Quality Assurance Project Plan:
Nature and Extent - Forest Activity-Based Sampling
Libby Asbestos Superfund Site

Revision 1 – July 2014

07/17/14

Project Period 09/17/2013 to 10/31/2014
Contract No. W9128F-11-D-0023
Task Order No. 0005

Prepared for:

U.S. Environmental Protection Agency
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Prepared under Libby Asbestos Interagency Agreement,
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A PROJECT MANAGEMENT

A1. Title and Approval Sheet

Title: Quality Assurance Project Plan: Nature and Extent - Forest Activity-Based Sampling, Libby Asbestos Superfund Site. Revision 1 - 07/17/14

Revision Log:

Revision No.	Date	Description
0	9/16/13	---
1	7/17/14	• Update project contract information from EPA RAC to USACE; add text to incorporate USACE's role in the sampling program • Changed sampling dates from fall 2013 to summer 2014 • Clarified data management requirements • Made editorial changes

Approvals:

Approved by: ______________________ Date: 7/28/14
Thomas Cook, PMP, CHMM
CDM Smith, Project Manager

Reviewed by: ______________________ Date: 7/28/14
Terry Crowell, CHMM
CDM Smith, Quality Assurance Manager

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David Ray or designee
USACE, Quality Assurance Manager

Approved by: ______________________ Date: 7/17/14
Christina Progess
EPA Region VIII, Libby Asbestos Project, Remedial Project Manager

Approved by: ______________________ Date: 7/17/14
Dania Zinner
EPA Region VIII, Libby Asbestos Project, Quality Assurance Reviewer

Approved by: ______________________ Date: 7/21/14
Rebecca Thomas
EPA Region VIII, Libby Asbestos Project, Team Leader

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A2. Table of Contents

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List of Acronyms and Abbreviations

%	percent
>	greater than
≥	greater than or equal to
95UCL	95 percent upper confidence limit
ABS	activity-based sampling
Ago	grid opening area
APP	accident prevention plan
C_{air}	air concentration
cc^{-1}	per cubic centimeter
CAR	corrective action request
CB&I	CB&I Federal Services, LLC
CDM Smith	CDM Federal Programs Corporation
CFR	Code of Federal Regulations
CHISQ	chi-squared
COC	chain-of-custody form
DE Tool	data entry tool
DQO	data quality objective
EDD	electronic data deliverable
EDS	energy dispersive spectroscopy
EFA	effective filter area
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERT	Environmental Response Team
ESAT	Environmental Services Assistance Team
f/cc	fibers per cubic centimeter
FSDS	field sample data sheet
FTL	field team leader
GIS	geographic information system
GO_x	number of grid openings
GPS	global positioning system
HAZWOPER	Hazardous Waste Operations and Emergency Response
H&S	health and safety
HV	high volume filter
ID	identification
IDW	investigation-derived waste
ISO	International Organization for Standardization
L	liters
L/cc	liters per cubic centimeter
L/min	liters per minute
LA	Libby amphibole

LC	laboratory coordinator
LV	low volume filter
MDEQ	Montana Department of Environmental Quality
mm^2	square millimeters
N	number
NFG	National Functional Guidelines
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NPL	National Priorities List
NVLAP	National Voluntary Laboratory Accreditation Program
OU	operable unit
OSHA	Occupational Safety and Health Administration
PCM	phase contrast microscopy
PCME	phase contrast microscopy-equivalent
PLM	polarized light microscopy
QA	quality assurance
QAM	quality assurance manager
QAPP	quality assurance project plan
QA/QC	quality assurance/quality control
QATS	Quality Assurance Technical Support
QC	quality control
RPM	Regional Project Manager
ROM	Record of Modification
s/cc	structures per cubic centimeter
Site	Libby Asbestos Superfund Site
SOP	standard operating procedure
SPF	Soil Preparation Facility
STEL	short-term exposure limit
TEM	transmission electron microscopy
TWA	time-weighted average
USACE	U.S. Army Corps of Engineers
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
V	sample air volume
VWC	volumetric water content
µm	micrometers

A3. Distribution List

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

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

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EPA Information Center – Libby
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Rapid Response Program Office
Offutt AFB, Nebraska 68113

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United States Forest Service
Kootenai National Forest – Forest Supervisor's Office
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Libby, Montana 59923

- Malcolm Edwards, medwards01@fs.fed.us (electronic copy)

United States Forest Service – Northern Region
200 East Broadway
Missoula, Montana 59802

- Nancy Rusho, nrusho@fs.fed.us (electronic copy)

Copies of the 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 designee) will distribute updated copies each time a QAPP revision occurs. An electronic copy of the final, signed QAPP (and any subsequent revisions) will also be posted to the Libby Field eRoom[1].

A4. Project Task Organization

Figure A-1 presents an organizational chart that shows lines of authority and reporting responsibilities for this project. The following sections summarize the entities and individuals that will be responsible for providing project management, technical support, and quality assurance (QA) 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 8 Libby Asbestos Project Team Leader is Rebecca Thomas. The EPA Remedial Project Manager (RPM) for this

[1] https://team.cdm.com/eRoom/R8-RAC/Libby

sampling effort is Christina Progess. The EPA Onsite RPM for this sampling effort is Michael Cirian.

The U.S. Army Corps of Engineers (USACE), Omaha District, is the contracting agency providing project management, environmental engineering, and remediation support at the Site, on behalf of the EPA. The USACE has an interagency agreement with the EPA, number DW96954027, through which work will be performed under this QAPP. Support services, including the sampling activities will be performed by the CDM Smith under contract to the USACE for Architect-Engineering and Surveying Services (Contract Number W9128F-11-D-0023, Task Order 0005) for remedial investigation and feasibility study support to the EPA Region 8. The USACE Program Manager is Mary Darling.

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, the National Contingency Plan, and applicable guidance in conducting Superfund activities.

The U.S. Forest Service (USFS) is the regulatory agency responsible for the parcels of land where activities are to occur as part of this QAPP. The EPA will consult the USFS for all activities being performed as part of this QAPP. The On-Scene Coordinator for the USFS is Nancy Rusho.

A4.2 Technical Support

A4.2.1 QAPP Development

This QAPP was developed by CDM Smith at the direction of, and with oversight by, the EPA. This QAPP contains all the elements required for both a sampling and analysis plan 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 QAPP will be distributed by the CDM Smith Project Manager (or their designee), either in hard copy or in electronic format, as indicated in Section A3. The CDM Smith Project Manager (or their designee) will distribute updated copies each time a QAPP revision occurs. An electronic copy of the final, signed QAPP (and any subsequent revisions) will also be posted to the Libby Field eRoom.

A4.2.2 Field Sampling Activities

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

- Thomas Cook, 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

The project data management processes and reporting requirements, and related contractor responsibilities, are described in the *EPA Data Management Plan for the Libby Asbestos Superfund Site* (EPA 2013). This document is managed by the EPA Data Manager and can be found in both the Libby Field eRoom and the Libby Lab eRoom[2]. Terry Crowell is the CDM Smith eRoom coordinator responsible for managing user accounts; eRoom accounts may be requested via email at CrowellTL@cdmsmith.com.

All field data generated as part of this sampling effort will be initially 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 overseeing the upload of sample information to the field Scribe project database.

[2] https://team.cdm.com/eRoom/mt/LibbyLab

The final repository for all field and analysis data associated with this investigation is the master operable unit 3 (OU3) database. Administration of the master OU3 database will be performed by EPA's contractor, CDM Smith. The primary OU3 database manager will be Lynn Woodbury (or her designee). She will be responsible for transferring field sample data from Scribe into the master OU3 database, uploading new analytical results, data tracking, performing data verification and error checks to identify incorrect, inconsistent or missing data, and ensuring that all data are checked and corrected as needed.

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 QA Manager (QAM) 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 (Christina Progess) and the delegated EPA QA reviewer (Dania Zinner), who is independent of the entities planning and obtaining the data, to ensure that this 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, CB&I Federal Services (CB&I). The QATS contractor will evaluate and monitor laboratory QA/QC and is responsible for performing annual audits of each analytical laboratory.

Additional QA support is provided by USACE QA management and staff, which includes senior-level members that perform duties as QA representatives for the project. These QA representatives are independent of the USACE project team that manage and execute the work (including data collection and use). They are responsible for assuring work is performed in conformance to the QA program and project-specific requirements. It is anticipated that David Ray will serve as the USACE QA representative for response action sampling efforts; however, other staff may ultimately be identified to fill this role. The USACE will notify the EPA of any changes in project QA staff.

USACE rotates several personnel to Libby to maintain an onsite presence. Collectively, the onsite personnel are responsible for oversight, coordination of project work/scope objectives, and contract administration. USACE onsite personnel report to the USACE Project Manager. The following onsite USACE personnel will maintain QA oversight of this sampling program:

- Jeremy Ayala, Project Engineer

- Jeff Hubbard, Backup Project Engineer
- Brian Broekemeier, Construction Control Representative

CDM Smith's QA Director, Jo Nell Mullins, implements the CDM Smith QA program. She is independent of project technical staff and reports directly to the firm's president on QA matters. The QA Director has the authority to objectively review projects and identify problems, and the authority to use corporate resources, as necessary, to resolve any quality-related problems. CDM Smith's QAM for this project, Terry Crowell, reports to Ms. Mullins on QA matters. Under Ms. Mullin's oversight, Ms. Crowell is responsible for monitoring and evaluating field QA/QC, providing oversight of field sampling and data collection activities, and coordinating field QA activities, including identifying qualified, independent staff to conduct assessments of field activities (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, 2004; Amandus and Wheeler 1987; Amandus *et al.* 1987; Whitehouse 2004; 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; Whitehouse *et al.* 2008; Antao *et al.* 2012; Larson *et al.* 2010, 2012a, 2012b). Although the mine has ceased operations, historic or continuing releases of LA from mine-related materials could be serving as a source of ongoing exposure and risk to current and future residents and workers in the area. The Site was listed on the National Priorities List (NPL) 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., tree bark, duff) at forested locations more than 10 miles from the mine site along the current NPL boundary (EPA 2012). As a result, individuals may be exposed to LA that is released to air during source disturbance activities. These inhalation exposures may pose a risk of cancer and/or non-cancer effects.

However, the detection of low levels of LA in tree bark and duff does not necessarily indicate that human exposures to these levels would result in unacceptable risks. The amount of LA that could be released to air and inhaled will vary depending upon a number of factors, including the level of LA in the source material (e.g., duff, tree bark, soil); the nature, intensity, and duration of the disturbance activity; meteorological conditions (e.g., relative humidity, wind direction and speed); and conditions of the source material (e.g., moisture content). Because of this, predicting LA levels in air based on measured LA levels in source materials is extremely difficult. For this reason, the EPA recommends an empiric approach for investigating asbestos-contaminated Superfund sites, where concentrations of asbestos in air from source disturbances are measured rather than predicted (EPA 2008a). This type of sampling is referred to as "activity-based sampling" (ABS) and involves the collection of personal air samples under representative source-disturbance conditions that can be used to calculate potential inhalation exposures and risks (EPA 2008a).

Measured ABS air data are needed to provide information on potential exposure and risk from LA due to the disturbance of environmental source media in forested areas near the NPL boundary. These risk estimates will be used to inform decisions on the boundaries of the nature and extent of LA contamination in the forest.

A5.3 Applicable Criteria and Action Limits

At the Site, the EPA has developed action levels and cleanup criteria for LA that are applicable to emergency response actions performed at residential/commercial properties (EPA 2003). However, there are no action levels or cleanup criteria that have been developed specific to ABS air. Final action levels for the Site will not be developed until completion of the remedial investigation/feasibility study and the publication of the record of decision.

Personal air monitoring of sampling personnel will be performed in accordance with Occupational Safety and Health Administration (OSHA) requirements. In accordance with these requirements, health and safety (H&S) air monitoring samples will be analyzed for asbestos by phase contrast microscopy (PCM) (see Section B4.1.3) and compared to the OSHA limits for workplace exposures. The short-term (30-minute) exposure limit (STEL) is 1.0 fiber per cubic centimeter (f/cc) of air, and the long-term time-weighted average (TWA) exposure limit is 0.1 f/cc. (Note that H&S air monitoring samples are collected separately from the ABS air samples under this investigation.)

A6. Project/Task Description

A6.1 Task Summary

Basic tasks required to implement this QAPP include collecting ABS air and soil samples from a subset of the locations along the current NPL boundary that were previously sampled as part of the *Nature and Extent of LA Contamination in the Forest* (EPA 2012) study. The ABS air samples will be analyzed for asbestos to provide measured data on potential airborne asbestos exposures. These basic tasks are described in detail in subsequent sections of this QAPP.

A6.2 Work Schedule

A total of three ABS sampling events will be conducted for each of the selected sampling locations. It is anticipated that sampling will be completed in July/August 2014, separated in time by approximately one week. Sample analysis and data evaluation and interpretation tasks are expected to be performed during the fall of 2014.

A6.3 Locations to be Evaluated

Locations selected for the collection of ABS air and soil samples are illustrated in **Figure B-1** and described in Section B1.1.

A6.4 Resources and Time Constraints

Collection of ABS air samples must be conducted under dry conditions when the potential for LA release for soil and duff would be highest. This will help ensure that the air samples are representative of the worst-case exposure conditions for fiber release from the soil or duff material. As noted previously, the sampling is scheduled to occur in July/August 2014.

The EPA has introduced both resource and time constraints with the scope of this sampling program. As such, this sampling program will be limited to sampling at ten locations, with a maximum of three ABS events at each location.

A7. Quality Objectives and Criteria

A7.1 Data Quality Objectives

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

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

A7.2 Performance Criteria

The primary goal of this study is to measure LA concentrations in outdoor ABS air from soil/duff disturbance activities at locations along the NPL boundary to estimate potential exposures and risks to populations that may be exposed to LA in these forested areas. These risk estimates will be used to inform decisions on the boundaries of the nature and extent of LA contamination in the forest. The performance criteria and analytical requirements for this study are specified as part of the DQOs (**Appendix A**).

The transmission electron microscopy (TEM) analytical requirements for LA measurements in ABS air, as established in Section B4.1.1, ensure concentrations will be reliably detected and quantified if present at levels of concern. Detailed calculations in support of these analytical requirements are provided as part of the DQOs (**Appendix A**).

The PCM analytical requirements for H&S air monitoring samples are based on the requirements specified in the National Institute for Occupational Safety and Health (NIOSH) Method 7400 (see Section B4.1.2).

A7.3 Precision

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

Recount and repreparation analyses will be performed as part of the TEM analysis (see Section B5.2.3). These analyses will provide information on analysis reproducibility and precision (both inter- and intra-laboratory).

A7.4 Bias and Representativeness

There is no established set of reference materials or spiked standards that can be used to assess accuracy of TEM analyses of LA in air. Results for field blanks and laboratory blanks will be utilized to ensure that air sample results are not biased as a consequence of cross-contamination due to field sampling procedures or preparation and analysis methods.

It is expected that LA levels in ABS air may vary widely as a function of the level of LA in the source materials disturbed, the types of activities performed, and meteorological and environmental conditions. Based on a review of various outdoor ABS datasets for the Libby Site, the “Pulaski digging” scenario (representative of firefighters constructing firelines using hand tools in forested areas at the Site) tended to yield higher ABS air concentrations relative to other ABS disturbance scenarios. Therefore, this scenario is being used as an "indicator" scenario in this study for the purposes of evaluating the nature and extent of potential LA contamination in ABS air, and resulting ABS air concentrations are likely to represent the higher end of the range of potential exposure conditions.

A7.5 Completeness

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

A7.6 Comparability

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

A7.7 Method Sensitivity

The method sensitivity (analytical sensitivity) needed for analysis of LA in ABS air 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 CDM Smith *Accident Prevention Plan* (*APP*)	*APP* signature sheet
Attend an orientation session with the field H&S Manager	Orientation session attendance sheet
OSHA 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) and relevant 8-hour refreshers	OSHA training certificates

Training Requirement	Location of Documentation Specifying Training Requirement Completion
Current 40-hour HAZWOPER medical clearance	Physician letter in the field personnel files
Respiratory protection training, as required by 29 Code of Federal Regulations (CFR) 1910.134	Training certificate
Asbestos awareness training, as required by 29 CFR 1910.1001	Training certificate
Sample collection techniques	Orientation session attendance sheet

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

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

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

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

A8.2 Laboratory

A8.2.1 Certifications

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

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

Each laboratory working on the Libby project is also required to pass an onsite EPA laboratory audit. The details of this EPA audit are discussed in Section B5. 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 onsite training provided by senior personnel from those laboratories already under contract on the Libby project, with oversight by the QATS contractor (CB&I). 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 2008c). Upon entry into the Libby program, each laboratory is provided samples of these LA reference materials. Each laboratory is required to analyze multiple LA structures present in these samples by TEM in order to become familiar with the physical and chemical appearance of LA and to establish a reference library of LA energy dispersive spectroscopy (EDS) spectra. These laboratory-specific and instrument-specific LA reference spectra (EPA 2008b) serve to guide the classification of asbestos structures observed in Libby field samples during TEM analysis.

Regular Technical Discussions

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.

Professional/Technical Meetings

Another important aspect of laboratory team training has been the participation in technical conferences. The first of these technical conferences was hosted by USGS in Denver, Colorado, in February 2001, and was followed by another held in December 2002. The Libby laboratory team has also convened on multiple occasions at the ASTM Johnston Conference in Burlington, Vermont, including in July 2002, July 2005, July 2008, and July 2011, and at the Michael E. Beard Asbestos Conferences in January 2010 and January 2013. 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 ongoing 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 (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 B5.2.1). The entire program is discussed to ensure understanding of requirements and responsibilities. In addition, analysts are trained in the project-specific reporting requirements and data reporting tools utilized in transmitting results. Upon completion of training, the TEM analyst is enrolled as an active participant in the Libby laboratory program.

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

A9. Documentation and Records

A9.1 Field

Field teams will record sample information on the most current version of the Site-specific field sample data sheets (FSDSs) developed for each medium[3]. Section B3.1.2 provides detailed information on the documentation requirements for FSDS forms. In brief, the FSDS forms document the unique sample identifier assigned to every sample collected as part of this program. In addition, the FSDSs provide information on whether the sample is representative of a field sample or a field-based QC sample (e.g., field blank, field duplicate).

A9.2 Laboratory

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

A9.3 Logbooks and Records of Modification/Deviations

It is the also responsibility of the field team and analytical laboratory staff to maintain logbooks and other internal records throughout the sample lifespan as a record of sample handling procedures. Significant deviations (i.e., those that impact or have the potential to impact investigation objectives) from this QAPP, or any procedures referenced herein governing sample handling, will be discussed with the EPA RPM (or their designee) 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,

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

respectively.

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B DATA GENERATION AND ACQUISITION

B1. Study Design

B1.1 Locations

The goal of this study is to collect data from ten sampling locations along the current NPL boundary, collocated with sampling locations evaluated in the *Nature & Extent in the Forest* investigation (EPA 2012). Sampling locations were selected to be spatially representative of the circumference of the current NPL boundary, but not duplicative with locations sampled as part of OU3 ABS studies. Sampling locations were placed in areas that were accessible via USFS roads and that appeared to have adequate tree cover (based on a cursory review of aerial images). **Figure B-1** identifies the ten selected sampling locations. **Appendix C** provides detailed topographic maps of each sampling location, including information on access roads that may be used to access each location.

Should these pre-determined sampling locations become inaccessible at any point during or prior to the sampling event, new locations that meet the same criteria will be identified and presented to the EPA for approval; these changes would be documented on a ROM form as described in Section B5.1.2.

B1.2 Sampling Design

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

Each sampling event will begin by conducting the fireline ABS. During the event, two individuals will participate in the ABS scenario and simulate firefighting activities of constructing a firebreak by hand. A Pulaski tool or other similar device will be used to scrape away all combustible material down to mineral soil to establish a line approximately 18 inches wide. The two ABS participants work side-by-side approximately 10 feet apart. The ABS activity is performed for a period of 30 minutes. After 15 minutes, the relative positions of the two participants will be reversed.

Each actor will wear two different sampling pumps, one with a high flow rate resulting in a high volume (HV) filter and one with a low flow rate resulting in a low volume (LV) filter. However, only one of the two air filters for each individual, either the HV filter or the LV filter, will be analyzed by TEM (see Section B4). Thus, each sampling event will include the collection of four fireline ABS air filters – two HV filters and two LV filters – of which two filters (one per actor) will be analyzed.

As shown in **Table B-1**, a total of 120 fireline ABS air samples will be collected (four ABS air samples per sampling location per sampling event, for each of the three sampling events, for each of ten sampling locations). A total of 60 ABS air samples will be analyzed by TEM (see Section B4).

In order to maximize to the amount of time between the sampling events, the second ABS event will not be conducted until the first event has been completed for all ten locations. Likewise, the third ABS event will not be conducted until the second event has been completed for all ten locations.

Following ABS air sample collection, one soil sample will be collected. One soil sample will be collected from each of the ten sampling locations. However, soil samples will only be collected during the first of the three sampling events scheduled for each sampling location. All soil samples collected under this study will be archived for potential future analysis as directed by the EPA.

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

Table B-1: Number of Samples per Medium

Medium	Number of samples collected per event per location	Number of events per location	Total number of samples collected	Number of samples analyzed
Fireline ABS Air	4 (2 HV, 2 LV)	3	120	60*
Soil	1	1	10	0**

* Either the HV or LV will be selected for analysis, depending upon filter loading.
** All samples will be archived for possible future analysis.
ABS = activity-based sampling
HV = high volume filter
LV= low volume filter

B1.3 Study Variables

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

It is preferable to conduct ABS sampling when the conditions for release of LA fibers are generally favorable, so outdoor ABS will be restricted to summer months (July through September) when rainfall and soil moisture levels are at their lowest. The exact sampling dates have not yet been set, however it is anticipated that this sampling program will occur in the summer of 2014. ABS sampling will not occur if rainfall in the past 36 hours has exceeded ¼ inch, if there is standing water present, or if the soil moisture content is greater than 50%.

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

B1.4 Critical Measurements

The critical measurement associated with this project is the measurement of the concentration of LA in ABS air from the ten proposed locations shown on **Figure B-1**. The analysis of LA in air may be achieved using several different types of microscope, but the EPA generally recommends using TEM because this technique has the ability to clearly distinguish asbestos from non-asbestos structures, and to classify different types of asbestos (i.e., LA, chrysotile). In addition, analysis by TEM provides structure-specific dimensions that allow for the estimation of PCM-equivalent[4] (PCME) concentrations, which is the concentration metric necessary to estimate exposure and risks from the ABS air samples.

B1.5 Data Reduction and Interpretation

ABS air filters collected as part of this study 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 (square millimeters [mm^2])
GOx	= Number of grid openings examined
Ago	= Area of a grid opening (mm^2)
V	= Sample air volume (liters [L])
1000	= L/cc (conversion factor; convert liters to cubic centimeters)
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 exposures to LA in air.

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

B2. Sampling Methods

B2.1 Sample Collection

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

B2.1.1 Health & Safety Air Samples

As part of this investigation, personal air samples will also be collected at the first three locations and the first event only, for ongoing H&S monitoring. H&S air samples will be evaluated by the H&S Manager to determine if personnel protection controls are adequate and if additional H&S air samples are necessary. The H&S samples will be collected using an additional LV sampling pump and are not intended for use as ABS air samples. To differentiate these samples from the other personal air samples collected as part of this sampling effort, "PA-EXC" or "PA-TWA" will be selected in the "Sample Air Type" field on the field sample data sheets (FSDS) to distinguish these personal air-excursion and personal air-time-weighted average samples, respectively. These samples will be collected and analyzed in accordance with the *Response Action Quality Assurance Project Plan* (CDM Smith 2014) and will represent both the TWA and STEL sampling periods.

B2.1.2 ABS Air Samples

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

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

During the ABS event, pump flow rates will be verified and recorded at the beginning and at the end of the ABS activity. See Section B6/B7 for details regarding pump calibration.

B2.1.3 Soil

Soil samples will be collected, handled, and documented in general accordance with Site-specific SOP CDM-LIBBY-05, *Site-Specific SOP for 30-point Composite Sampling of Surface Soil for Asbestos* (**Appendix B**), with the following project modifications:

- Pin flags will not be used to identify composite points within each sampling area.
- Plastic bristle brushes and aluminum foil will not be required for decontamination and storage. Instead, sampling equipment will be rinsed with locally available deionized water before and after each sample is collected.
- Visual Vermiculite Estimation Forms will not be used. The contents of this form have been incorporated into the soil FSDS.
- Soil will be deposited into a clean 5-gallon bucket as it is collected. Enough soil will be collected from each sub-location such that the 30-point composite fills the 5-gallon bucket. Semi-quantitative estimation of vermiculite will be performed at each aliquot sub-location as described below.
- Prior to the start of ABS air sampling, the soil moisture should be determined as described later in this section.

<u>Visible Vermiculite Estimation</u>

As mentioned above, visual estimation of the amount of visible vermiculite in each of the 30 aliquot sub-locations will be performed in general accordance with Site-specific SOP CDM-LIBBY-06, *Semi-Quantitative Visual Estimation of Vermiculite in Soils* (**Appendix B**) with the following project modifications:

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

<u>Soil Moisture Measurement</u>

Prior to conducting ABS activities, soil moisture will be measured in the field using a portable soil moisture meter from a minimum of 10 locations along the fireline between 0 and 3 inches below ground surface. ABS activities will not be performed if the average volumetric water content (VWC) is greater than 50%, or if the VWC for any of the measurement points is greater than 75%. The 10 soil moisture readings for each area will be recorded in the field logbook.

B2.2 Global Positioning System Coordinate Collection

For this investigation, it is anticipated that global positioning system (GPS) coordinates will not be necessary, since coordinates for each location should already be available from the earlier *Nature & Extent in the Forest* investigation (EPA 2012). If the sampling location becomes inaccessible and a new location is utilized, GPS location coordinates for the new location will be recorded in basic accordance with SOP CDM-LIBBY-09, *GPS Coordinate Collection and Handling* (**Appendix B**). GPS coordinates will be collected as Sample Points, requiring the input of sample identification (ID) and location ID.

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

B2.3 Equipment Decontamination

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

B2.4 Handling Investigation-derived Waste

Any disposable equipment or other IDW will be handled in general conformance with Site-specific SOP EPA-LIBBY-2012-05, *Guide to Handling of Investigation-Derived Waste* (**Appendix B**). 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) using an indelible marker or a taped label. All IDW generated during this investigation will enter the waste stream at the local class IV asbestos landfill.

B3. Sample Handling and Custody

B3.1 Sample Identification and Documentation

B3.1.1 Sample Labels

Samples will be labeled with sample ID numbers supplied by field administrative staff and will be signed out by the sampling teams. For air samples, the labels will be affixed to the sample cassette and the inside of the sample bag. For soil samples, the labels will be affixed to the outside of the 5-gallon bucket side and lid and covered with clear packaging tape.

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

NE-2####

where:

NE-2 = Prefix that designates samples collected under this ABS QAPP
= A sequential four-digit number

B3.1.2 Field Sample Data Sheets

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

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

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

Each hard copy FSDS is assigned a unique sequential number. This number will be referenced in the field logbook entries related to samples recorded on individual sheets. Field administrative staff will manage the hard copy FSDSs at the CDM Smith Libby field office. Original FSDSs will be filed by medium and FSDS number.

B3.1.3 Field Logbooks

The field logbook is an accounting of activities at the Site and will duly note problems or deviations from the governing documents. Field logbooks will be maintained in general conformance with Site-specific SOP EPA-LIBBY-2012-01, *Field Logbook Content and Control* (**Appendix B**). In addition to general logbook content requirements outlines in the SOP, the pump calibration and flow rate verification should also be recorded.

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 designee) 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, 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 of the CDM Smith office in Libby.

B3.1.4 Photographs

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

Photograph file names will be in the format:

Station#_NE2_date_### (e.g., Station01_NE2_072214_001)

where:

Station# is the sampling location ID (see **Figure B-1**)
NE2 indicates the Nature and Extent – Forest ABS Study
The date is formatted as MMDDYY
The ### is a three-digit number to indicate the photo identifier

As appropriate, a digital video may be prepared to document a representative example of ABS activities and will include any special conditions or circumstances that arise during the activity. File names will be in the same format as photographic documentation listed above.

B3.2 Field Sample Custody

All teams will ensure that samples, while in their possession, are maintained in a secure manner to prevent tampering, damage, or loss. All samples and FSDSs will be relinquished to the sample coordinator or designated secure sample storage area at the end of each day. The field team will be responsible for documenting this transfer of sample custody in the logbook.

B3.3 Chain-of-Custody Requirements

The chain-of-custody form (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 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* (**Appendix B**).

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

A member of the sample coordination staff will manually enter sample information from the hard copy FSDS into the local Scribe field project database using a series of standardized data entry forms developed in Microsoft Access® by ESAT, referred to as the sample Data Entry Tool, or the "DE Tool". The DE Tool has a variety of built-in QC functions that improve accuracy of data entry and help maintain data integrity. After the data entry is checked against the hard copy FSDSs (by a different sample coordination staff member than completed the original data entry), the DE Tool is used to prepare an electronic COC. A two-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 hard copy of the COC will accompany the sample shipment. A copy of the investigation-specific Analytical Requirements Summary Sheet (**Appendix D**) will also accompany each COC.

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

B3.4 Sample Packaging and Shipping

Samples will be packaged and shipped in general accordance with SOP EPA-LIBBY-2012-07, *Packaging and Shipping of Environmental Samples* (**Appendix B**). In brief, 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. For this investigation, all samples will be hand-delivered to the Troy Sample Preparation Facility (SPF) for subsequent shipment to the appropriate analytical laboratory, or archive.

For hand-deliveries, 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. There are no preservation requirements for ABS air or soil samples.

B3.5 Holding Times

There are no holding time requirements for ABS air or soil samples collected as part of this investigation.

B3.6 Archival and Final Disposition

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

B4. Analytical Methods

B4.1 Analytical Methods and Requirements

This section discusses the analytical methods and requirements for samples collected in support of this investigation. This section includes detailed information on the analysis of ABS air, as well as the data reporting requirements, analysis turn-around times, and custody procedures.

An analytical requirements summary sheet (**NEABS-0714**), which details the specific preparation and analytical requirements associated with this investigation, is provided in **Appendix D**. The analytical requirements summary sheet will be reviewed and approved by all participating laboratories in this investigation prior to any sample handling. A copy of this analytical requirements summary sheet will be submitted with each COC.

B4.1.1 ABS Air Samples

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

Sample Preparation

Two filters are collected for each ABS actor during each sampling event – an HV filter and a LV filter. The HV filter will be analyzed in preference to the LV filter. If the HV filter is deemed to be overloaded (i.e., greater than [>] 25% particulate loading on the filter), the LV filter should be analyzed in preference to performing an indirect preparation on the HV filter. If the LV filter is also deemed to be overloaded, an indirect preparation (with ashing) may be performed of the HV filter in accordance with the procedures in Libby-specific SOP EPA-LIBBY-08, *Indirect*

Preparation of Air and Dust Samples for Analysis by TEM (**Appendix B**), as modified by the most recent version of Libby Laboratory Modification[5] LB-000091. The filter 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).

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.

Counting Rules

All ABS air samples will be examined using counting protocols for recording PCME structures only (in basic accordance with 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 patterns and EDS spectra, and having length > 5 µm, width greater than or equal to [≥] 0.25 µm, and aspect ratio ≥ 3:1 will be recorded on the Libby-specific TEM laboratory bench sheets and EDDs for the recording of air samples. If observed, chrysotile structures should be recorded in accordance with ISO 10312 recording procedures.

Stopping Rules

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

1. Count a minimum of two grid openings from each of two grids.
2. Continue counting until one of the following is achieved:
   a. The target analytical sensitivity (0.00022 per cubic centimeter [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 1,500 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).

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

B4.1.2 Soil

All soil samples collected for asbestos analysis will be transmitted to the SPF located in Troy, MT. For this study, all collected soil samples will be archived and only analyzed at the direction of the EPA.

B4.1.3 Health & Safety Air Samples

The personal air samples collected for the ongoing H&S monitoring will be analyzed in accordance with the *Response Action Quality Assurance Project Plan* (CDM Smith 2014). In brief, air samples will be prepared and analyzed by PCM in accordance with NIOSH Method 7400, Issue 2 and the most recent version of Libby Laboratory Modification LB-000015.

B4.2 Analytical Data Reports

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

B4.3 Laboratory Data Reporting Tools

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

For TEM analyses, detailed raw structure data will be recorded and results will be transmitted using the Libby-specific EDDs for TEM. Standard project data reporting requirements will be met for all TEM analyses.

B4.4 Analytical Turn-around Time

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

B4.5 Custody Procedures

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

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

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

B5. Quality Assurance/Quality Control

B5.1 Field

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

B5.1.1 Training

Before performing field work in Libby, field personnel are required to read all governing field guidance documents relevant to the work being performed and attend a field planning meeting specific to the Nature and Extent – Forest ABS 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 QAPP will be recorded on the Libby field ROM form[6]. 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-000226) 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 EPA RPM for review and approval. Copies of approved field ROMs are maintained on the CDM Smith server in Libby.

B5.1.3 Field Surveillances

Field surveillances consist of periodic observations made to evaluate continued adherence to investigation-specific governing documents. A field surveillance is not planned for ABS activities conducted under this QAPP.

B5.1.4 Field Audits

Field audits are broader in scope than field surveillances. Audits are evaluations conducted by qualified technical or QA staff that are independent of the activities audited. Field audits can be conducted by field contractors, internal EPA staff, or EPA contracted auditors. It is the responsibility of the CDM Smith Project Manager to ensure that field auditing requirements are met for each investigation. One field audit will be conducted during the early stages of this investigation to identify any early deficiencies and minimize/mitigate impacts to data quality.

B5.1.5 Field QC Samples

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

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

Air

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

<u>Lot Blank</u>

Lot blanks are collected to ensure air samples for asbestos analysis are collected on asbestos-free filters. A lot blank is a randomly selected filter cassette from a manufactured lot. One lot blank is required for every 500 unused cassettes. It is the responsibility of the FTL to submit the appropriate number of lot blanks and evaluate the results prior to cassette use in the field. The lot blanks are analyzed for asbestos by TEM as described above (see Section B4.1.1). 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 will be used for this study.

<u>Field Blank</u>

Field blanks are collected to evaluate potential contamination introduced during sample collection, shipping and handling, or analysis. For this sampling effort, field blanks will be collected at a rate of one per field team per air sampling 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. A total of six field blanks, chosen at random by the sample coordinator, will be analyzed (i.e., two field blanks from each sampling event). The field blanks are analyzed for asbestos by TEM as described above (see Section B4.1.1).

If any asbestos is observed on a field blank, all other field blanks collected by that field team will be submitted for analysis to determine the potential impact on the related sample results. 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" may be added to the related field sample results in the project database to denote that the associated field blank had asbestos structures detected.

Soil

One type of field QC sample will be collected as part of the soil sampling portion of this program – field duplicates. Field duplicates for soil are collected from the same area as the parent sample but from different individual sampling points. One field duplicate sample of soil, from a sampling location chosen at random, will be collected as part of this sampling program. It is the responsibility of the FTL to ensure that this field duplicate sample is collected.

Each field duplicate is given a unique sample number, and field personnel record the sample number of the associated co-located sample in the parent sample number field of the FSDS. The same location ID is assigned to the field duplicate sample as the parent field sample. As noted above, all collected soil samples (including the field duplicate) will be archived for possible future analysis at the direction of the EPA.

B5.2 Analytical Laboratory

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

B5.2.1 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 investigation will be provided a copy of and will adhere to the requirements of this QAPP. Samples collected under this 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[7]. 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,

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

this QAPP will be revised to incorporate necessary modifications.

Copies of approved ROMs for this QAPP will be made available in the Libby Lab eRoom.

B5.2.3 Laboratory Audits

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

External Audits

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

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

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

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

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

Internal Audits

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

B5.2.4 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 for TEM – laboratory blanks, recounts, and repreparations. Detailed information on the Libby-specific requirements for each type of TEM QC analysis, including the minimum frequency rates, selection procedures, acceptance criteria, and corrective actions are provided in the most recent version of Libby Laboratory Modification LB-000029.

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

B6/B7. Instrument Maintenance and Calibration

B6/B7.1 Field Equipment

B6/B7.1.1 General Maintenance

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

B6/B7.1.2 Air Pump Calibration

Air sampling pumps will be calibrated at the start of each day's sampling period using a rotameter that has been calibrated to a primary calibration source. The primary calibration standard used at the Site is a Bios DryCal® DC-Lite. For pre-sampling purposes, calibration will be considered complete when ± 5% 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 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 voided. The sample collector will record the pump serial number, sample number, initial flow rate, sample start/end times, sample locations, and final flow rate, as well as mark the sample "void" in the field logbook and FSDS. These samples will not be submitted for analysis.

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

B6/B7.2 Laboratory Instruments

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

B8. Inspection/Acceptance of Supplies and Consumables

B8.1 Field

In advance of field activities, the FTL will check the field equipment/supply inventory and procure any additional equipment and supplies that are needed. The FTL will also ensure any in-house measurement and test equipment used to collect data/samples as part of this 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 this investigation:

- 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.

- FSDS forms – 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 designee). 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.

- COCs and custody seals – Used to document sample custody from field collection through analysis reporting. See Section B3.3 for standard procedures for the completion of COCs.

- Indelible ink pen, permanent marker – 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.

- Personal protective equipment - As required by the *APP*.

- 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.

- GPS unit – Used to identify and mark sampling locations. See Section B2.2 for standard procedures in GPS documentation.

- Plastic zip-top bags – 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.

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

- Soil sampling equipment: trowel, 5-gallon bucket

B8.2 Laboratory

The laboratory manager is responsible for ensuring that all reagents and disposable equipment used in this project is free of asbestos contamination. This is demonstrated by the collection of blank samples, as described in Section B5.2.4.

B9. Non-direct Measurements

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

Data users will utilize the appropriate project databases to access data for comparison. See Sections B10.3 and B10.4 for additional information on project databases and data reporting. Only those data that have undergone data verification and validation (see Section D2) and been evaluated with regard to data usability (see Section D3) should be utilized for the purposes of making comparisons.

B10. Data Management

The following subsections describe the field 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 2013).

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.

The OU3 Data Manager will transfer a copy of the field data from the field Scribe database to the master OU3 database (see Section B10.3). The master OU3 database will be the final data repository for all field and analytical data collected under this QAPP.

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 completed the appropriate analysis, results from the laboratory benchsheet will be manually transferred into the EDD. A copy of all EDDs and scanned copies of all analytical data packages will be posted to the OU3 eRoom[8].

Data from the EDDs are uploaded directly into the master OU3 database by the CDM Smith OU3 data manager.

B10.3 Libby Project Databases

<u>Field Scribe Database</u>

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 field data collected for this investigation will initially be maintained in Scribe. As discussed above, data will be are captured in a local field Scribe project (i.e., LibbyCDM_Field.mdb). After

[8] https://team.cdm.com/eRoom/mt/LibbyOU3

all sample collection efforts are complete, a copy of the field data will be transferred to the master OU3 project database (see below).

Master OU3 Project Database

The master OU3 project database is a relational Microsoft Access® database developed specifically for OU3. This database includes all sample, analysis, and results data for samples collected in OU3. The *Libby OU3 Database User's Guide* provides an overview of the master OU3 project database structure and content. The most recent version of this *User's Guide* is provided on the OU3 website (http://cbec.srcinc.com/libby/).

The master OU3 project database is kept on the CDM Smith server in Denver, Colorado. Incremental backups of the master OU3 project database are performed daily Monday through Friday, and a full backup is performed each Saturday.

B10.4 Data Reporting

A comprehensive summary of the sampling and analysis results for this study will be prepared by the EPA's contractor (CDM Smith) and included in the 2014 amendment to the *OU3 Data Summary Report* (CDM Smith 2013), which will be made available on the OU3 website. Specialized requests for data summaries may be submitted to the OU3 EPA RPM.

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C ASSESSMENT AND OVERSIGHT

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

C1. Assessment and Response Actions

C1.1 Assessments

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

System assessments/audits of the analytical laboratories will be conducted by the QATS contractor, as 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 via logbook and reported to the appropriate manager (e.g., the FTL or EPA LC). For deficiencies or quality problems that are not resolved with rapid corrective action, the individual identifying the quality problem will initiate a corrective action request (CAR) and will forward the form to the QAM, who will be responsible for investigating the problem and following up on the resolution of the problem. The CAR and documentation of the resolution will be provided to the EPA RPM and the CDM Smith project manager EPA project management will be notified when quality problems arise that cannot be corrected quickly through routine procedures.

C2. Reports to Management

No regularly-scheduled written reports to management are planned as part of this investigation. However, QA reports may be provided to management for routine audits and whenever significant 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.

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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 OU3 database manager (CDM Smith), who will then notify the appropriate entity (field, Troy SPF, or analytical laboratory) in order to correct the issue.

D1.2 Criteria for LA Measurement Acceptability

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

1. *Evenness of filter loading.* This is evaluated using a chi-squared (CHISQ) test, as described in 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 repreparation analyses. If significant LA contamination is detected in field or laboratory blanks, all samples prepared on that day should be considered to be potentially biased high. If agreement between original analyses and field or laboratory duplicates (i.e., repreparation or recount analyses) is poor, results for those samples should be given low confidence.

D2. Verification and Validation Methods

D2.1 Data Verification

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

For analytical laboratories that utilize the Libby-specific EDD spreadsheets, data checking of reported analytical results begins with automatic QC checks that have been built into the spreadsheets. In addition to these automated checks, a detailed manual data verification effort will be performed for 10% of all ABS air samples and TEM analytical results collected as part of this sampling effort. This data verification process utilizes Site-specific SOPs (**Appendix B**) developed to ensure TEM results and field sample information in the project databases is accurate and reliable:

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

- EPA-LIBBY-11 - *SOP for FSDS Data Review and Data Entry Verification* – This Site-specific SOP describes the steps for the verification of field sample information, based on a review of the FSDS form, and verification of the transfer of results from the FSDS forms into the project database. An FSDS review is performed on all samples selected for TEM 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 CDM Smith staff that is 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. It is the responsibility of the OU3 database manager (CDM Smith) to coordinate with the FTL and/or LC to resolve any master OU3 database corrections and address any recommended field or laboratory procedural changes from the data verifier. The OU3 database manager is also responsible for electronically tracking in the project database which data have been verified, who performed the verification, and when verification occurred.

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 (CB&I, or their designee), with support from technical support staff that are familiar with project-specific data reporting, analytical methods, and investigation requirements.

Data validation for asbestos will be performed in basic accordance with Libby-specific SOPs developed by CB&I based on 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 will be completed annually 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 technical memorandum will also include a summary of any data qualifiers that are to be added to the project database to denote when results do not meet project-specific acceptance criteria.

For OU3 reviews, electronic files summarizing the records that have been validated, the date they were validated, any recommended data qualifiers and their associated reason codes should be posted to the OU3 eRoom. It is the responsibility of the OU3 database manager (CDM Smith) 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 annual data validation efforts, it is the responsibility of the QATS contractor (or their designate) to perform regular evaluations of all blanks, to ensure that any potential contamination issues are quickly identified and resolved. If any blank results are outside the acceptable limits, the QATS contractor should immediately contact the EPA RPM to ensure that appropriate corrective actions are made.

D3. Reconciliation with User Requirements

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

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

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

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

Data Usability Indicator	General Evaluation Method
Precision	Review results for TEM 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).

% = percent
ASTM = American Society of Testing and Materials
ROM = record of modification
SOP = standard operating procedure
TEM = transmission electron microscopy

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FIGURE A-1

ORGANIZATIONAL CHART

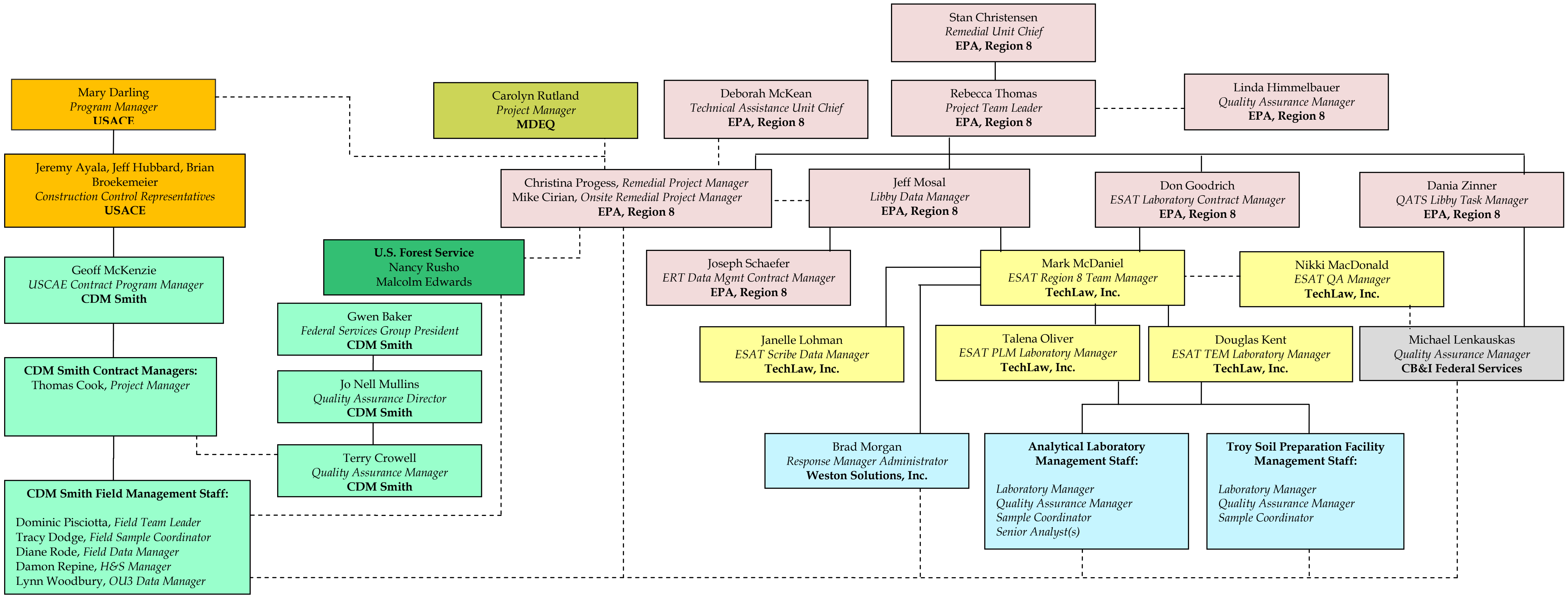

Figure A-1. Organizational Chart for Nature and Extent – Forest ABS

EPA Region 8 Staff
USACE Staff
MDEQ Staff
CDM Smith Staff
USFS
TechLaw Staff
TechLaw Subcontractors
CB&I Federal Services
Lines of authority
Lines of communication

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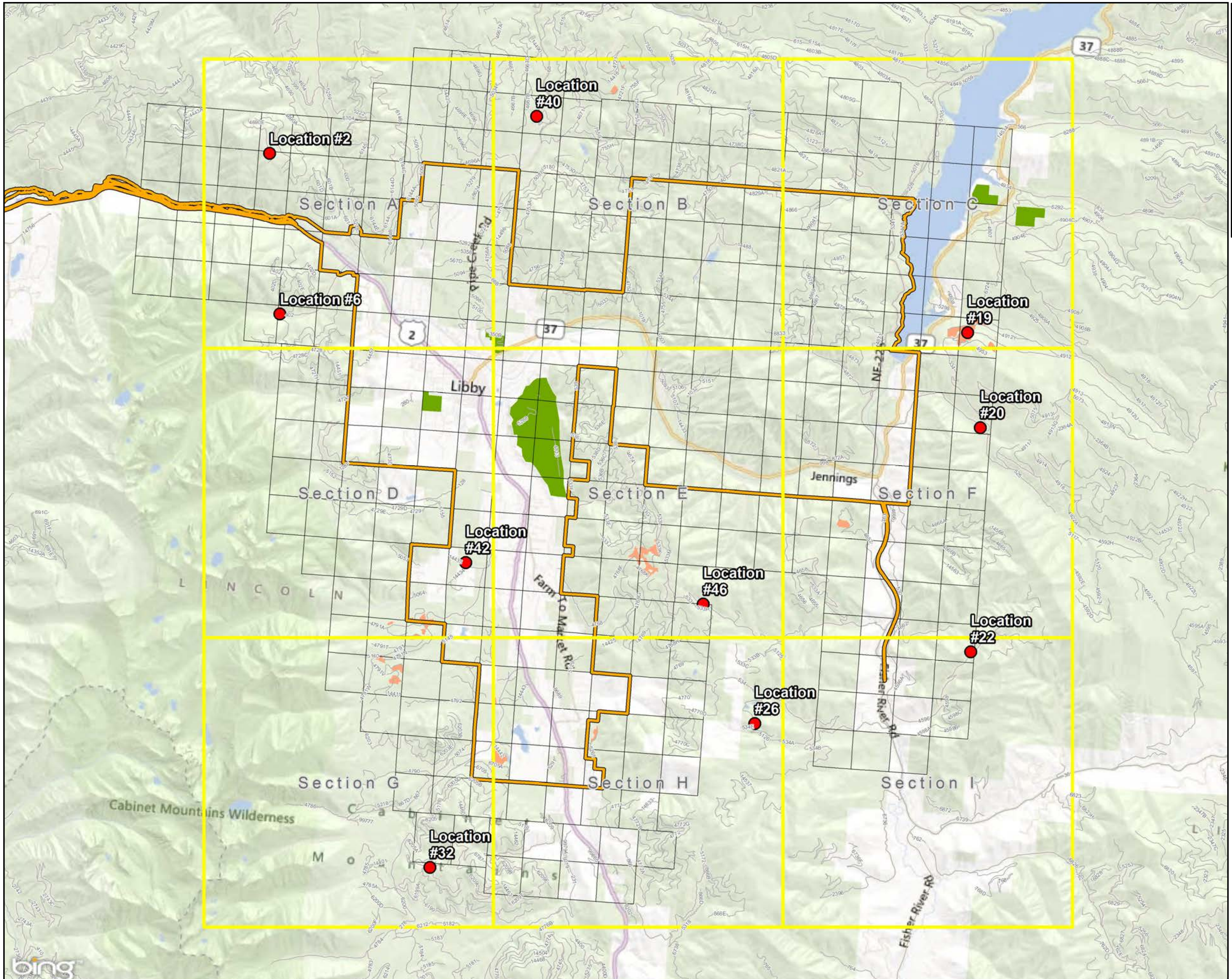
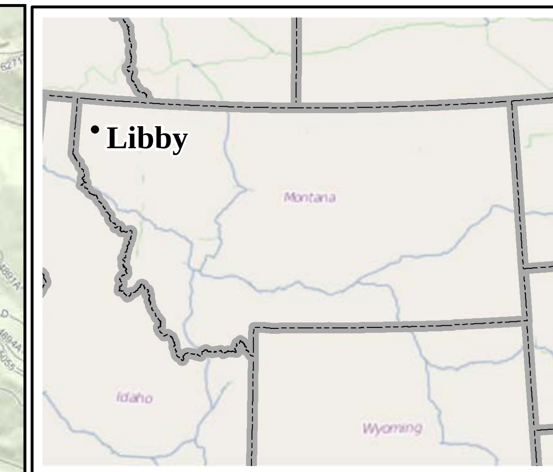
FIGURE B-1

GENERAL SAMPLING LOCATIONS FOR NATURE AND EXTENT – FOREST ABS





Legend

- Sampling Locations
- Forest Service Roads
- Libby Asbestos NPL Boundary
- Two Mile Buffer Along the NPL Boundary
- DNRC Timber Sales
- DNRC Precommercial Tree Thinning
- Detailed Map Index

* See Appendix C for Detailed Maps

N W E S

Miles
0 1.25 2.5 5

1 inch = 2.5 miles

Data Sources:
NPL Boundary - U.S. EPA Region 8 (2011);
Timber Sales and Precommercial Tree Thinning - MT DNRC (2011);
Base - Microsoft Bing (2011)

For Official Use Only

Figure B-1

General Sampling Locations for Nature and Extent - Forest ABS

CDM Smith

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Quality Assurance Project Plan:
Nature and Extent - Forest Activity-Based Sampling
Libby Asbestos Superfund Site
Revision 1 – July 2014

07/08/14

Project Period 09/17/2013 to 10/31/2014
Contract No. W9128F-11-D-0023
Task Order No. 0005

APPENDIX A

Data Quality Objectives for Nature and Extent – Forest Activity-based Sampling

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

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

A.1 Step 1: State the Problem

Previous investigations conducted at the Site have demonstrated that LA is present in environmental source media (e.g., tree bark, duff) at forested locations more than 10 miles from the mine site along the current NPL boundary (EPA 2012a). As a result, individuals may be exposed to LA that is released to air during source disturbance activities. These inhalation exposures may pose a risk of cancer and/or non-cancer effects.

However, the detection of low levels of LA in tree bark and duff does not necessarily indicate that human exposures to these levels would result in unacceptable risks. The amount of LA that could be released to air and inhaled will vary depending upon a number of factors, including the level of LA in the source material (e.g., duff, tree bark, soil), the nature, intensity, and duration of the disturbance activity, meteorological conditions (e.g., relative humidity, wind direction and speed), and conditions of the source material (e.g., moisture content). Because of this, predicting the LA levels in air based on measured LA levels in source materials is extremely difficult. For this reason, the EPA recommends an empiric approach for investigating asbestos-contaminated Superfund sites, where concentrations of asbestos in air from source disturbances are measured rather than predicted (EPA 2008). This type of sampling is referred to as "activity-based sampling" (ABS) and involves the collection of personal air samples under representative source-disturbance conditions that can be used to calculate potential inhalation exposures and risks (EPA 2008).

Measured ABS air data are needed to provide information on potential exposure and risk from LA due to the disturbance of environmental source media in forested areas near the NPL boundary.

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

The goal of this study is to measure LA concentrations in outdoor ABS air from locations along the NPL boundary to estimate potential exposures and risks to populations that may be exposed to LA in these forested areas. These risk estimates will be used to inform decisions on the boundaries of the nature and extent of LA contamination in the forest.

A.3 Step 3: Identify Information Inputs

The following subsections describe the types of information needed to meet the study goals.

A.3.1 Outdoor ABS Air Concentrations of LA

The primary information needed consists of reliable measurements of LA concentrations in air under realistic and representative scenarios that are characteristic of source-disturbing activities that may occur in the forested areas surrounding the Site.

Disturbance Activities

A variety of ABS investigations have been performed in the forested areas surrounding the mine, including recreational activities (e.g., hiking, riding all-terrain vehicles), wood harvesting activities (residential and commercial), simulated firefighting activities, and forest maintenance worker activities. Based on a review of these ABS data, the highest ABS LA air concentrations tend to be generated under high-intensity disturbances of duff and soil materials, such as during timber skidding activities during commercial logging operations or when a firefighter manually cuts fire lines into the soil using a Pulaski tool (referred to as the "Pulaski digging" scenario). It is not feasible to conduct timber skidding operations at multiple locations throughout the forest, as this activity requires specialized personnel and equipment and terrain conditions would likely preclude use of this ABS scenario at remote forest locations; therefore, this ABS activity cannot be used as a worst case disturbance scenario for the purposes of evaluating potential LA releases to ABS air in the forest. However, the Pulaski digging scenario also tended to yield higher (but not the highest) ABS air concentrations relative to other ABS disturbance activities; in addition, this ABS scenario does not require any specialized equipment or staff training and can be easily implemented at remote forest locations. Thus, this scenario should be used as an "indicator" scenario for the purposes of evaluating the nature and extent of potential LA contamination in the forest.

The ABS Pulaski digging "script" utilized in this study should be the same as was used during the *Comparative Exposure* investigation[9] (EPA 2012c). In brief, two ABS participants simulate firefighting activities of constructing a firebreak by hand. A Pulaski tool or other similar device is used to scrape away all combustible material down to mineral soil to establish a line approximately 18 inches wide. The two ABS participants work side-by-side approximately 10 feet apart. The ABS activity is performed for a period of 30 minutes. After 15 minutes, the relative positions of the two participants are reversed.

Type of Air Sample

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

Analysis Method

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

A.3.2 Other Data

Release of LA from source media into outdoor air is expected to depend on several environmental factors that may tend to vary over time. These factors may include meteorological conditions (e.g., temperature, humidity). It may be helpful to evaluate ABS air concentrations as a function of these environmental factors. Therefore, meteorological weather station data should be downloaded from the National Oceanic Atmospheric Administration (NOAA) station in Libby for days when ABS activities are scheduled.

Additionally, soil moisture data should be collected and evaluated prior to conducting the ABS event to ensure that conditions are optimal for release of LA, if present, to outdoor air.

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

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

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[9] In the Comparative Exposure investigation, this script was referred to as the “fireline digging” scenario.

A.4.1 Spatial Bounds

During the *Nature & Extent in the Forest* investigation (EPA 2012), low levels of LA were detected in tree bark and duff in forested areas along the circumference of the current NPL boundary. This study should seek to collect data on LA ABS air concentrations from locations previously studied under the *Nature & Extent in the Forest* investigation (EPA 2012), but that are not duplicative with locations where Pulaski digging ABS was performed in support of OU3 (CDM Smith 2013).

A.4.2 Temporal Bounds

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

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

A.5 Step 5: Define the Analytic Approach

ABS data collected as part of this study can be used to estimate exposure and risk from LA that will support risk management decision-making. These data can also be used to make comparisons to other Pulaski digging ABS datasets. The analytic approach for each intended data use is described below.

A.5.1 Risk Characterization

The EPA will use the ABS results to estimate exposure and calculate potential risks to recreational visitors in the forested areas to inform decisions on the boundaries of the nature and extent of LA contamination in the forest. Recreational visitors were selected as the exposure population of interest because this receptor group is likely to have the highest exposure frequency in the forested areas.

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 LA-specific lifetime inhalation unit risk (IUR) value is 0.17 LA PCM[10] $(s/cc)^{-1}$ and the LA-specific reference concentration (RfC) value is 0.00002 LA PCM s/cc. The EPA is currently reviewing these values. The following sections describe how cancer risks and non-cancer HQs are expected to be

[10] 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 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.

calculated using the Libby-specific toxicity values.

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 (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 (hours/day)
EF = Average exposure frequency (days/year)

ED = Exposure duration (years)

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

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:

$$HQ = EPC * TWF / RfC_{LA}$$

where:

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

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

TWF_{nc} = Time-weighting factor for non-cancer. Note that the interval over which exposure duration is calculated is from age 0 to age 60. This is because the non-cancer toxicity factor is based on cumulative lifetime exposure lagged by 10 years.

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

where:

ET = Average exposure time (hours/day)

EF = Average exposure frequency (days/year)

ED = Exposure duration (years)

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

Decision Rule

These risk estimates will be used to inform decisions on the boundaries of the nature and extent of LA contamination in the forest.

If estimated risks to recreational visitors are below the threshold decision level (i.e., the individual exposure pathway cancer risk based on reasonable maximum exposure is less than 1E-06 and the non-cancer HQ is less than 0.1), this would provide the basis for delineating the boundary for LA contamination in the forest (i.e., forested areas beyond the ABS locations evaluated would, likewise, be assumed to be below the threshold decision level).

If estimated risks to recreational visitors are above the threshold decision level, this would support the conclusion that the extent of LA contamination extends beyond the current NPL boundary and that further study may be warranted to determine the nature and extent of LA contamination in the forest. Note: The threshold decision levels of 1E-06 for cancer and 0.1 for non-cancer were selected to ensure that the contribution from this individual exposure pathway is not likely to contribute significantly to cumulative risk estimates.

A.5.2 Dataset Comparisons

The EPA will also use the ABS results from this study to make comparisons to the Pulaski digging ABS results from other studies to help risk managers gain a better understanding of spatial differences in ABS air.

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

A.6 Step 6: Specify Acceptance Criteria

A.6.1 Risk Assessment

ABS data collected as part of this study will be used to evaluate risks to support risk management decision-making. In making decisions about human health risks, two types of decision errors are possible – false negative and false positive.

- A *false negative decision error* occurs when a risk manager decides an exposure is acceptable when it actually results in unacceptable health risks.

- A *false positive decision error* occurs when a risk manager decides an exposure is unacceptable when it really is acceptable.

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% 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 2010). However, equations and functions in ProUCL are not designed for asbestos datasets and application of ProUCL to asbestos datasets is not recommended (EPA 2008). Because the 95UCL cannot presently be calculated with confidence, risk calculations will be based on the sample mean only, as recommended by EPA (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.

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 rule. If between-sample variability is low, or if the EPC is not near a decision rule, then the number of samples needed is usually relatively low. However, if between-sample variability is high and the EPC is relatively near a decision rule, then the number of samples needed is usually higher.

A.6.2 Dataset Comparisons

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

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

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

Sampling Locations and Events

Ten locations will be selected from the 51 locations originally studied during the *Nature & Extent in the Forest* investigation (EPA 2012). A total of three ABS fireline scenario events will be conducted at each of the 10 locations chosen for this study. The three events for each location should not be done consecutively, to allow the resulting ABS data to reflect temporal variability. That is, the second event will not be done until all locations have been sampled under the first event, and the third event will not be done until all locations have been sampled under the second event.

ABS Air Sampling Approach

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

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

The high volume filter will be analyzed in preference to the low volume filter. If the high volume filter is deemed to be overloaded, the low volume filter should be analyzed in preference to performing an indirect preparation on the high volume filter to avoid potential bias associated with indirect preparation[11]. If the low volume filter is deemed to be overloaded, an indirect preparation (with ashing) may be performed (following consultation with and approval from the LC).

TEM Stopping Rules

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

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

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:

<u>Step 1. Calculation of Risk-Based Concentrations</u>

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

RBC(cancer) = Target Cancer Risk / (TWFc * IUR)

For cancer, the maximum acceptable risk is a risk management decision. Although the decision thresholds identified in the DQOs specify a cancer risk threshold of 1E-06 and non-cancer HQ of 0.1, for the purposes of calculating target analytical sensitivity requirements, to limit potential analytical cost and time, a target cancer risk of 1E-05 and non-cancer HQ of 1 are assumed. The adequacy of the achieved sensitivity for ABS samples collected as part of this study will be re-evaluated once the LA-specific toxicity values are finalized; supplemental TEM analysis may be warranted in the future.

As noted above, decisions regarding potential exposure and risk will be based on a recreational visitor exposure scenario because this receptor group is likely to have the highest exposure frequency in the forested areas. The exposure parameters needed to calculate the time-weighting factor (TWF) for the purposes of establishing target analytical requirements are as follows:

---

[11] Indirect preparation has the potential to increase the number of LA structures recorded during TEM analysis, which may bias resulting air concentrations high, but this bias is only likely to increase LA air concentrations by a factor of 2-3 (Berry *et al.* 2014).

Exposure Parameter	Value
Exposure Time (ET)	8 hours/day
Exposure Frequency (EF)	50 days/year
Exposure Duration (ED)	40 years

Based on these exposure parameters, the TWF for cancer is 0.026 (8/24 * 50/365 * 40/70 = 0.026). The proposed LA-specific IUR is 0.17 $(\text{PCM s/cc})^{-1}$. Based on these values, the RBC for cancer is 0.0023 LA PCME s/cc.

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

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

For non-cancer, the target HQ is 1. Based on the exposure parameters specified above, the TWF for non-cancer is 0.0027 (8/24 * 50/365 * 40/60 = 0.030). The proposed LA-specific RfC is 0.00002 LA PCM s/cc. Based on these values, the RBC for non-cancer is 0.00066 LA PCME s/cc.

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

<u>Step 2: Determining the TAS</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 / 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%, the target count is 3 structures. Based on this, the TAS is:

TAS = (0.00066 s/cc) / (3 s) = 0.00022 cc^{-1}

Maximum Number of LA Structures

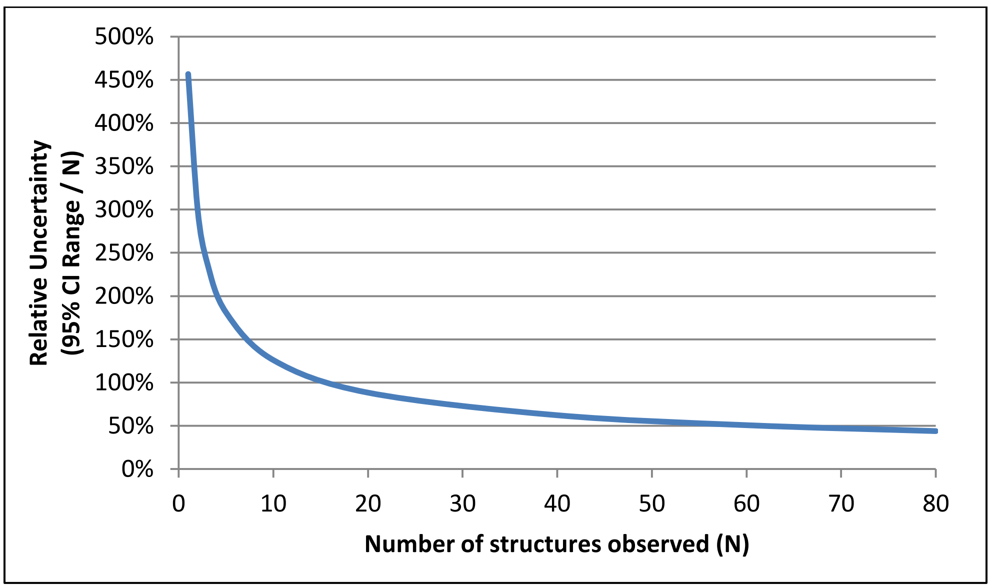
Ideally, all samples would be examined by TEM until the TAS is achieved. However, for filters that have high asbestos loading, reliable estimates of concentration may be achieved before achieving the TAS. This is because the uncertainty around a TEM estimate of asbestos concentration in a sample is a 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:

$$\text{Lower bound (2.5\%)} = \tfrac{1}{2} \cdot \text{CHIINV}(0.975, 2 \cdot N_{observed} + 1)$$

$$\text{Upper bound (97.5\%)} = \tfrac{1}{2} \cdot \text{CHIINV}(0.025, 2 \cdot N_{observed} + 1)$$

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

Relationship Between Number of Structures Observed and Relative Uncertainty



Maximum Area to be Examined

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

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

where:

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

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

Ago = Grid opening area (assumed to be 0.013 mm^2)

V = Sample air volume (liters [L])

1000 = Conversion factor; convert liters to cubic centimeters

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

Based on a sampling duration of 30 minutes and an assumption that the high flow (5.5 L/minute) filter is able to be prepared directly (i.e., f-factor = 1), , the GOx to achieve the TAS of 0.00022 cc^{-1} is about 820 grid openings. In the event an indirect preparation is necessary, the number of grid openings that will need to be examined is inversely proportional to the dilution needed (i.e., an *f* of 0.1 will increase the number of grid openings by a factor of 10). In this case, it is possible that the GOx to achieve the TAS 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 0.013 mm^2, this would correspond to about 1,500 grid openings.

Summary of TEM Stopping Rules

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

1. Count a minimum of two grid openings from each of two grids.
2. Continue counting until one of the following is achieved:
    a. The TAS (0.00022 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 1,500 grid openings).

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

A.7.6 Refining the Study Design

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

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Quality Assurance Project Plan:
Nature and Extent - Forest Activity-Based Sampling
Libby Asbestos Superfund Site
Revision 1 – July 2014

07/08/14

Project Period 09/17/2013 to 10/31/2014
Contract No. W9128F-11-D-0023
Task Order No. 0005

APPENDIX B

STANDARD OPERATING PROCEDURES (SOPs)

Panel A: Field SOPs

SOP ID	SOP Description
EPA-LIBBY-2012-01, Revision 1	Field Logbook Content and Control
EPA-LIBBY-2012-02, Revision 0	Photographic Documentation of Field Activities
EPA-LIBBY-2012-04, Revision 0	Field Equipment Decontamination
EPA-LIBBY-2012-05, Revision 0	Handling Investigation-derived Waste
EPA-LIBBY-2012-06, Revision 0	Sample Custody
EPA-LIBBY-2012-07, Revision 0	Packaging and Shipping Environmental Samples
EPA-LIBBY-2012-10, Revision 0	Air Sample Collection
CDM-LIBBY-05, Revision 5	30-point Composite Sampling of Surface Soil for Asbestos
CDM-LIBBY-06, Revision 2	Semi-Quantitative Visual Estimation of Vermiculite in Soils
CDM-LIBBY-09, Revision 5	GPS Coordinate Collection and Handling

Panel B: Laboratory SOPs

SOP ID	SOP Description
EPA-LIBBY-08, Revision 1	Indirect Preparation of Samples for TEM Analysis

Panel C: Data Verification SOPs

SOP ID	SOP Description
EPA-LIBBY-09, Revision 2	TEM Data Review and Data Entry Verification
EPA-LIBBY-11, Revision 0	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).

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Quality Assurance Project Plan:
Nature and Extent - Forest Activity-Based Sampling
Libby Asbestos Superfund Site

Revision 1 – July 2014

07/08/14

Project Period 09/17/2013 to 10/31/2014
Contract No. W9128F-11-D-0023
Task Order No. 0005

APPENDIX C

DETAILED TOPGRAPHIC MAPS OF SAMPLE LOCATIONS

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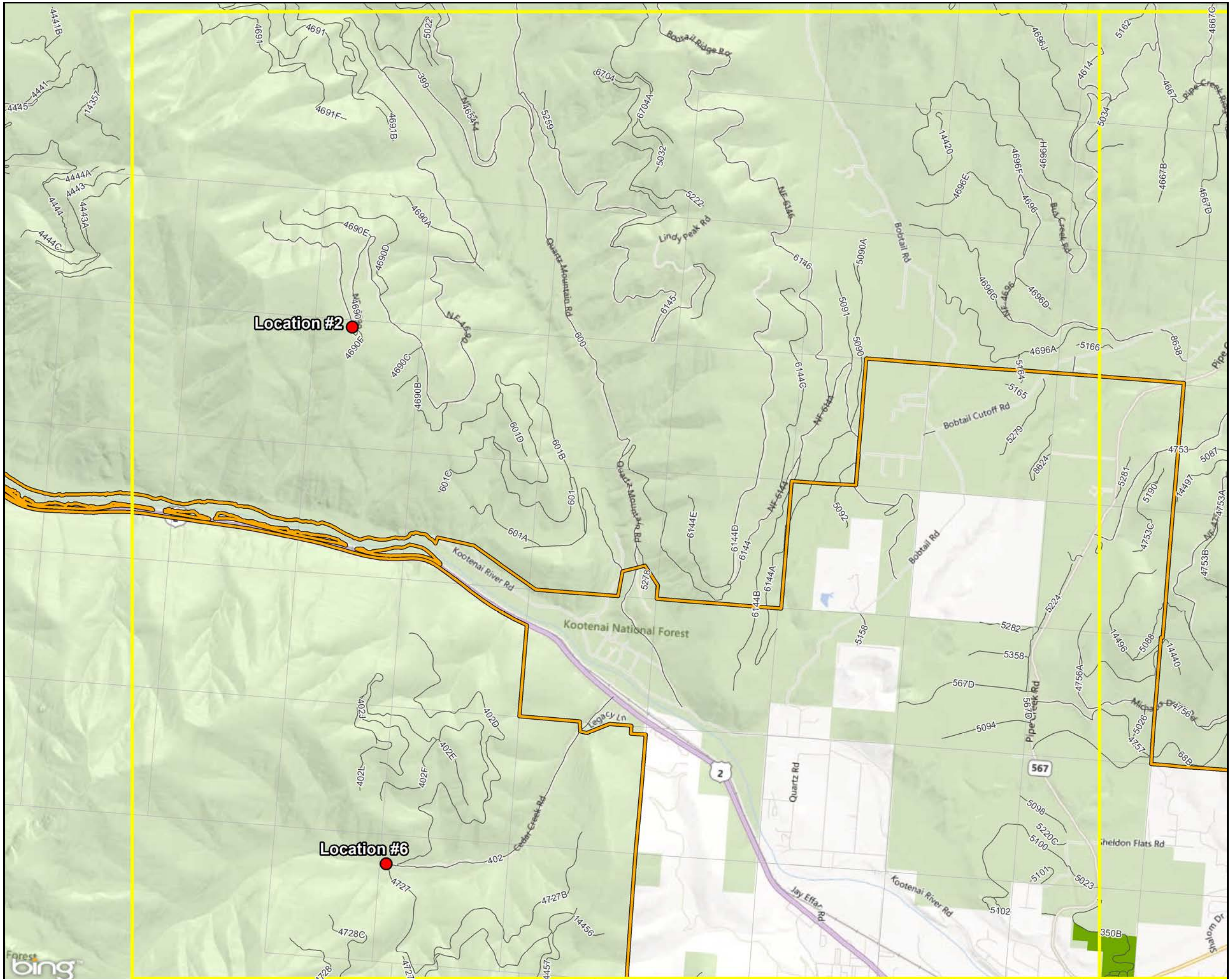

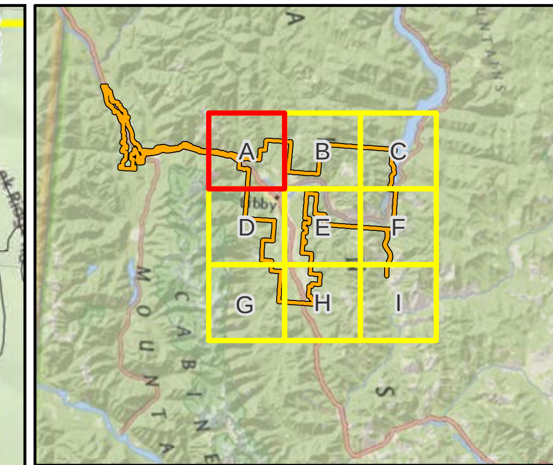

Legend

- Sampling Locations
- Forest Service Roads
- Two Mile Buffer Along the NPL Boundary
- Libby Asbestos NPL Boundary
- DNRC Timber Sales
- DNRC Precommercial Tree Thinning
- Detailed Map Index

N
W E
S

Miles
0 0.75 1.5

Data Sources:
NPL Boundary - U.S. EPA Region 8 (2011);
Timber Sales and Precommercial Tree Thinning - MT DNRC (2011)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

For Official Use Only

Appendix C
Figure A

ABS Areas
Sampling Locations

CDM Smith

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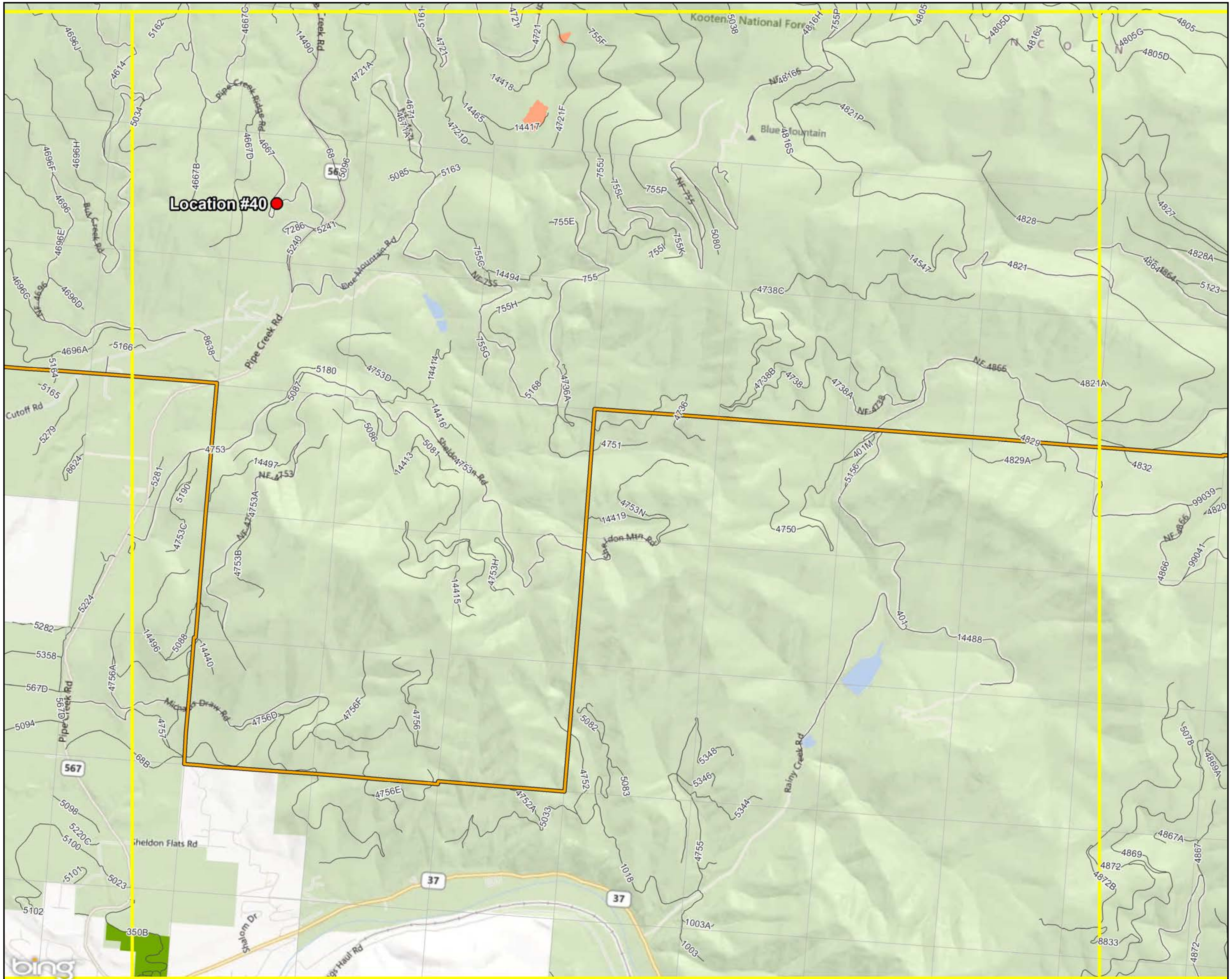

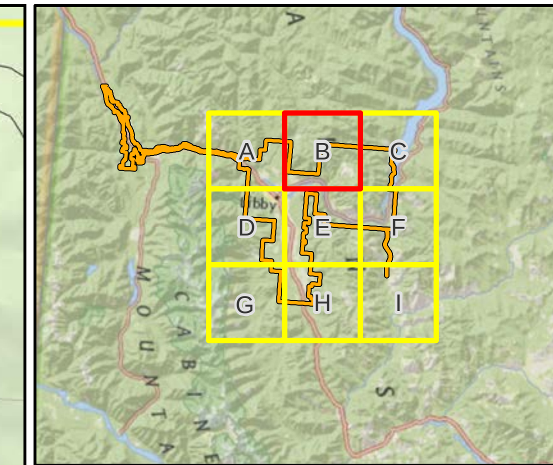

Legend

- Sampling Locations
- Forest Service Roads
- Two Mile Buffer Along the NPL Boundary
- Libby Asbestos NPL Boundary
- DNRC Timber Sales
- DNRC Precommercial Tree Thinning
- Detailed Map Index

N / W / E / S

Miles: 0 — 0.75 — 1.5

Data Sources:
NPL Boundary - U.S. EPA Region 8 (2011);
Timber Sales and Precommercial Tree Thinning - MT DNRC (2011)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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Appendix C
Figure B

ABS Areas
Sampling Locations

CDM Smith

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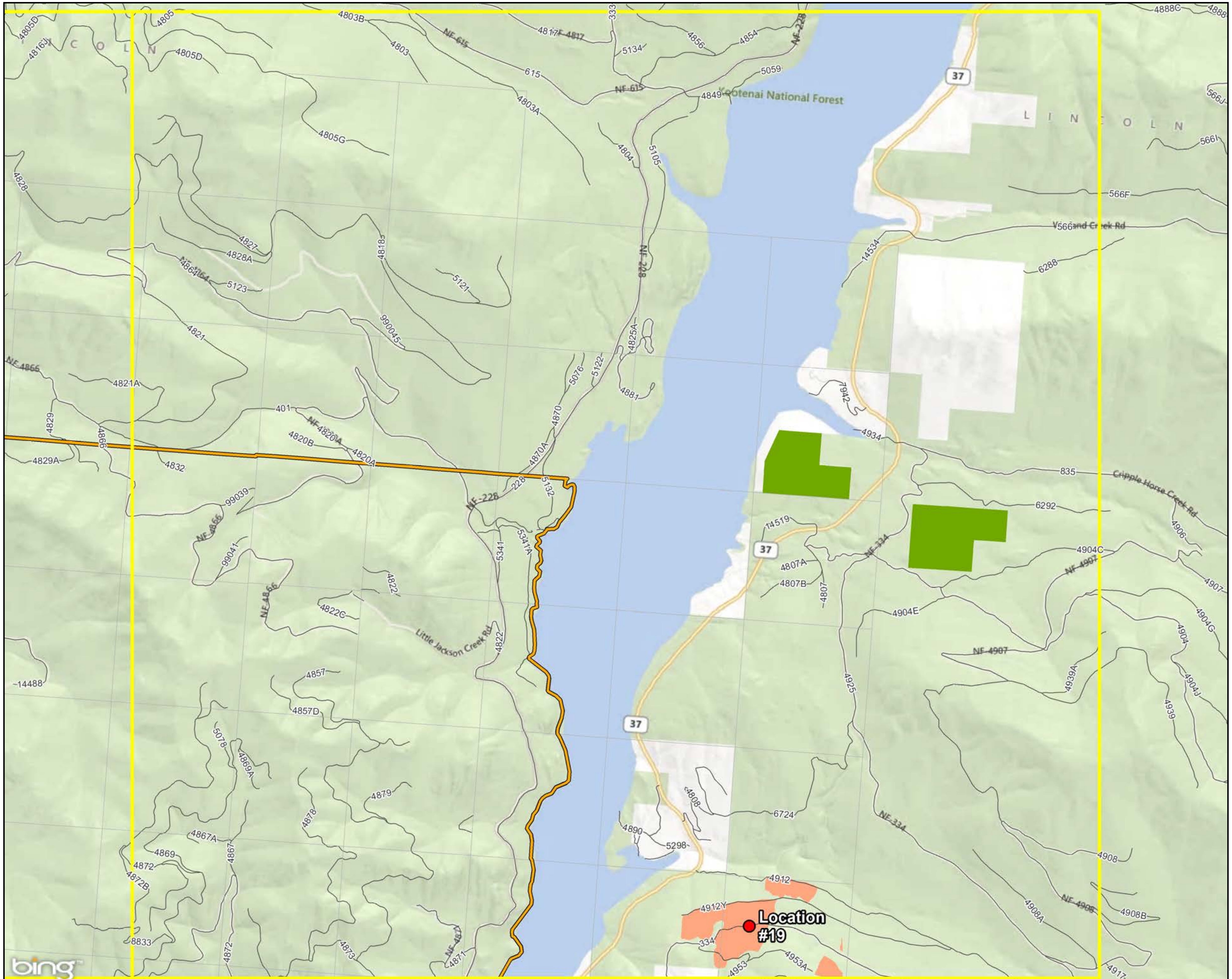

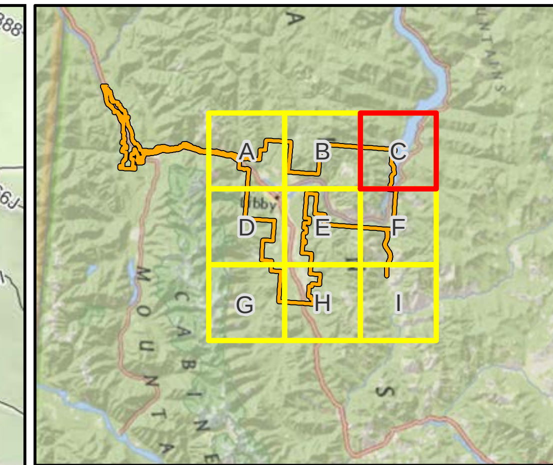

Legend

- Sampling Locations
- Forest Service Roads
- Two Mile Buffer Along the NPL Boundary
- Libby Asbestos NPL Boundary
- DNRC Timber Sales
- DNRC Precommercial Tree Thinning
- Detailed Map Index

N W E S

Miles

0 0.75 1.5

Data Sources:
NPL Boundary - U.S. EPA Region 8 (2011);
Timber Sales and Precommercial Tree Thinning - MT DNRC (2011)

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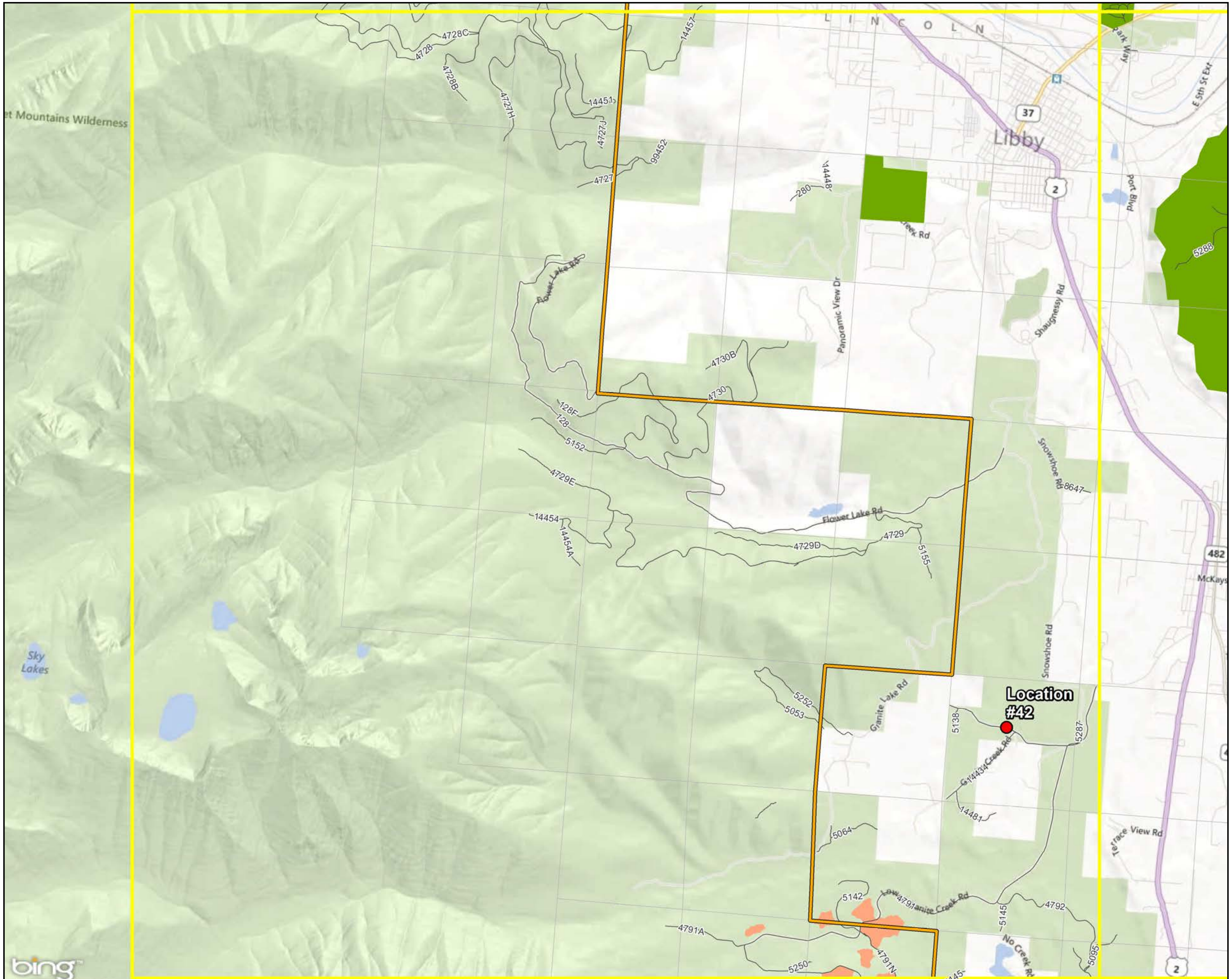
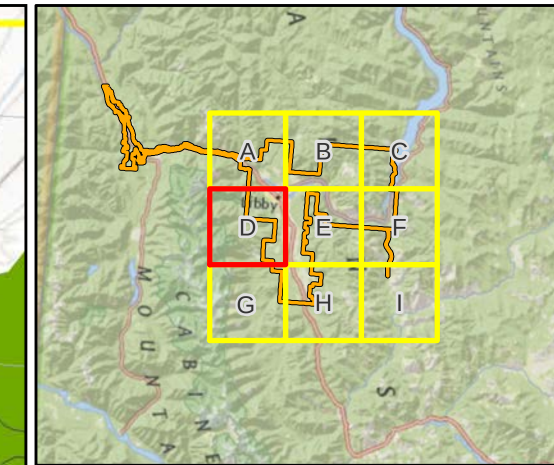
Appendix C
Figure C

ABS Areas
Sampling Locations

Path: R:\85158-OU3\3120.001-RA\GIS\MXD\ABS_Samples\SampleGrid\C-A_ABS_SampleGrid_130820.mxd





Legend

- Sampling Locations
- Forest Service Roads
- Two Mile Buffer Along the NPL Boundary
- Libby Asbestos NPL Boundary
- DNRC Timber Sales
- DNRC Precommercial Tree Thinning
- Detailed Map Index

N E S W

Miles
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Data Sources:
NPL Boundary - U.S. EPA Region 8 (2011);
Timber Sales and Precommercial Tree Thinning - MT DNRC (2011)

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Appendix C
Figure D

ABS Areas
Sampling Locations

CDM Smith

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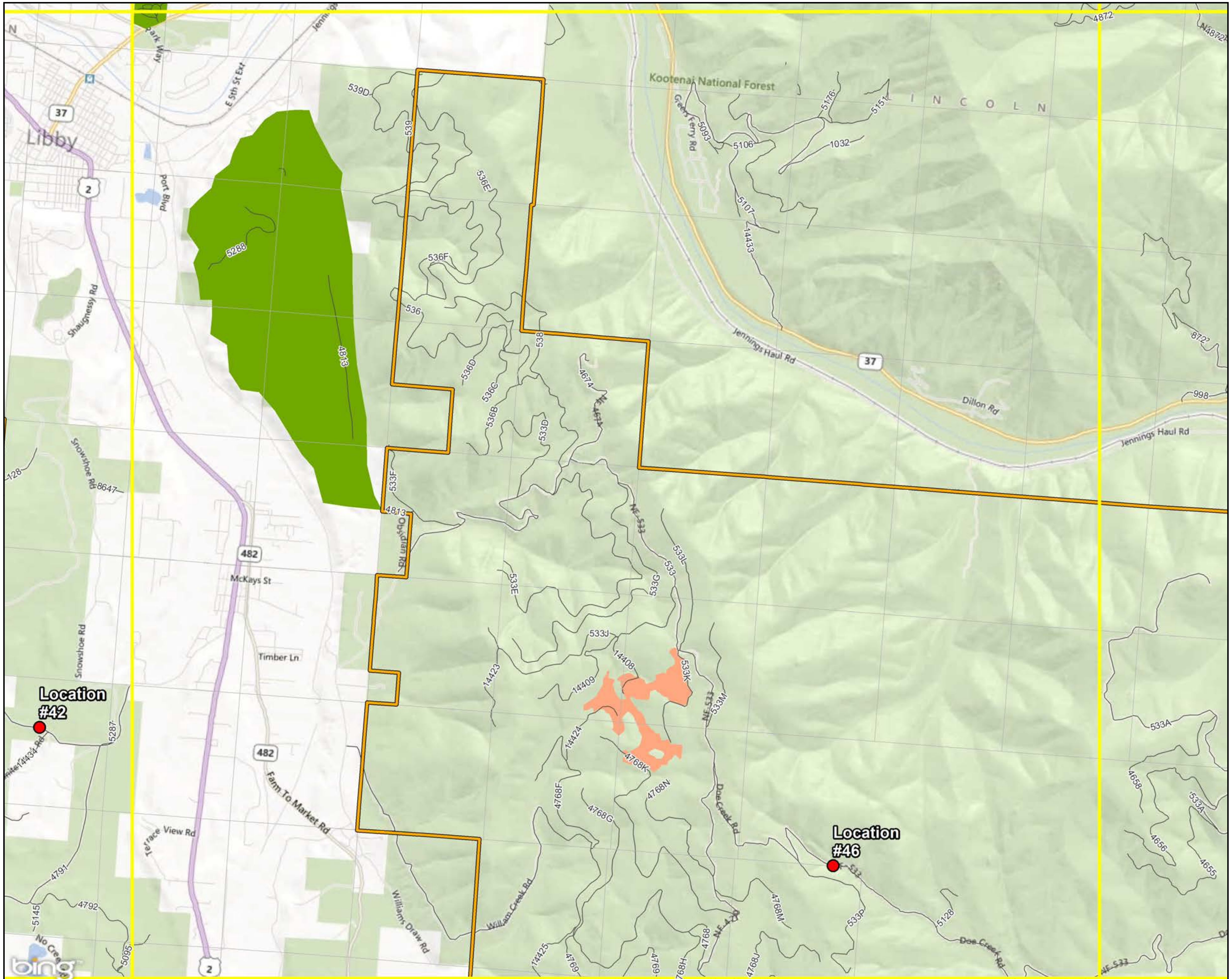

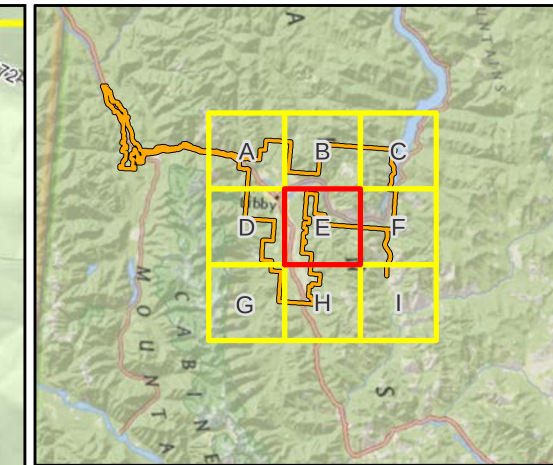

Legend

- Sampling Locations
- Forest Service Roads
- Two Mile Buffer Along the NPL Boundary
- Libby Asbestos NPL Boundary
- DNRC Timber Sales
- DNRC Precommercial Tree Thinning
- Detailed Map Index

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Miles
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Data Sources:
NPL Boundary - U.S. EPA Region 8 (2011);
Timber Sales and Precommercial Tree Thinning - MT DNRC (2011)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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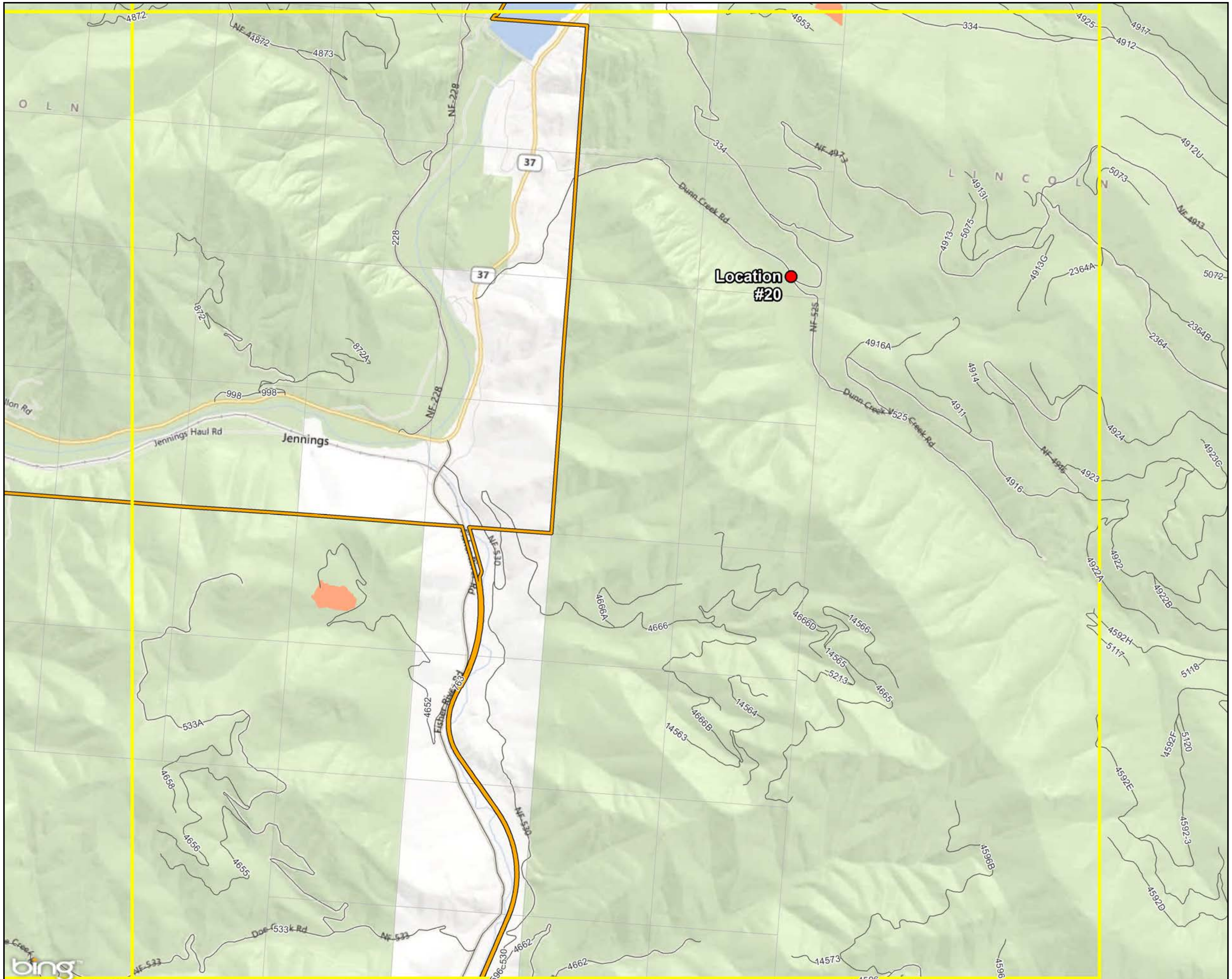
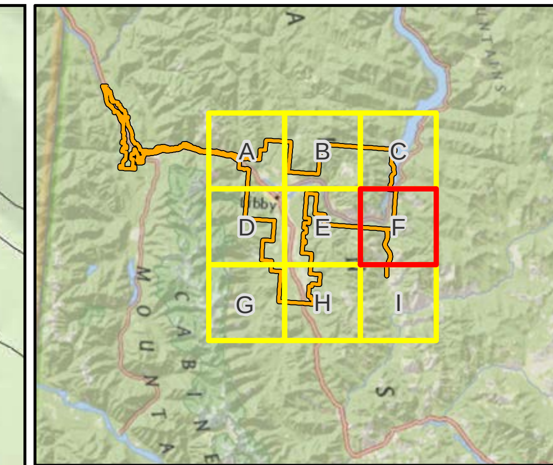
Appendix C
Figure E

ABS Areas
Sampling Locations

CDM Smith

Path: R:\85158-OU3\3120.001-RA\GIS\MXD\ABS_Samples\SampleGrid\C-A_ABS_SampleGrid_130820.mxd





Legend

- Sampling Locations
- Forest Service Roads
- Two Mile Buffer Along the NPL Boundary
- Libby Asbestos NPL Boundary
- DNRC Timber Sales
- DNRC Precommercial Tree Thinning
- Detailed Map Index

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S

Miles

0 0.75 1.5

Data Sources:
NPL Boundary - U.S. EPA Region 8 (2011);
Timber Sales and Precommercial Tree Thinning - MT DNRC (2011)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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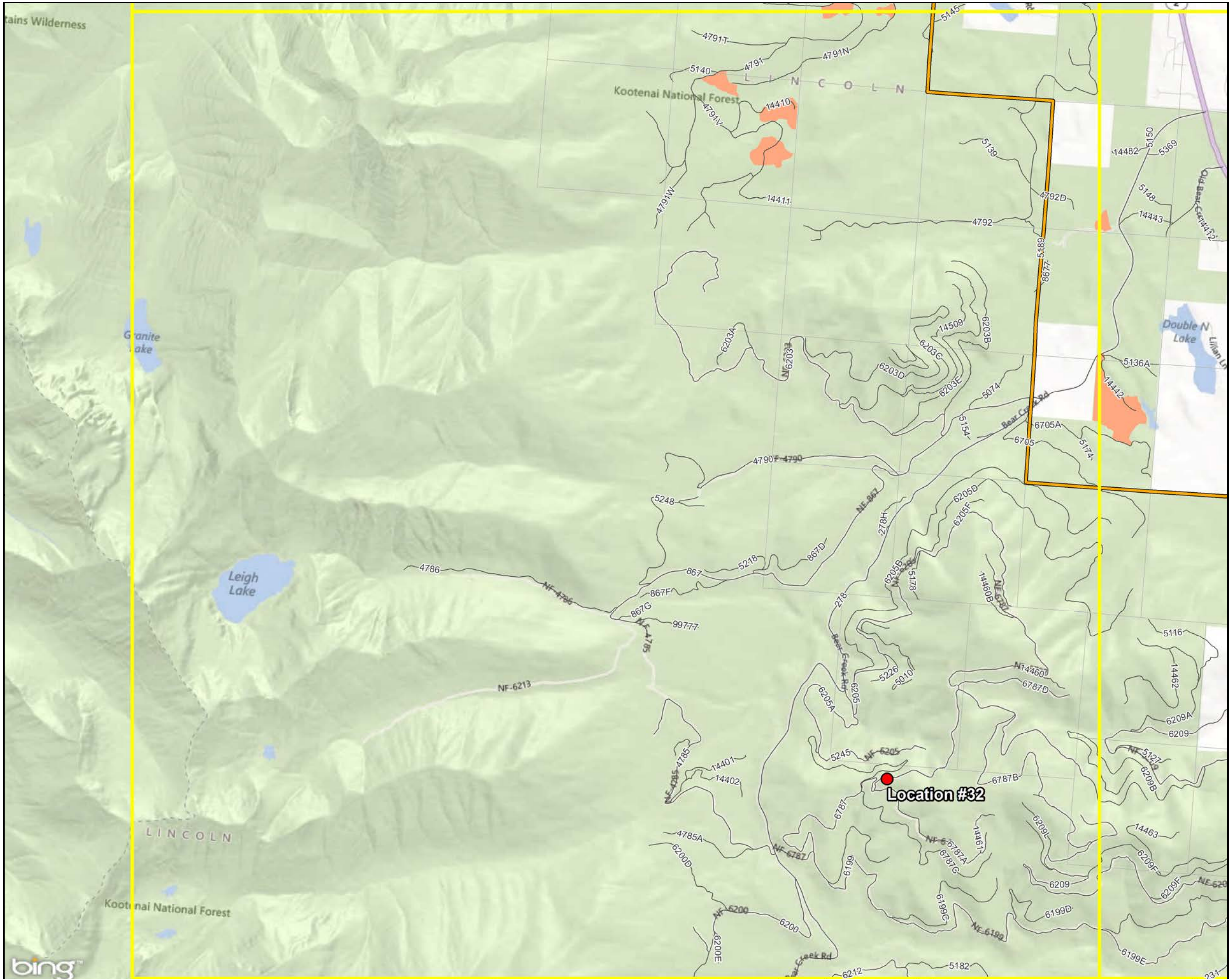
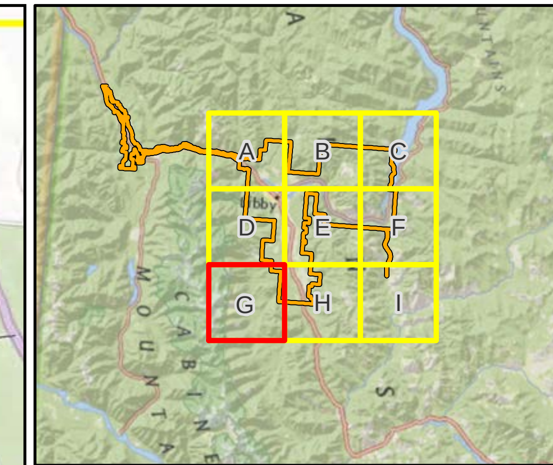
Appendix C
Figure F

ABS Areas
Sampling Locations

CDM Smith

Path: R:\85158-OU3\3120.001-RA\GIS\MXD\ABS_Samples\SampleGrid\C-A_ABS_SampleGrid_130820.mxd





Legend

- Sampling Locations
- Forest Service Roads
- Two Mile Buffer Along the NPL Boundary
- Libby Asbestos NPL Boundary
- DNRC Timber Sales
- DNRC Precommercial Tree Thinning
- Detailed Map Index

N W E S

Miles
0 0.75 1.5

Data Sources:
NPL Boundary - U.S. EPA Region 8 (2011);
Timber Sales and Precommercial Tree Thinning - MT DNRC (2011)

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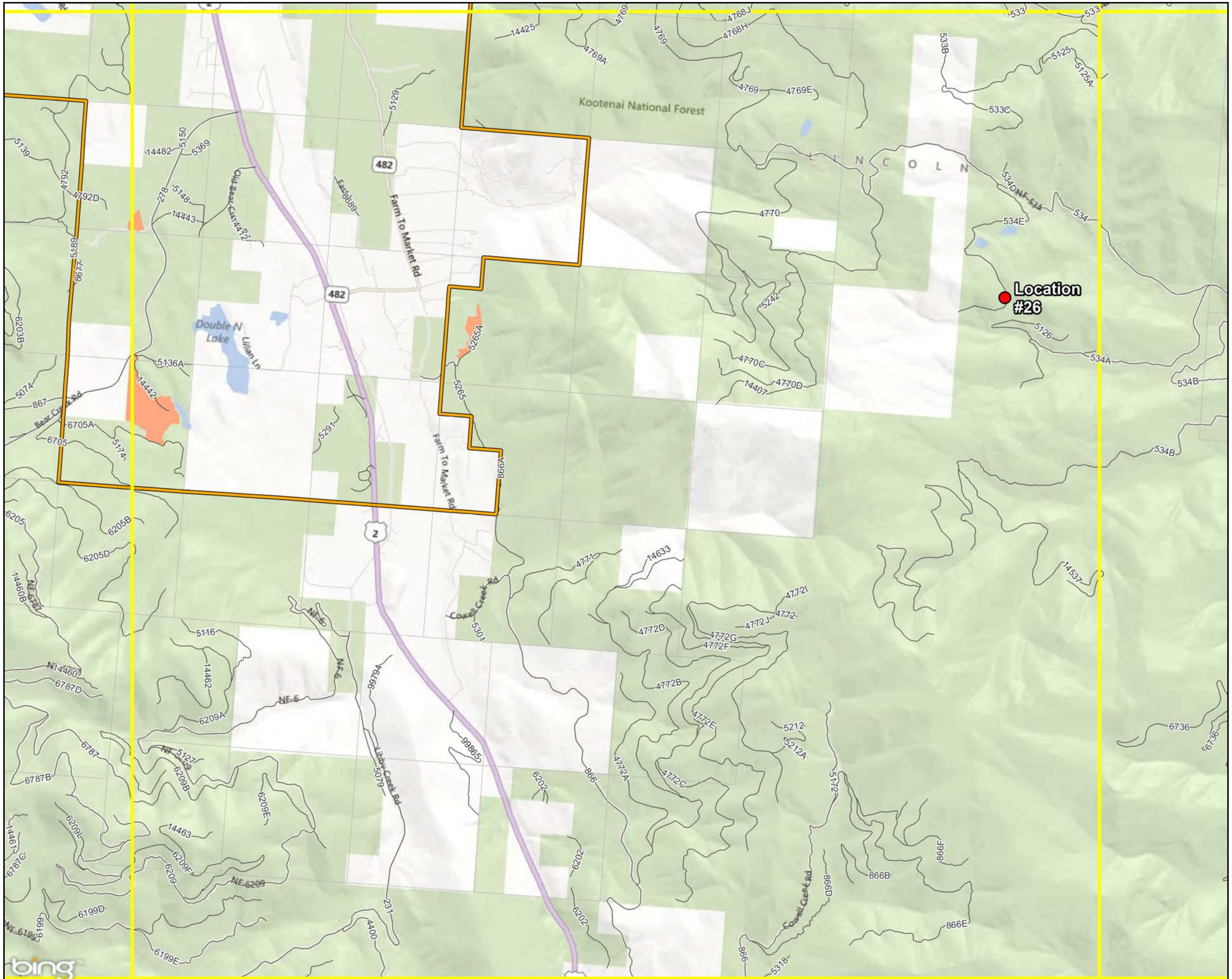
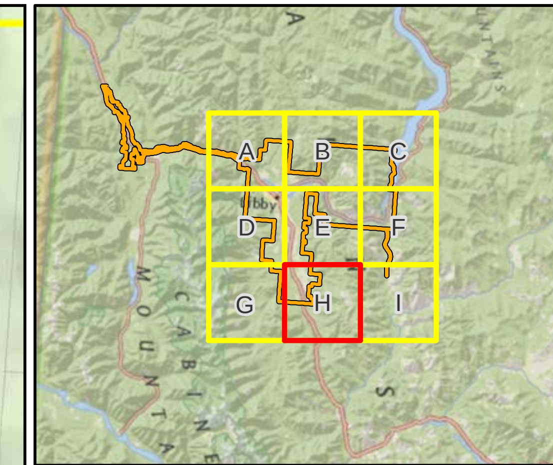
Appendix C
Figure G

ABS Areas
Sampling Locations

Path: R:\85158-OU3\3120.001-RA\GIS\MXD\ABS_Samples\SampleGrid\SampleGridC-A_ABS_SampleGrid_130820.mxd





Legend

- Sampling Locations
- Forest Service Roads
- Two Mile Buffer Along the NPL Boundary
- Libby Asbestos NPL Boundary
- DNRC Timber Sales
- DNRC Precommercial Tree Thinning
- Detailed Map Index

Miles

0 0.75 1.5

Data Sources:
NPL Boundary - U.S. EPA Region 8 (2011);
Timber Sales and Precommercial Tree Thinning - MT DNRC (2011)

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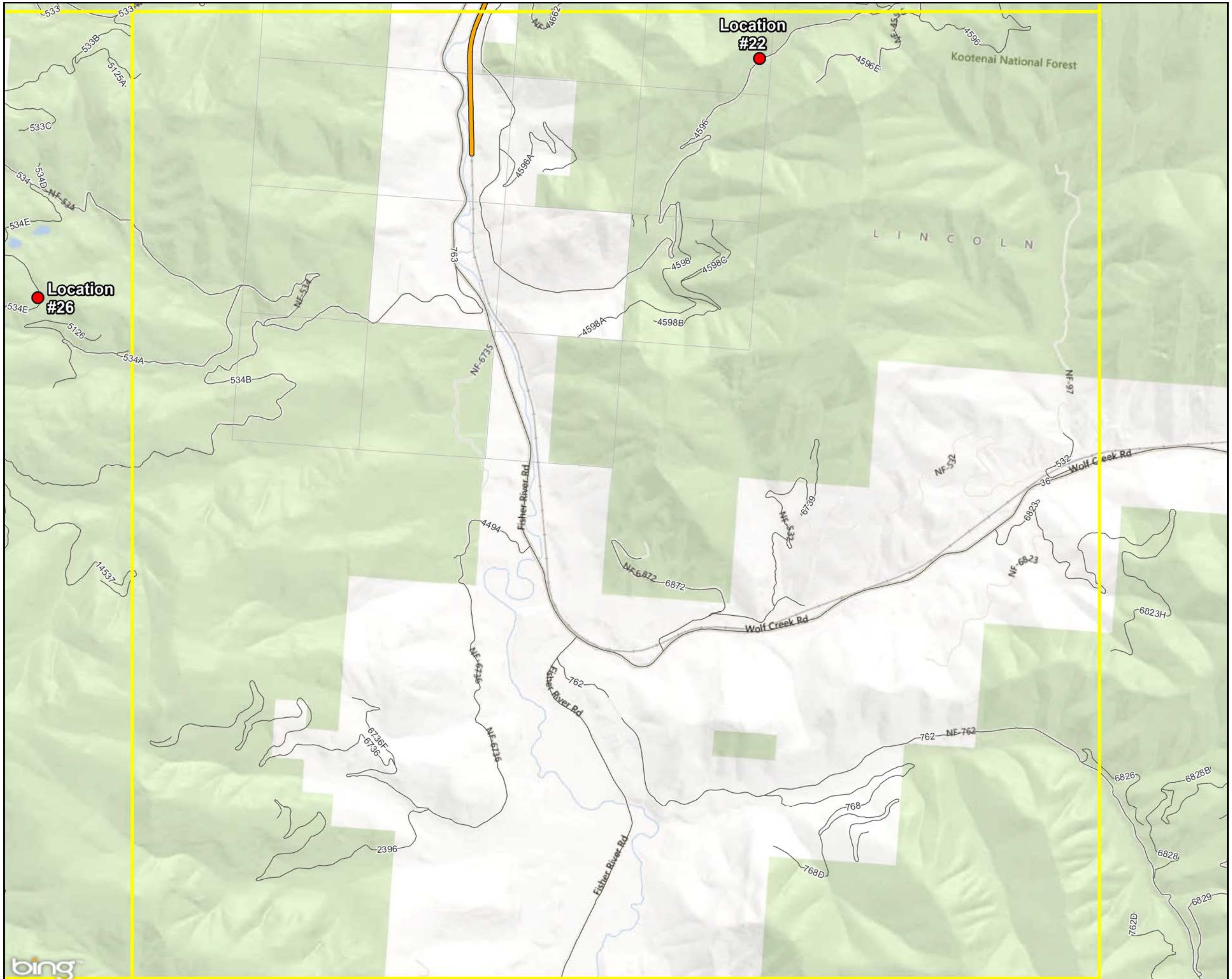
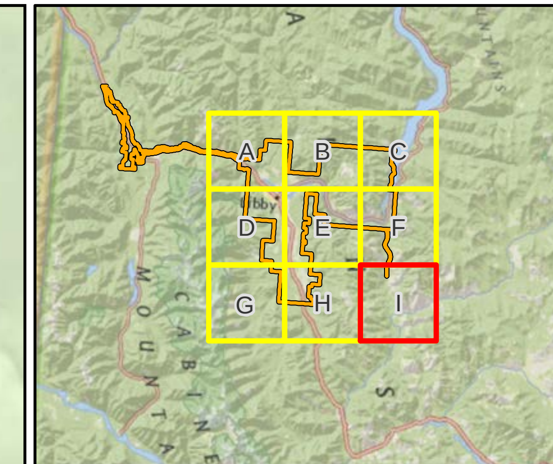
Appendix C
Figure H

ABS Areas
Sampling Locations

Path: R:\85158-OU3\3120.001-RA\GIS\MXD\ABS_Samples\SampleGrid\C-A_ABS_SampleGrid_130820.mxd





Legend

- Sampling Locations
- Forest Service Roads
- Two Mile Buffer Along the NPL Boundary
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- DNRC Precommercial Tree Thinning
- Detailed Map Index

N W E S

Miles

0 0.75 1.5

Data Sources:
NPL Boundary - U.S. EPA Region 8 (2011);
Timber Sales and Precommercial Tree Thinning - MT DNRC (2011)

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Appendix C
Figure I

ABS Areas
Sampling Locations

CDM Smith

Path: R:\85158-OU3\3120.001-RA\GIS\MXD\ABS_Samples\SampleGrid\C-A_ABS_SampleGrid_130820.mxd

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Quality Assurance Project Plan:
Nature and Extent - Forest Activity-Based Sampling
Libby Asbestos Superfund Site

Revision 1 – July 2014

07/08/14

Project Period 09/17/2013 to 10/31/2014
Contract No. W9128F-11-D-0023
Task Order No. 0005

APPENDIX D

ANALYTICAL REQUIREMENTS SUMMARY SHEET**

[NEABS-0714]

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

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QAPP ANALYTICAL SUMMARY # NEABS-0714
SUMMARY OF PREPARATION AND ANALYTICAL REQUIREMENTS

SAP Title: Nature and Extent – Forest Activity-Based Sampling Quality Assurance Project Plan, Libby Asbestos Superfund Site

SAP Date/Revision: July 2014 (Revision 1)

EPA Technical Advisor: Christina Progess (303-312-6009, progess.christina@epa.gov)
(contact to advise on DQOs of QAPP related to preparation/analytical requirements)

Sampling Program Overview: The purpose of this study is to collect activity-based samples during fireline digging scenarios at ten locations around the NPL boundary. Personal air samples will also be collected for H&S monitoring and analyzed by PCM. All samples will be analyzed by TEM – Modified ISO under low magnification. All soil samples collected as part of this sampling program will be held in archive at the Sample Preparation Facility in Troy.

Index ID Prefix: NE-2xxxx

Estimated number and timing of field samples:
Samples will be collected in August 2014 timeframe (exact dates to be determined)
>> ABS Air = (10 locations * 3 ABS events * 2 ABS actors) = 60 samples + field QC samples

TEM/PCM Preparation and Analytical Requirements for Air Samples [a]:

<table>
<tr><th rowspan="3">Medium Code</th><th rowspan="3">Medium</th><th colspan="4">Preparation Details [b]</th><th colspan="3">Analysis Details</th><th rowspan="3">Applicable Laboratory Modifications (current version of)</th></tr>
<tr><th rowspan="2">Investi-gative?</th><th colspan="2">Indirect Prep?</th><th rowspan="2">Filter Archive?</th><th rowspan="2">Method</th><th rowspan="2">Recording Rules [c]</th><th rowspan="2">Analytical Sensitivity/ Stopping Rules</th></tr>
<tr><th>With Ashing</th><th>Without Ashing</th></tr>
<tr><td>A</td><td>Air, ABS Fireline</td><td>Yes</td><td>Yes, if material is overloaded (>25%) or unevenly loaded on filter</td><td>No</td><td>Yes</td><td>TEM – Modified ISO 10312, Annex E (Low Mag, 5,000X)</td><td>All PCME asbestos [c];
L: > 5 µm
W: ≥ 0.25 µm
AR: ≥ 3:1</td><td>Count a minimum of 2 grid openings in 2 grids, then continue counting until one is achieved:
i) the target sensitivity of 0.00022 cc^{-1} is achieved
ii) 25 PCME LA structures are recorded
iii) 20 mm^2 of filter has been examined</td><td>LB-000016, LB-000029, LB-000066, LB-000067, LB-000085, LB-000091</td></tr>
</table>

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

[a] The high volume filter will be analyzed in preference to the low volume filter if direct preparation is possible. If the high volume filter is overloaded, use the low volume filter. If the low volume filter is overloaded, prepare indirectly (with ashing), calculate number of grid openings to analyze to reach target analytical sensitivity, and contact EPA project managers or their designate before proceeding with analysis.
[b] See most current version of SOP EPA-LIBBY-08 (as modified by LB-000091) for preparation details.
[c] If observed, chrysotile and other amphibole asbestos should be recorded.

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

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

Requirements for Soil Samples: All soil samples collected as part of this sampling program will be held in archive at the CDM Smith field office. EPA will provide future direction on the analysis of these samples.

Analytical Laboratory Quality Control Sample Frequencies:

TEM [e]:
- Lab Blank – 4%
- Recount Same – 1%
- Recount Different – 2.5%
- Verified Analysis – 1%
- Interlab – 0.5%
- Repreparation – 1%

PCM [f]: Blind Recounts – 10%

[e] See LB-000029 for selection procedure and QC acceptance criteria
[f] See NIOSH 7400 for QC acceptance criteria

Requirements Revision:

Revision #:	Effective Date:	Revision Description
0	7/17/14	--

Analytical Laboratory Review Sign-off:

- ☐ EMSL – Libby [sign & date: ______________________]
- ☐ EMSL – Cinnaminson [sign & date: ______________________]
- ☐ EMSL – Manhattan [sign & date: ______________________]
- ☐ EMSL – Denver [sign & date: ______________________]
- ☐ Hygeia [sign & date: ______________________]
- ☐ RESI [sign & date: ______________________]
- ☐ ESAT [sign & date: ______________________]

[Checking the box and initialing above indicates that the laboratory has reviewed and acknowledged the preparation and analytical requirements associated with the specified QAPP.]