL LOGGING ABS

Data Quality Objectives (DQOs) are statements that define the type, quality, quantity, purpose, and use of data to be collected. The following sections implement the seven-step DQO process (EPA 2006) for the commercial logging ABS investigation.

Step 1: State the Problem

Available data indicate that detectable levels of LA in tree bark and duff are present within an area of OU4 referred to as the Upper Flower Creek timber sale site (Tetra Tech 2011). As stated in the *Framework for Investigating Asbestos-Contaminated Superfund Sites* (EPA 2008), asbestos fibers in source materials are typically not inherently hazardous, unless the asbestos is released from the source material into air where it can be inhaled. If inhaled, asbestos fibers can increase the risk of developing lung cancer, mesothelioma, pleural fibrosis, and asbestosis. Thus, the evaluation of risks to humans from exposure to asbestos is most reliably achieved by the collection of data on the level of asbestos in breathing zone air during disturbance of asbestos source materials, referred to as activity-based sampling (ABS) (EPA 2008). While there have been several ABS studies conducted at OU4 to assess potential exposures under a variety of exposure conditions, at present, there are no ABS data that are adequate to evaluate the exposures of commercial logging workers that harvest trees in OU4. Therefore, it is currently unknown whether LA concentrations in tree bark and duff in OU4 present an unacceptable risk to commercial logging workers.

Step 2: Identify the Goal of the Study

The goal of this study is to provide sufficient data to allow the EPA to complete an exposure assessment for commercial logging workers that harvest trees in OU4. The EPA will use the exposure assessment in an evaluation of risks to human health. The risk assessment will support decisions about whether or not response actions are needed to protect humans from unacceptable risks from LA in air that is attributable to releases from disturbances of contaminated environmental media in OU4.

Step 3: Identify Information Inputs

The information needed to characterize exposure of commercial logging workers to LA consist of reliable and representative measurements of LA in air during the harvesting of trees in OU4. Such measurements are obtained by drawing a known volume of air through a filter during various activities that disturb LA source materials and measuring the number of LA fibers that become deposited on the filter surface.

The following sections discuss the types of disturbance activities that should be evaluated, the types of ABS air samples that should be collected, and the analytical methods that should be used to analyze these ABS air samples.

Disturbance Activities

During a commercial logging operation, workers may disturb LA source materials by a variety of different activities. Based on a review of the logging narrative provided by the logging stakeholder group, and after observing logging operations at a state parcel near Libby Creek, it was determined that these activities should include hand-felling of trees, skidding timber, mechanical limbing and cutting of timber, and mechanical preparation of area for re-planting. In addition, it is also desirable to obtain information on milling activities. If it is not possible to assess all these types of logging activities, focus should be placed on those activities that require specialized logging equipment and/or worker expertise.

Type of Air Sample

Experience at Libby and at other 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 2007), especially if the person is engaged in an activity that disturbs an asbestos source material. Because personal air samples are more representative of breathing zone exposures, to the extent feasible, this study should focus on the collection of personal air samples that are located in the breathing zone of the individual performing the disturbance activity.

Analysis Method

ABS air samples should be analyzed for asbestos using transmission electron microscopy (TEM). For ABS air samples, because asbestos toxicity depends on the particle size and mineral type, results should include the size attributes (length, width) of each asbestos structure observed, along with the mineral classification (LA, other amphibole, chrysotile). In addition, because it is possible that there could be various sources of LA present, information on the sodium and potassium content of each LA structure observed, as determined by energy dispersive spectroscopy (EDS), should also be recorded. This requirement is based on the observation of Meeker et al. (2003) that most particles from the Libby ore body contain detectable levels of both sodium and potassium, whereas other potential sources of LA may not.

Step 4: Define the Bounds of the Study

Spatial Bounds

Ideally, ABS sampling for the commercial logging scenario would occur at multiple areas across the Libby Asbestos Superfund Site, to allow risks to be calculated at various distances from the mine and in all directions. However, this would require ABS sampling over an area of hundreds of square miles. Available data on levels of LA measured in tree bark, soil, and duff indicate that, in general, the levels of LA tend to decrease with distance away from the center of the mine. Therefore, the approach that will be taken at OU4 is to collect ABS samples in an area that is representative of actual locations where logging may occur.

If deemed necessary to support risk management decisions, additional ABS efforts at other locations may be warranted.

Temporal Bounds

The release of LA from source materials (soil, duff, tree bark) into air is expected to depend on several factors that may tend to vary over time, including, for example, the moisture content of the source, the amount of ground cover, and the wind speed and direction when disturbance occurs. In general, it is expected that human exposures are more likely to occur when snow is limited or absent from OU4, and that releases will tend to be higher in the dry summer months (August-September) than during wet conditions in spring or fall. Thus, by collecting ABS data in the summer months, this approach will help ensure that the mean concentration calculated using the set of measurements obtained during dry periods is more likely to overestimate than underestimate the actual long-term mean exposure.

If deemed necessary to support risk management decisions, additional ABS efforts at times when exposures may be reduced due to temporal factors (e.g., during the winter when sources are covered by snow) may be warranted.

Step 5: Define the Analytical Approach

The results of this ABS study will be used to calculate an exposure point concentration (EPC). The EPC will be calculated as the average measured ABS air concentration. The EPC will be combined with assumptions about exposure frequency and duration and toxicity factors for LA in a baseline human health risk assessment for OU4 that is expected to provide a basis for the EPA to determine, in consultation with MDEQ, whether response action is needed within OU4 to protect human health.

The EPA has recently proposed LA-specific toxicity values for use in estimating cancer risks and non-cancer hazard quotients (HQs) from exposures to LA in air. The lifetime inhalation unit risk (IUR) value is 0.17 LA phase contrast microscopy (PCM)[6] (structures per cubic centimeter [s/cc])$^{-1}$ and the lifetime reference concentration (RfC) value is 0.00002 LA PCM s/cc (EPA 2011). The EPA is currently reviewing these values. Basic methods for estimating human health risk from LA in air are provided below.

Estimation of Cancer Risk

The basic equation for estimating cancer risk from LA using the LA-specific IUR value is as follows:

$$Risk = EPC * TWF_c * IUR_{LA}$$

where:

Risk = Lifetime excess risk of developing cancer (lung cancer or mesothelioma) as a consequence of site-related LA exposure.

EPC = Exposure point concentration of LA in air (PCM or PCM-equivalent [PCME] s/cc). The EPC is an estimate of the long-term average concentration of LA in inhaled air for the specific activity being assessed.

TWF_c = Time-weighting factor for cancer. The value of the TWF term ranges from zero to one, and describes the average fraction of a lifetime during which exposure occurs from the specific activity being assessed.

$$TWF_c = ET/24 * EF/365 * ED/70$$

where:

ET = Average exposure time (hrs/day)
EF = Average exposure frequency (days/year)
ED = Exposure duration (years)

IUR_{LA}= LA-specific lifetime inhalation unit risk (LA PCM s/cc)$^{-1}$

[6] Calculations of human exposure and risk from asbestos in air are expressed in terms of PCM s/cc. When analysis is performed by TEM, structures that satisfy PCM counting rules are referred to as PCM-equivalent (PCME) structures. The PCM counting rules include structures with a length > 5 microns (µm), a width greater than or equal to (≥) 0.25 um, and an aspect ratio ≥ 3:1.

Estimation of Non-Cancer Hazard Quotient

The basic equation for characterizing non-cancer risk from LA using the LA-specific RfC value is as follows:

$$HQ = EPC * TWF_{nc} / RfC_{LA}$$

where:

HQ = Hazard quotient for non-cancer effects from site-related LA exposure

EPC = Exposure point concentration of LA in air (PCM or PCME s/cc)

TWF_{nc} = Time-weighting factor for non-cancer.

$$TWF_{nc} = ET/24 * EF/365 * ED/60$$

where:

ET = Average exposure time (hrs/day)

EF = Average exposure frequency (days/year)

ED = Exposure duration (years)

RFC_{LA} = LA-specific lifetime reference concentration (LA PCM s/cc)

Decision Rule

The EPA guidance provided in OSWER Directive #9355.0-30, "*Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*" (EPA 1991) indicates that if the cumulative cancer risk to an individual based on reasonable maximum exposure (RME) is less than 1E-04 and the non-cancer HQ is less than 1, then remedial action is generally not warranted unless there are adverse environmental impacts. The guidance also states that a risk manager may decide that a risk level lower than 1E-04 is unacceptable and that remedial action is warranted where there are uncertainties in the risk assessment results.

Step 6: Specify Performance Criteria

In making decisions about the risks to humans in OU4, two types of decision errors are possible:

- A *false negative decision error* would occur if a risk manager decides that exposure to LA is not of health concern, when in fact it is of concern.

- A *false positive decision error* would occur if a risk manager decides that exposure to LA is above a level of concern, when in fact it is not.

The EPA is most concerned about guarding against the occurrence of false negative decision errors, since an error of this type may leave humans exposed to unacceptable levels of LA. To minimize chances of underestimating the true amount of exposure and risk, the EPA generally recommends that risk calculations be based on the 95 percent upper confidence limit (95UCL) of the sample mean (EPA 1992). Use of the 95UCL in risk calculations limits the probability of a false negative decision error to no more than 5 percent. To support this approach, the EPA has developed a software application (ProUCL) to assist with the calculation of 95UCL values (EPA 2010b). However, equations and functions in ProUCL are not designed for asbestos datasets and application of ProUCL to asbestos datasets is not recommended (EPA 2008). The EPA is presently working to develop a new software application that will be appropriate for use with asbestos datasets, but the application is not yet available for use. Because the 95UCL cannot presently be calculated with confidence, risk calculations will be based on the sample mean only, as recommended by EPA (2008). This means that risk estimates may be either higher or lower than true values, and this will be identified as a source of uncertainty in the risk assessment.

The EPA is also concerned with the probability of making false positive decision errors. Although this type of decision error does not result in unacceptable human exposure, it may result in unnecessary expenditure of resources. The risk of false positive decision errors can be minimized by increasing the number of samples. The number of samples needed depends on the magnitude of between-sample variability and the proximity of EPC to the decision threshold. If between-sample variability is low, or if the EPC is not near a decision threshold, then the number of samples needed is relatively low. However, if between-sample variability is high and the EPC is relatively near a decision threshold, then the number of samples needed is usually higher. Based on measured data from previous outdoor ABS sampling efforts (EPA 2010a), there is often substantial variability in measured ABS concentrations of LA in air and measured concentrations may be near risk management decision thresholds. Therefore, there is a need to collect multiple samples to limit the level of uncertainty. Because it is not possible at present to quantify the uncertainty in the mean of an asbestos dataset as a function of the number of samples, it is not possible to calculate a minimum number of samples required to minimize the risk of false positive decision errors.

Step 7: Develop the Plan for Obtaining Data

A detailed study design for the collection of commercial logging ABS data in OU4 is provided in Section B1 of this SAP/QAPP. Key features of this study design are discussed below.

Activities to be Included in the ABS

During a commercial logging operation, workers may disturb LA source materials by a variety of different activities. Unlike traditional ABS efforts, where the ABS scenario is conducted in accordance with a specific script that details the particular activities that should be conducted, how they should be conducted, where they should be conducted, and for how long, the commercial logging ABS script is designed to simply monitor worker exposures under authentic commercial logging conditions. It is anticipated that these activities will include hand-felling of trees, skidding operations, mechanical processing of harvested trees (limb removal and cutting), milling activities, and site preparation for replanting using heavy machinery.

Selection of Sampling Location

Because of the very complex nature of the source material (a mixture of duff, soil, and tree bark), the difficulty in thoroughly characterizing the LA concentrations in these source media, and the potential difficulty in establishing a reliable quantitative relation between source and ABS air, no attempt will be made to establish a quantitative relation between LA levels in source media and the mean concentration in ABS air. Rather, ABS air data will be collected at a location in OU4, selected to be representative of an area of high potential LA exposure where commercial logging could occur.

The strategy for selection of the sampling location is based mainly on a consideration available data on LA levels in source media (i.e., duff, tree bark, and soil). The ABS area should be in close proximity to the Upper Flower Creek timber sale area. In addition, the ABS area should be accessible to logging operations (i.e., roads are available that can enable equipment access to trees).

The EPA should be immediately notified in the event that any changes in the ABS area are needed for reasons of safety or implementation.

Timing of the ABS Effort

Commercial logging ABS efforts will be conducted in the summer of 2012, when environmental conditions are likely to be driest (i.e., August-September). To avoid collecting data that are biased low, ABS sampling will not occur during or within 1 day of rainfall (>1/4 inch).

If the results from the summer ABS effort show that resulting exposures are above a level of potential concern, an additional ABS event may be conducted in the winter to provide information that may be used in support of a possible institutional control for seasonal restrictions on commercial logging in OU4.

Optimizing Sample Number

As noted above, there is often substantial variability in measured ABS concentrations of LA in air due to outdoor source disturbances. Ideally, to limit uncertainty in the calculation of long-term exposures, the goal would be to collect multiple samples during the commercial logging scenario that encompass the range of conditions that influence sampling variability. However, due to the nature of this ABS effort – a small-scale commercial logging effort on a parcel of limited size with a limited number of participating workers – it may not be possible to collect enough samples to fully characterize the extent of variability within each scenario. To the extent feasible, this study should maximize the number of samples collected such that there are multiple air measurements across multiple workers and multiple days.

If the results of the commercial logging ABS effort show that the data are variable and/or are near a decision threshold, additional sampling may be needed to support risk management decision-making.

Optimizing the Sample Collection Strategy

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). 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 makes it easier 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.

However, there is a limit to how much air can be drawn through a filter. In cases where the air being sampled contains a significant level of airborne particulates (e.g., dust, sawdust), it is possible that particulate loading on the filter could influence the ability to maintain the optimal flow rate. To minimize this possibility, pump flow rates should be checked regularly throughout the collection period and filter cassettes should be changed if flow rates become impacted.

While particulate loading on the filter may not impact pump flow rates, it is possible that the filter will become so overloaded with airborne particulates that the filter cannot be examined directly by the TEM analyst. In this event, the filter must undergo an "indirect" preparation in which the original filter is ashed and the resulting residue is suspended in water and re-deposited on a "secondary" filter, such that the secondary filter is not overloaded. In some cases, indirect preparation of air samples may alter (usually increase) the observed concentration of asbestos in air samples. The EPA Region 8 has reviewed published studies on this topic (see HEI-AR 1991 and Breysse 1991 for reviews), and interprets the data to indicate that, in contrast to what is usually observed in the case of chrysotile asbestos, effects of indirect preparation of samples containing amphibole asbestos are generally small (e.g., Bishop *et al.* 1978, Sahle and Laszlo 1996, Berry *et al.* 2012). However, to reduce the frequency of indirect preparations, ABS samples will be collected using two different sampling pumps – one that operates at a high flow rate and one that operates at a low flow rate. Whenever possible, the filter from the high flow pump will be selected for analysis. In cases where the high flow filter is deemed to be overloaded (i.e., the particulate loading on the filter is > 25%), then the low flow filter will be analyzed. If both filters are deemed to be overloaded, the high flow filter will be prepared indirectly following ashing.

Analytical Requirements for ABS Air Samples

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

The basis for each of these values for this study is presented below.

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:

$$RBC(cancer) = \text{Maximum Acceptable Cancer Risk} / (TWF_c * IUR_{LA})$$

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 TWF are not known with certainty, so the following RME exposure parameters were selected based on information provided by local commercial logging workers on potential exposures for workers in the Libby Valley:

Exposure Parameter	Hand-felling	Skidding/mechanical processing/site preparation
Exposure Time	8 hours/day	10 hours/day
Exposure Frequency	140 days/year	160 days/year
Exposure Duration (Libby Valley)	6 years	12 years

Because individuals performing skidding/mechanical processing/site preparation operations tended to have higher exposures than individuals performing hand-felling operations, this exposure scenario was utilized to compute the TAS. For the purposes of deriving the TAS, it was assumed that only about 10% of the time spent logging within the Libby Valley would be within OU3.

Based on these exposure parameters, the TWF_c is 0.0031 (10/24 * 160/365 * 12/70 * 0.1 = 0.0031). Thus, the RBC for cancer is 0.019 LA PCME s/cc.

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

$$RBC(\text{non-cancer}) = (\text{Maximum Acceptable HQ} * RfC_{LA}) / TWF_{nc}$$

For non-cancer, the maximum acceptable HQ is 1. Based on the exposure parameters presented above, the TWF_{nc} is 0.0037 (10/24 * 160/365 * 12/60 * 0.1 = 0.0037). Thus, the RBC for non-cancer is 0.0055 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.

<u>Step 2: Determining the Target Analytical Sensitivity</u>

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:

$$TAS = RBC / \text{Target Count}$$

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 = (0.0055 s/cc) / (3 s) = 0.0018 cc^{-1}

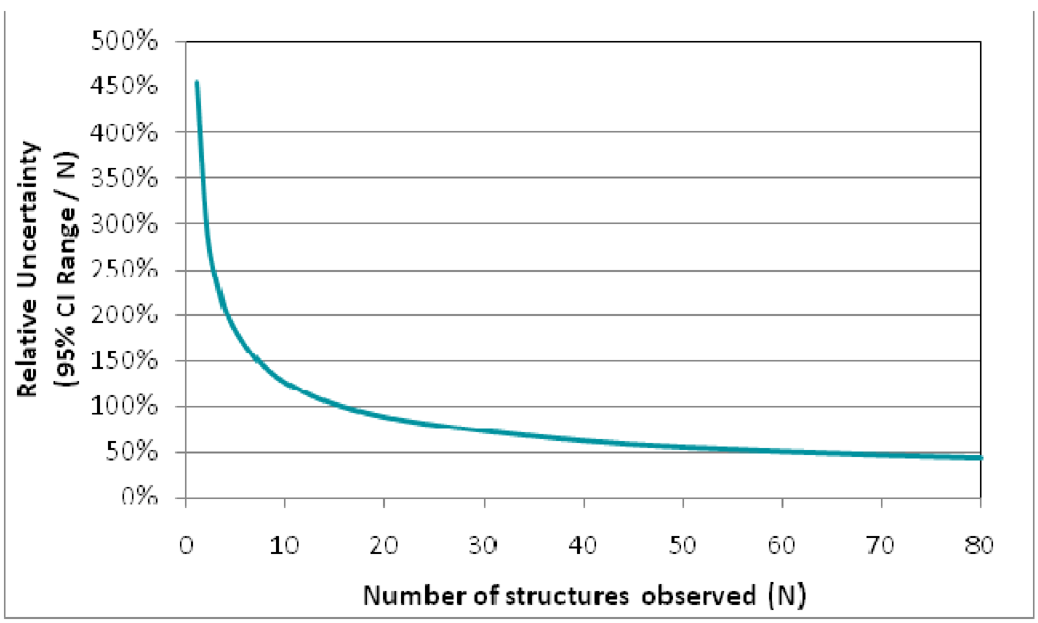
Maximum Number of LA Structures

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 95% confidence interval (CI) around a count of N structures is computed as follows:

Lower bound (2.5%) = ½ · CHIINV(0.975, 2 · $N_{observed}$ + 1)
Upper bound (97.5%) = ½ · CHIINV(0.025, 2 · $N_{observed}$ + 1)

As N_{obs} increases, the absolute width of the CI range increases, but the relative uncertainty (expressed as the CI range divided by N_{obs}) decreases. This concept is illustrated in the figure below.

RELATIONSHIP BETWEEN THE NUMBER OF STRUCTURES OBSERVED AND RELATIVE UNCERTAINTY



CI = confidence interval

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 in the figure, 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 25 structures.

Because the ABS air concentrations will be used to estimate potential risks, which are derived based on the total number of structures that meet PCM counting rules, the maximum structure count is applicable to PCME LA structures (not total LA structures).

Maximum Area to be Examined

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

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

where:

EFA = Effective filter area (assumed to be 385 mm^2)
TAS = Target analytical sensitivity $(cc)^{-1}$
Ago = Grid opening area (assumed to be 0.01 mm^2)
V = Sample air volume (L)
1000 = L/cc (conversion factor in L/cc)
f = Indirect preparation dilution factor (assumed to be 1 for direct preparation)

A total of about 700 grid openings will need to be examined to achieve the target analytical sensitivity, assuming an air sample volume of 960 liters (2 hour sample duration x 60 minutes/hour x 5 liters/minute flow rate) and that the filter is prepared indirectly at an f-factor of 0.05. The number of grid openings that will need to be examined is inversely proportional to the dilution needed (i.e., an f-factor of 0.01 will increase the number of grid openings by a factor of 5). If the f-factor is very small, 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 for this study should be as follows:

1. Examine a minimum of two grid openings from each of two grids.
2. Continue examining grid openings until one of the following is achieved:
   a. The TAS (0.0018 cc^{-1}) is achieved.
   b. 25 PCME LA structures have been observed.
   c. A total filter area of 20 mm^2 has been examined.

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

REFERENCES

Bishop K, Ring S, Suchanek R, Gray D. 1978. Preparation Losses and Size Alterations for Fibrous Mineral Samples. *Scanning Electron Microsc.* I:207.

Breysse PN. 1991. Electron Microscopic Analysis of Airborne Asbestos Fibers. *Crit. Rev. Analyt. Chem.* 22:201-227.

EPA. 1991. Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions. Washington, DC. OSWER Directive 9355.0-30.

_____. 1992. United States Environmental Protection Agency, Office of Solid Waste and Emergency Response. Supplemental Guidance to RAGS: Calculating the Concentration Term. Publication 9285.7-081.

_____. 2006. Guidance on Systematic Planning Using the Data Quality Objective Process, QA/G-4. February.

_____ 2007. Summary Report for Data Collected under the Supplemental Remedial Investigation Quality Assurance Project Plan Libby, Montana Superfund Site. U.S. Environmental Protection Agency, Region 8. October.

_____. 2008. Framework for Investigating Asbestos-Contaminated Sites. Report prepared by the Asbestos Committee of the Technical Review Workgroup of the Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency. OSWER Directive #9200.0-68.

____. 2010a. Activity-Based Sampling Summary Report, Operable Unit 4, Libby, Montana, Superfund Site. U.S. Environmental Protection Agency, Region 8. June 2.

____. 2010b. ProUCL Version 4.00.05 Technical Guide (Draft). U.S. Environmental Protection Agency, Office of Research and Development. EPA/600/R-07/041. May 2010. http://www.epa.gov/esd/tsc/ProUCL_v4.00.05/ProUCL_v4.00.05_tech_guide(draft).pdf

_____. 2011. Remedial Investigation for Operable Unit 3, Libby Asbestos Superfund Site. Phase IV Sampling And Analysis Plan Part A – Data to Support Human Health Risk Assessment. Addendum: Opportunistic Sampling During Authentic Wildfires. Prepared for, and with oversight by U.S. Environmental Protection Agency, Region 8, Denver, CO, by CDM, Denver, CO and SRC, Inc, Denver, CO. August 20, 2011

HEI-AR. 1991. Asbestos in Public and Commercial Buildings: A Literature Review and Synthesis of Current Knowledge. Health Effects Institute – Asbestos Research. Cambridge, Massachusetts.

Meeker GP, Bern AM, Brownfield IK, Lowers HA, Sutley SJ, Hoeffen TM, Vance JS. 2003. The Composition and Morphology of Amphiboles from the Rainy Creek Complex, Near Libby, Montana. *American Mineralogist* 88:1955-1969.

Sahle W, Laszlo I. 1996. Airborne Inorganic Fibre Monitoring by Transmission Electron Microscope (TEM): Comparison of Direct and Indirect Sample Transfer Methods. *Ann. Occup. Hyg.* 40:29-44.

APPENDIX B

COMMERICAL LOGGING ABS SCRIPT

All commercial ABS scenarios will be conducted in the specified ABS area (see Figure B-1 in the SAP/QAPP).

Hand-Felling

Hand felling has been identified as being a commonly utilized method to fell timber within the Libby Valley. Each individual sawyer participating in hand-felling activities will wear two sampling pumps – a high volume pump and a low volume pump – attached such that the sample collection is in close proximity to the breathing zone (e.g., shoulder). Thus, two filters will be collected for each sampling period (i.e., a high volume filter and a low volume filter) for each individual.

During the hand-felling activity, the sawyer(s) will utilize a chain saw to fell trees located within the ABS area. Trees to be felled should be Douglas fir with a diameter (caliper) of at least 8 inches. If these trees are not available, trees with a large diameter and rough bark will be selected preferentially. The sawyer will fell marked trees until a total of 100 trees have been felled. Air sampling cassettes will be changed out every 2 hours.

Skidding/Hooking of Timber

Both skidding and hooking operations are methods commonly practiced within the Libby Valley during commercial logging operations. For this ABS scenario, the skidder operator will wear two sampling pumps – a high volume pump and a low volume pump – attached such that the sample collection is in close proximity to the breathing zone (e.g., shoulder). Thus, two filters will be collected for each sampling period (i.e., a high volume filter and a low volume filter) for the skidder operator.

Trees to be utilized during the skidding scenario will be the same trees that were felled during the hand-felling ABS scenario. During the skidding activity, one operator will utilize a machine to gain access to felled trees. The skidder operator will exit the machine cab and attach cables to felled trees. Once trees are hooked with cables, the operator will re-enter the machine cab and drag the hooked trees to a staging area for the mechanical processing scenario. The skidder operator will continue this process until all 100 felled trees have been skidded. Air sampling cassettes will be changed out every 2 hours.

Mechanical Processing

For the mechanical processing ABS scenario, air sampling equipment will be placed within the cab of the machine in an area representative of the operator's breathing zone. Two sampling pumps will be utilized – a high volume pump and a low volume pump – thus, two filters will be collected for each sampling period (i.e., a high volume filter and a low volume filter). Trees to be utilized during the processing scenario will be the same trees felled during the hand-felling ABS scenario and moved to the staging area via operations during the skidding ABS scenario. During the processing activity, one operator will utilize a machine to gain access to the felled trees located at the staging area. The timber processing operator will process trees (i.e., de-limb and cut timber to size) in the staging area and move the processed trees to the loading deck. The operator will continue this process until all 100 trees have been processed. Air sampling cassettes will be changed out every 2 hours.

Milling Process

For the milling process ABS scenario, slabs will be cut from logs prepared following the mechanical processing scenario. The purpose of cutting logs into slabs is to remove the bark from the logs in order to minimize the amount of core wood being put through the chipper. Once slabs with remaining bark from logs have been removed, a laborer will continually feed slabs through a chipper to simulate a mill debarking scenario. Air sampling equipment will be placed at varying distances in a downwind direction from the chipper at a height representative of an average persons breathing zone (4-6 feet). Four sampling pumps will be utilized – a high volume pump and a low volume pump – thus, four filters will be collected for each sampling period (i.e., a high volume filter and a low volume filter). Both a high volume and low volume pump will be placed at a distance of approximately 10 feet of the chipping process in a downwind direction. In addition, both a high volume and low volume pump will be placed at a distance of approximately 50 feet from the chipping process in a downwind direction. This activity will continue until all logs from the mechanical processing scenario have been chipped. Air sampling cassettes will be changed out every two hours.

Site Restoration

This ABS event will not include a replanting component. For the site restoration ABS scenario, restoration of the logging road/landing area will be performed. Air sampling equipment will be placed within the cab of the machine in an area representative of the operator's breathing zone. Two sampling pumps will be utilized – a high volume pump and a low volume pump – thus, two filters will be collected for each 2-hour sampling period (i.e., a high volume filter and a low volume filter).

During the site restoration activity, one operator will utilize a machine to remove tree litter from the area. One or more laborers may also assist in this task. The operator (and laborers, if used) will continue this process until the landing area has been cleared and the road restored to its original condition. Air sampling cassettes will be changed out every 2 hours.

Equipment

The following list summarizes general equipment which will be utilized to complete the scripts described above, as part of this event.

- Two Stihl chainsaws (or equivalent)
- Chokers for skidding logs
- John Deere 550 dozer (or equivalent)
- Caterpillar de-limber/processor (or equivalent)
- Case 580 backhoe (or equivalent)
- Vermeer BC1000XL wood chipper (or equivalent)
- Norwood 2500 sawmill (or equivalent)

This page intentionally left blank to facilitate double-sided printing

APPENDIX C

STANDARD OPERATING PROCEDURES**

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
Laboratory Procedures	
EPA-LIBBY-08	Indirect Preparation of Air and Dust Samples for TEM Analysis
Data Verification Procedures	
EPA-LIBBY-09	SOP for TEM Data Review and Data Entry Verification
EPA-LIBBY-11	SOP for 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).

This page intentionally left blank to facilitate double-sided printing

APPENDIX D
DECONTAMINATION CHECKLIST FOR VEHICLES AND HEAVY EQUIPMENT

Libby Asbestos Project Equipment Decontamination Checklist

Date:			Site Location:	
Removal Contractor :			Owner of Equipment:	
Type of Equipment:			Odometer or Hour Meter :	
Equipment Identification Number:			USACE pre-notification:	
Purpose of Decontamination	**Check One**	**Air Filtration Units**	**Yes/NA**	**Parts Number**
End of Service		Cab Filter Replaced		
Change of Duty		Engine Intake Filter Replaced		
Repairs		Main HEPA Filter Replaced		
Other:		Prefilter on HEPA Replaced		
General Requirements	**Yes/NA**	**Water Truck (Mine Use)**	**Yes/NA**	
Remove All Protective Plating		Flush Water Delivery System	Number of Times:	
Pressurize Wash All Surfaces		Water System Sampled		
Wash Engine Compartment		Non-detect Sample Results		
Remove All Floor Mats		**Industrial Vacuum**		
Wet Wipe/ HEPA Vac Interior		Hopper Decontamination		
Comments:				
Filter Disposal Information:				

Sign below when the full decontamination has been performed per the RAWP standard.

Form Completed by:	Signed:		Date
RC Inspection Performed by :	Signed:		Date
TQA Inspection Performed by:	Signed:		Date
USACE Completion Notification:	Rep:	Time:	Date:

This page intentionally left blank to facilitate double-sided printing

APPENDIX E

ANALYTICAL REQUIREMENTS SUMMARY SHEET

[LOGOU4-0912]

[see the Libby Lab eRoom for the most recent version of this summary sheet]

This page intentionally left blank to facilitate double-sided printing