# Summary of Outdoor Ambient Air Monitoring for Asbestos at the Libby Asbestos Superfund Site Libby, Montana

## (May 2010 to August 2013)

*Addendum*

*February 2014*

Prepared for:

**U.S. ENVIRONMENTAL PROTECTION AGENCY**
**Region 8**

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**(May 2010 to August 2013)**

***Addendum***

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## List of Acronyms and Abbreviations

| | |
|---|---|
| % | percent |
| 1E-06 | one in a million |
| $A_{go}$ | grid opening area |
| $C_{air}$ | Concentration of asbestos in air (structures per cc of air) |
| CB&I | CB&I Federal Services, LLC |
| CDM Smith | CDM Federal Programs Corporation |
| cc/L | cubic centimeters per liter |
| $cc^{-1}$ | per cubic centimeter |
| CHISQ | Chi-square |
| DQA | Data Quality Assessment |
| EDD | Electronic Data Deliverable |
| EDS | Energy Dispersive Spectroscopy |
| EPA | Environmental Protection Agency |
| ESAT | Environmental Services Assistance Team |
| FSDS | field sample data sheet |
| HV | high volume |
| ID | identification |
| ISO | International Organization for Standardization |
| LA | Libby Amphibole Asbestos |
| LV | low volume |
| MCE | Mixed Cellulose Ester |
| $mm^2$ | square millimeters |
| NAM | non-asbestos material |
| NFG | National Functional Guidelines |
| OA | other amphibole-type asbestos |
| OU | Operable Unit |
| PCME | PCM-equivalent |
| QA | Quality Assurance |
| QATS | Quality Assurance Technical Support |
| QC | Quality Control |
| ROM | record of modification |
| s/cc | structures per cubic centimeter of air |
| S | Sensitivity (1/cc) |
| SAED | Selected Area Electron Diffraction |
| SAP | Sampling and Analysis Plan |
| Shaw E&I | Shaw Environmental & Infrastructure Group |
| Site | Libby Asbestos Superfund Site |
| SOP | Standard Operating Procedure |
| TEM | Transmission Electron Microscopy |

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# 1 INTRODUCTION

## 1.1 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 and 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 Libby Asbestos Superfund Site (Site) was listed on the U.S. Environmental Protection Agency (EPA) National Priorities List in October 2002.

## 1.2 Document Purpose

Under current site conditions, humans may be exposed to LA in air by a number of different pathways. One pathway that applies to all residents and workers in Libby is inhalation of LA in ambient outdoor air. Beginning in 2000, the EPA started to collect outdoor ambient air samples of opportunity (or in conjunction with cleanup monitoring activities) at a number of locations around Libby. These data were culled from various collection efforts from 2000 to 2002 and summarized in an internal draft report prepared in 2005 (EPA 2005).

Although these data were useful in providing initial impressions of outdoor ambient air levels, because they were not collected under a sampling and analysis plan (SAP) specifically designed to characterize outdoor ambient air levels, they were insufficient for drawing strong conclusions regarding the true levels of exposure and risk from ambient air. Consequently, the EPA determined that ambient air data should be collected that were sufficiently representative and of adequate quality to estimate human health risks associated with inhalation of LA in outdoor ambient air in the vicinity of Libby. In addition, the data should aim to characterize potential spatial patterns and temporal trends of LA occurrence in outdoor ambient air. In 2006, the EPA formalized the ambient air collection protocol with the development of the *2006 Ambient Air SAP* (EPA 2006b).

Following this protocol, the EPA collected ambient air data from stations in several operable units (OUs), including OU4 (the Libby community), OU2 (the former Screening Plant), and OU6 (the Burlington Northern Santa Fe rail yard and rail lines) between 2006 and 2008. In addition, the EPA collected ambient air data from a station in Helena, Montana to provide a frame of reference for Site data. These data results were summarized and compared to the 2000-2002 data in the *2009 Outdoor Ambient Air Report* (EPA 2009). For ease of discussion, the 2006 to 2008 sampling events[1] are hereafter referred to in this report as:

- Year 1 (October 2006 to September 19, 2007)
- Year 2 (September 20, 2007 to June 2008)

The purpose of this 2013 report is to serve as an addendum to the 2009 outdoor ambient air summary report. It describes the ambient air sampling program that was conducted from May 2010 to August 2013 and provides an interpretation of outdoor ambient air data that were collected during this same period. A brief comparison of the 2010-2013 data to the 2006-2008 data and the earlier 2000-2002 data is also presented in this report.

## 1.3 Document Organization

In addition to this introduction, this report is organized into the following sections:

Section 2 This section summarizes data management procedures, including sample collection, documentation, handling, custody, and data management.

Section 3 This section summarizes the study design, selection of sampling locations, and any changes in the sampling protocols for each sampling year.

Section 4 This section summarizes the analytical methods used for estimating the level of LA in ambient air and the data reduction methods utilized in this report.

Section 5 This section summarizes the data that were collected and provides an interpretation of the collected data.

Section 6 This section presents the results of the data quality assessment, including a summary of program audits, modifications, data verification and validation efforts, an evaluation of quality control samples, and a data adequacy assessment.

Section 7 This section provides full citations for all analytical methods, site-related documents, and scientific publications referenced in this document.

[1] The 2000-2002 data have not been given "Year" designations because these data were collected as "outdoor ambient air samples of opportunity" or in conjunction with cleanup monitoring activities and were not collected under a SAP specifically designed to determine outdoor ambient air levels.

# 2 DATA MANAGEMENT

## 2.1 Sample Collection, Documentation, Handling, and Custody

All samples generated as part of this study were collected, documented, and handled in accordance with Libby-specific standard operating procedures (SOPs), as specified in the 2006 Ambient Air SAP (EPA 2006b) and modified sampling protocols identified below.

### 2.1.1 Collection Methods

*Ambient Air*
The ambient air samples presented in this report were collected during several sampling events from 2010 through 2013. Although the sampling and analysis strategy for all the sampling events is based on the 2006 Ambient Air SAP (EPA 2006b), the sampling protocol was updated with modifications to the 2006 Ambient Air SAP through the years. Documents utilized to revise sampling approaches include: *2010 OU4 Outdoor Ambient Air Sampling Technical Memorandum* (CDM Smith 2010a), *OU4 Outdoor Ambient Air Sampling Program for June 2011 – April 2012* (CDM Smith 2011), *OU4 Outdoor Ambient Air Sampling Program for May 2012 – March 2013* (CDM Smith 2012a), and *OU4 Outdoor Ambient Air Sampling Program for Libby Asbestos Superfund Site, April 2013 – March 2014* (CDM Smith 2013). Details of these sampling protocols are provided in Section 3.

*Meteorological Data*
On days when ambient air sampling activities were scheduled, meteorological data from the National Oceanic Atmospheric Administration station in Libby (LBBM8), at the mine (ZONM8), and in Troy, Montana (TROM8) were downloaded electronically from the MesoWest website[2].

### 2.1.2 Documentation, Handling, and Custody Methods

All ambient air samples collected were identified with sample identification (ID) numbers that included a program-specific prefix of "AA-#####" (e.g., AA-20001). Data on the sample type, location, collection method, and collection date of all samples were recorded both in a field logbook maintained by the field sampling team and on an field sample data sheet (FSDS) form designed to facilitate data entry into the Libby site database (see Section 2.4). All samples collected in the field were maintained under chain of custody during sample handling, preparation, shipment, and analysis.

[2] http://mesowest.utah.edu/

## 2.2 Analytical Results Recording

Standardized data entry spreadsheets (electronic data deliverables, or EDDs) have been developed specifically for the Libby project to ensure consistency between laboratories in the presentation and submittal of analytical data. In general, a unique EDD has been developed for each analytical method and each medium. Each EDD provides the analyst with a standardized laboratory bench sheet and accompanying data entry form for recording analytical data. The data entry forms contain a variety of built-in quality control functions that improve the accuracy of data entry and help maintain data integrity. These spreadsheets also perform automatic computations of analytical input parameters (e.g., sensitivity, dilution factors, and concentration), thus reducing the likelihood of analyst calculation errors. The EDDs generated by the laboratories are uploaded directly into the Libby site database (see Section 2.4).

## 2.3 Hard Copy Data Management

Hard copies of all FSDSs, field logbooks, and chain of custody forms generated during this study are stored in the CDM Federal Programs Corporation (CDM Smith) field office in Libby, Montana. **Appendix A** of this report provides copies of the field documentation for this study.

All analytical bench sheets are scanned and included in the analytical laboratory job reports. These analytical reports are submitted to the Libby laboratory coordinator (i.e., the EPA's Environmental Services Assistance Team [ESAT] contractor, TechLaw) and stored electronically. **Appendix B** of this report provides copies of all the analytical laboratory reports for analyses performed as part of this study.

## 2.4 Electronic Data Management

Sample and analytical electronic data are stored and maintained in the Libby Scribe project databases which are housed on a local computer located at the TechLaw office in Golden, Colorado, which is backed up daily to an external hard drive. Raw data summarized in this report were downloaded from Scribe.NET on 02/25/2014, into a Microsoft Access® database by CDM Smith. Because data for the Libby project are maintained in multiple Scribe projects (e.g., analytical data are managed in annual projects, field information is managed in a project separate from the analytical information), the data have been combined into one Access database reflecting a compilation of tables from multiple Scribe projects. Any changes made to these Scribe projects since this download will not be reflected in the Microsoft Access® database. A frozen copy of this Access database is provided in **Appendix C** of this report.

# 3 STUDY DESIGN

Ambient air samples were collected during multiple sampling events from 2010 through 2013. For ease of discussion, these sampling events have been identified as:

- Year 3 (May 2010 to April 2011)
- Year 4 (July 2011 to April 2012)
- Year 5 (May 2012 to March 2013)
- Year 6 (April 2013 to September 2013)

The sampling protocols followed for each sampling event are summarized briefly below. To avoid unnecessary repetition, the sections below focus on protocol changes since the previous sampling year. **Figure 3-1** shows all 2010 to 2013 sampling locations, stationary and mobile. Separate figures showing sampling locations for each sampling year (Years 1 through 6) are provided in **Appendix D** (**Figures D-1 through D-6**).

## 3.1 Year 3 (May 2010 – April 2011) Study Design

In 2010, the EPA decided to resume the OU4 outdoor ambient air sampling program that ceased in 2008, with a focus on major transportation corridors within OU4. As such, five new outdoor ambient air sampling stations were created, located along the transportation corridors. The ambient air sampling protocol for Year 3 was based on the 2006 Ambient Air SAP with modifications as described in detail in the *2010 OU4 Outdoor Ambient Air Sampling Technical Memorandum* (CDM Smith 2010a) which include EPA-approved field modifications LFO-000150, LFO-00153, and LFO-000159. The main features of the Year 3 study design are summarized below.

### 3.1.1 Selection of Sampling Locations

As noted above, five new sampling stations (L20, L21, L22, L23, and L24) were positioned along the main transportation routes within OU4 for monitoring in Year 3 (**Figure D-3**). Note that for the purposes of this document, the station names have been altered as presented in **Table 3-1** to be unique and therefore differ from those included in the governing technical memorandums because station names were repeated for different sampling stations over time. Care was given to select locations where public safety (i.e., positioned away from foot and actual vehicle traffic) and security of sampling equipment was optimized, and where electricity was accessible. The locations also provided adequate spatial coverage of the major transportation corridors with OU4. In addition to these five new sampling stations, one station (L8) originally sampled in Years 1 and 2 was retained for sampling in Year 3. Reference samples from offsite locations were not collected in Year 3.

Equipment shelters were installed at each of the locations by a licensed electrician to connect electricity to the shelters. The shelters house the sampling pumps and protect the sampling equipment from adverse weather conditions that could have otherwise interfered with sample collection. Where buildings were present, sampling equipment was placed on the east or west side of buildings approximately 15 feet away from outer walls to reduce building interference with wind patterns and allow the samples to be exposed to the dominant northwest to southeast air patterns in the Libby valley. Global positioning system coordinates of each sampling station were recorded for use in spatial pattern analysis and for map preparation.

### 3.1.2 Sampling Protocols

Samples collected in Year 3 of the program were collected using the same equipment and sampling techniques as Years 1 and 2.

*Schedule*
At each of the six stations, sampling occurred roughly twice per month for seven months, for a total of 14 sampling events. The original schedule for sampling was for samples to be collected on approximately a 15-day schedule (5 days on and 10 days off), starting during a 3- to 4-hour period on a predetermined day of the week. However, the planned schedule was slightly modified (through field modification LFO-000150) so that the days between samplings actually varied from 8 to 16 days, to better represent days when response action truck hauling along transportation corridors was in progress.

Two times per day during each day of the sampling period, sampling equipment was checked to ensure proper operation, and cassette filters were observed for any obvious signs of overloading.

*Flow Rate*
Two samples were collected at each station – a high volume (HV) sample and a low volume (LV) sample – using target flow rates of 2.0 and 1.5 liters per minute (L/min), respectively. For HV samples, if visible loading was observed on a sample filter or if decreased flow was noted, the collection of that sample was concluded and the sample marked for archive following drying of the filter. The corresponding LV sample continued to be collected for the full sampling event period and submitted for analysis. Thus, for each sampling event, one HV filter and one LV filter were collected per station.

*Filter Type*
Samples were collected using 25-millimeter (mm) diameter, 0.8-micrometer (µm) pore size mixed cellulose ester (MCE) filter cassettes[3].

[3] Previous comparisons of pore size (0.45 µm versus 0.8 µm) revealed that pore size does not have an impact on fiber retention at the flow rates used in this study (EPA 2009, 2011a).

*Sample Height*
Samples were collected at approximately five to six feet above ground level at all stations to represent the breathing zone height of most adults.

*Quality Control Samples*
Three types of quality control (QC) samples were collected in the field: lot blanks, field blanks, and co-located samples. The *2006 Ambient Air SAP* (EPA 2006b) includes descriptions of each of these field QC samples. The prescribed collection and analysis frequencies were followed during the Year 3 sampling with the following exceptions: only one field blank was collected per sampling event at one random location on the final day of the sampling (versus one field blank being collected at the start of each sampling event from each station as indicated in the *2006 Ambient Air SAP* (EPA 2006b). Additionally, only one lot blank was collected and analyzed versus two as originally specified in the *2006 Ambient Air SAP* (EPA 2006b). This frequency does keep with overall Libby project lot blank collection and analysis frequencies.

Co-located samples were collected using a separate HV and LV pump on a rotation basis, meaning that co-located samples were collected at the first station for the first sampling event, collected at the second station for the second event, etc. This ensured that co-located samples are representative of all the stations, and not just one or two.

In addition to the field QC samples that were collected, preparation drying blanks were analyzed (in accordance with laboratory modification LB-000055B) to ensure that field samples were not contaminated during the filter drying process.

## 3.2 Year 4 (July 2011 – April 2012) Study Design

For Year 4, the EPA continued the Year 3 outdoor ambient air sampling program (which focused on major transportation corridors); however, sample collection also focused on the core of OU4. Specifically, sampling stations were placed in areas where removal activities were occurring, with the intent of serving as preparation for the development of a long-term ambient air sampling program to be carried out by Lincoln County. The ambient air sampling protocol for Year 4 was the same as the Year 3 protocol with modifications described as described in *OU4 Outdoor Ambient Air Sampling Program for June 2011 – April 2012* (CDM Smith 2011) and the subsections below.

### 3.2.1 Selection of Sampling Locations

Five stationary sampling stations and one mobile station were sampled in Year 4 of the ambient air sampling program. Four of the outdoor ambient air sampling locations stations (L21, L22, L23, and L8) sampled in Year 4 were stations that were also sampled in Year 3 (**Figure D-4**). Sampling stations (L20 and L24) were discontinued and were not sampled in Year 4. Instead, one new stationary sampling station (L25) was added.

Two mobile stations were also sampled during Year 4. Mobile stations are intended to represent ambient air within general areas where removal activities are in progress; therefore, the exact locations of the mobile station were determined as the 2011 removal schedule was developed. As with other ambient air sampling, care was given to select a mobile location where public safety and security of sampling equipment was optimized. Once established, the mobile station remained in-place for a minimum of two sampling events, regardless of ongoing removal activities.

During Year 4, one of the mobile sampling stations was placed near stationary station L22 from October 1 to 15, 2011. Although outwardly this may seem redundant, removal actions at this property encompassed a large area, so the two stations were not placed in the exact same location. The mobile station was located in the predominant downwind direction of the removal work. In addition, the property was the former Export Plant site and the only removal site active at the time. Hence, the EPA recommended that this location be selected as a mobile station.

### 3.2.2 Sampling Protocols

Samples collected in Year 4 of the program were collected using the same equipment and sampling techniques as Year 3 with the following changes.

*Schedule*
During June 2011, one sampling event was conducted at the five stationary ambient air sampling stations and the mobile station was established but not sampled. From July 2011 through November 2011, sampling occurred twice per month at each of the five stationary stations, focusing on days when removal actions were in progress (typically Monday through Saturday). Two mobile stations were each sampled during two consecutive events in October. From December 2011 through April 2012, sampling occurred once monthly at each station. This once-monthly schedule was not contingent upon removal actions, since this timeframe represented the off-season for construction.

*Quality Control Samples*
Field QC samples collected in Year 4 were collected following the same protocol used in Year 3 with the following exception. Co-located samples were collected on a more random basis rather than a strict rotation.

## 3.3 Year 5 (May 2012 to March 2013) Study Design

For Year 5, the OU4 outdoor ambient air sampling program was essentially the same as Year 4. Five stationary sampling stations and one mobile station were sampled in Year 5. The ambient air sampling protocol for Year 5 was the same as the Year 4 protocol with modifications as described in *OU4 Outdoor Ambient Air Sampling Program for May 2012 – March 2013* (CDM Smith 2012a) and in the following subsections.

### 3.3.1 Selection of Sampling Locations

The Year 5 ambient air sampling program had five stationary sampling stations and one mobile station. The five stationary sampling stations (L21, L22, L23, L25, and L8) are unchanged from Year 4 (**Figure D-5**). However, sampling at station L23 was discontinued at the owner's request in November 2012 (as reported in field modification LFO-000176). Sampling at a new replacement station (L26; see **Figure D-5**) began in November 2012[4]. The locations of the mobile station was determined as the 2012 removal schedule was developed. Mobile stations remained in place for a minimum of two sampling events, regardless of ongoing removal activities. In all, five mobile locations were sampled during Year 5.

### 3.3.2 Sampling Protocols

Samples collected in Year 5 of the program were collected using the same equipment and sampling techniques as Year 4 with the following changes.

*Schedule*
From May 2012 through October 2012, sampling occurred twice per month at each of the five stationary ambient air stations. The mobile station was sampled twice per month from May 2012 through September 2012. Sampling days were selected when removal actions were in progress (typically Monday through Friday). From November 2012 through March 2013 (the off-season), sampling occurred once monthly at each of the five stationary locations. Samples were not collected from the mobile station during the off-season.

*Quality Control Samples*
Field QC samples collected in Year 5 were collected following the same protocol used in Year 4.

## 3.4 Year 6 (April 2013 to August 2013) Study Design

For Year 6, the OU4 outdoor ambient air sampling program reduced the number of stationary sampling stations compared to Year 5. Only three stationary sampling stations were sampled. The ambient air sampling protocol for Year 6 was the same as the Year 5 protocol with modifications as described as described in *OU4 Outdoor Ambient Air Sampling Program for Libby Asbestos Superfund Site, April 2013 – March 2014* (CDM Smith 2013) and in the following subsections.

[4] This location was not formally documented in a field modification until it was identified in OU4 Outdoor Ambient Air Sampling Program for Libby Asbestos Superfund Site, April 2013 – March 2014 (CDM Smith, 2013)

### 3.4.1 Selection of Sampling Locations

As noted above, the Year 6 ambient air sampling program had three stationary sampling stations. Two of the stationary sampling stations were unchanged from Year 5 (L2 and L8); the third stationary station (L4) was previously sampled in Years 1 and 2 (**Figure 3-1**). Although one mobile station was planned, none were collected.

### 3.4.2 Sampling Protocols

Samples collected in Year 6 of the program were collected using the same equipment and sampling techniques as Year 5 with the following changes.

*Schedule*
Sampling occurred once monthly during April 2013 and twice per month from May 2013 through August 2013. This schedule focused on days when removal actions were in progress (typically Monday through Friday). This resulted in a total of nine sampling events.

*Quality Control Samples*
Field QC samples collected in Year 6 were collected following the same protocol used in Year 5.

## 3.5 Summary of Sample Collection Schedule

**Figure 3-2** identifies all of the stations at which ambient air samples were collected during the course of the ambient air program from 2010 to 2013, and indicates the calendar period over which sampling occurred at each station.

# 4 SAMPLE PREPARATION AND ANALYSIS METHODS

## 4.1 Ambient Air Sample Analysis Hierarchy

As noted previously, each sampling event resulted in two ambient air samples – one HV sample and one LV sample. The HV sample was analyzed in preference to the LV sample. If the HV sample was deemed to be overloaded (i.e., more than 25% particulate loading on the filter), the LV sample was analyzed in preference to performing an indirect preparation of the HV filter. If the LV sample was also deemed to be overloaded, an indirect preparation (with ashing) of the HV filter was performed in accordance with SOP EPA-LIBBY-08.

## 4.2 Analysis Method and Counting Rules

Air filters collected as part of this effort were prepared and analyzed for asbestos using transmission electron microscopy (TEM) in basic accordance with International Organization for Standardization (ISO) 10312:1995(E) (ISO 1995), with all applicable Libby-specific laboratory modifications[5], including LB-000016H, LB-000029D, LB-000055B, LB-000066C/D, LB-000067C , LB-000085A.

When a sample is analyzed by TEM, the analyst records the size (length, width) and mineral type of each individual asbestos structure that is observed. Mineral type is determined by selected area electron diffraction (SAED) and energy dispersive spectroscopy (EDS), and each structure is assigned to one of the following four categories:

**LA** Libby-class amphibole. Structures having an amphibole SAED pattern and an elemental composition similar to the range of fiber types observed in ores from the Libby mine (Meeker *et al.* 2003). This is a sodic tremolitic solid solution series of minerals including winchite and richterite, with lower amounts of tremolite, magnesio-arfvedsonite, magnesio-riebeckite, and edenite/ferro-edenite. Depending on the valence state of iron, some minerals may also be classified as actinolite.

**OA** Other amphibole-type asbestos fibers. Structures having an amphibole SAED pattern and an elemental composition that is not similar to fiber types from the Libby mine. Examples include crocidolite, amosite, and anthophyllite. There is presently no evidence that these fibers are associated with the Libby mine.

**C** Chrysotile fibers. Structures having a serpentine SAED pattern and an elemental composition characteristic of chrysotile. There is presently no evidence that these fibers are associated with the Libby mine. *For the purposes of this study, recording of chysotile structures was not required.*

[5] Copies of all Libby laboratory modifications are maintained on the Libby Lab eRoom.

**NAM** Non-asbestos material. These may include non-asbestos mineral fibers such as gypsum, glass, or clay, and may also include various types of organic and synthetic fibers derived from carpets, hair, etc. *Recording of NAM structures is not required.*

## 4.3 Stopping Rules

The TEM stopping rules for all ambient air field samples were as follows:

- Examine a minimum of two grid openings from each of two grids.
- Continue examining grid openings until one of the following was achieved:
  - The target analytical sensitivity (0.00004 structures per cubic centimeter (s/cc) was achieved.
  - 25 total LA structures were observed.
  - A total filter area of 0.1 square millimeters ($mm^2$) was examined (approximately 100 grid openings).

For lot blanks and field blanks, the TEM analysis included an examination of a filter area of 0.1 $mm^2$ (approximately 100 grid openings).

## 4.4 Calculation of Air Concentration

The concentration of LA in ambient air is given by:

$$C_{air} = N \cdot S$$

where:

$C_{air}$ = Air concentration, expressed as structures per cubic centimeter of air (s/cc)
N = Number of LA structures observed
S = Analytical sensitivity (per cubic centimeter [$cc^{-1}$])

For air, the analytical sensitivity is calculated as:

$$S = EFA / (GOx \cdot Ago \cdot V \cdot 1000 \cdot F)$$

where:

S = Analytical sensitivity ($cc^{-1}$)
EFA = Effective area of the filter ($mm^2$)
GOx = Number of grid openings examined
Ago = Area of a grid opening ($mm^2$)
V = Volume of air passed through the filter (L)
1000 = Conversion factor (cubic centimeters per liter [cc/L])

F = Fraction of primary filter deposited on secondary filter (indirect preparation only)

Note that air samples with a count of zero (and hence a concentration of zero) are reported as zero. When computing the best estimate of the mean, samples with a count of zero are evaluated as zero, not at ½ the analytical sensitivity (EPA 2008). This approach yields an unbiased estimate of the true mean that does not depend on the analytical sensitivity of the samples included in the data set.

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# 5 RESULTS

## 5.1 Raw Data

**Appendix D** presents figures for all sampling station and **Appendix E** presents the detailed analytical results for each station for each sampling event. Key findings of the ambient air sampling program, for total[6] and PCM-equivalent[7] (PCME) LA air concentrations, are summarized below.

## 5.2 Spatial Pattern for Geographic Areas (North, East, Central, South)

**Figure 5-1** displays the monthly average concentration of total LA (Panel A) and PCME LA (Panel B) in each of the four main geographic areas of OU4 for the ambient air study (north, east, central, and south) as well as for all stations combined. Because concentration values appear to vary seasonally (see Section 5.3), monthly means for each geographic area were computed using all of the data collected from 2010 through 2013. Mobile data have not been included in the monthly averages because these stations were placed in locations where ambient air could be influenced by removal activities, which could potentially bias the data.

As shown in Panel A, for most of the year, concentrations in the east are highest, followed by the north, then central, and with lowest concentrations in the south. This pattern is consistent with the distance of the sampling stations from the Libby vermiculite mine and the prevailing winds (see the windrose in **Figure 5-2**). In reviewing the data reported for the north area, the elevated air concentrations in February and March appear to be attributable to samples collected in 2013 at Station L25 (**Figure 5-3**). Due to the nature of these samples (along a road), concentrations are heavily influenced by road traffic (i.e., how many trucks drive on the road and stir up road dust and what the trucks are hauling). Therefore, although these concentrations are unexpectedly high, they are not considered outliers.

The mean monthly results for different areas were compared to each other using the Wilcoxon-Rank-Sum test (WRS). This test was selected for use because it is non-parametric, and can accommodate many samples of the same rank (non-detect). It is important to note that this test does not take into account analytical uncertainty due to Poisson counting error, so this limitation needs to be recognized when drawing firm conclusions about the data. The results are of the WRS test are presented in **Table 5-1**. For total LA, there are no statistically significant differences among the four different parts of OU4 (north, east, central, south). However, the northern and eastern portions of OU4 were nearly statistically different (higher) than the south

[6] All structures having length greater than or equal 0.5 µm and an aspect ratio (length:width) greater than or equal 3:1.
[7] PCME structures have a length greater than 5 µm, width greater than or equal to 0.25 µm, and an aspect ratio (length:width) greater than or equal to 3:1.

portion (p = 0.069); and the eastern portion was also nearly statistically different (higher) than the central portion (p = 0.078).

## 5.3 Temporal Pattern

### 5.3.1 Seasonal Variation

**Figure 5-3** presents the total LA concentration measured for all samples collected (excluding the mobile stations) from 2010 to 2013. As seen, in general, measured ambient air concentrations tended to be lower during the winter months and higher in mid- to late-summer. This result could reflect the higher frequency of trucks hauling during the summer months and the hypothesis that releases are lowest when the ground is frozen or snow-covered, and highest when the ground is dry in the summer. Noticeable "spikes" occurred during the summer months (i.e., June to September), also supporting the concept that meteorological conditions (e.g., soil moisture, wind speed, etc.) are likely to be important factors in determining releases of LA into ambient air.

### 5.3.2 Long-Term Trends

Data from the most recent study of ambient air in Libby (summarized in this report) span too narrow a time interval (2010-2013) to evaluate long-term time trends. It is difficult to draw conclusions by comparing ambient air data collected in Libby the 2000-2002 time frame (summarized in EPA 2005) with those collected in 2006-2008 (summarized in EPA 2009), and with those collected in 2010-2013 (this report) for the following reasons:

- The achieved analytical sensitivity varies for the different datasets. For samples collected in 2000-2002, the achieved analytical sensitivity was 0.003 $cc^{-1}$, whereas compared to the achieved analytical sensitivity in 2006-2008 and 2010-2013 was 0.00004 $cc^{-1}$. Even after 33 samples collected in 2000-2002 were re-analyzed by TEM to improve the achieved analytical sensitivity, the achieved sensitivity (0.000096) was still two times higher than what was achieved in the 2006-2008 and 2010-2013 studies. Thus, it is difficult to make comparisons between datasets because of the high frequency of non-detects.
- The number and locations of the stations where the ambient air samples were collected has not been consistent through the years.
- The intent for collecting samples has changed through the years.
    - From 2000-2002, the data were culled from various sampling collection efforts and were not collected under a SAP specifically designed to determine outdoor ambient air levels. Samples were collected from eight stationary locations and 27 mobile locations where EPA clean-up activities removal action were scheduled (samples were collected prior to removals). As such, the stations sampled may not be spatially representative of OU4.

- From 2006-2008, the purpose was to adequately characterize ambient air concentrations at the Site and establish a frame of reference by which observations in Libby could be compared, so the sampling stations were selected using a stratified random approach to provide adequate spatial coverage of the study area. The study area was divided into 14 grids, and one location was selected within each grid. The specific location within each grid was chosen on a random basis by selecting locations that have available electricity and could be accessed year-round.
- From 2010-2013, the focus was to collect samples along main transportation routes and to collect from a mobile station adjacent to where removals were taking place. As such, the 2010-2013 data are likely to be higher than the 2000-2002 and 2006-2008 data since locations were specifically chosen to represent the higher end of the potential ambient air exposure range.

Recognizing these limitations, **Figure 5-4** shows annual average total LA air concentrations for each year (excluding mobile stations). As shown, the averages for Years 3 and 4, which represent transportation corridors sample locations, are about the same as the averages for Years 1 and 2 and for 2000-2002. However, Years 5 and 6, which also represent transportation corridors samples locations, are higher than Years 1 and 2. Annual averages were calculated by first determining a monthly average, then averaging the monthly averages for all months for which data were available.

Concentration trends were also reviewed for Station L8 (60 Port Boulevard), the only sampling station consistently sampled in Years 1, 3, 4, and 5 (**Figure 5-5**). As shown, mean monthly concentrations at this station suggest there is a seasonal variation, with concentrations tending to be highest in summer and lowest in winter, but it is difficult to determine if there is a long-term temporal pattern present. Although LA was detected more frequently in 2012 compared to the previous years.

## 5.4 Mobile Station Results

A total of 14 samples were collected from mobile stations in 2011 and 2012. No LA structures were detected in any of the samples. These results support that dust suppression techniques required during removal activities help ensure that any LA being disturbed and removed doesn't migrate offsite.

Since there were no statistically significant differences among the four different geographic areas of OU4 (north, east, central, south) (see Section 5.2), a monthly average concentration across for the stationary sampling stations was used for the purposes of making comparisons to the mobile station data. The resulting p-value from the WRS test was 0.0025 for total LA, which indicates there is a statistically significant difference between the ambient air concentrations measured at the stationary sampling stations and the concentrations measured at the mobile stations, with concentrations measures at the stationary sampling stations being greater than

those measured at the mobile stations. However, as noted above in Section 5.2, this test does not take into account analytical uncertainty due to Poisson counting error.

# 6 DATA QUALITY ASSESSMENT

Data quality assessment (DQA) is the process of reviewing existing data to establish the quality of the data and to determine how any data quality limitations may influence data interpretation (EPA 2006a). This section provides the DQA for ambient air data collected in Years 3 through 6 (May 2010 to August 2013). The DQA of ambient air data collected in Years 1 and 2 is provided in the *2009 Outdoor Ambient Air Report* (EPA 2009).

## 6.1 Field and Laboratory Oversight

### 6.1.1 Field

Field surveillances consist of periodic observations made to evaluate adherence to study-specific governing documents. Field audits are broader in scope than field surveillances and conducted by qualified technical or quality assurance (QA) staff that are independent of the activities audited.

Two field audits were conducted for the outdoor ambient air monitoring program – one on May 28, 2010 (CDM Smith 2010b) and the other on September 10, 2012 (CDM Smith 2012b). The audits reviewed field sampling activities (air sampling equipment setup, field measurements, sample collection, sample handling procedures, and field logbook content and control) and maintenance of applicable guidance documents onsite. In addition, the auditor reviewed all documentation (field logbook notes and field sample data sheets for stationary air) generated for the respective ambient air sampling rounds. The following overall conclusions were noted:

<u>May 28, 2010 Audit</u>

- Although the documentation was onsite and available during the sampling event, not all field team members had current copies of the SAP and the governing Memorandum to the SAP.
- When the auditor observed the set-up of air samples, she noted that it was not physically possible to orient the cassette facing up and turn the pump off in accordance with SAP (Section 5.3.2 step 6) because the pump and the cassette are 15 feet or more away from each other. The auditor's observations were used to issue a field modification LFO-000153 to delete the requirement to "orient the sample cassette up."
- The SAP did not include an SOP on how to complete an FSDS form. Field modification LFO-000153 included a clarification that field sampling staff should refer to SOP CDM-LIBBY-03, Revision 5, *Project-specific Guidance for the Completion of FSDSs*, to assist in completing air sample documentation.
- According to the SAP, lot blanks should have been collected only once and the case of cassettes set aside for the ambient air program. However, due to complications in purchasing air sampling cassettes, cassettes were not able to be purchased prior to the start of the first ambient air sampling event on May 12, 2010. As a result, cassettes from

the general supply were used to collect Event 1 samples. Prior to use of the cassettes for sampling, results for the lot blank were verified to be non-detect for asbestos. Further, once the cassettes designated for the ambient air program were received, they were added to the general supply (rather than segregating them for the ambient air program). Field modification LFO-000153 documented this discrepancy and noted that cassettes for the ambient air program would continue to be obtained from the general supply and that lot blanks would continue to be collected and evaluated as required per lot blank collection/acceptance protocol.

September 10, 2012 Audit

- On the FSDS form, the sample classification for all blanks should have been recorded as "AA-Blank" in the "Sample Location Description" field for all blank types. In this instance, the sample technician wrote "blank" and "dry blank" in this field; which was redundant with information already captured in the "Sample Type" field.
- The SAP was prepared in 2006 and could use updating rather than utilizing memorandums to capture changes; however, the ambient air monitoring program may be terminated after March 2013. The auditor recommends that if the program is to be continued in the future, consideration should be given to updating the SAP.

No deficiencies were noted regarding sampling requirement and general field processes; the general process requirements specified in the SAP were met by field personnel. The field QC sample types and collection frequencies specified in the SAP were met by field personnel. Each of the observations was discussed and resolved with the ambient air field team leader. None of the observations posed a significant condition adverse to quality. In summary, no significant deficiencies were observed during the field audits.

### 6.1.2 Laboratory

Laboratory audits are conducted to evaluate laboratory personnel to ensure that samples are handled and analyzed in accordance with the program-specific documents and analytical method requirements (or approved Libby laboratory modification forms) to make certain that analytical results reported are correct and consistent. All aspects of sample handling, preparation, and analysis are evaluated. If any issues are identified, laboratory personnel are notified and retrained as appropriate.

A series of laboratory audits was performed in May-September of 2012 with follow-up audits performed in 2013 to evaluate all of the Libby laboratories. Detailed audit findings for each laboratory audited in 2012 are documented in separate laboratory-specific audit reports (Shaw Environmental & Infrastructure Group [Shaw E&I] 2012a-g). No critical deficiencies were noted during the 2012 laboratory audits that would be expected to impact data quality for TEM analyses. A summarization of the findings of the 2013 follow-up audits is currently pending.

## 6.2 Field and Laboratory Modifications

During a large-scale sampling program, such as this ambient air study, deviations from the original SAP or SOPs may occur and/or it may be necessary to modify procedures as originally specified to optimize sample collection. Any field or laboratory deviations or modifications from the SAP and/or SOPs have been recorded on a Libby-specific Record of Modification (ROM) form. The ROM forms have been used to document all permanent and temporary changes to procedures contained in guidance documents governing this study that have the potential to impact data quality or usability. Any minor deviations (i.e., those that will not impact data quality or usability) have been documented in the field logbooks. **Appendix F** provides copies of all applicable modifications associated with this study.

Libby field ROMs that impact the ambient air program from 2010 to 2013 include LFO-000150, LFO-000153, LFO-000159, LFO-000176, and LFO-000177. **Table 6-1** presents the field deviations summarized in each field ROM and includes an evaluation of the potential data quality implications for each deviation. As shown, only one deviation, noted in LFO-000176, is expected to negatively impact data quality or usability. As noted in this ROM, sampling at Station L23 (originally identified as L4 per Section 3.3.1) halted early at the request of the property owner. However, because a replacement station was established nearby (L26), any implications of this deviation should be negligible.

Libby laboratory ROMs that were active during the laboratory analyses of the ambient air samples are presented in **Table 6-2**. Laboratory modifications seek to standardize analysis procedures and do not have any negative implications on data quality or interpretation.

## 6.3 Data Review, Verification, and Validation

### 6.3.1 Data Review and Verification

The Libby Scribe project databases have a number of built-in quality control checks to identify unexpected or unallowable data values during upload into the database. Any issues identified by these automatic upload checks were resolved by consultation with the field teams and/or analytical laboratory before entry of the data into the database. After entry of the data into the database, several additional data verification steps were taken to ensure the data were recorded and entered correctly.

In order to ensure that the database accurately reflects the original hard copy documentation, all data downloaded from the database were examined to identify data omissions, unexpected values, or apparent inconsistencies. In addition, 10% of all samples and analytical results for this study underwent a detailed verification. In brief, verification involves comparing the data for a sample in the database to information on the original hard copy FSDS form and on the original hard copy analytical bench sheets for that sample. Any omissions or apparent errors identified during the verification were submitted to the field teams and/or analytical laboratories for

resolution in the database and in the hard copy documentation. **Appendix G** presents the detailed findings of the data verification effort for this ambient air study. These findings are summarized below.

FSDS Review. Hard copy FSDS forms were not used during the collection of a subset of samples in this study (i.e., samples collected in 2010). Instead, field documentation was recorded in a field logbook and entered into a hand-held mobile surveyor device at the time of sample collection. Hard copy field logbooks were reviewed for a total of five ambient air samples and hard copy FSDS forms were reviewed for a total of 73 ambient air samples as part of the data verification effort in accordance with Libby-specific SOP EPA-LIBBY-11, *FSDS Data Review and Data Entry Verification*. No critical[8] discrepancies were identified in the verification process.

In brief, the issues identified were important for the purposes of sample tracking (e.g., location description, sample date, logbook number), but would not have influenced the quantitative analytical results reported for the sample.

TEM Review. A total of 78 TEM analyses for ambient air were reviewed as part of the data verification effort in accordance with Libby-specific SOP EPA-LIBBY-09, *TEM Data Review and Data Entry Verification*. The critical error rate based on a review of the TEM benchsheets was about 14%.

In brief, most of the issues identified were non-critical in nature form a data interpretation perspective. The majority of the issues were related to data entry errors in the analysis date, preparation date, grid opening name, etc. fields in the EDD. Critical errors were noted in 11 ambient air analyses. For these 11 analyses, the laboratory entered the incorrect sample volume or grid opening name in the EDD, which influenced the achieved analytical sensitivity. Because the critical error rate was high, the data fields (e.g., sample volume, number of grid openings examined) that influence the achieved analytical sensitivity were reviewed for all ambient air analyses within this dataset, including analyses not selected for verification. An additional nine critical errors were identified.

All issues identified during the data verification effort were submitted to the field teams and/or analytical laboratories for resolution and rectification. All tables, figures, and appendices (including all hard copy documentation and the database [provided in **Appendix A, B,** and **Appendix C**, respectively]) generated for this report reflect corrected data.

### 6.3.2 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.

[8] A critical discrepancy is defined as an issue that could influence the reported sample concentration or sample location information

Data validation is performed by the EPA Quality Assurance Technical Support (QATS) contractor, CB&I Federal Services, LLC (CB&I), with support from technical support staff that are familiar with study-specific data reporting, analytical methods, and study requirements. For the Libby project, data validation of TEM results is performed in accordance with a Libby-specific validation SOP that was developed based on the draft *National Functional Guidelines (NFG) for Asbestos Data Review* (EPA 2011b).

The EPA QATS contractor prepares an annual summary of the program-wide assessment of quality assurance/quality control (QA/QC). This annual addendum provides detailed information on the validation procedures performed and provides a narrative on the quality assessment for each type of analysis (e.g., TEM), including the data qualifiers assigned and the reason(s) for these qualifiers to denote when results do not meet acceptance criteria. This annual summary details any deficiencies, required corrective actions, and makes recommendations for changes to the QA/QC program to address any data quality issues. The most recent version of the program-wide QA/QC summary report contains validation conclusions for samples collected and analyzed in 2010-2012 (CB&I 2013). In brief, very few analytical results were qualified. Qualifiers were applied to seven field sample analyses and one laboratory QC sample analysis of the 2,227 asbestos analyses validated (0.36%); the remainder (99.6%) of the Libby asbestos results analyzed between 2010 and 2012 required no qualification. No ambient air analyses required qualification. Based on this, data utilized in this report are not thought to be negatively impacted by the findings of the validation.

## 6.4 Field Quality Control

Field-based QC samples are those samples which are prepared in the field and submitted to the laboratory in a blind fashion. That is, the laboratory is not aware the sample is a QC sample, with the exception of field and lot blanks, and treats the sample in the same way as a field sample. Four types of field QC samples were collected as part of ambient air sampling for this study – lot blanks, field blanks, co-located samples, and preparation drying blanks.

### 6.4.1 Lot Blanks

A lot blank is a randomly selected filter cassette from a manufactured lot. Lot blanks are collected to ensure air samples for asbestos analysis are collected on asbestos-free filters. Lot blank sampling is performed at a frequency of one lot blank per every 500 cassettes. Only cassette lots where no asbestos is detected in the lot blank are placed into circulation for use in air sample collection, which ensures that the air cassette filters used in this study were free of asbestos fibers prior to sampling activities.

### 6.4.2 Field Blanks

Field blanks are collected to evaluate potential contamination introduced during sample collection, shipping and handling, or analysis. As specified in the Section 3, field blanks are collected at the frequency of one per event at one random sampling location, collected on the final day of the event. A total of 60 field blank samples were collected during the 2010-2013 ambient air sampling events (**Appendix E**). No asbestos structures were reported in any of the analyzed field blanks. These results demonstrate that asbestos was not introduced into the air samples as a consequence of sample collection, shipping and handling, or analysis.

### 6.4.3 Co-Located Samples

The results of 57 co-located sample pairs are presented in **Table 6-3**. Each pair was compared using the Poisson ratio test (Nelson 1982) to determine if the results were statistically different from each other at the 95% confidence level. As indicated, there were 42 of 57 pairs in which both samples were non-detect (i.e., no LA structures were detected for either sample). By definition, these results are not different from each other. For 15 of the 57 sample pairs, one or more LA structures were detected in one or both of the samples. In all cases, there was no statistically significant difference between the measured concentrations. These results indicate that sampling variability is low and that measured concentrations for a station are reproducible. Detailed results for co-located samples are presented in **Appendix E.**

### 6.4.4 Preparation Drying Blanks

Preparation drying blanks were collected to evaluate potential contamination introduced during the filter drying process conducted at the laboratory. Due to meteorological conditions that are sometimes prevalent in Libby (e.g., fog, inversions, rain, snow, and other potential precipitation), the collected air filters may arrive at the laboratory in a damp condition. For these samples to be properly prepared for TEM analysis and to prevent subsequent biological growth that may interfere with the analysis, the samples were dried at the laboratory, as necessary, in distinct batches with each "drying batch" consisting of: investigative samples, the accompanying field blank(s), and an unopened cassette provided by field personnel. The unopened cassette served as the "drying blank."

A total of 60 preparation dry blank samples were analyzed with the 2010-2013 ambient air samples (**Appendix E**). No asbestos structures were reported in any of the preparation dry blank samples. These results demonstrate that asbestos was not introduced into the air samples as a consequence of the filter drying process.

## 6.5 Laboratory Quality Control

Preparation and analytical laboratory QC analyses are evaluated by the EPA QATS contractor on a program-wide basis rather than a study-specific basis. The rationale for this is that the number of laboratory QC samples directly related to this study is too limited to draw meaningful conclusions regarding overall data quality. The program-wide QA/QC summary report covering samples collected and analyzed in 2010-2012 (CB&I 2013) contains conclusions for each analytical method and type of QC analysis. See below for a brief overview of the findings of this report for TEM analyses performed in 2010 through 2012.

- No LA structures were detected in laboratory blank analyses.
- Recount same and recount different analyses ranked as good to acceptable based on program-wide criteria.
- Repreparation analyses were all within 90% Poisson confidence interval.
- There is generally good concordance for intra-laboratory analyses. However, for inter-laboratory comparison, there are differences in methods or procedures between analytical laboratories and corrective action may be useful in achieving better agreement and reducing discrepancies due to analytical procedure differences.

## 6.6 Data Adequacy

A comparison of the data collected with the DQOs specified in the governing SAP and technical memorandums (EPA 2006b, CDM Smith 2010a, CDM Smith 2011, CDM Smith 2012a, and CDM Smith 2013) is presented below.

### 6.6.1 Spatial and Temporal Representativeness

*Spatial*
As specified in the *2010 OU4 Outdoor Ambient Air Sampling Technical Memorandum* (CDM Smith 2010a), sampling locations were selected to be spatially representative of major transportation corridors within OU4. OU4 includes most residential and commercial properties in the Libby community. Since the sampling stations evaluated from 2010 to 2013 were all located in the vicinity of U.S. Highway 2 and Montana State Highway 37, the collected data meet the spatial objectives specified in the in the governing SAP and technical memos.

*Temporal*
Ambient air monitoring of the transportation corridors was conducted for three and a half years, and encompassed all seasons. Thus, it is concluded that, the collected data meet the temporal objectives specified in the in the governing SAP and technical memos.

### 6.6.2 Sample Completeness

The completeness of the dataset is described as a ratio of the amount of data expected from the field program versus the amount of valid data received from the laboratory. For the purposes of this study, valid data are considered to be those that have not been rejected during the validation process and have been verified in accordance with the Libby-specific data verification SOPs. Completeness can be expressed by the following equation:

$$\text{Completeness} = \frac{\text{(total number of valid results)}}{\text{(total number of requested results)}} \times 100$$

Based on the data verification (Section 6.3.1) and data validation (Section 6.3.2) findings discussed above, the completeness of each sample set collected as part of this ambient air program is shown in **Table 6-4**. As shown, with the exception of Year 6, the actual number of samples collected and analyses performed were 88% percent complete or greater for each protocol year. In Year 6, responsibility for the implementation of the ambient air monitoring program was transferred from the EPA to the Lincoln County in September 2013. Because this report only includes results for samples collected by the EPA, the completeness is only 38% for Year 6. Thus, while sample completeness is low, this was determined to not be a data limitation.

### 6.6.3 Confirmation of TEM Analysis Stopping Rules

Specific requirements for the TEM analysis of ambient air samples were detailed in the SAP (CDM Smith 2010a) and are summarized in analytical requirements summary sheet #OU4AA-0310 (Revision 2). The analysis stopping rules were summarized in Section 4.3 of this report. In brief, analysis continued until either the target analytical sensitivity (0.00004 $cc^{-1}$) was achieved, 25 or 100 total LA structures were observed (the structure stopping rule has changed throughout the course of the study).

Of the 380 ambient air samples analyzed, 379 samples (99.7%) achieved the target analytical sensitivity (or lower) and none of the samples reached a structures counted stopping rule (**Table 6-5**). For the remaining air sample (AA-02607), no stopping rule was achieved. For this sample, the laboratory was only one grid opening short of achieving the target analytical sensitivity. Because the achieved sensitivity was within rounding error of the target, there is likely to be little impact on the reported air concentration for this sample.

### 6.6.4 Air Filter Loading

The TEM analysis of air filters examines only a portion of the total filter. For the purposes of computing air concentration for the sample, it is assumed that the filter is evenly loaded. The assessment of filter loading evenness is evaluated using a Chi-square (CHISQ) test, as described in ISO 10312 Annex F2. If a filter fails the CHISQ test for evenness, the reported result may not be representative of the true concentration in the sample, and the results should be given low

confidence. An evaluation of filter loading for the air samples from this study shows that 378 of 380 filters (99.5%) passed the CHISQ test (i.e., p value ≥ 0.001). Two samples, AA-02102 and AA-02875 did not pass the CHISQ test. Thus, it is concluded that uneven filter loading is not of concern for the air samples analyzed in this study.

### 6.6.5 Indirect Preparation of Ambient Air Filters

During TEM analysis, the analytical laboratories noted that the HV filter for 43 ambient air samples was overloaded with particulates (i.e., particulate loading was greater than 25%). For 32 of these ambient air samples, the corresponding LV filter was able to be prepared directly. Because the LV filter represents the same sampling duration but a lower total air sample volume, the only consequence of preparing the LV filter instead of the HV filter is that more grid openings needed to be examined to achieve the analytic requirements.

For the remaining 11 ambient air samples, the corresponding LV filter was also determined to be overloaded, thus the sample filter was prepared using an indirect preparation method after ashing in accordance with Libby-specific SOP EPA-LIBBY-08, *Indirect Preparation of Air and Dust Samples for TEM Analysis*. For chrysotile asbestos, indirect preparation often tends to increase structure counts due to dispersion of bundles and clusters (Hwang and Wang 1983; HEI-AR 1991; Breysse 1991). For amphibole asbestos, the effects of indirect preparation are generally much smaller (Bishop *et al.* 1978; Sahle and Laszlo, 1996; Harris 2009). Libby-specific studies to evaluate the potential effect of indirect preparation on reported LA air concentrations show that indirect preparation may increase PCME LA air concentrations by a factor of about 2-3 relative to direct preparation (Berry *et al.* 2013).

For the 11 samples that were prepared indirectly, all samples were reported as non-detect. Based on these considerations, it is concluded that preparation of samples using an indirect preparation method is a relatively minor source of uncertainty for ambient air samples collected from 2010 to 2013.

## 6.7 Data Quality Conclusions

Taken together, these results indicate that data collected as part of the 2010-2013 residential ambient air study are of acceptable quality and are considered to be reliable and appropriate for their intended use.

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_____. 2012f. *Summary on-site audit report for Reservoirs Environmental, Inc. in Denver, CO.* Prepared by Shaw E & I, EPA QATS contractor. Document ID No. 1019-10182012-1; October 18.

_____. 2012g. *Summary On-site Audit Report for the ESAT Sample Preparation Facility (SPF) in Troy, MT.* Prepared by Shaw E & I, EPA QATS contractor. Document ID No. 1019-09122012-1; September 12.

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# Summary of Outdoor Ambient Air Monitoring for Asbestos at the Libby Asbestos Superfund Site

## TABLES

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## TABLE 3-1. TRANSLATION OF ORIGINAL STATION NAMES TO REVISED STATION NAMES

| Original Station Names | | | | | Revised Station Name |
|---|---|---|---|---|---|
| Years 1 and 2 | Year 3 | Year 4 | Year 5 | Year 6 | |
| SAP - 2006 | Tech Memo - 10/1/2010 | Tech Memo - 6/20/2011 | Tech Memo - 4/24/2012 | Tech Memo- 4/9/2013 | |
| L1 | -- | -- | -- | -- | L1 |
| L2 | -- | -- | -- | -- | L2 |
| L3 | -- | -- | -- | -- | L3 |
| L4 | -- | -- | -- | -- | L4 |
| L5 | -- | -- | -- | -- | L5 |
| L5 | -- | -- | -- | -- | L5 |
| L6 | -- | -- | -- | -- | L6 |
| L7 | -- | -- | -- | -- | L7 |
| L8 | L5 | L5 | L5 | -- | L8 |
| L9 | -- | -- | -- | -- | L9 |
| L10 | -- | -- | -- | -- | L10 |
| L11 | -- | -- | -- | -- | L11 |
| L12 | -- | -- | L8 | L8 | L12 |
| L13 | -- | -- | -- | -- | L13 |
| L14 | -- | -- | -- | -- | L14 |
| L15 | -- | -- | -- | -- | L15 |
| L16 | -- | -- | -- | -- | L16 |
| L17 | -- | -- | -- | -- | L17 |
| L18 | -- | -- | -- | -- | L18 |
| -- | L1 | -- | -- | -- | L20 |
| -- | L2 | L2 | L2 | L2 | L21 |
| -- | L3 | L3 | L3 | -- | L22 |
| -- | L4 | L4 | L4 | -- | L23 |
| -- | L6 | -- | -- | -- | L24 |
| -- | -- | L7 | L7 | -- | L25 |
| -- | -- | -- | -- | L4A | L26 |

Notes:

-- = station was not sampled.

SAP = sampling and analysis plan

**TABLE 5-1. COMPARISON OF AREAS BY WILCOXON RANK-SUM TEST (P-VALUES)**

| Area | OU4 (North) | OU4 (East) | OU4 (Central) |
|---|---|---|---|
| **OU4 (East)** | 0.908 | | |
| **OU4 (Central)** | 0.112 | 0.069 | |
| **OU4 (South)** | 0.069 | 0.061 | 0.89 |

Notes:

Comparisons were made on monthly total Libby amphibole area averages from ambient air data collected 2010 to 2013.

**TABLE 6-1. DATA QUALITY IMPACT ASSESSMENT FOR FIELD MODIFICATIONS**

| ROM Number/ Effective Date | Applicable Project SAP or QAPP | Description | Impact on Data Quality |
|---|---|---|---|
| **LFO-000150**/ June 7, 2010 | Final Technical Memorandum for 2010 Outdoor Ambient Air Sampling at OU4 (3/15/10); Final Revision 1, Sampling and Analysis Plan for Outdoor Ambient Air Monitoring at OU4 (AA SAP) (12/7/06) | In Section 4.6.2. the AA SAP calls for the collection of field blanks at a frequency of one per day of ambient air sampling. with one field blank analyzed per week. The 2010 program. will employ a field blank collection frequency of one per event at one random sampling location, to be collected on the final day of the event.<br><br>The 2010 program will follow a revised schedule, slightly modified from the original 5-day on, 10-day off schedule identified in the 2010 Technical Memorandum to better represent days when response action truck hauling along transportation corridors is in progress. | No negative implications associated with these modifications are expected. |
| **LFO-000153**/ July 23, 2010 | Final Technical Memorandum for 2010 Outdoor Ambient Air Sampling at OU4 (3/15/10) (aka 2010 AA tech memo); Final Revision 1, Sampling and Analysis Plan for Outdoor Ambient Air Monitoring at OU4 (AA SAP) (12/7/06) | 1) The Site-specific SOP for the Collection of Outdoor Ambient Air Samples (CDM-LIBBY-12, Revision 1), Section 5.3.2 – Sampling Protocol procedure #6 is modified as follows: "At the end of the sampling period, orient the sample cassette up, do not remove the sampling cassette from the sampling train. Turn the pump off." Based on the sample collection setup implemented in 2010 where the sampling cassette is placed up to 15 feet away from the pump, it is physically impossible to orient the cassette<br>upwards while simultaneously turning off the pump. Additionally, no other air sample collection procedures implemented at the Libby site, including those governing other ambient/perimeter air sampling activities, require sampling cassettes to be oriented upwards upon collection. This procedure was unique to the 2006 AA SAP.<br><br>2) Field sampling staff should refer to SOP CDM-LIBBY-03, Revision 5, Project-specific Guidance for the Completion of Field Sample Data Sheets (FSDSs), to assist in completing air sample documentation.<br><br>3) CDM Denver IMS/GIS support staff will compile Libby weather data for each sampling event. The weather station to be used is NOAA station LBBM8, located at 1263 MT Highway 37 (Libby fire cache). The data will be provided promptly (within a few days) following each event via email (Excel file) to the Libby investigation lead, who will post the files to e-room. The coordinates for this location are: Longitude -115.539080941, Latitude 48.403632031<br><br>4) The Data Collection section of the 2010 AA tech memo referred to an Attachment 1, which was intended to be a copy of the current version of the Libby project Stationary Air FSDS. This attachment was not distributed with the tech memo; therefore, is provided in this modification.<br><br>5) Due to complications in purchasing air sampling cassettes through CDM's EPA Libby work assignment, cassettes were not provided nor able to be purchased prior to the start of the first AA sampling event on May 12, 2010. As a result, cassettes from the general CDM cassette supply were used to collect Event 1 samples. Prior to use of the cassettes for sampling, results for the lot blank associated with the batch of cassettes used to collect Event 1 AA samples (sample 2R-09901, collected May 10, 2010) were verifiedto be non-detect tor asbestos by CUM health and satety start responsible tor controlling the general supply of project sampling cassettes. Further, once the AA cassettes were received upon purchase, the cassettes were added to the general project supply rather than segregating them for AA use. Cassettes to be used for collecting AA samples will continue to be available from the general project supply and all lot blanks associated with Libby AA samples will continue to be collected/evaluated by COM health and safety staff prior to use per standard project lot blank collection/acceptance protocol. Lot blank documentation will be provided to EPA and its contractors via COM e-room as applicable. | No negative implications associated with these modifications are expected. |

**TABLE 6-1. DATA QUALITY IMPACT ASSESSMENT FOR FIELD MODIFICATIONS**

| ROM Number/ Effective Date | Applicable Project SAP or QAPP | Description | Impact on Data Quality |
|---|---|---|---|
| **LFO-000159**/ September 24, 2010 | Revision 1 Technical Memorandum for 2010 Outdoor Ambient Air Sampling at OU4 (10/1/10) (aka Revised AA Tech Memo) | Consistent with other text within the Revised AA Tech Memo, the last sentence of the second paragraph of the Quality Assurance/Quality Control section (page 6) is modified to read: Samples will be checked once twice daily to ensure that eguipment is operating properly and that no obvious overloading of cassette filters is occurring. | No negative implications associated with this modification are expected. |
| **LFO-000176**/ February 20, 2013 | Technical Mamorandum, OU4 Outdoor Ambient Air Sampling Program for May 2012 - March 2013 (4/24/12): Final Revision 1. Sampling and Analysis Plan for Outdoor Ambient Air Monitoring at OU4 (AA SAP) (12/7/06) | 1. Station L8 (933 Fanm to Market Rd) was initiated 8/6/12 to capture data from a southem location within OU4. | 1. Adding a southern station will provide a more spatially representative dataset. Implications may be positive. |
| | | 2. Station L4 (1575 MT Highway 37) was discontinued at the property owners request starting with the 11/12/12 event. | 2. Resulting dataset is less spatially representative. Implications may be negative but minimal given the overall substantive dataset for this location. |
| | | 3. Due to the ramp-down of the removal schedule, the mobile unit (Station M1) was discontinued starting with the 10/8/12 event rather than the 11/12/12 event. | 3. No negative impacts are expected. |
| | | 4. MET station data from LBBM8 was not available for download for the following event 12/10/12 -12/15/12. | 4. No negative implication is expected. |
| **LFO-000177**/ July 10, 2013 | Final Sampling and Analysis Plan for Outdoor Ambient Air Monitoring at OU4, Revision 1, dated 12/7/06, and associated Technical Memoranda dated 3/15/10, 10/1/10, 6/20/11, 4/24/12, and 4/9/13. | General informational updates to the Analytical Requirements Summary Sheet and specific updates as follows:<br>1. LB-000028 was superseded by LB-000029 on 5/4/12.<br>2. LB-000031 has been omitted from the laboratory modifications list since TEM-AHERA is not being used.<br>3. LB-000053 (investigative/non-investigative ashing requirement) was retired in February 2012. Indirect preparation with ashing should be performed for ambient air samples if filter is overloaded with particulates (>25%) or appears unevenly loaded.<br>4. Specific versions of laboratory modifications are no longer cited, rather, the most recent version of the laboratory modifications should be followed. | No negative implications have been identified. A positive implication is that laboratories will have up-to-date guidance. |

Notes:
AA = ambient air
ROM = Record of Modification
SAP = sampling and analyis plan
SOP = standard operating procedure
QAPP = quality assurance project plan
OU4 = Operable Unit 4
TEM-AHERA = transmission electron microscopy Asbestos Hazard Emergency Response Act

**TABLE 6-2. LIST OF ACTIVE LABORATORY MODIFICATIONS**

| Lab Modification Form | Method | Brief Description | Laboratory Applicability | Permanent or Temporary | Effective Date |
|---|---|---|---|---|---|
| LB-000016H | TEM-ISO | Clarifications and modifications to analyses by TEM-ISO | All | Permanent | 05-Dec-11 |
| LB-000029D | All TEM Methods | Project-wide TEM QC requirements. | All | Permanent | 20-Feb-13 |
| LB-000055B | TEM-ISO | Drying procedure for ambient air samples. Rain, snow, or fog can cause these to be damp. | EMSL-Libby | Permanent | 05-Nov-12 |
| LB-000066c | All TEM Methods | Recording structure EDS spectra, photos, and NaK data for investigative samples. | All | Temporary | 12-Sep-07 |
| LB-000066d | All TEM Methods | Recording structure EDS spectra, photos, and NaK data for investigative samples. LB-000066c still applies to projects that require morphology photos. | All | Permanent | 20-Jul-10 |
| LB-000067C | All TEM Methods | --Use ND for "Not Detected" not NSD on structure count sheets<br>--Sketch all structures, to a maximum of 50 per sample.<br>--Structure ID codes in ISO method apply to all TEM methods.<br>--Specify sample ID and tag ID to apply to lab blanks. | All | Permanent | 20-Feb-13 |
| LB-000085A | All TEM Methods | Frequency and performance criteria for TEM calibrations. Also covers quarterly air monitoring in laboratory areas. | All | Permanent | 21-May-12 |

Notes:
TEM = transmission electron microscopy
ND = non-detect
ID = identifier
ISO = International Organization for Standardization
NSD = no structures detected
QC = quality control

**TABLE 6-3. FIELD DUPLICATE RESULTS**

| Event Year | Sample Date | Original Sample | | | | | Co-Located Sample | | | | | Poisson Rate Comparison (95% CI) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sample Number | Total LA Structures | Sample Volume (L) | Sensitivity (1/cc) | Total LA Conc (s/cc) | Sample Number | Total LA Structures | Sample Volume (L) | Sensitivity (1/cc) | Total LA Conc (s/cc) | |
| Year 3 | 5/17/2010 | AA-01986 | 0 | 14,415 | 4.0E-05 | 0 | AA-01998 | 0 | 14,047 | 4.0E-05 | 0 | Both counts are 0; the rates are not different |
| | 6/2/2010 | AA-02010 | 0 | 14,400 | 4.0E-05 | 0 | AA-02022 | 0 | 14,400 | 4.0E-05 | 0 | Both counts are 0; the rates are not different |
| | 6/19/2010 | AA-02030 | 0 | 14,186 | 3.9E-05 | 0 | AA-02032 | 0 | 14,186 | 3.9E-05 | 0 | Both counts are 0; the rates are not different |
| | 7/11/2010 | AA-02049 | 0 | 14,265 | 3.8E-05 | 0 | AA-02051 | 0 | 14,265 | 3.8E-05 | 0 | Both counts are 0; the rates are not different |
| | 7/31/2010 | AA-02059 | 0 | 13,620 | 4.0E-05 | 0 | AA-02061 | 0 | 8,062 | 3.4E-05 | 0 | Both counts are 0; the rates are not different |
| | 8/14/2010 | AA-02073 | 0 | 13,991 | 4.0E-05 | 0 | AA-02087 | 0 | 13,991 | 4.0E-05 | 0 | Both counts are 0; the rates are not different |
| | 8/28/2010 | AA-02096 | 1 | 10,820 | 3.9E-05 | 3.9E-05 | AA-02102 | 3 | 10,817 | 3.9E-05 | 1.2E-04 | [0.01-4.15] The rates are not different |
| | 9/11/2010 | AA-02111 | 0 | 13,747 | 4.0E-05 | 0 | AA-02113 | 0 | 13,745 | 4.0E-05 | 0 | Both counts are 0; the rates are not different |
| | 9/25/2010 | AA-02129 | 0 | 13,576 | 4.0E-05 | 0 | AA-02131 | 0 | 12,028 | 4.0E-05 | 0 | Both counts are 0; the rates are not different |
| | 10/9/2010 | AA-02147 | 0 | 13,626 | 4.0E-05 | 0 | AA-02149 | 0 | 13,626 | 4.0E-05 | 0 | Both counts are 0; the rates are not different |
| | 10/23/2010 | AA-02159 | 0 | 13,761 | 3.9E-05 | 0 | AA-02161 | 0 | 13,893 | 3.9E-05 | 0 | Both counts are 0; the rates are not different |
| | 11/6/2010 | AA-02180 | 0 | 13,904 | 3.9E-05 | 0 | AA-02178 | 0 | 13,906 | 3.9E-05 | 0 | Both counts are 0; the rates are not different |
| | 11/20/2010 | AA-02185 | 0 | 14,162 | 3.9E-05 | 0 | AA-02187 | 0 | 14,162 | 3.9E-05 | 0 | Both counts are 0; the rates are not different |
| | 12/20/2010 | AA-02205 | 0 | 14,021 | 4.0E-05 | 0 | AA-02207 | 0 | 14,021 | 4.0E-05 | 0 | Both counts are 0; the rates are not different |
| | 1/17/2011 | AA-02221 | 0 | 14,014 | 4.0E-05 | 0 | AA-02223 | 0 | 14,014 | 4.0E-05 | 0 | Both counts are 0; the rates are not different |
| | 2/20/2011 | AA-02239 | 0 | 14,005 | 4.0E-05 | 0 | AA-02241 | 0 | 14,005 | 4.0E-05 | 0 | Both counts are 0; the rates are not different |
| | 3/20/2011 | AA-02257 | 1 | 14,035 | 3.9E-05 | 3.9E-05 | AA-02259 | 0 | 14,035 | 3.8E-05 | 0 | [0-38.29] The rates are not different |
| | 4/16/2011 | AA-02275 | 0 | 14,045 | 3.8E-05 | 0 | AA-02277 | 0 | 14,045 | 3.9E-05 | 0 | Both counts are 0; the rates are not different |
| Year 4 | 7/16/2011 | AA-02303 | 0 | 15,310 | 3.9E-05 | 0 | AA-02305 | 0 | 15,304 | 3.9E-05 | 0 | Both counts are 0; the rates are not different |
| | 8/13/2011 | AA-02331 | 0 | 15,225 | 3.9E-05 | 0 | AA-02333 | 0 | 15,223 | 3.9E-05 | 0 | Both counts are 0; the rates are not different |
| | 8/27/2011 | AA-02348 | 0 | 15,247 | 3.9E-05 | 0 | AA-02351 | 0 | 15,247 | 3.9E-05 | 0 | Both counts are 0; the rates are not different |
| | 9/17/2011 | AA-02358 | 0 | 14,485 | 3.9E-05 | 0 | AA-02360 | 0 | 14,485 | 3.9E-05 | 0 | Both counts are 0; the rates are not different |
| | 10/1/2011 | AA-02370 | 0 | 14,824 | 4.0E-05 | 0 | AA-02372 | 0 | 14,824 | 4.0E-05 | 0 | Both counts are 0; the rates are not different |
| | 10/15/2011 | AA-02388 | 0 | 15,240 | 3.9E-05 | 0 | AA-02386 | 0 | 15,240 | 3.9E-05 | 0 | Both counts are 0; the rates are not different |
| | 10/29/2011 | AA-02406 | 0 | 14,696 | 3.9E-05 | 0 | AA-02409 | 0 | 14,696 | 3.9E-05 | 0 | Both counts are 0; the rates are not different |
| | 11/12/2011 | AA-02420 | 0 | 14,795 | 3.9E-05 | 0 | AA-02423 | 0 | 14,795 | 3.9E-05 | 0 | Both counts are 0; the rates are not different |
| | 11/19/2011 | AA-02432 | 0 | 14,703 | 3.9E-05 | 0 | AA-02435 | 0 | 14,703 | 3.9E-05 | 0 | Both counts are 0; the rates are not different |
| | 12/17/2011 | AA-02448 | 0 | 15,210 | 3.9E-05 | 0 | AA-02450 | 0 | 15,210 | 3.9E-05 | 0 | Both counts are 0; the rates are not different |
| | 1/21/2012 | AA-02468 | 0 | 15,753 | 3.9E-05 | 0 | AA-02470 | 0 | 15,753 | 3.9E-05 | 0 | Both counts are 0; the rates are not different |
| | 2/18/2012 | AA-02476 | 0 | 15,262 | 3.9E-05 | 0 | AA-02478 | 0 | 15,262 | 3.9E-05 | 0 | Both counts are 0; the rates are not different |
| | 3/17/2012 | AA-02496 | 0 | 14,764 | 3.9E-05 | 0 | AA-02498 | 0 | 14,764 | 3.9E-05 | 0 | Both counts are 0; the rates are not different |
| | 4/14/2012 | AA-02506 | 1 | 14,798 | 3.9E-05 | 3.9E-05 | AA-02509 | 3 | 14,798 | 2.7E-05 | 8.1E-05 | [0.01-6.02] The rates are not different |
| Year 5 | 5/5/2012 | AA-02524 | 0 | 13,977 | 3.9E-05 | 0 | AA-02526 | 0 | 13,977 | 3.9E-05 | 0 | Both counts are 0; the rates are not different |
| | 5/26/2012 | AA-02544 | 0 | 14,745 | 3.7E-05 | 0 | AA-02547 | 0 | 14,745 | 3.7E-05 | 0 | Both counts are 0; the rates are not different |
| | 6/16/2012 | AA-02555 | 0 | 14,738 | 3.9E-05 | 0 | AA-02552 | 0 | 14,738 | 3.9E-05 | 0 | Both counts are 0; the rates are not different |
| | 6/30/2012 | AA-02570 | 1 | 14,811 | 3.9E-05 | 3.9E-05 | AA-02574 | 0 | 10,160 | 3.9E-05 | 0 | [0-38.87] The rates are not different |
| | 7/14/2012 | AA-02592 | 1 | 14,083 | 3.5E-05 | 3.5E-05 | AA-02595 | 0 | 14,083 | 3.4E-05 | 0 | [0-38.02] The rates are not different |
| | 7/28/2012 | AA-02608 | 2 | 15,118 | 4.0E-05 | 8.0E-05 | AA-02611 | 7 | 15,118 | 4.0E-05 | 2.8E-04 | [0.03-1.5] The rates are not different |
| | 8/11/2012 | AA-02628 | 0 | 14,148 | 4.0E-05 | 0 | AA-02626 | 0 | 14,148 | 4.0E-05 | 0 | Both counts are 0; the rates are not different |
| | 8/25/2012 | AA-02640 | 1 | 14,770 | 3.1E-05 | 3.1E-05 | AA-02643 | 1 | 14,770 | 3.4E-05 | 3.4E-05 | [0.01-71.11] The rates are not different |
| | 9/15/2012 | AA-02652 | 1 | 14,891 | 4.0E-05 | 4.0E-05 | AA-02656 | 0 | 10,606 | 3.9E-05 | 0 | [0-38.74] The rates are not different |
| | 9/29/2012 | AA-02676 | 4 | 14,573 | 4.0E-05 | 1.6E-04 | AA-02679 | 0 | 14,573 | 4.0E-05 | 0.0E+00 | [0-1.51] The rates are not different |
| | 10/13/2012 | AA-02696 | 2 | 14,150 | 4.0E-05 | 8.0E-05 | AA-02699 | 1 | 14,150 | 4.0E-05 | 4.0E-05 | [0.1-117.99] The rates are not different |
| | 10/27/2012 | AA-02715 | 0 | 10,596 | 4.0E-05 | 0 | AA-02718 | 0 | 10,596 | 4.0E-05 | 0 | Both counts are 0; the rates are not different |
| | 11/17/2012 | AA-02730 | 0 | 14,982 | 3.6E-05 | 0 | AA-02733 | 0 | 14,982 | 3.4E-05 | 0 | Both counts are 0; the rates are not different |
| | 12/15/2012 | AA-02822 | 1 | 14,893 | 3.4E-05 | 3.4E-05 | AA-02825 | 0 | 14,893 | 3.0E-05 | 0 | [0-35.33] The rates are not different |
| | 1/19/2013 | AA-02843 | 0 | 10,246 | 4.0E-05 | 0 | AA-02845 | 0 | 14,768 | 4.0E-05 | 0 | Both counts are 0; the rates are not different |
| | 2/16/2013 | AA-02852 | 0 | 15,211 | 3.0E-05 | 0 | AA-02855 | 0 | 15,211 | 4.0E-05 | 0 | Both counts are 0; the rates are not different |
| | 3/16/2013 | AA-02871 | 0 | 10,208 | 4.0E-05 | 0 | AA-02874 | 0 | 10,208 | 4.0E-05 | 0 | Both counts are 0; the rates are not different |

**TABLE 6-3. FIELD DUPLICATE RESULTS**

| Event Year | Sample Date | Original Sample | | | | | Co-Located Sample | | | | | Poisson Rate Comparison (95% CI) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sample Number | Total LA Structures | Sample Volume (L) | Sensitivity (1/cc) | Total LA Conc (s/cc) | Sample Number | Total LA Structures | Sample Volume (L) | Sensitivity (1/cc) | Total LA Conc (s/cc) | |
| Year 6 | 4/27/2013 | AA-02744 | 0 | 14,781 | 3.6E-05 | 0 | AA-02747 | 0 | 14,781 | 3.6E-05 | 0 | Both counts are 0; the rates are not different |
| | 5/11/2013 | AA-02752 | 0 | 15,056 | 3.7E-05 | 0 | AA-02755 | 1 | 15,056 | 3.7E-05 | 3.7E-05 | [0-39] The rates are not different |
| | 5/25/2013 | AA-02760 | 0 | 14,967 | 3.6E-05 | 0 | AA-02763 | 0 | 14,967 | 3.6E-05 | 0 | Both counts are 0; the rates are not different |
| | 6/15/2013 | AA-02770 | 1 | 14,439 | 4.0E-05 | 4.0E-05 | AA-02773 | 3 | 14,439 | 4.0E-05 | 1.2E-04 | [0.01-4.15] The rates are not different |
| | 6/29/2013 | AA-02780 | 0 | 14,477 | 4.0E-05 | 0 | AA-02783 | 1 | 14,477 | 4.0E-05 | 4.0E-05 | [0-39] The rates are not different |
| | 7/13/2013 | AA-02884 | 0 | 14,502 | 3.9E-05 | 0 | AA-02887 | 0 | 14,502 | 3.9E-05 | 0 | Both counts are 0; the rates are not different |
| | 7/27/2013 | AA-02795 | 0 | 11,400 | 3.9E-05 | 0 | AA-02797 | 1 | 14,215 | 3.9E-05 | 3.9E-05 | [0-39.13] The rates are not different |
| | 8/24/2013 | AA-02900 | 0 | 14,649 | 3.7E-05 | 0 | AA-02903 | 0 | 14,649 | 3.7E-05 | 0 | Both counts are 0; the rates are not different |

**Notes:**
LA - Libby amphibole
cc = cubic centimeter
L = liter
s/cc = structures per cubic centimeter
% = percent
CI = confidence interval

**TABLE 6-4. SAMPLE COMPLETENESS EVALUATION**

| Protocol Year | Protocol | Station Location Type | Number of Stations | Scheduled Sampling Period | Planned Frequency of Sampling | Number of Samples Collected | Number of Requested Results | Number of Valid Results | Percent Complete |
|---|---|---|---|---|---|---|---|---|---|
| | EPA 2010c/LF-000150 | Stationary | 6 | May 2010-September 2010 | 9 sampling events | 108 | 54 | 53 | 98% |
| | EPA 2010 | Stationary | 6 | October 2010 - April 2011 | 7 sampling events | 84 | 42 | 54 | 129% |
| **3** | **SUBTOTAL YEAR 3** | | | | | | **96** | **107** | **111%** |
| | EPA 2011a | Stationary | 5 | June 2011 - April 2012 | 16 sampling events | 160 | 80 | 80 | 100% |
| | EPA 2011a | Mobile | 1 | June 2011 - April 2012 | 15 sampling events | 30 | 15 | 4 | 27% |
| **4** | **SUBTOTAL YEAR 4** | | | | | | **95** | **84** | **88%** |
| | EPA 2012a | Stationary | 5 | April 2012 - March 2013 | 17 sampling events | 170 | 85 | 95 | 112% |
| | EPA 2012a | Mobile | 1 | April 2012 - March 2013 | 12 sampling events | 24 | 12 | 10 | 83% |
| **5** | **SUBTOTAL YEAR 5** | | | | | | **97** | **105** | **108%** |
| | CDM Smith, 2013b | Stationary | 3 | April 2013 - March 2014 | 18 sampling events | 108 | 54 | 27 | 50% |
| | CDM Smith, 2013b | Mobile | 1 | April 2013 - March 2014 | 18 sampling events | 36 | 18 | 0 | 0% |
| **6** | **SUBTOTAL YEAR 6** | | | | | | **72** | **27** | **38%** |
| **All** | | | | | **All Air Samples** | | **360** | **323** | **89.7%** |

Notes:

Year 3 (May 2010 to April 2011)

Year 4 (July 2011 to April 2012)

Year 5 (May 2012 to March 2013)

Year 6 (April 2013 to September 2013)

EPA 2010c = 2010 OU4 Outdoor Ambient Air Sampling Technical Memorandum

EPA 2010 = SAP Analytical Summary # OU4AA0310 – Revision 1, October 1, 2010

EPA 2011a = Revision 2, OU4 Outdoor Ambient Air Sampling Program for June 2011 – April 2012

EPA 2012a = OU4 Outdoor Ambient Air Sampling Program for May 2012 – March 2013

CDM Smith, 2013b = OU4 Outdoor Ambient Air Sampling Program for Libby Asbestos Superfund Site, April 2013 – March 2014

**TABLE 6-5. TARGET ANALYTICAL SENSITIVITY**

| Year | Type of Sample | TAS ($cc^{-1}$) | Total Number of Valid Results | Number of Results Achieving TAS | Percent of Samples Meeting TAS |
|---|---|---|---|---|---|
| **3** | Stationary | 0.00004 | 125 | 125 | 100% |
| | ***SUBTOTAL YEAR 3*** | ***125*** | ***125*** | ***100%*** |
| **4** | Stationary | 0.00004 | 94 | 94 | 100% |
| | Mobile | 0.00004 | 4 | 4 | 100% |
| | ***SUBTOTAL YEAR 4*** | ***98*** | ***98*** | ***100%*** |
| **5** | Stationary | 0.00004 | 112 | 111 | 99% |
| | Mobile | 0.00004 | 10 | 10 | 100% |
| | ***SUBTOTAL YEAR 5*** | ***122*** | ***121*** | ***99%*** |
| **6** | Stationary | 0.00004 | 35 | 35 | 100% |
| | ***SUBTOTAL YEAR 6*** | ***35*** | ***35*** | ***100%*** |
| **All** | | **All Air Samples** | **380** | **379** | **100%** |

Notes:

$cc^{-1}$ = per cubic centimeters

TAS = Targeted Analytical Sensitivity

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# Summary of Outdoor Ambient Air Monitoring for Asbestos at the Libby Asbestos Superfund Site

## FIGURES

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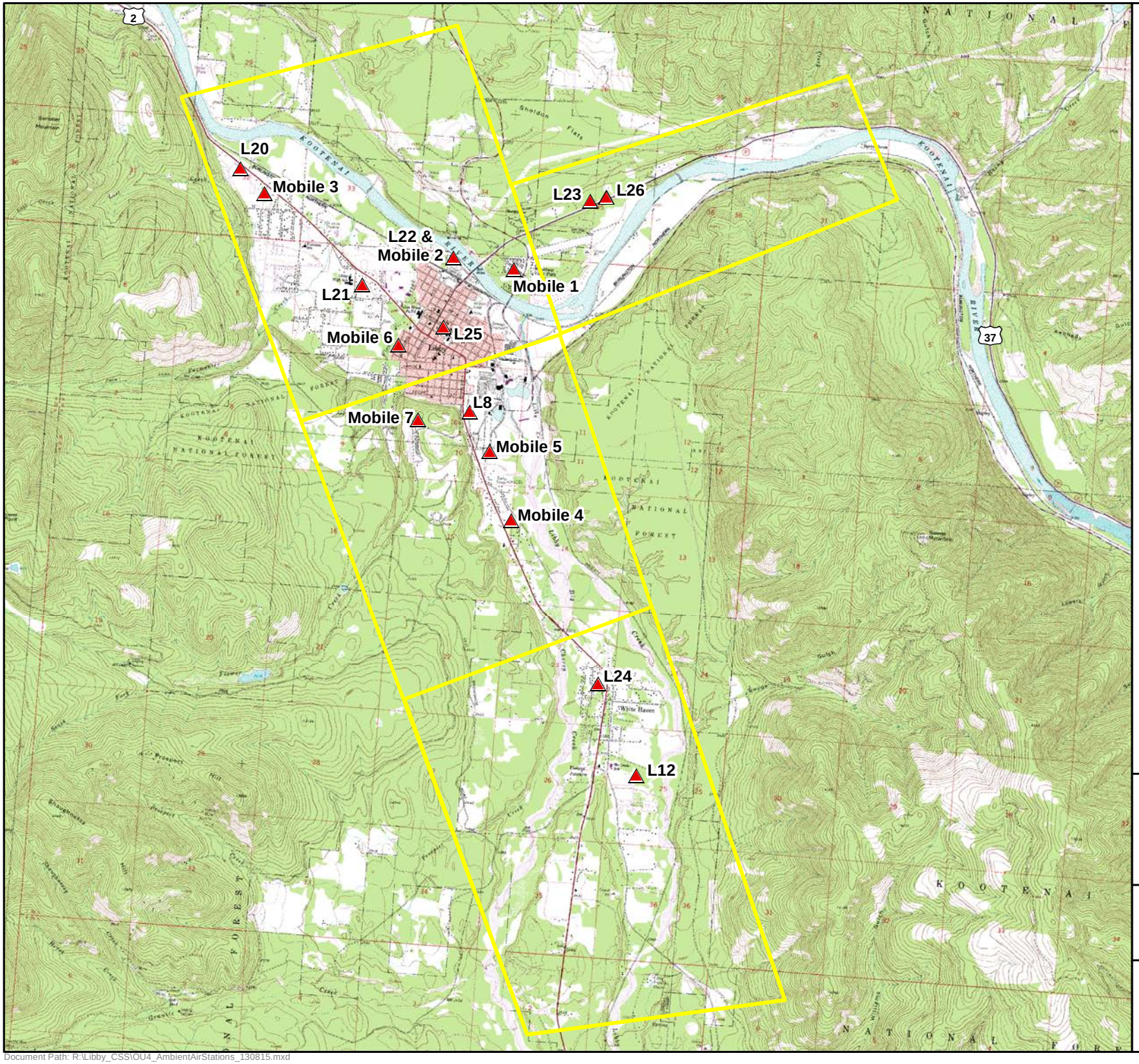



## Legend

- OU4 Sample Stations
- Outdoor Ambient Air Boundary

N
W E
S

Miles

0 0.5 1 2

Libby Asbestos Site

Figure 3-1
Outdoor Ambient
Air Sampling
Stations
Libby, Montana

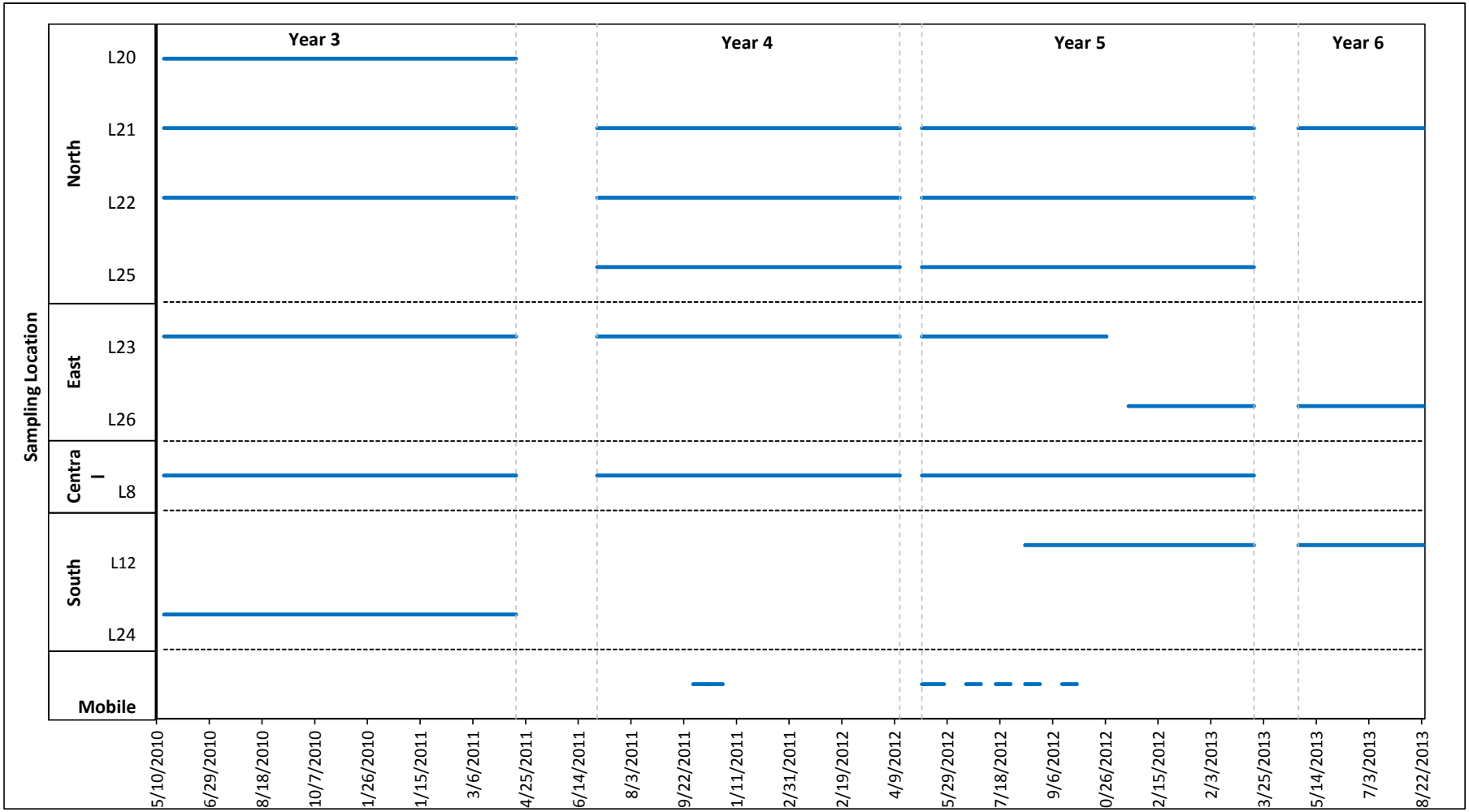
CDM Smith

**Digital Raster Graphic Data Source**
Montana USGS Digital Raster Graphics:
Libre Map Project
http://libremap.org/data/state/montana/drg/

Map Date: September 2013

Document Path: R:\Libby_CSS\OU4_AmbientAirStations_130815.mxd

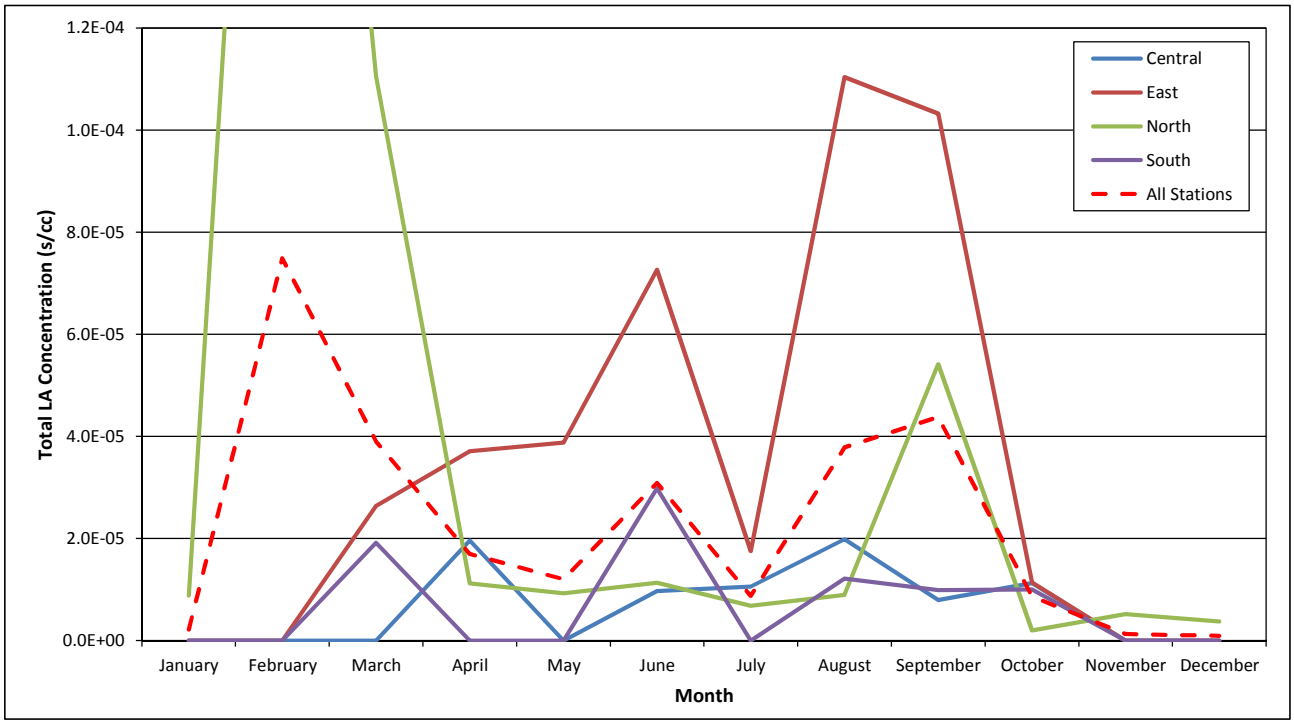
**FIGURE 3-2. AMBIENT AIR SAMPLING SCHEDULE BY STATION**




| Group | Station | Location |
|---|---|---|
| North | L20 | 30414 US Highway 2 |
| | L21 | 32000 US Highway 2 |
| | L22 | 303 W Thomas St |
| | L25 | Lincoln Blvd & Mineral Ave |
| East | L23 | 1675 MT Highway 37 |
| | L26 | 1799 MT Highway 37 |
| Central | L8 | 60 Port Blvd |
| South | L12 | 933 Farm to Market Rd |
| | L24 | 36304 US Highway 2 |

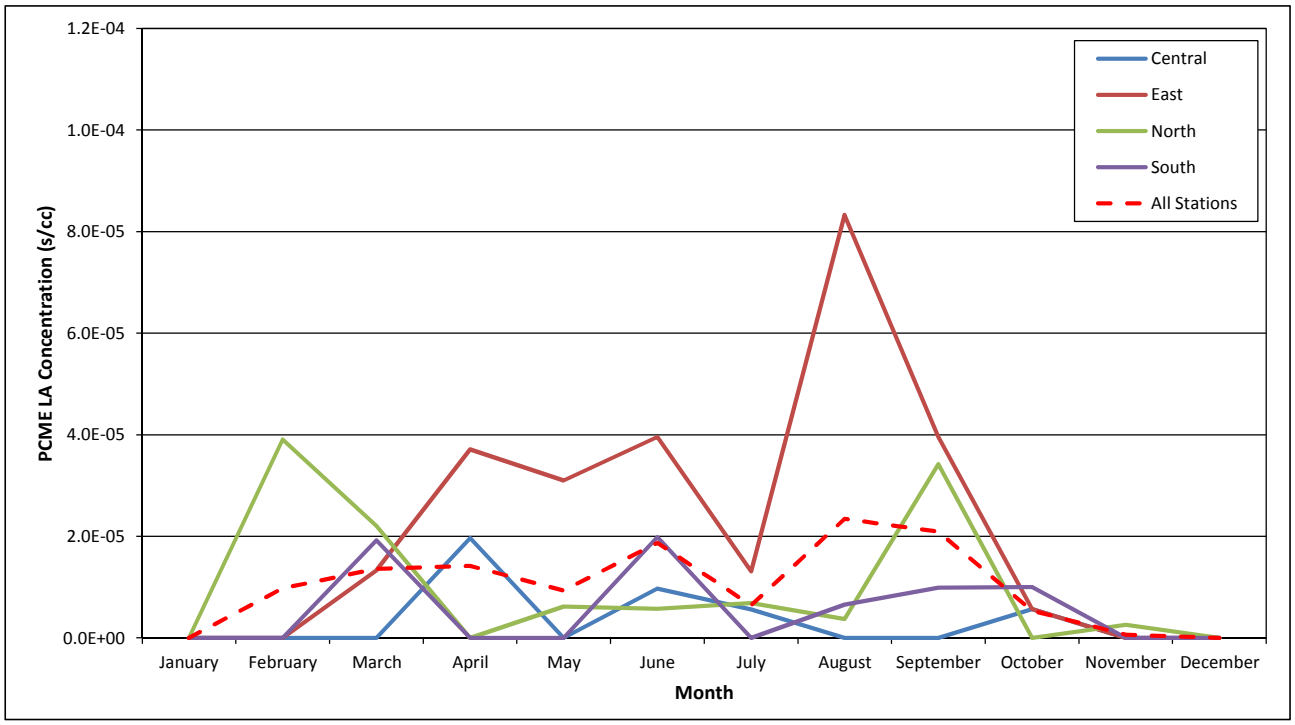
**FIGURE 5-1. AVERAGE MONTHLY LA CONCENTRATION BY GEOGRAPHIC AREA (2010-2013)**

**PANEL A: TOTAL LA**




Notes: For presentation purposes, the February average concentration for the North area is off-scale (3.0E-04 s/cc).
Figure excludes data from mobile stations.

**PANEL B: PCME LA**




Notes:
Figure excludes data from mobile stations.
LA = Libby amphibole
PCME = phase contrast microscopy-equivalent
s/cc = structures per cubic centimeter

WIND ROSE PLOT:

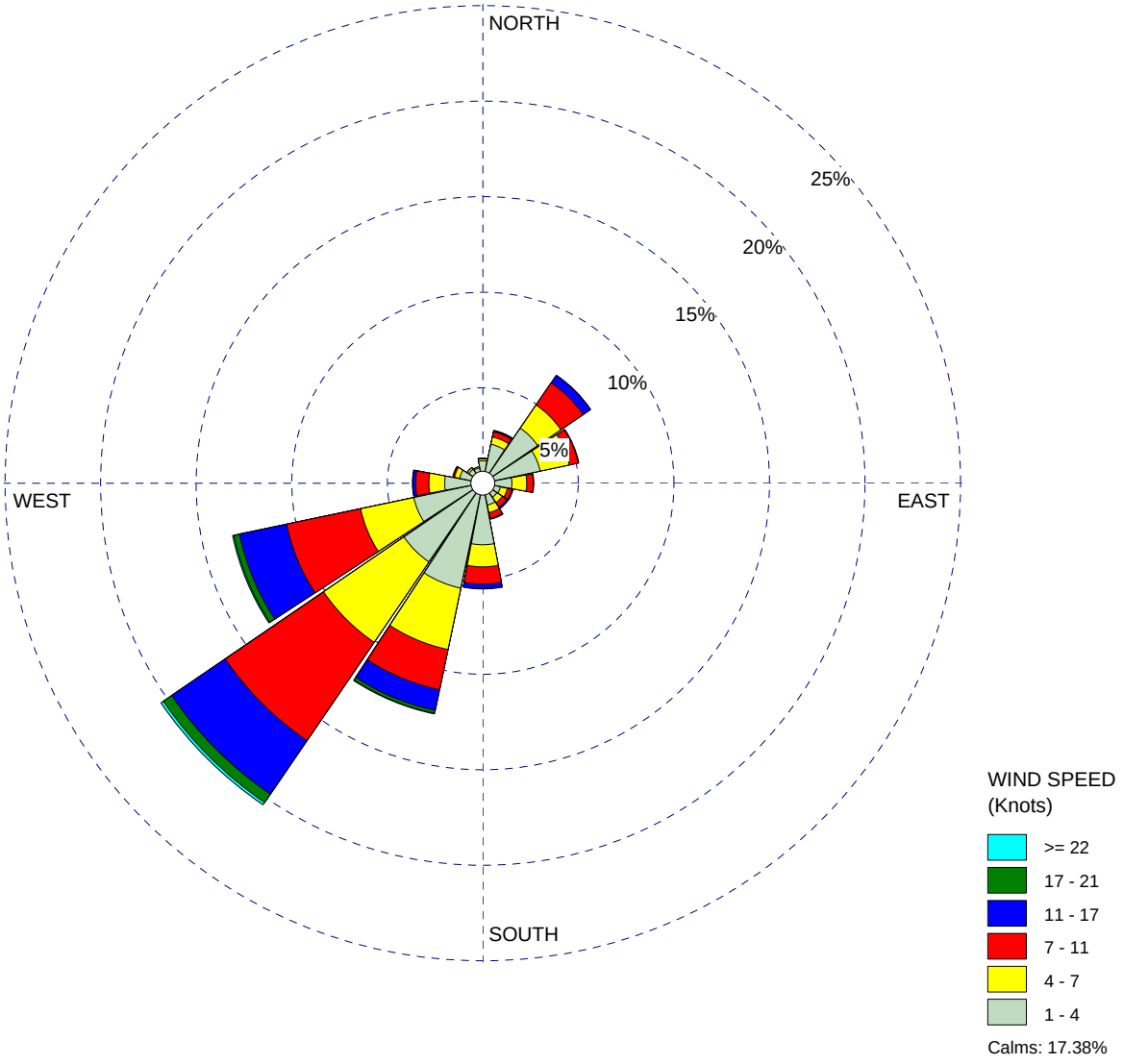
**Figure 5-2**

**WindRose for Zonolite Mountain, Libby, MT**

DISPLAY:

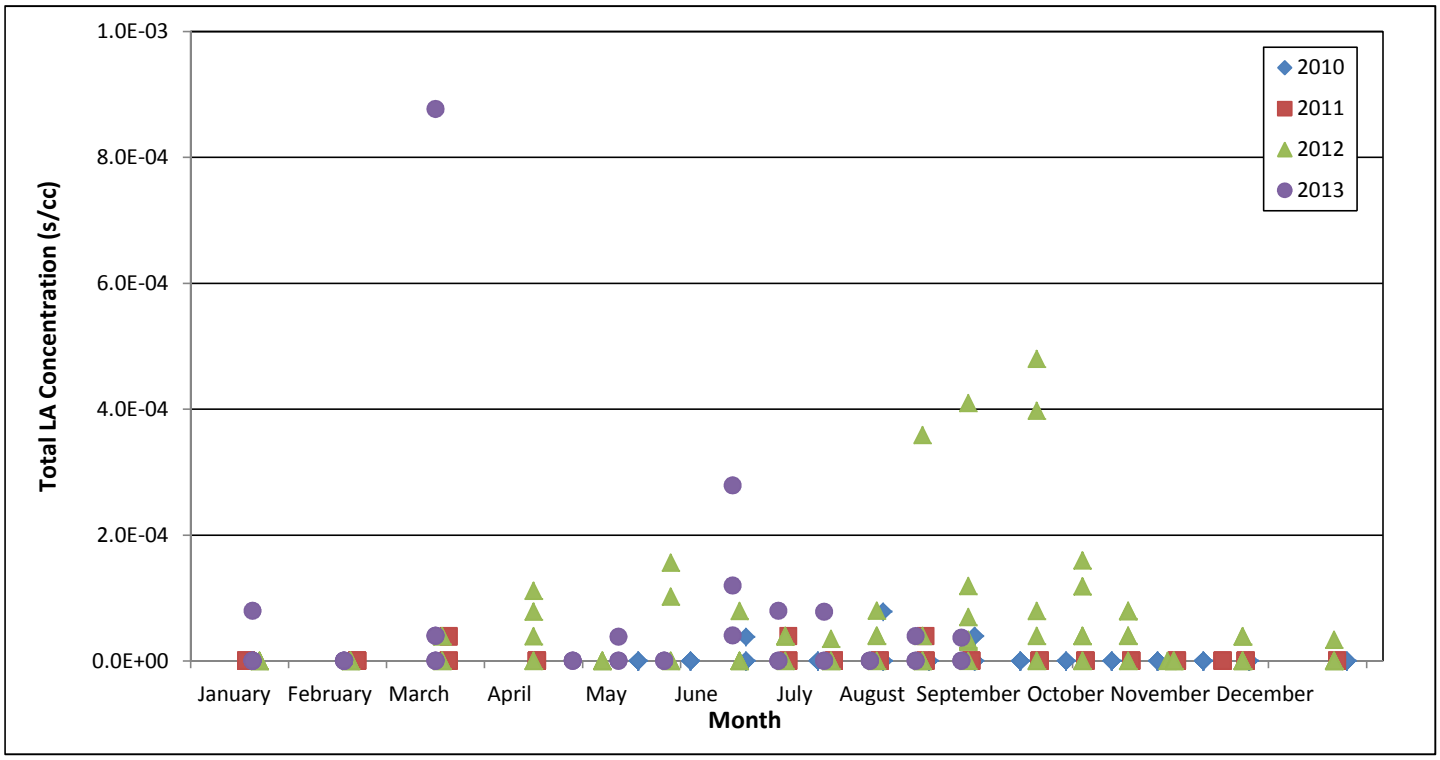
**Wind Speed**

**Direction (blowing from)**




| | | | |
|---|---|---|---|
| COMMENTS: | DATA PERIOD:<br>**Start Date: 1/4/2007 - 00:00**<br>**End Date: 8/20/2013 - 08:00** | COMPANY NAME: | |
| | | MODELER: | |
| | CALM WINDS:<br>**17.38%** | TOTAL COUNT:<br>**54074 hrs.** | |
| | AVG. WIND SPEED:<br>**4.67 Knots** | DATE:<br>**8/20/2013** | PROJECT NO.: |

**FIGURE 5-3. TOTAL LA CONCENTRATION FOR ALL SAMPLES COLLECTED (2010-2013)**



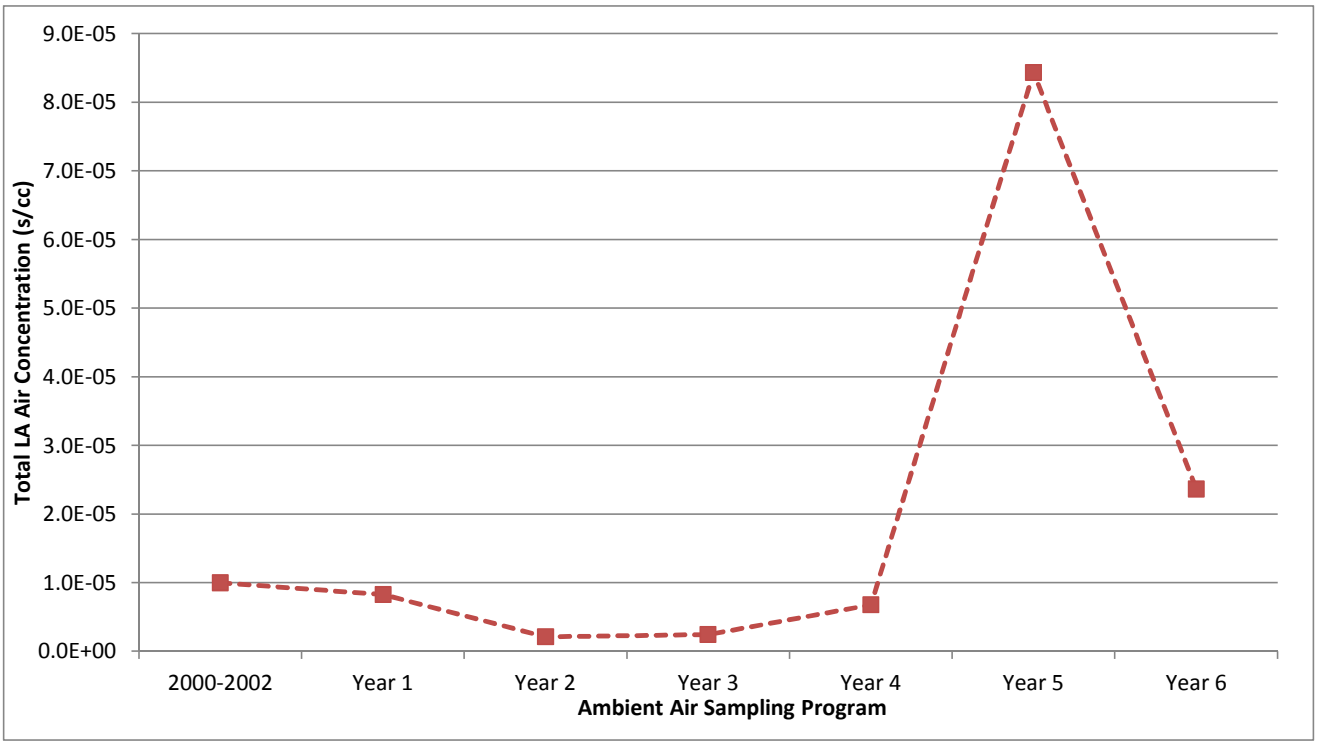

Notes:

Figure excludes data from mobile stations.

LA = Libby amphibole

s/cc = structures per cubic centimeter

**FIGURE 5-4. AVERAGE YEARLY AMBIENT AIR TOTAL LA CONCENTRATION FOR ALL LIBBY STATIONS**




**Notes:**

Figure excludes data from mobile stations.

Year 2 includes September through December only.

Year 4 does not include May or June.

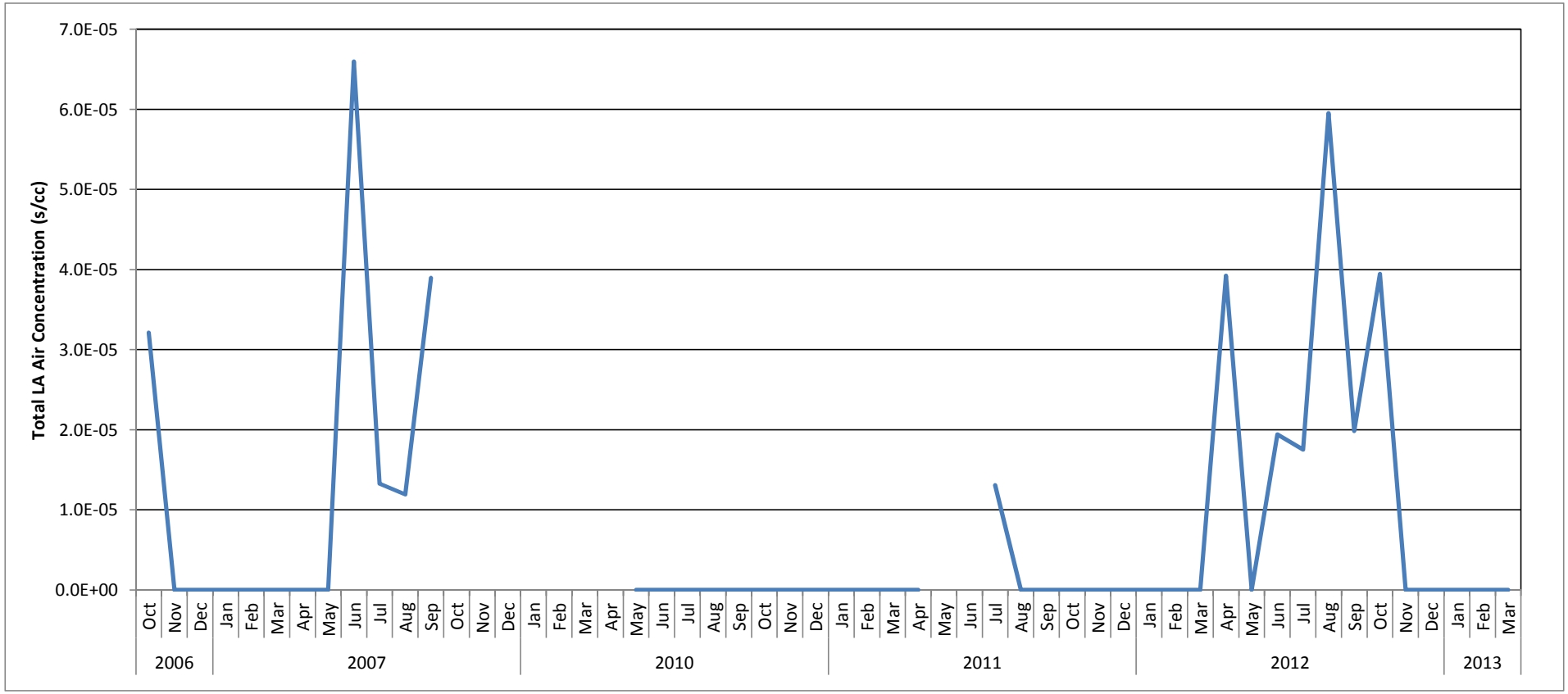
Year 5 does not include April.

Year 6 includes June through August only.

LA = Libby amphibole

s/cc = structures per cubic centimeter

**FIGURE 5-5. AVERAGE MONTHLY LA CONCENTRATION FOR 60 PORT BLVD. (2006-2013)**




Notes:

LA = Libby amphibole

s/cc = structures per cubic centimeter

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# Summary of Outdoor Ambient Air Monitoring for Asbestos at the Libby Asbestos Superfund Site

## Appendix A

## Field Documentation

*[provided electronically]*

# Summary of Outdoor Ambient Air Monitoring for Asbestos at the Libby Asbestos Superfund Site

## Appendix B

## Analytical Laboratory Documentation

*[provided electronically]*

# Summary of Outdoor Ambient Air Monitoring for Asbestos at the Libby Asbestos Superfund Site

## Appendix C

## Project Database (downloaded from Scribe.NET on 2/25/2014)

*[provided electronically]*

*This page intentionally left blank to facilitate double-sided printing.*

# Summary of Outdoor Ambient Air Monitoring for Asbestos at the Libby Asbestos Superfund Site

## Appendix D

## Sampling Station Location Maps (Year 1 to Year 6)

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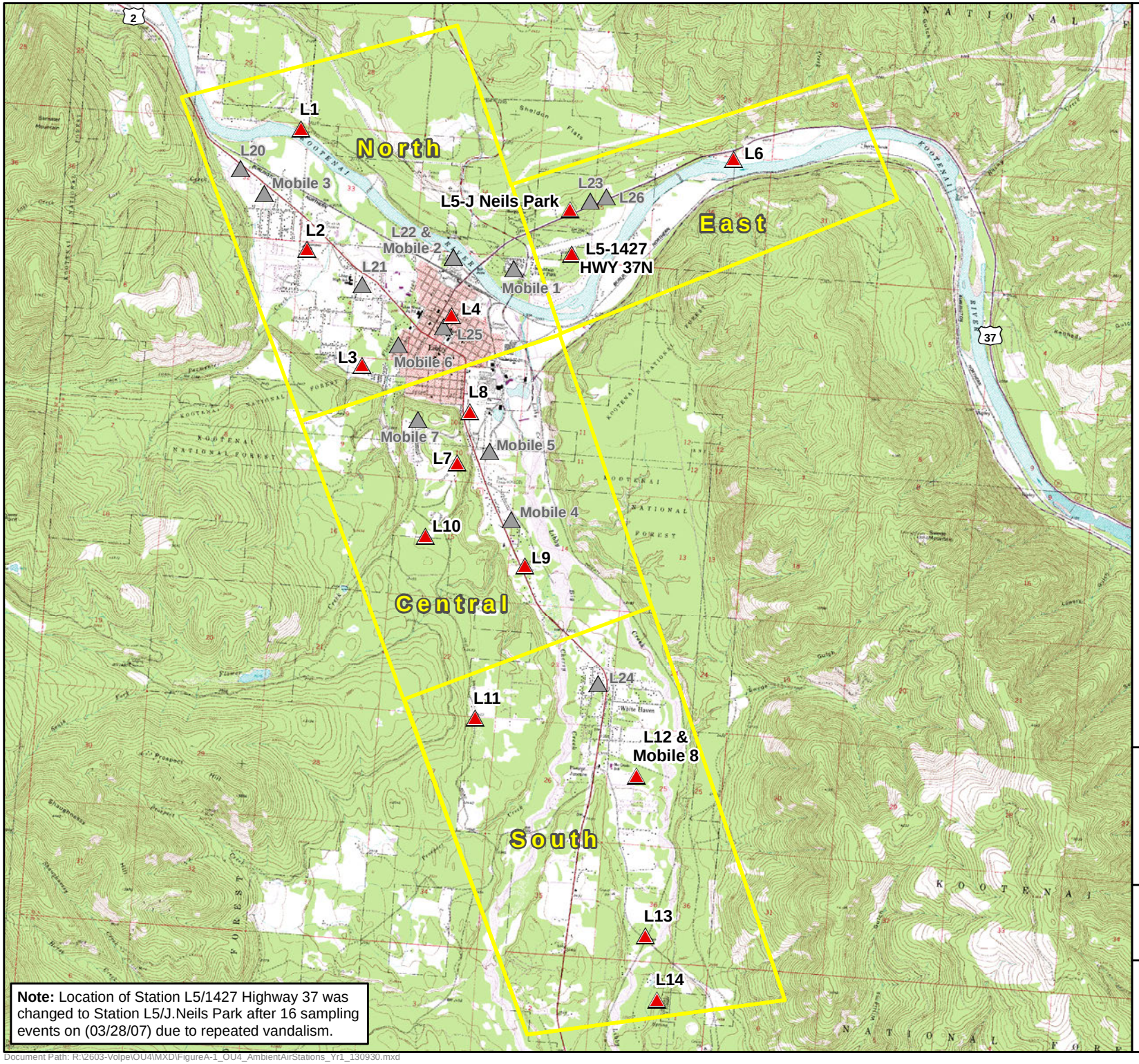



**Legend**

Outdoor Ambient Air Boundary

OU4 Sample Stations

Year 1

Years 2 to 6

N
W E
S

Miles

0 0.5 1 2

Libby Asbestos Site

Figure D-1
Outdoor Ambient Air
Sampling Stations Year 1
October 2006 - September 2007

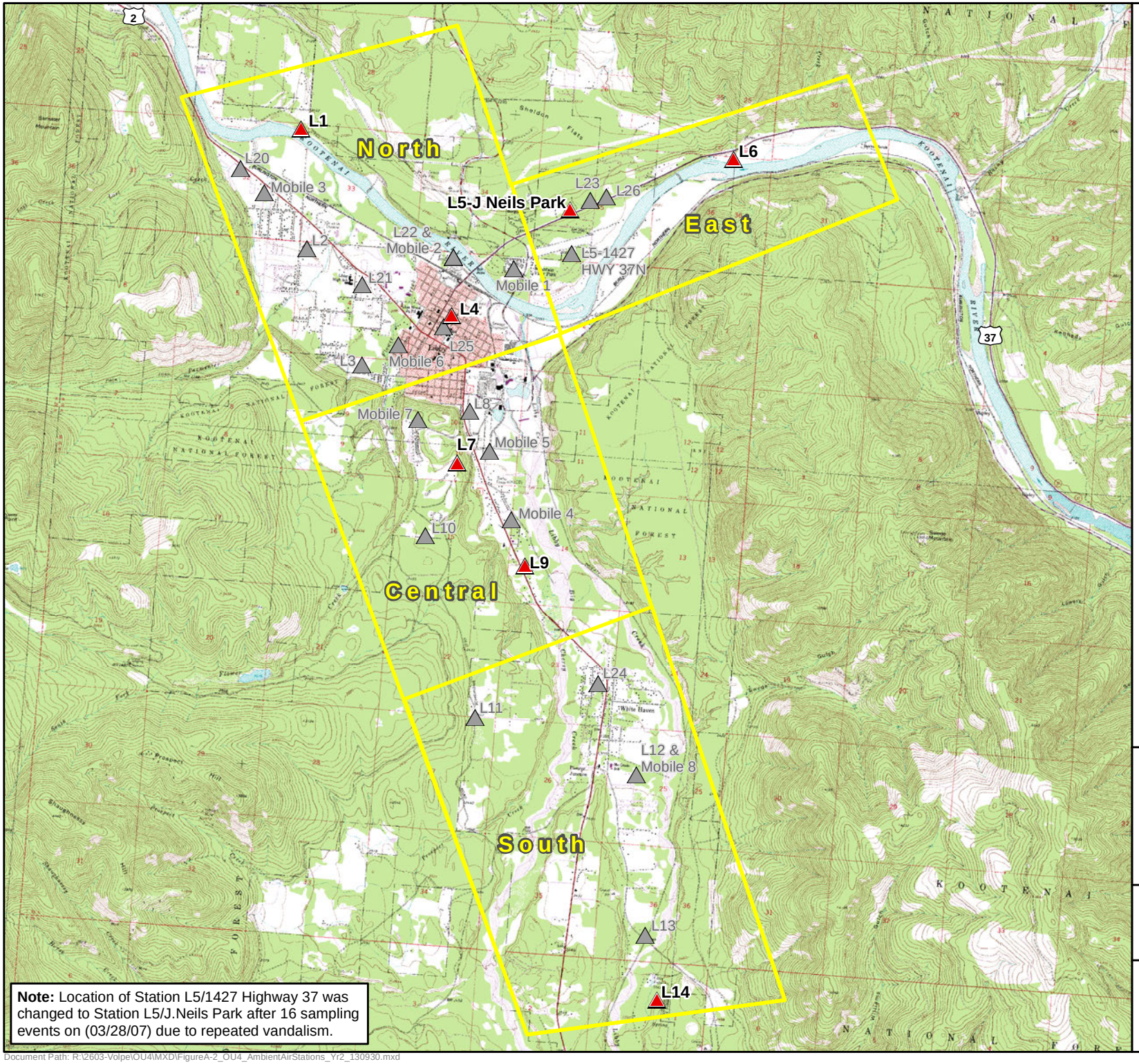
Libby, Montana

CDM Smith

**Digital Raster Graphic Data Source**
Montana USGS Digital Raster Graphics:
Libre Map Project
http://libremap.org/data/state/montana/drg/

Map Date: September 2013

Document Path: R:\2603-Volpe\OU4\MXD\FigureA-1_OU4_AmbientAirStations_Yr1_130930.mxd




**Legend**

Outdoor Ambient Air Boundary

OU4 Sample Stations

Year 2

Years 1, 3 to 6

N
W E
S

Miles

0 0.5 1 2

Libby Asbestos Site

Figure D-2
Outdoor Ambient Air Sampling Stations Year 2
September 2007 - June 2008

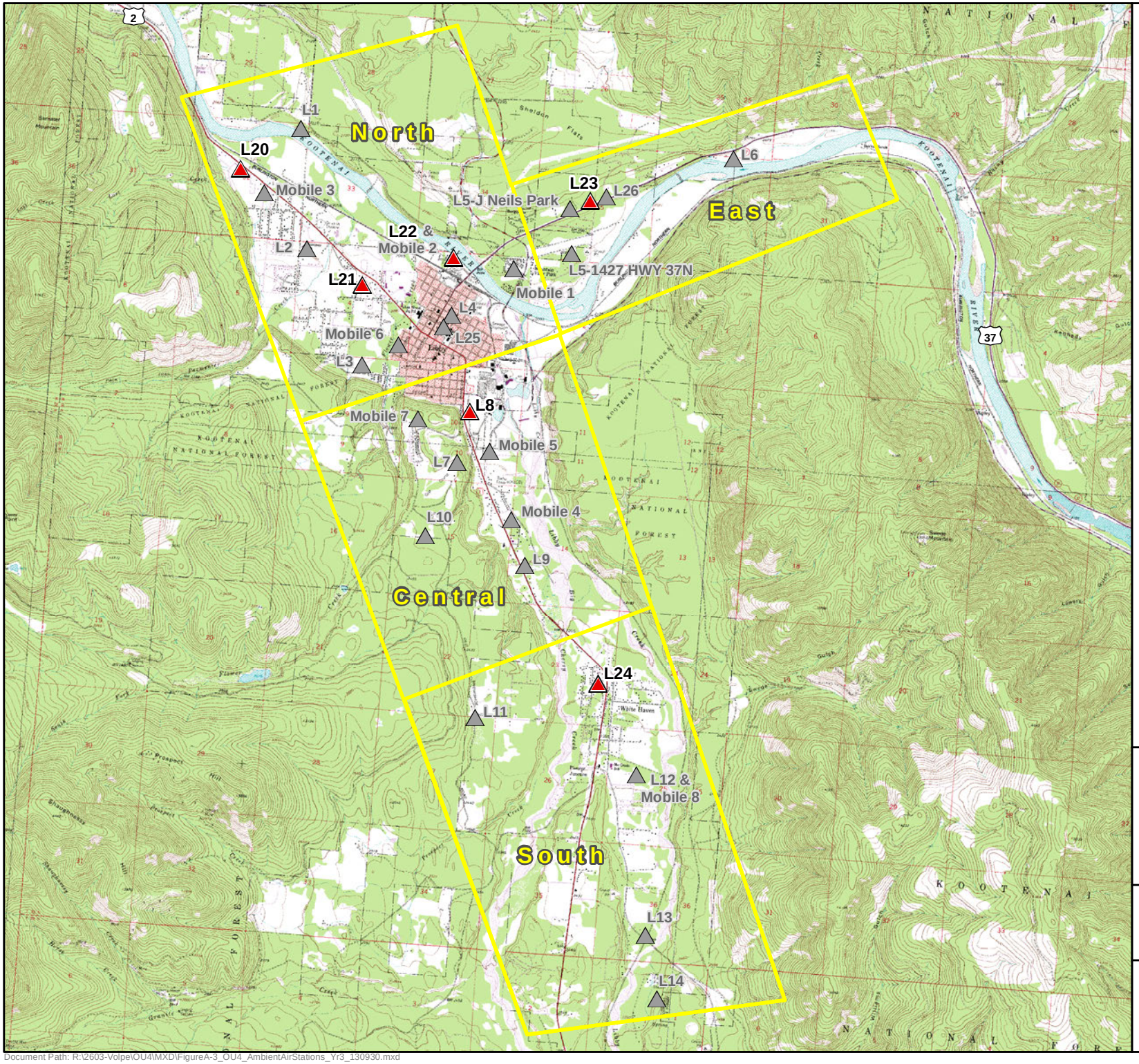
Libby, Montana

CDM Smith

**Digital Raster Graphic Data Source**
Montana USGS Digital Raster Graphics:
Libre Map Project
http://libremap.org/data/state/montana/drg/

Map Date: September 2013

Document Path: R:\2603-Volpe\OU4\MXD\FigureA-2_OU4_AmbientAirStations_Yr2_130930.mxd




## Legend

Outdoor Ambient Air Boundary

OU4 Sample Stations

Year 3

Years 1, 2, 4 to 6

N
W E
S

Miles

0 0.5 1 2

Libby Asbestos Site

Figure D-3 Outdoor Ambient Air Sampling Stations
Year 3
May 2010 - April 2011

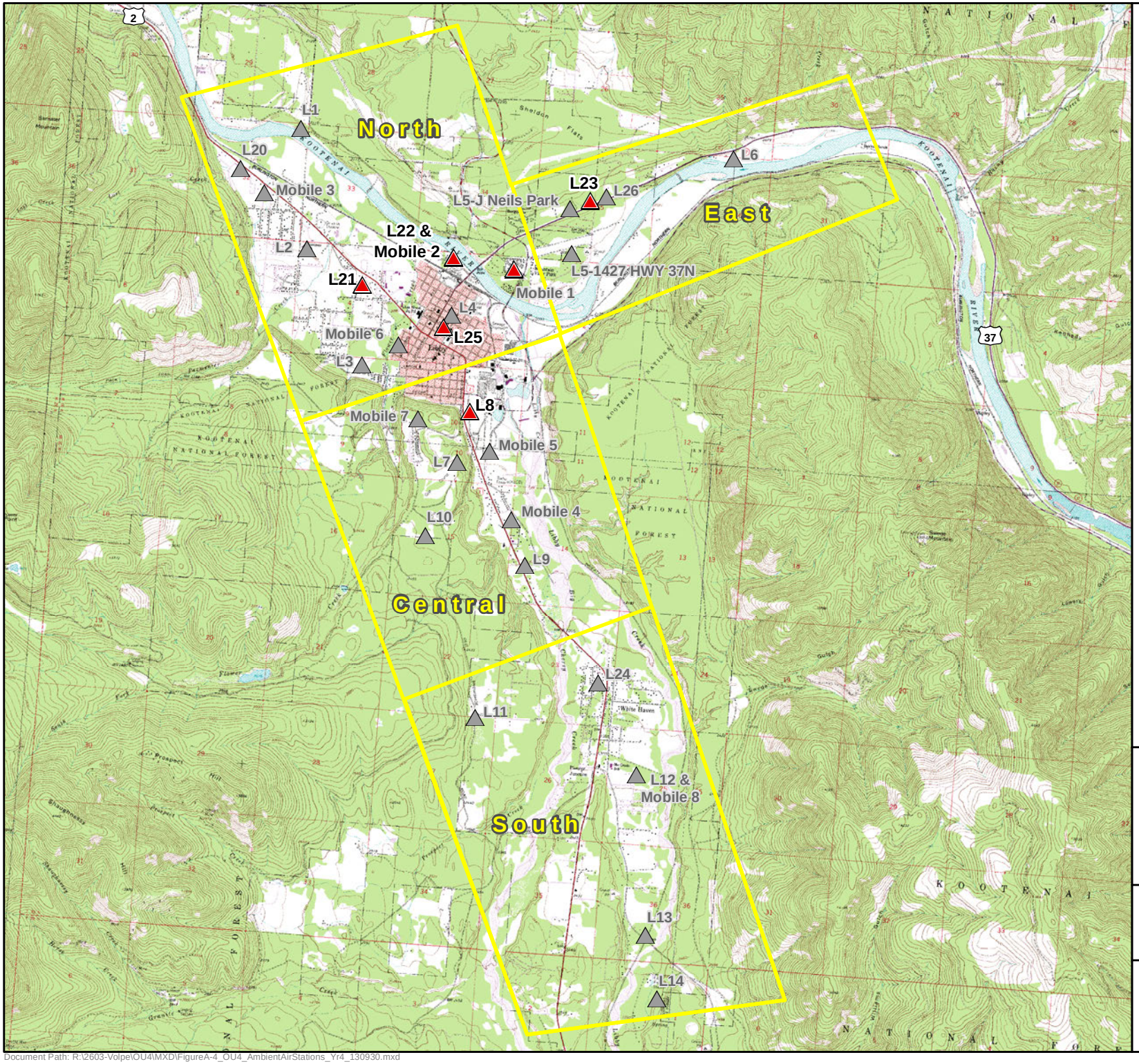
Libby, Montana

CDM Smith

**Digital Raster Graphic Data Source**
Montana USGS Digital Raster Graphics:
Libre Map Project
http://libremap.org/data/state/montana/drg/

Map Date: September 2013

Document Path: R:\2603-Volpe\OU4\MXD\FigureA-3_OU4_AmbientAirStations_Yr3_130930.mxd




## Legend

Outdoor Ambient Air Boundary

OU4 Sample Stations

Year 4

Years 1 to 3, 5 and 6

N
W E
S

Miles

0 0.5 1 2

Libby Asbestos Site

Figure D-4 Outdoor Ambient Air Sampling Stations Year 4

July 2011 - April 2012

Libby, Montana

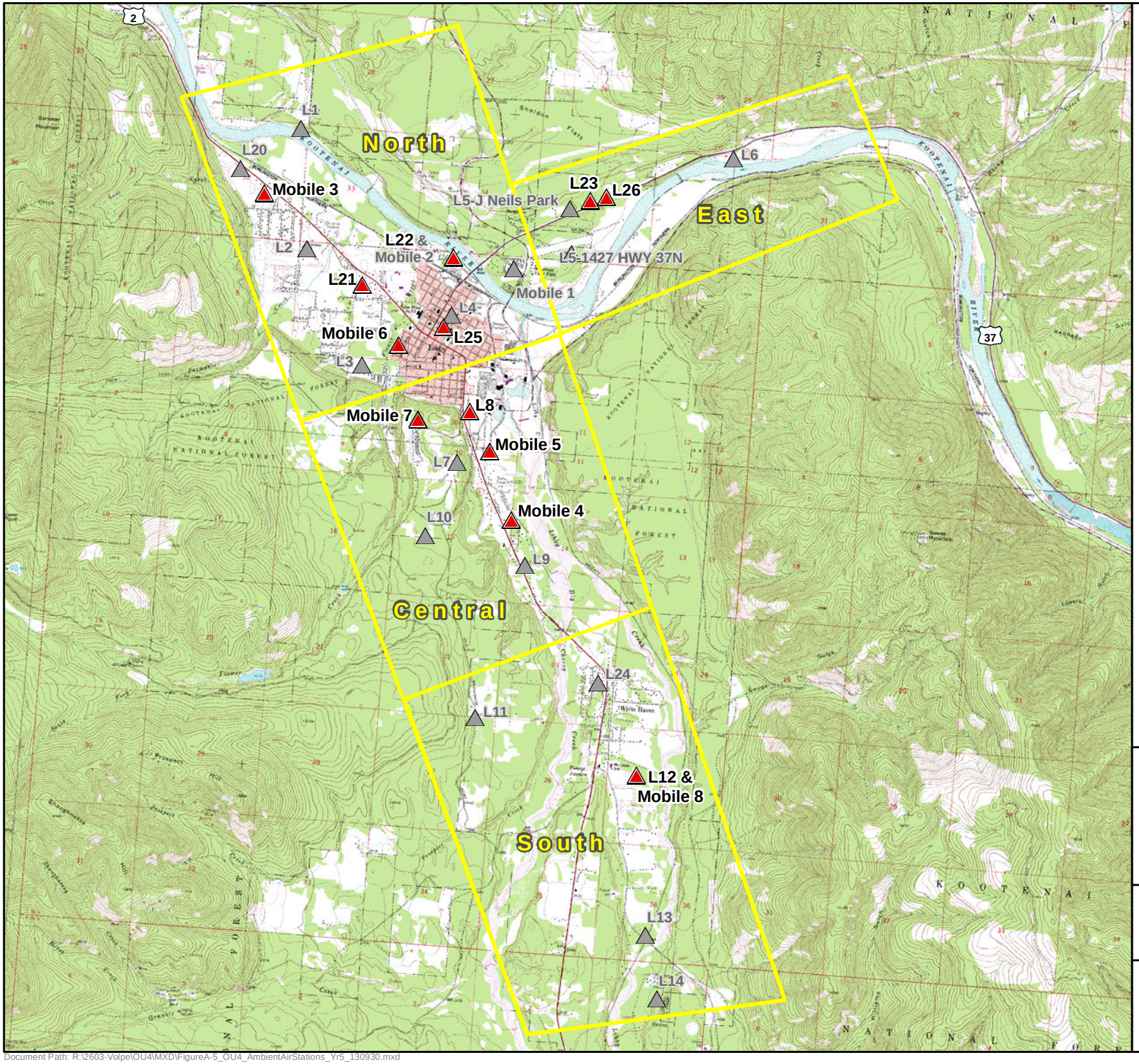
CDM Smith

**Digital Raster Graphic Data Source**

Montana USGS Digital Raster Graphics: Libre Map Project
http://libremap.org/data/state/montana/drg/

Map Date: September 2013

Document Path: R:\2603-Volpe\OU4\MXD\FigureA-4_OU4_AmbientAirStations_Yr4_130930.mxd




**Legend**

Outdoor Ambient Air Boundary

OU4 Sample Stations

Year 5

Years 1 to 4, and 6

N
W E
S

Miles

0 0.5 1 2

Libby Asbestos Site

Figure D-5
Outdoor Ambient Air Sampling Stations
Year 5
May 2012 - March 2013

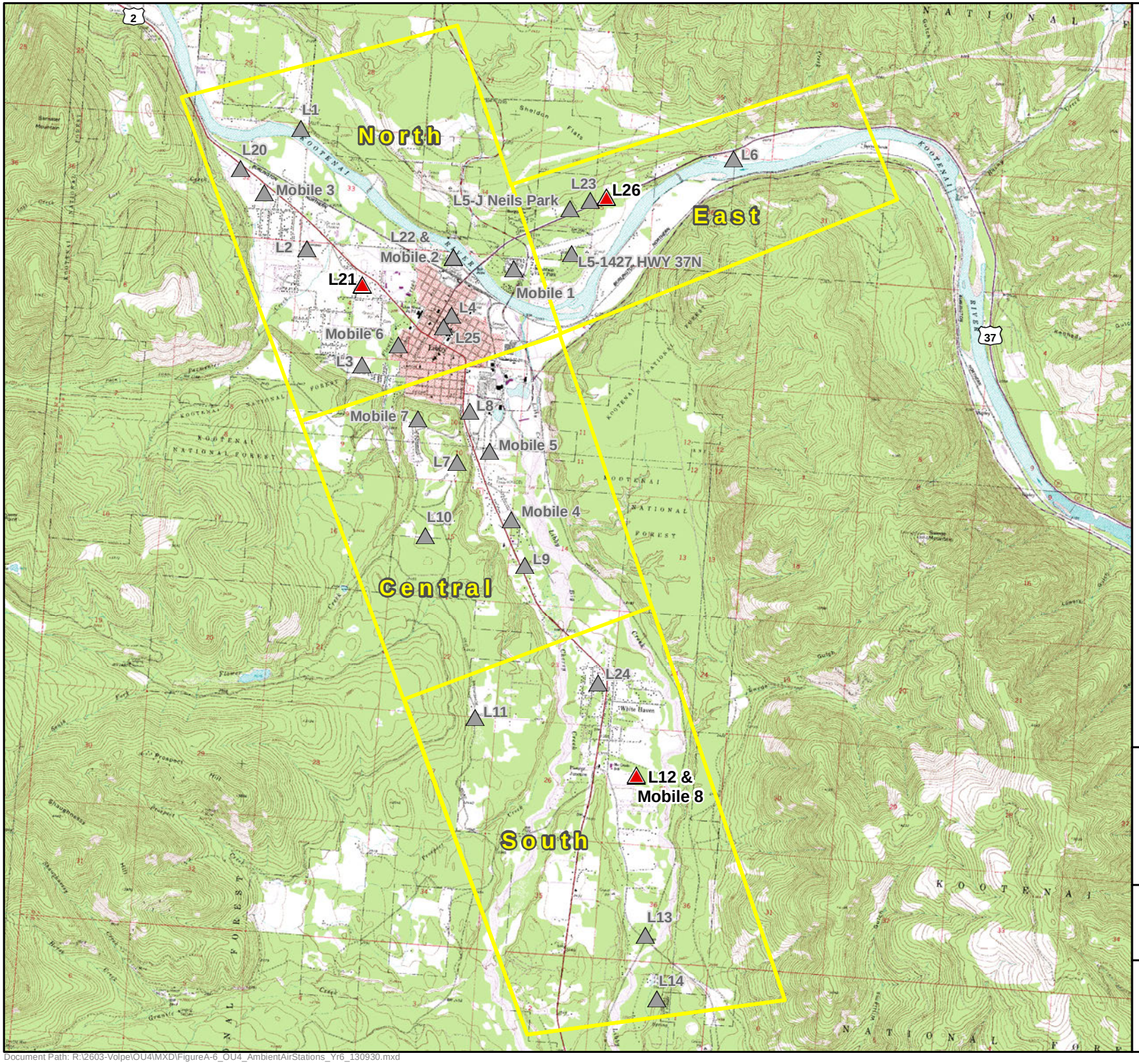
Libby, Montana

CDM Smith

**Digital Raster Graphic Data Source**
Montana USGS Digital Raster Graphics:
Libre Map Project
http://libremap.org/data/state/montana/drg/

Map Date: September 2013

Document Path: R:\2603-Volpe\OU4\MXD\FigureA-5_OU4_AmbientAirStations_Yr5_130930.mxd




**Legend**

Outdoor Ambient Air Boundary

OU4 Sample Stations

Year 6

Years 1 to 5

N
W E
S

Miles

0 0.5 1 2

Libby Asbestos Site

Figure D-6
Outdoor Ambient Air
Sampling Stations
Year 6
April 2013 - August 2013

Libby, Montana

CDM Smith

**Digital Raster Graphic Data Source**
Montana USGS Digital Raster Graphics:
Libre Map Project
http://libremap.org/data/state/montana/drg/

Map Date: September 2013

Document Path: R:\2603-Volpe\OU4\MXD\FigureA-6_OU4_AmbientAirStations_Yr6_130930.mxd

# Summary of Outdoor Ambient Air Monitoring for Asbestos at the Libby Asbestos Superfund Site

## Appendix E

## Detailed Data Summary Tables

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**Appendix E. Detailed Results of Ambient Air Samples Collected at 1675 MT Highway 37**
*Libby Asbestos Superfund Site, Libby, Montana*

*Group:* East
*Original Station ID:* L4
*Revised Station ID:* L23

| Sample ID | Sample Date | Laboratory Name | Laboratory QC Type | Analysis Date | Analysis Method | Preparation Method | EFA ($mm^2$) | GO Size ($mm^2$) | GOs Counted | F-factor | Sample Volume (L) | Sensitivity (1/cc) | N Structures | | | | Air Concentration (s/cc) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | N Total LA | N PCME LA | N Total LA NaK | N PCME LA NaK | Total LA | PCME LA | Total LA NaK | PCME LA NaK |
| AA-01986 | 5/17/10 | EMSL27 | NOT QC | 5/27/10 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,415 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02008 | 6/2/10 | EMSL27 | NOT QC | 6/16/10 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,411 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02036 | 6/19/10 | EMSL27 | NOT QC | 7/20/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,050 | 3.8E-05 | 1 | 1 | 1 | 1 | 3.8E-05 | 3.8E-05 | 3.8E-05 | 3.8E-05 |
| AA-02041 | 7/11/10 | EMSL27 | NOT QC | 7/21/10 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,377 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02069 | 7/31/10 | EMSL27 | NOT QC | 8/10/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,755 | 3.9E-05 | 2 | 2 | 2 | 2 | 7.8E-05 | 7.8E-05 | 7.8E-05 | 7.8E-05 |
| AA-02083 | 8/14/10 | EMSL27 | NOT QC | 8/24/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,133 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02096 | 8/28/10 | EMSL27 | NOT QC | 10/1/10 | TEM-ISO | Direct | 385 | 0.013 | 70 | 1 | 10,820 | 3.9E-05 | 1 | 1 | 1 | 1 | 3.9E-05 | 3.9E-05 | 3.9E-05 | 3.9E-05 |
| AA-02109 | 9/11/10 | EMSL27 | NOT QC | 9/20/10 | TEM-ISO | Direct | 385 | 0.013 | 54 | 1 | 13,817 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02125 | 9/25/10 | EMSL27 | NOT QC | 10/4/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,587 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02137 | 10/9/10 | EMSL27 | NOT QC | 10/20/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,664 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02165 | 10/23/10 | EMSL27 | NOT QC | 11/5/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,792 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02174 | 11/6/10 | EMSL27 | NOT QC | 11/16/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,933 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02189 | 11/20/10 | EMSL27 | NOT QC | 11/30/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,158 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02205 | 12/20/10 | EMSL27 | NOT QC | 1/3/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,021 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02219 | 1/17/11 | EMSL27 | NOT QC | 2/7/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,009 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02235 | 2/20/11 | EMSL27 | NOT QC | 2/28/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,039 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02251 | 3/20/11 | EMSL27 | NOT QC | 3/23/11 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,041 | 3.8E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02267 | 4/16/11 | EMSL27 | NOT QC | 5/3/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,052 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02293 | 7/2/11 | EMSL27 | NOT QC | 7/15/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,221 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02303 | 7/16/11 | EMSL27 | NOT QC | 8/2/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,310 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02313 | 7/30/11 | EMSL27 | NOT QC | 8/10/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,183 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02327 | 8/13/11 | EMSL27 | NOT QC | 9/7/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,219 | 3.9E-05 | 1 | 1 | 1 | 1 | 3.9E-05 | 3.9E-05 | 3.9E-05 | 3.9E-05 |
| AA-02340 | 8/27/11 | EMSL27 | NOT QC | 9/19/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,319 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02358 | 9/17/11 | EMSL27 | NOT QC | 10/5/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,485 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02376 | 10/1/11 | EMSL27 | NOT QC | 10/12/11 | TEM-ISO | Direct | 385 | 0.013 | 51 | 1 | 14,766 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02391 | 10/15/11 | EMSL27 | NOT QC | 10/31/11 | TEM-ISO | Direct | 385 | 0.013 | 57 | 1 | 13,142 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02411 | 10/29/11 | EMSL27 | NOT QC | 11/22/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,621 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02427 | 11/12/11 | EMSL27 | NOT QC | 12/1/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,768 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02441 | 11/19/11 | EMSL27 | NOT QC | 12/2/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,688 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02448 | 12/17/11 | EMSL27 | NOT QC | 1/9/12 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,210 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02464 | 1/21/12 | EMSL27 | NOT QC | 2/9/12 | TEM-ISO | Direct | 385 | 0.013 | 48 | 1 | 15,758 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02480 | 2/18/12 | EMSL27 | NOT QC | 3/8/12 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,253 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02494 | 3/17/12 | EMSL27 | NOT QC | 4/6/12 | TEM-ISO | Direct | 385 | 0.013 | 51 | 1 | 14,768 | 3.9E-05 | 1 | 0 | 0 | 0 | 3.9E-05 | 0 | 0 | 0 |
| AA-02513 | 4/14/12 | EMSL27 | NOT QC | 5/2/12 | TEM-ISO | Direct | 385 | 0.013 | 54 | 1 | 14,788 | 3.7E-05 | 3 | 3 | 3 | 3 | 1.1E-04 | 1.1E-04 | 1.1E-04 | 1.1E-04 |
| AA-02524 | 5/5/12 | EMSL27 | NOT QC | 5/21/12 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,977 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02538 | 5/26/12 | RESI | NOT QC | 6/21/12 | TEM-ISO | Direct | 385 | 0.01 | 67 | 1 | 14,743 | 3.9E-05 | 4 | 3 | 2 | 1 | 1.6E-04 | 1.2E-04 | 7.8E-05 | 3.9E-05 |
| AA-02559 | 6/16/12 | ESATR8 | NOT QC | 7/2/12 | TEM-ISO | Direct | 385 | 0.00983 | 67 | 1 | 14,852 | 4.0E-05 | 2 | 1 | 2 | 1 | 7.9E-05 | 4.0E-05 | 7.9E-05 | 4.0E-05 |
| AA-02575 | 6/30/12 | ESATR8 | NOT QC | 7/23/12 | TEM-ISO | Direct | 385 | 0.00983 | 67 | 1 | 14,809 | 3.9E-05 | 1 | 0 | 1 | 0 | 3.9E-05 | 0 | 3.9E-05 | 0 |
| AA-02586 | 7/14/12 | RESI | NOT QC | 7/27/12 | TEM-ISO | Direct | 385 | 0.01 | 75 | 1 | 14,227 | 3.6E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02608 | 7/28/12 | Hygeia | NOT QC | 8/6/12 | TEM-ISO | Direct | 385 | 0.0097 | 66 | 1 | 15,118 | 4.0E-05 | 2 | 1 | 2 | 1 | 8.0E-05 | 4.0E-05 | 8.0E-05 | 4.0E-05 |
| AA-02624 | 8/11/12 | EMSL22 | NOT QC | 8/24/12 | TEM-ISO | Direct | 385 | 0.0129 | 53 | 1 | 14,133 | 4.0E-05 | 9 | 7 | 9 | 7 | 3.6E-04 | 2.8E-04 | 3.6E-04 | 2.8E-04 |
| AA-02647 | 8/25/12 | RESI | NOT QC | 8/31/12 | TEM-ISO | Direct | 385 | 0.01 | 75 | 1 | 15,035 | 3.4E-05 | 12 | 8 | 11 | 8 | 4.1E-04 | 2.7E-04 | 3.8E-04 | 2.7E-04 |
| AA-02664 | 9/15/12 | Hygeia | NOT QC | 9/28/12 | TEM-ISO | Direct | 385 | 0.01 | 92 | 1 | 10,526 | 4.0E-05 | 10 | 3 | 9 | 3 | 4.0E-04 | 1.2E-04 | 3.6E-04 | 1.2E-04 |
| AA-02685 | 9/29/12 | ESATR8 | NOT QC | 10/19/12 | TEM-ISO | Direct | 385 | 0.0099 | 68 | 1 | 14,480 | 3.9E-05 | 3 | 2 | 1 | 1 | 1.2E-04 | 7.9E-05 | 3.9E-05 | 3.9E-05 |
| AA-02696 | 10/13/12 | ESATR8 | NOT QC | 11/12/12 | TEM-ISO | Direct | 385 | 0.0099 | 69 | 1 | 14,150 | 4.0E-05 | 2 | 1 | 2 | 1 | 8.0E-05 | 4.0E-05 | 8.0E-05 | 4.0E-05 |
| AA-02710 | 10/27/12 | Hygeia | NOT QC | 11/5/12 | TEM-ISO | Direct | 385 | 0.01 | 65 | 1 | 14,988 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Notes:**
QC - quality control
TEM - transmission electron microscopy
ISO - international organization for standardization
EFA - effective filter area
mm - millimeter
GO - grid opening
L - liter
cc - cubic centimeter
N - number of asbestos structures
LA - Libby amphibole
NaK - sodium/potassium
PCME - phase contrast microscopy-equivalent
s/cc - structures per cubic centimeter
n/a - not applicable

**Appendix E. Detailed Results of Ambient Air Samples Collected at 1799 MT Highway 37**
*Libby Asbestos Superfund Site, Libby, Montana*

*Group:* East
*Original Station ID:* n/a
*Revised Station ID:* L26

| Sample ID | Sample Date | Laboratory Name | Laboratory QC Type | Analysis Date | Analysis Method | Preparation Method | EFA ($mm^2$) | GO Size ($mm^2$) | GOs Counted | F-factor | Sample Volume (L) | Sensitivity (1/cc) | N Structures | | | | Air Concentration (s/cc) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | N Total LA | N PCME LA | N Total LA NaK | N PCME LA NaK | Total LA | PCME LA | Total LA NaK | PCME LA NaK |
| AA-02728 | 11/17/12 | RESI | NOT QC | 12/6/12 | TEM-ISO | Direct | 385 | 0.01 | 67 | 1 | 15,067 | 3.8E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02827 | 12/15/12 | RESI | NOT QC | 1/1/13 | TEM-ISO | Direct | 385 | 0.01 | 83 | 1 | 14,893 | 3.1E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02847 | 1/19/13 | ESATR8 | NOT QC | 2/7/13 | TEM-ISO | Direct | 385 | 0.0099 | 66 | 1 | 14,801 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02863 | 2/16/13 | RESI | NOT QC | 2/23/13 | TEM-ISO | Direct | 385 | 0.01 | 64 | 1 | 15,249 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02880 | 3/16/13 | Hygeia | NOT QC | 3/26/13 | TEM-ISO | Direct | 385 | 0.01 | 94 | 1 | 10,288 | 4.0E-05 | 1 | 1 | 1 | 1 | 4.0E-05 | 4.0E-05 | 4.0E-05 | 4.0E-05 |
| AA-02740 | 4/27/13 | EMSL27 | NOT QC | 5/6/13 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,889 | 3.6E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02750 | 5/11/13 | RESI | NOT QC | 5/17/13 | TEM-ISO | Direct | 385 | 0.01 | 67 | 1 | 15,060 | 3.8E-05 | 1 | 1 | 0 | 0 | 3.8E-05 | 3.8E-05 | 0 | 0 |
| AA-02760 | 5/25/13 | EMSL27 | NOT QC | 6/3/13 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,967 | 3.6E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02777 | 6/15/13 | Hygeia | NOT QC | 6/23/13 | TEM-ISO | Indirect - Ashed | 346 | 0.01 | 80 | 0.75 | 14,483 | 4.0E-05 | 7 | 4 | 7 | 4 | 2.8E-04 | 1.6E-04 | 2.8E-04 | 1.6E-04 |
| AA-02787 | 6/29/13 | Hygeia | NOT QC | 7/8/13 | TEM-ISO | Direct | 385 | 0.01 | 67 | 1 | 14,469 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02891 | 7/13/13 | ESATR8 | NOT QC | 7/25/13 | TEM-ISO | Direct | 385 | 0.0099 | 69 | 1 | 14,500 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02795 | 7/27/13 | ESATR8 | NOT QC | 8/5/13 | TEM-ISO | Direct | 385 | 0.0099 | 87 | 1 | 11,400 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02800 | 8/10/13 | ESATR8 | NOT QC | 8/21/13 | TEM-ISO | Direct | 385 | 0.0099 | 68 | 1 | 14,635 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02907 | 8/24/13 | EMSL27 | NOT QC | 9/3/13 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,744 | 3.7E-05 | 1 | 1 | 1 | 1 | 3.7E-05 | 3.7E-05 | 3.7E-05 | 3.7E-05 |

**Notes:**
QC - quality control
TEM - transmission electron microscopy
ISO - international organization for standardization
EFA - effective filter area
mm - millimeter
GO - grid opening
L - liter
cc - cubic centimeter
N - number of asbestos structures
LA - Libby amphibole
NaK - sodium/potassium
PCME - phase contrast microscopy-equivalent
s/cc - structures per cubic centimeter
n/a - not applicable

**Appendix E. Detailed Results of Ambient Air Samples Collected at 208 Park St**
*Libby Asbestos Superfund Site, Libby, Montana*

*Group:* North
*Original Station ID:* Mobile
*Revised Station ID:* Mobile 1

| Sample ID | Sample Date | Laboratory Name | Laboratory QC Type | Analysis Date | Analysis Method | Preparation Method | EFA ($mm^2$) | GO Size ($mm^2$) | GOs Counted | F-factor | Sample Volume (L) | Sensitivity (1/cc) | N Structures | | | | Air Concentration (s/cc) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | N Total LA | N PCME LA | N Total LA NaK | N PCME LA NaK | Total LA | PCME LA | Total LA NaK | PCME LA NaK |
| AA-02399 | 10/15/11 | EMSL27 | NOT QC | 10/31/11 | TEM-ISO | Direct | 385 | 0.013 | 62 | 1 | 15,142 | 3.2E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02413 | 10/29/11 | EMSL27 | NOT QC | 11/22/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,623 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Notes:**
QC - quality control
TEM - transmission electron microscopy
ISO - international organization for standardization
EFA - effective filter area
mm - millimeter
GO - grid opening
L - liter
cc - cubic centimeter
N - number of asbestos structures
LA - Libby amphibole
NaK - sodium/potassium
PCME - phase contrast microscopy-equivalent
s/cc - structures per cubic centimeter
n/a - not applicable

**Appendix E. Detailed Results of Ambient Air Samples Collected at 303 W Thomas St**
*Libby Asbestos Superfund Site, Libby, Montana*

*Group:* North
*Original Station ID:* L3
*Revised Station ID:* L22

| Sample ID | Sample Date | Laboratory Name | Laboratory QC Type | Analysis Date | Analysis Method | Preparation Method | EFA ($mm^2$) | GO Size ($mm^2$) | GOs Counted | F-factor | Sample Volume (L) | Sensitivity (1/cc) | N Structures | | | | Air Concentration (s/cc) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | N Total LA | N PCME LA | N Total LA NaK | N PCME LA NaK | Total LA | PCME LA | Total LA NaK | PCME LA NaK |
| AA-01988 | 5/17/10 | EMSL27 | NOT QC | 5/27/10 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,307 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02010 | 6/2/10 | EMSL27 | NOT QC | 6/15/10 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,400 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02028 | 6/19/10 | EMSL27 | NOT QC | 6/30/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,048 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02044 | 7/11/10 | EMSL27 | NOT QC | 7/28/10 | TEM-ISO | Direct | 385 | 0.013 | 66 | 1 | 11,315 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02065 | 7/31/10 | EMSL27 | NOT QC | 8/3/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,732 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02079 | 8/14/10 | EMSL27 | NOT QC | 8/19/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,104 | 3.8E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02099 | 8/28/10 | EMSL27 | NOT QC | 9/9/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,757 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02111 | 9/11/10 | EMSL27 | NOT QC | 9/21/10 | TEM-ISO | Direct | 385 | 0.013 | 54 | 1 | 13,747 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02139 | 10/9/10 | EMSL27 | NOT QC | 10/18/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,651 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02163 | 10/23/10 | EMSL27 | NOT QC | 11/5/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,792 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02182 | 11/6/10 | EMSL27 | NOT QC | 11/15/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,931 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02191 | 11/20/10 | EMSL27 | NOT QC | 11/24/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,030 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02209 | 12/20/10 | EMSL27 | NOT QC | 12/28/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,020 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02221 | 1/17/11 | EMSL27 | NOT QC | 2/4/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,014 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02237 | 2/20/11 | EMSL27 | NOT QC | 2/28/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,005 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02253 | 3/20/11 | EMSL27 | NOT QC | 3/22/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,041 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02269 | 4/16/11 | EMSL27 | NOT QC | 5/3/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,050 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02291 | 7/2/11 | EMSL27 | NOT QC | 7/14/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,223 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02301 | 7/16/11 | EMSL27 | NOT QC | 8/1/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,302 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02315 | 7/30/11 | EMSL27 | NOT QC | 8/10/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,170 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02329 | 8/13/11 | EMSL27 | NOT QC | 8/25/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,215 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02343 | 8/27/11 | EMSL27 | NOT QC | 9/9/11 | TEM-ISO | Direct | 385 | 0.013 | 72 | 1 | 10,552 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02362 | 9/17/11 | EMSL27 | NOT QC | 10/4/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,424 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02378 | 10/1/11 | EMSL27 | NOT QC | 10/7/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,717 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02380 | 10/1/11 | EMSL27 | NOT QC | 10/7/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,676 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02393 | 10/15/11 | EMSL27 | NOT QC | 10/28/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,200 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02395 | 10/15/11 | EMSL27 | NOT QC | 10/28/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,157 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02406 | 10/29/11 | EMSL27 | NOT QC | 11/22/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,696 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02425 | 11/12/11 | EMSL27 | NOT QC | 12/1/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,768 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02439 | 11/19/11 | EMSL27 | NOT QC | 12/2/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,682 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02452 | 12/17/11 | EMSL27 | NOT QC | 1/9/12 | TEM-ISO | Indirect - Ashed | 360 | 0.013 | 95 | 0.5 | 15,225 | 3.8E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02466 | 1/21/12 | EMSL27 | NOT QC | 2/9/12 | TEM-ISO | Direct | 385 | 0.013 | 48 | 1 | 15,756 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02482 | 2/18/12 | EMSL27 | NOT QC | 3/15/12 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,258 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02496 | 3/17/12 | EMSL27 | NOT QC | 4/9/12 | TEM-ISO | Direct | 385 | 0.013 | 51 | 1 | 14,764 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02504 | 4/14/12 | EMSL27 | NOT QC | 4/24/12 | TEM-ISO | Direct | 385 | 0.013 | 51 | 1 | 14,832 | 3.9E-05 | 2 | 0 | 1 | 0 | 7.8E-05 | 0 | 3.9E-05 | 0 |
| AA-02522 | 5/5/12 | EMSL27 | NOT QC | 5/21/12 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,981 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02541 | 5/26/12 | RESI | NOT QC | 6/22/12 | TEM-ISO | Direct | 385 | 0.01 | 112 | 1 | 10,109 | 3.4E-05 | 3 | 2 | 1 | 1 | 1.0E-04 | 6.8E-05 | 3.4E-05 | 3.4E-05 |
| AA-02557 | 6/16/12 | ESATR8 | NOT QC | 6/29/12 | TEM-ISO | Direct | 385 | 0.00983 | 68 | 1 | 14,807 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02570 | 6/30/12 | ESATR8 | NOT QC | 7/18/12 | TEM-ISO | Direct | 385 | 0.00983 | 67 | 1 | 14,811 | 3.9E-05 | 1 | 0 | 1 | 0 | 3.9E-05 | 0 | 3.9E-05 | 0 |
| AA-02585 | 7/14/12 | RESI | NOT QC | 7/27/12 | TEM-ISO | Direct | 385 | 0.01 | 97 | 1 | 11,167 | 3.6E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02607 | 7/28/12 | Hygeia | NOT QC | 8/6/12 | TEM-ISO | Direct | 385 | 0.0097 | 92 | 1 | 10,774 | 4.0E-05 | 1 | 1 | 0 | 0 | 4.0E-05 | 4.0E-05 | 0 | 0 |
| AA-02622 | 8/11/12 | EMSL22 | NOT QC | 8/24/12 | TEM-ISO | Direct | 385 | 0.0129 | 53 | 1 | 14,129 | 4.0E-05 | 1 | 1 | 1 | 1 | 4.0E-05 | 4.0E-05 | 4.0E-05 | 4.0E-05 |
| AA-02645 | 8/25/12 | RESI | NOT QC | 8/31/12 | TEM-ISO | Direct | 385 | 0.01 | 74 | 1 | 14,997 | 3.5E-05 | 2 | 1 | 2 | 1 | 6.9E-05 | 3.5E-05 | 6.9E-05 | 3.5E-05 |
| AA-02662 | 9/15/12 | Hygeia | NOT QC | 9/27/12 | TEM-ISO | Direct | 385 | 0.01 | 92 | 1 | 10,531 | 4.0E-05 | 2 | 1 | 2 | 1 | 7.9E-05 | 4.0E-05 | 7.9E-05 | 4.0E-05 |
| AA-02676 | 9/29/12 | ESATR8 | NOT QC | 10/18/12 | TEM-ISO | Direct | 385 | 0.0099 | 67 | 1 | 14,573 | 4.0E-05 | 4 | 3 | 2 | 2 | 1.6E-04 | 1.2E-04 | 8.0E-05 | 8.0E-05 |
| AA-02694 | 10/13/12 | ESATR8 | NOT QC | 11/2/12 | TEM-ISO | Direct | 385 | 0.0099 | 69 | 1 | 14,166 | 4.0E-05 | 1 | 0 | 0 | 0 | 4.0E-05 | 0 | 0 | 0 |
| AA-02724 | 11/17/12 | RESI | NOT QC | 12/5/12 | TEM-ISO | Direct | 385 | 0.01 | 65 | 1 | 15,109 | 3.9E-05 | 1 | 0 | 1 | 0 | 3.9E-05 | 0 | 3.9E-05 | 0 |
| AA-02829 | 12/15/12 | RESI | NOT QC | 1/1/13 | TEM-ISO | Direct | 385 | 0.01 | 85 | 1 | 14,893 | 3.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02843 | 1/19/13 | ESATR8 | NOT QC | 2/4/13 | TEM-ISO | Direct | 385 | 0.0099 | 95 | 1 | 10,246 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02861 | 2/16/13 | RESI | NOT QC | 2/22/13 | TEM-ISO | Direct | 385 | 0.01 | 85 | 1 | 15,244 | 3.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02878 | 3/16/13 | Hygeia | NOT QC | 3/25/13 | TEM-ISO | Direct | 385 | 0.01 | 94 | 1 | 10,294 | 4.0E-05 | 1 | 0 | 1 | 0 | 4.0E-05 | 0 | 4.0E-05 | 0 |

**Notes:**
QC - quality control
TEM - transmission electron microscopy
ISO - international organization for standardization
EFA - effective filter area
mm - millimeter
GO - grid opening
L - liter
cc - cubic centimeter
N - number of asbestos structures
LA - Libby amphibole
NaK - sodium/potassium
PCME - phase contrast microscopy-equivalent
s/cc - structures per cubic centimeter
n/a - not applicable

**Appendix E. Detailed Results of Ambient Air Samples Collected at 30414 US Highway 2**
*Libby Asbestos Superfund Site, Libby, Montana*

*Group:* North
*Original Station ID:* L1
*Revised Station ID:* L20

| Sample ID | Sample Date | Laboratory Name | Laboratory QC Type | Analysis Date | Analysis Method | Preparation Method | EFA ($mm^2$) | GO Size ($mm^2$) | GOs Counted | F-factor | Sample Volume (L) | Sensitivity (1/cc) | N Structures | | | | Air Concentration (s/cc) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | N Total LA | N PCME LA | N Total LA NaK | N PCME LA NaK | Total LA | PCME LA | Total LA NaK | PCME LA NaK |
| AA-01994 | 5/17/10 | EMSL27 | NOT QC | 5/28/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,137 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02016 | 6/2/10 | EMSL27 | NOT QC | 6/16/10 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,521 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02026 | 6/19/10 | EMSL27 | NOT QC | 7/19/10 | TEM-ISO | Direct | 385 | 0.013 | 54 | 1 | 13,969 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02049 | 7/11/10 | EMSL27 | NOT QC | 7/27/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,265 | 3.8E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02063 | 7/31/10 | EMSL27 | NOT QC | 8/10/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,838 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02077 | 8/14/10 | EMSL27 | NOT QC | 8/24/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,056 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02093 | 8/28/10 | EMSL27 | NOT QC | 9/10/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,775 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02105 | 9/11/10 | EMSL27 | NOT QC | 9/20/10 | TEM-ISO | Direct | 385 | 0.013 | 54 | 1 | 13,846 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02121 | 9/25/10 | EMSL27 | NOT QC | 10/4/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,578 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02141 | 10/9/10 | EMSL27 | NOT QC | 10/20/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,647 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02159 | 10/23/10 | EMSL27 | NOT QC | 11/5/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,761 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02176 | 11/6/10 | EMSL27 | NOT QC | 11/17/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,923 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02193 | 11/20/10 | EMSL27 | NOT QC | 11/30/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,162 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02211 | 12/20/10 | EMSL27 | NOT QC | 1/3/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,037 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02225 | 1/17/11 | EMSL27 | NOT QC | 2/8/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,030 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02239 | 2/20/11 | EMSL27 | NOT QC | 3/1/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,005 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02255 | 3/20/11 | EMSL27 | NOT QC | 3/23/11 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,035 | 3.8E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02271 | 4/16/11 | EMSL27 | NOT QC | 5/3/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,047 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Notes:**
QC - quality control
TEM - transmission electron microscopy
ISO - international organization for standardization
EFA - effective filter area
mm - millimeter
GO - grid opening
L - liter
cc - cubic centimeter
N - number of asbestos structures
LA - Libby amphibole
NaK - sodium/potassium
PCME - phase contrast microscopy-equivalent
s/cc - structures per cubic centimeter
n/a - not applicable

**Appendix E. Detailed Results of Ambient Air Samples Collected at 30772 US Highway 2**
*Libby Asbestos Superfund Site, Libby, Montana*

*Group:* North
*Original Station ID:* Mobile
*Revised Station ID:* Mobile 3

| Sample ID | Sample Date | Laboratory Name | Laboratory QC Type | Analysis Date | Analysis Method | Preparation Method | EFA ($mm^2$) | GO Size ($mm^2$) | GOs Counted | F-factor | Sample Volume (L) | Sensitivity (1/cc) | N Structures | | | | Air Concentration (s/cc) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | N Total LA | N PCME LA | N Total LA NaK | N PCME LA NaK | Total LA | PCME LA | Total LA NaK | PCME LA NaK |
| AA-02531 | 5/5/12 | EMSL27 | NOT QC | 5/18/12 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,898 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02542 | 5/26/12 | RESI | NOT QC | 6/21/12 | TEM-ISO | Direct | 385 | 0.01 | 70 | 1 | 14,743 | 3.7E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Notes:**
QC - quality control
TEM - transmission electron microscopy
ISO - international organization for standardization
EFA - effective filter area
mm - millimeter
GO - grid opening
L - liter
cc - cubic centimeter
N - number of asbestos structures
LA - Libby amphibole
NaK - sodium/potassium
PCME - phase contrast microscopy-equivalent
s/cc - structures per cubic centimeter
n/a - not applicable

**Appendix E. Detailed Results of Ambient Air Samples Collected at 32000 US Highway 2**
*Libby Asbestos Superfund Site, Libby, Montana*

*Group:* North
*Original Station ID:* L2
*Revised Station ID:* L21

| Sample ID | Sample Date | Laboratory Name | Laboratory QC Type | Analysis Date | Analysis Method | Preparation Method | EFA ($mm^2$) | GO Size ($mm^2$) | GOs Counted | F-factor | Sample Volume (L) | Sensitivity (1/cc) | N Structures | | | | Air Concentration (s/cc) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | N Total LA | N PCME LA | N Total LA NaK | N PCME LA NaK | Total LA | PCME LA | Total LA NaK | PCME LA NaK |
| AA-01996 | 5/17/10 | EMSL27 | NOT QC | 5/28/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,098 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02018 | 6/2/10 | EMSL27 | NOT QC | 6/30/10 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,517 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02034 | 6/19/10 | EMSL27 | NOT QC | 7/19/10 | TEM-ISO | Direct | 385 | 0.013 | 57 | 1 | 13,242 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02055 | 7/11/10 | EMSL27 | NOT QC | 7/21/10 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,317 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02057 | 7/31/10 | EMSL27 | NOT QC | 8/4/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,830 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02073 | 8/14/10 | EMSL27 | NOT QC | 8/24/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 13,991 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02089 | 8/28/10 | EMSL27 | NOT QC | 9/10/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,757 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02107 | 9/11/10 | EMSL27 | NOT QC | 9/20/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,703 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02123 | 9/25/10 | EMSL27 | NOT QC | 10/4/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,576 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02143 | 10/9/10 | EMSL27 | NOT QC | 10/20/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,643 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02157 | 10/23/10 | EMSL27 | NOT QC | 11/5/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,850 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02180 | 11/6/10 | EMSL27 | NOT QC | 11/17/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,904 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02195 | 11/20/10 | EMSL27 | NOT QC | 12/1/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,072 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02213 | 12/20/10 | EMSL27 | NOT QC | 1/3/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,048 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02227 | 1/17/11 | EMSL27 | NOT QC | 2/8/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,033 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02243 | 2/20/11 | EMSL27 | NOT QC | 3/1/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 13,973 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02257 | 3/20/11 | EMSL27 | NOT QC | 3/30/11 | TEM-ISO | Direct | 385 | 0.013 | 54 | 1 | 14,035 | 3.9E-05 | 1 | 1 | 1 | 1 | 3.9E-05 | 3.9E-05 | 3.9E-05 | 3.9E-05 |
| AA-02273 | 4/16/11 | EMSL27 | NOT QC | 5/3/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,049 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02284 | 7/2/11 | EMSL27 | NOT QC | 7/25/11 | TEM-ISO | Direct | 385 | 0.013 | 70 | 1 | 10,818 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02307 | 7/16/11 | EMSL27 | NOT QC | 8/2/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,306 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02311 | 7/30/11 | EMSL27 | NOT QC | 8/10/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,108 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02326 | 8/13/11 | EMSL27 | NOT QC | 9/1/11 | TEM-ISO | Direct | 385 | 0.013 | 75 | 1 | 10,499 | 3.8E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02346 | 8/27/11 | EMSL27 | NOT QC | 9/19/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,236 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02356 | 9/17/11 | EMSL27 | NOT QC | 10/5/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,506 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02370 | 10/1/11 | EMSL27 | NOT QC | 10/12/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 14,824 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02397 | 10/15/11 | EMSL27 | NOT QC | 10/31/11 | TEM-ISO | Direct | 385 | 0.013 | 62 | 1 | 15,193 | 3.1E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02415 | 10/29/11 | EMSL27 | NOT QC | 11/22/11 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,821 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02429 | 11/12/11 | EMSL27 | NOT QC | 12/1/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,752 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02443 | 11/19/11 | EMSL27 | NOT QC | 12/2/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,670 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02456 | 12/17/11 | EMSL27 | NOT QC | 1/9/12 | TEM-ISO | Indirect - Ashed | 360 | 0.013 | 92 | 0.5 | 15,202 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02468 | 1/21/12 | EMSL27 | NOT QC | 2/10/12 | TEM-ISO | Direct | 385 | 0.013 | 48 | 1 | 15,753 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02484 | 2/18/12 | EMSL27 | NOT QC | 3/15/12 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,256 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02500 | 3/17/12 | EMSL27 | NOT QC | 4/10/12 | TEM-ISO | Direct | 385 | 0.013 | 51 | 1 | 14,757 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02515 | 4/14/12 | EMSL27 | NOT QC | 5/3/12 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,734 | 3.7E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02529 | 5/5/12 | EMSL27 | NOT QC | 5/18/12 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,960 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02544 | 5/26/12 | RESI | NOT QC | 6/21/12 | TEM-ISO | Direct | 385 | 0.01 | 70 | 1 | 14,745 | 3.7E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02561 | 6/16/12 | ESATR8 | NOT QC | 7/2/12 | TEM-ISO | Direct | 385 | 0.00983 | 68 | 1 | 14,767 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02577 | 6/30/12 | ESATR8 | NOT QC | 7/23/12 | TEM-ISO | Direct | 385 | 0.00983 | 67 | 1 | 14,809 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02588 | 7/14/12 | RESI | NOT QC | 7/27/12 | TEM-ISO | Direct | 385 | 0.01 | 80 | 1 | 14,223 | 3.4E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02614 | 7/28/12 | Hygeia | NOT QC | 8/7/12 | TEM-ISO | Direct | 385 | 0.0097 | 93 | 1 | 10,712 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02628 | 8/11/12 | EMSL22 | NOT QC | 8/25/12 | TEM-ISO | Direct | 385 | 0.0129 | 53 | 1 | 14,148 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02649 | 8/25/12 | RESI | NOT QC | 9/4/12 | TEM-ISO | Direct | 385 | 0.01 | 75 | 1 | 14,914 | 3.4E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02668 | 9/15/12 | Hygeia | NOT QC | 10/1/12 | TEM-ISO | Direct | 385 | 0.01 | 91 | 1 | 10,605 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02674 | 9/29/12 | ESATR8 | NOT QC | 10/17/12 | TEM-ISO | Direct | 385 | 0.0099 | 67 | 1 | 14,656 | 4.0E-05 | 1 | 1 | 0 | 0 | 4.0E-05 | 4.0E-05 | 0 | 0 |
| AA-02701 | 10/13/12 | ESATR8 | NOT QC | 11/14/12 | TEM-ISO | Direct | 385 | 0.0099 | 69 | 1 | 14,148 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02712 | 10/27/12 | Hygeia | NOT QC | 11/5/12 | TEM-ISO | Direct | 385 | 0.01 | 65 | 1 | 14,982 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02730 | 11/17/12 | RESI | NOT QC | 12/6/12 | TEM-ISO | Direct | 385 | 0.01 | 72 | 1 | 14,982 | 3.6E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02831 | 12/15/12 | RESI | NOT QC | 1/1/13 | TEM-ISO | Direct | 385 | 0.01 | 85 | 1 | 14,900 | 3.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02849 | 1/19/13 | ESATR8 | NOT QC | 2/7/13 | TEM-ISO | Direct | 385 | 0.0099 | 66 | 1 | 14,787 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02865 | 2/16/13 | RESI | NOT QC | 2/23/13 | TEM-ISO | Direct | 385 | 0.01 | 64 | 1 | 15,261 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02882 | 3/16/13 | Hygeia | NOT QC | 3/26/13 | TEM-ISO | Direct | 385 | 0.01 | 94 | 1 | 10,292 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02742 | 4/27/13 | EMSL27 | NOT QC | 5/6/13 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,838 | 3.6E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02752 | 5/11/13 | RESI | NOT QC | 5/17/13 | TEM-ISO | Direct | 385 | 0.01 | 69 | 1 | 15,056 | 3.7E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02765 | 5/25/13 | EMSL27 | NOT QC | 6/3/13 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,976 | 3.6E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02775 | 6/15/13 | Hygeia | NOT QC | 6/23/13 | TEM-ISO | Indirect - Ashed | 346 | 0.01 | 80 | 0.75 | 14,459 | 4.0E-05 | 3 | 2 | 2 | 1 | 1.2E-04 | 8.0E-05 | 8.0E-05 | 4.0E-05 |
| AA-02780 | 6/29/13 | Hygeia | NOT QC | 7/10/13 | TEM-ISO | Indirect - Ashed | 346 | 0.01 | 80 | 0.75 | 14,477 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02889 | 7/13/13 | ESATR8 | NOT QC | 7/24/13 | TEM-ISO | Direct | 385 | 0.0099 | 69 | 1 | 14,502 | 3.9E-05 | 2 | 2 | 1 | 1 | 7.8E-05 | 7.8E-05 | 3.9E-05 | 3.9E-05 |
| AA-02792 | 7/27/13 | ESATR8 | NOT QC | 8/6/13 | TEM-ISO | Direct | 385 | 0.0099 | 69 | 1 | 14,209 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02802 | 8/10/13 | ESATR8 | NOT QC | 8/22/13 | TEM-ISO | Direct | 385 | 0.0099 | 68 | 1 | 14,603 | 3.9E-05 | 1 | 0 | 0 | 0 | 3.9E-05 | 0 | 0 | 0 |
| AA-02905 | 8/24/13 | EMSL27 | NOT QC | 9/3/13 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,748 | 3.7E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Notes:**
QC - quality control
TEM - transmission electron microscopy
ISO - international organization for standardization
EFA - effective filter area
mm - millimeter
GO - grid opening
L - liter
cc - cubic centimeter
N - number of asbestos structures
LA - Libby amphibole
NaK - sodium/potassium
PCME - phase contrast microscopy-equivalent
s/cc - structures per cubic centimeter
n/a - not applicable

**Appendix E. Detailed Results of Ambient Air Samples Collected at 36304 US Highway 2**
*Libby Asbestos Superfund Site, Libby, Montana*

*Group:* South
*Original Station ID:* L6
*Revised Station ID:* L24

| Sample ID | Sample Date | Laboratory Name | Laboratory QC Type | Analysis Date | Analysis Method | Preparation Method | EFA ($mm^2$) | GO Size ($mm^2$) | GOs Counted | F-factor | Sample Volume (L) | Sensitivity (1/cc) | N Structures | | | | Air Concentration (s/cc) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | N Total LA | N PCME LA | N Total LA NaK | N PCME LA NaK | Total LA | PCME LA | Total LA NaK | PCME LA NaK |
| AA-01992 | 5/17/10 | EMSL27 | NOT QC | 5/27/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,129 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02014 | 6/2/10 | EMSL27 | NOT QC | 6/16/10 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,468 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02024 | 6/19/10 | EMSL27 | NOT QC | 7/16/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,128 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02047 | 7/11/10 | EMSL27 | NOT QC | 7/27/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,259 | 3.8E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02059 | 7/31/10 | EMSL27 | NOT QC | 8/4/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,620 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02075 | 8/14/10 | EMSL27 | NOT QC | 8/24/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,093 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02091 | 8/28/10 | EMSL27 | NOT QC | 9/10/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,662 | 3.9E-05 | 1 | 1 | 1 | 1 | 3.9E-05 | 3.9E-05 | 3.9E-05 | 3.9E-05 |
| AA-02115 | 9/11/10 | EMSL27 | NOT QC | 9/21/10 | TEM-ISO | Direct | 385 | 0.013 | 54 | 1 | 13,761 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02133 | 9/25/10 | EMSL27 | NOT QC | 10/6/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,570 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02147 | 10/9/10 | EMSL27 | NOT QC | 10/20/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,626 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02155 | 10/23/10 | EMSL27 | NOT QC | 11/5/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,670 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02169 | 11/6/10 | EMSL27 | NOT QC | 11/16/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,937 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02185 | 11/20/10 | EMSL27 | NOT QC | 11/30/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,162 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02203 | 12/20/10 | EMSL27 | NOT QC | 12/30/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,010 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02229 | 1/17/11 | EMSL27 | NOT QC | 2/8/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,043 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02245 | 2/20/11 | EMSL27 | NOT QC | 3/1/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 13,971 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02261 | 3/20/11 | EMSL27 | NOT QC | 3/31/11 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,035 | 3.8E-05 | 1 | 1 | 1 | 1 | 3.8E-05 | 3.8E-05 | 3.8E-05 | 3.8E-05 |
| AA-02275 | 4/16/11 | EMSL27 | NOT QC | 5/4/11 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,045 | 3.8E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Notes:**
QC - quality control
TEM - transmission electron microscopy
ISO - international organization for standardization
EFA - effective filter area
mm - millimeter
GO - grid opening
L - liter
cc - cubic centimeter
N - number of asbestos structures
LA - Libby amphibole
NaK - sodium/potassium
PCME - phase contrast microscopy-equivalent
s/cc - structures per cubic centimeter
n/a - not applicable

**Appendix E. Detailed Results of Ambient Air Samples Collected at 416 W Oak St**
*Libby Asbestos Superfund Site, Libby, Montana*

*Group:* North
*Original Station ID:* Mobile
*Revised Station ID:* Mobile 6

| Sample ID | Sample Date | Laboratory Name | Laboratory QC Type | Analysis Date | Analysis Method | Preparation Method | EFA ($mm^2$) | GO Size ($mm^2$) | GOs Counted | F-factor | Sample Volume (L) | Sensitivity (1/cc) | N Structures | | | | Air Concentration (s/cc) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | N Total LA | N PCME LA | N Total LA NaK | N PCME LA NaK | Total LA | PCME LA | Total LA NaK | PCME LA NaK |
| AA-02666 | 9/15/12 | Hygeia | NOT QC | 9/28/12 | TEM-ISO | Direct | 385 | 0.01 | 91 | 1 | 10,608 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02681 | 9/29/12 | ESATR8 | NOT QC | 10/19/12 | TEM-ISO | Direct | 385 | 0.0099 | 67 | 1 | 14,528 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Notes:**
QC - quality control
TEM - transmission electron microscopy
ISO - international organization for standardization
EFA - effective filter area
mm - millimeter
GO - grid opening
L - liter
cc - cubic centimeter
N - number of asbestos structures
LA - Libby amphibole
NaK - sodium/potassium
PCME - phase contrast microscopy-equivalent
s/cc - structures per cubic centimeter
n/a - not applicable

**Appendix E. Detailed Results of Ambient Air Samples Collected at 420 Spencer Rd**
*Libby Asbestos Superfund Site, Libby, Montana*

*Group:* Central
*Original Station ID:* Mobile
*Revised Station ID:* Mobile 4

| Sample ID | Sample Date | Laboratory Name | Laboratory QC Type | Analysis Date | Analysis Method | Preparation Method | EFA ($mm^2$) | GO Size ($mm^2$) | GOs Counted | F-factor | Sample Volume (L) | Sensitivity (1/cc) | N Structures | | | | Air Concentration (s/cc) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | N Total LA | N PCME LA | N Total LA NaK | N PCME LA NaK | Total LA | PCME LA | Total LA NaK | PCME LA NaK |
| AA-02563 | 6/16/12 | ESATR8 | NOT QC | 7/3/12 | TEM-ISO | Direct | 385 | 0.00983 | 68 | 1 | 14,732 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02579 | 6/30/12 | ESATR8 | NOT QC | 7/23/12 | TEM-ISO | Direct | 385 | 0.00983 | 67 | 1 | 14,647 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Notes:**
QC - quality control
TEM - transmission electron microscopy
ISO - international organization for standardization
EFA - effective filter area
mm - millimeter
GO - grid opening
L - liter
cc - cubic centimeter
N - number of asbestos structures
LA - Libby amphibole
NaK - sodium/potassium
PCME - phase contrast microscopy-equivalent
s/cc - structures per cubic centimeter
n/a - not applicable

**Appendix E. Detailed Results of Ambient Air Samples Collected at 60 Port Blvd**
*Libby Asbestos Superfund Site, Libby, Montana*

*Group:* Central
*Original Station ID:* L5
*Revised Station ID:* L8

| Sample ID | Sample Date | Laboratory Name | Laboratory QC Type | Analysis Date | Analysis Method | Preparation Method | EFA ($mm^2$) | GO Size ($mm^2$) | GOs Counted | F-factor | Sample Volume (L) | Sensitivity (1/cc) | N Structures | | | | Air Concentration (s/cc) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | N Total LA | N PCME LA | N Total LA NaK | N PCME LA NaK | Total LA | PCME LA | Total LA NaK | PCME LA NaK |
| AA-01990 | 5/17/10 | EMSL27 | NOT QC | 5/27/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,118 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02012 | 6/2/10 | EMSL27 | NOT QC | 6/15/10 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,211 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02030 | 6/19/10 | EMSL27 | NOT QC | 7/14/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,186 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02045 | 7/11/10 | EMSL27 | NOT QC | 7/28/10 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,261 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02067 | 7/31/10 | EMSL27 | NOT QC | 8/3/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,643 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02081 | 8/14/10 | EMSL27 | NOT QC | 8/19/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,091 | 3.8E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02097 | 8/28/10 | EMSL27 | NOT QC | 9/9/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,740 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02117 | 9/11/10 | EMSL27 | NOT QC | 9/21/10 | TEM-ISO | Direct | 385 | 0.013 | 54 | 1 | 13,751 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02129 | 9/25/10 | EMSL27 | NOT QC | 10/4/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,576 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02145 | 10/9/10 | EMSL27 | NOT QC | 10/18/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,639 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02153 | 10/23/10 | EMSL27 | NOT QC | 11/4/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,811 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02171 | 11/6/10 | EMSL27 | NOT QC | 11/15/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,801 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02197 | 11/20/10 | EMSL27 | NOT QC | 11/24/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,110 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02201 | 12/20/10 | EMSL27 | NOT QC | 12/21/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,010 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02217 | 1/17/11 | EMSL27 | NOT QC | 2/3/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,001 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02233 | 2/20/11 | EMSL27 | NOT QC | 2/28/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,037 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02249 | 3/20/11 | EMSL27 | NOT QC | 3/23/11 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,041 | 3.8E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02265 | 4/16/11 | EMSL27 | NOT QC | 5/3/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,052 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02288 | 7/2/11 | EMSL27 | NOT QC | 7/18/11 | TEM-ISO | Direct | 385 | 0.013 | 70 | 1 | 10,796 | 3.9E-05 | 1 | 1 | 1 | 1 | 3.9E-05 | 3.9E-05 | 3.9E-05 | 3.9E-05 |
| AA-02297 | 7/16/11 | EMSL27 | NOT QC | 8/1/11 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 15,300 | 3.5E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02322 | 7/30/11 | EMSL27 | NOT QC | 8/4/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,112 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02335 | 8/13/11 | EMSL27 | NOT QC | 8/31/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 15,198 | 3.8E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02348 | 8/27/11 | EMSL27 | NOT QC | 9/19/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,247 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02354 | 9/17/11 | EMSL27 | NOT QC | 10/4/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,489 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02368 | 10/1/11 | EMSL27 | NOT QC | 10/6/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 14,879 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02384 | 10/15/11 | EMSL27 | NOT QC | 10/27/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,400 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02402 | 10/29/11 | EMSL27 | NOT QC | 11/22/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,801 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02418 | 11/12/11 | EMSL27 | NOT QC | 12/1/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,807 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02432 | 11/19/11 | EMSL27 | NOT QC | 12/5/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,703 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02447 | 12/17/11 | EMSL27 | NOT QC | 1/9/12 | TEM-ISO | Direct | 385 | 0.013 | 65 | 1 | 11,781 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02460 | 1/21/12 | EMSL27 | NOT QC | 2/9/12 | TEM-ISO | Direct | 385 | 0.013 | 48 | 1 | 15,764 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02474 | 2/18/12 | EMSL27 | NOT QC | 3/8/12 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,270 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02490 | 3/17/12 | EMSL27 | NOT QC | 4/5/12 | TEM-ISO | Direct | 385 | 0.013 | 51 | 1 | 14,766 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02506 | 4/14/12 | EMSL27 | NOT QC | 4/26/12 | TEM-ISO | Direct | 385 | 0.013 | 51 | 1 | 14,798 | 3.9E-05 | 1 | 1 | 1 | 1 | 3.9E-05 | 3.9E-05 | 3.9E-05 | 3.9E-05 |
| AA-02518 | 5/5/12 | EMSL27 | NOT QC | 5/21/12 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,989 | 3.8E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02534 | 5/26/12 | RESI | NOT QC | 6/21/12 | TEM-ISO | Direct | 385 | 0.01 | 70 | 1 | 14,749 | 3.7E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02550 | 6/16/12 | ESATR8 | NOT QC | 6/27/12 | TEM-ISO | Direct | 385 | 0.00983 | 68 | 1 | 14,666 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02566 | 6/30/12 | ESATR8 | NOT QC | 7/17/12 | TEM-ISO | Direct | 385 | 0.00983 | 68 | 1 | 14,821 | 3.9E-05 | 1 | 1 | 1 | 1 | 3.9E-05 | 3.9E-05 | 3.9E-05 | 3.9E-05 |
| AA-02592 | 7/14/12 | RESI | NOT QC | 7/28/12 | TEM-ISO | Direct | 385 | 0.01 | 78 | 1 | 14,083 | 3.5E-05 | 1 | 0 | 0 | 0 | 3.5E-05 | 0 | 0 | 0 |
| AA-02602 | 7/28/12 | Hygeia | NOT QC | 8/6/12 | TEM-ISO | Direct | 385 | 0.0097 | 66 | 1 | 15,234 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02616 | 8/11/12 | EMSL22 | NOT QC | 8/20/12 | TEM-ISO | Direct | 385 | 0.0129 | 53 | 1 | 14,099 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02634 | 8/25/12 | RESI | NOT QC | 8/31/12 | TEM-ISO | Direct | 385 | 0.01 | 65 | 1 | 14,931 | 4.0E-05 | 3 | 0 | 0 | 0 | 1.2E-04 | 0 | 0 | 0 |
| AA-02652 | 9/15/12 | Hygeia | NOT QC | 10/1/12 | TEM-ISO | Indirect - Ashed | 346 | 0.01 | 78 | 0.75 | 14,891 | 4.0E-05 | 1 | 0 | 0 | 0 | 4.0E-05 | 0 | 0 | 0 |
| AA-02672 | 9/29/12 | ESATR8 | NOT QC | 10/17/12 | TEM-ISO | Direct | 385 | 0.0099 | 67 | 1 | 14,687 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02690 | 10/13/12 | ESATR8 | NOT QC | 11/1/12 | TEM-ISO | Direct | 385 | 0.0099 | 69 | 1 | 14,287 | 3.9E-05 | 2 | 1 | 1 | 0 | 7.9E-05 | 3.9E-05 | 3.9E-05 | 0 |
| AA-02704 | 10/25/12 | Hygeia | NOT QC | 11/2/12 | TEM-ISO | Direct | 385 | 0.01 | 97 | 1 | 10,125 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02720 | 11/17/12 | RESI | NOT QC | 12/3/12 | TEM-ISO | Direct | 385 | 0.01 | 64 | 1 | 15,054 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02820 | 12/15/12 | RESI | NOT QC | 12/27/12 | TEM-ISO | Direct | 385 | 0.01 | 79 | 1 | 14,902 | 3.3E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02836 | 1/19/13 | ESATR8 | NOT QC | 2/5/13 | TEM-ISO | Direct | 385 | 0.0099 | 66 | 1 | 14,841 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02852 | 2/16/13 | RESI | NOT QC | 2/22/13 | TEM-ISO | Direct | 385 | 0.01 | 85 | 1 | 15,211 | 3.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02869 | 3/16/13 | Hygeia | NOT QC | 3/22/13 | TEM-ISO | Direct | 385 | 0.01 | 94 | 1 | 10,295 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Notes:**
QC - quality control
TEM - transmission electron microscopy
ISO - international organization for standardization
EFA - effective filter area
mm - millimeter
GO - grid opening
L - liter
cc - cubic centimeter
N - number of asbestos structures
LA - Libby amphibole
NaK - sodium/potassium
PCME - phase contrast microscopy-equivalent
s/cc - structures per cubic centimeter
n/a - not applicable

**Appendix E. Detailed Results of Ambient Air Samples Collected at 67 Reese Ct**
*Libby Asbestos Superfund Site, Libby, Montana*

*Group:* Central
*Original Station ID:* Mobile
*Revised Station ID:* Mobile 7

| Sample ID | Sample Date | Laboratory Name | Laboratory QC Type | Analysis Date | Analysis Method | Preparation Method | EFA ($mm^2$) | GO Size ($mm^2$) | GOs Counted | F-factor | Sample Volume (L) | Sensitivity (1/cc) | N Structures | | | | Air Concentration (s/cc) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | N Total LA | N PCME LA | N Total LA NaK | N PCME LA NaK | Total LA | PCME LA | Total LA NaK | PCME LA NaK |
| AA-02618 | 8/11/12 | EMSL22 | NOT QC | 8/22/12 | TEM-ISO | Direct | 385 | 0.0129 | 53 | 1 | 14,104 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02636 | 8/25/12 | RESI | NOT QC | 8/31/12 | TEM-ISO | Direct | 385 | 0.01 | 65 | 1 | 14,827 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Notes:**
QC - quality control
TEM - transmission electron microscopy
ISO - international organization for standardization
EFA - effective filter area
mm - millimeter
GO - grid opening
L - liter
cc - cubic centimeter
N - number of asbestos structures
LA - Libby amphibole
NaK - sodium/potassium
PCME - phase contrast microscopy-equivalent
s/cc - structures per cubic centimeter
n/a - not applicable

**Appendix E. Detailed Results of Ambient Air Samples Collected at 875 US Highway 2**
*Libby Asbestos Superfund Site, Libby, Montana*

*Group:* Central
*Original Station ID:* Mobile
*Revised Station ID:* Mobile 5

| Sample ID | Sample Date | Laboratory Name | Laboratory QC Type | Analysis Date | Analysis Method | Preparation Method | EFA ($mm^2$) | GO Size ($mm^2$) | GOs Counted | F-factor | Sample Volume (L) | Sensitivity (1/cc) | N Structures | | | | Air Concentration (s/cc) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | N Total LA | N PCME LA | N Total LA NaK | N PCME LA NaK | Total LA | PCME LA | Total LA NaK | PCME LA NaK |
| AA-02590 | 7/14/12 | RESI | NOT QC | 7/28/12 | TEM-ISO | Direct | 385 | 0.01 | 79 | 1 | 14,093 | 3.5E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02600 | 7/28/12 | Hygeia | NOT QC | 8/4/12 | TEM-ISO | Direct | 385 | 0.0097 | 66 | 1 | 15,154 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Notes:**
QC - quality control
TEM - transmission electron microscopy
ISO - international organization for standardization
EFA - effective filter area
mm - millimeter
GO - grid opening
L - liter
cc - cubic centimeter
N - number of asbestos structures
LA - Libby amphibole
NaK - sodium/potassium
PCME - phase contrast microscopy-equivalent
s/cc - structures per cubic centimeter
n/a - not applicable

**Appendix E. Detailed Results of Ambient Air Samples Collected at 933 Farm to Market Rd**
*Libby Asbestos Superfund Site, Libby, Montana*

*Group:* South
*Original Station ID:* L8
*Revised Station ID:* L12

| Sample ID | Sample Date | Laboratory Name | Laboratory QC Type | Analysis Date | Analysis Method | Preparation Method | EFA ($mm^2$) | GO Size ($mm^2$) | GOs Counted | F-factor | Sample Volume (L) | Sensitivity (1/cc) | N Structures | | | | Air Concentration (s/cc) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | N Total LA | N PCME LA | N Total LA NaK | N PCME LA NaK | Total LA | PCME LA | Total LA NaK | PCME LA NaK |
| AA-02631 | 8/11/12 | EMSL22 | NOT QC | 8/28/12 | TEM-ISO | Direct | 385 | 0.0129 | 53 | 1 | 14,172 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02639 | 8/25/12 | RESI | NOT QC | 9/4/12 | TEM-ISO | Direct | 385 | 0.01 | 109 | 1 | 10,579 | 3.3E-05 | 1 | 0 | 1 | 0 | 3.3E-05 | 0 | 3.3E-05 | 0 |
| AA-02658 | 9/15/12 | Hygeia | NOT QC | 9/27/12 | TEM-ISO | Direct | 385 | 0.01 | 92 | 1 | 10,538 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02670 | 9/29/12 | ESATR8 | NOT QC | 10/16/12 | TEM-ISO | Direct | 385 | 0.0099 | 67 | 1 | 14,649 | 4.0E-05 | 1 | 1 | 0 | 0 | 4.0E-05 | 4.0E-05 | 0 | 0 |
| AA-02688 | 10/13/12 | ESATR8 | NOT QC | 10/31/12 | TEM-ISO | Direct | 385 | 0.0099 | 68 | 1 | 14,304 | 4.0E-05 | 1 | 1 | 1 | 1 | 4.0E-05 | 4.0E-05 | 4.0E-05 | 4.0E-05 |
| AA-02715 | 10/27/12 | Hygeia | NOT QC | 11/5/12 | TEM-ISO | Direct | 385 | 0.01 | 91 | 1 | 10,596 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02722 | 11/17/12 | RESI | NOT QC | 12/3/12 | TEM-ISO | Direct | 385 | 0.01 | 65 | 1 | 14,927 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02833 | 12/15/12 | RESI | NOT QC | 1/1/13 | TEM-ISO | Direct | 385 | 0.01 | 85 | 1 | 14,799 | 3.1E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02839 | 1/19/13 | ESATR8 | NOT QC | 2/6/13 | TEM-ISO | Direct | 385 | 0.0099 | 95 | 1 | 10,265 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02857 | 2/16/13 | RESI | NOT QC | 2/22/13 | TEM-ISO | Direct | 385 | 0.01 | 78 | 1 | 15,230 | 3.2E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02871 | 3/16/13 | Hygeia | NOT QC | 3/22/13 | TEM-ISO | Direct | 385 | 0.01 | 95 | 1 | 10,208 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02744 | 4/27/13 | EMSL27 | NOT QC | 5/6/13 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,781 | 3.6E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02757 | 5/11/13 | RESI | NOT QC | 5/18/13 | TEM-ISO | Direct | 385 | 0.01 | 69 | 1 | 15,060 | 3.7E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02767 | 5/25/13 | EMSL27 | NOT QC | 6/3/13 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,976 | 3.6E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02770 | 6/15/13 | Hygeia | NOT QC | 6/22/13 | TEM-ISO | Indirect - Ashed | 346 | 0.01 | 80 | 0.75 | 14,439 | 4.0E-05 | 1 | 0 | 0 | 0 | 4.0E-05 | 0 | 0 | 0 |
| AA-02786 | 6/29/13 | Hygeia | NOT QC | 7/6/13 | TEM-ISO | Direct | 385 | 0.01 | 95 | 1 | 10,206 | 4.0E-05 | 2 | 2 | 0 | 0 | 7.9E-05 | 7.9E-05 | 0 | 0 |
| AA-02884 | 7/13/13 | ESATR8 | NOT QC | 7/23/13 | TEM-ISO | Direct | 385 | 0.0099 | 69 | 1 | 14,502 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02790 | 7/27/13 | ESATR8 | NOT QC | 8/5/13 | TEM-ISO | Direct | 385 | 0.0099 | 69 | 1 | 14,219 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02804 | 8/10/13 | ESATR8 | NOT QC | 8/21/13 | TEM-ISO | Direct | 385 | 0.0099 | 68 | 1 | 14,526 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02900 | 8/24/13 | EMSL27 | NOT QC | 9/3/13 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,649 | 3.7E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Notes:**
QC - quality control
TEM - transmission electron microscopy
ISO - international organization for standardization
EFA - effective filter area
mm - millimeter
GO - grid opening
L - liter
cc - cubic centimeter
N - number of asbestos structures
LA - Libby amphibole
NaK - sodium/potassium
PCME - phase contrast microscopy-equivalent
s/cc - structures per cubic centimeter
n/a - not applicable

**Appendix E. Detailed Results of Ambient Air Samples Collected at Lincoln Blvd & Mineral Ave**
*Libby Asbestos Superfund Site, Libby, Montana*

*Group:* North
*Original Station ID:* L7
*Revised Station ID:* L25

| Sample ID | Sample Date | Laboratory Name | Laboratory QC Type | Analysis Date | Analysis Method | Preparation Method | EFA ($mm^2$) | GO Size ($mm^2$) | GOs Counted | F-factor | Sample Volume (L) | Sensitivity (1/cc) | N Structures | | | | Air Concentration (s/cc) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | N Total LA | N PCME LA | N Total LA NaK | N PCME LA NaK | Total LA | PCME LA | Total LA NaK | PCME LA NaK |
| AA-02282 | 7/2/11 | EMSL27 | NOT QC | 7/25/11 | TEM-ISO | Direct | 385 | 0.013 | 70 | 1 | 10,803 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02300 | 7/16/11 | EMSL27 | NOT QC | 8/2/11 | TEM-ISO | Direct | 385 | 0.013 | 73 | 1 | 10,563 | 3.8E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02320 | 7/30/11 | EMSL27 | NOT QC | 8/10/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,198 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02331 | 8/13/11 | EMSL27 | NOT QC | 9/7/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,225 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02344 | 8/27/11 | EMSL27 | NOT QC | 9/19/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,255 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02364 | 9/17/11 | EMSL27 | NOT QC | 10/5/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,446 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02374 | 10/1/11 | EMSL27 | NOT QC | 10/12/11 | TEM-ISO | Direct | 385 | 0.013 | 51 | 1 | 14,629 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02388 | 10/15/11 | EMSL27 | NOT QC | 10/28/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,240 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02404 | 10/29/11 | EMSL27 | NOT QC | 11/22/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,754 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02420 | 11/12/11 | EMSL27 | NOT QC | 12/1/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,795 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02437 | 11/19/11 | EMSL27 | NOT QC | 12/2/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,690 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02454 | 12/17/11 | EMSL27 | NOT QC | 1/9/12 | TEM-ISO | Indirect - Ashed | 360 | 0.013 | 92 | 0.5 | 15,151 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02462 | 1/21/12 | EMSL27 | NOT QC | 2/9/12 | TEM-ISO | Direct | 385 | 0.013 | 48 | 1 | 15,760 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02476 | 2/18/12 | EMSL27 | NOT QC | 3/8/12 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,262 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02492 | 3/17/12 | EMSL27 | NOT QC | 4/5/12 | TEM-ISO | Direct | 385 | 0.013 | 51 | 1 | 14,770 | 3.9E-05 | 1 | 0 | 1 | 0 | 3.9E-05 | 0 | 3.9E-05 | 0 |
| AA-02511 | 4/14/12 | EMSL27 | NOT QC | 5/2/12 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,881 | 3.6E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02520 | 5/5/12 | EMSL27 | NOT QC | 5/21/12 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,991 | 3.8E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02536 | 5/26/12 | RESI | NOT QC | 6/21/12 | TEM-ISO | Direct | 385 | 0.01 | 70 | 1 | 14,743 | 3.7E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02555 | 6/16/12 | ESATR8 | NOT QC | 6/28/12 | TEM-ISO | Direct | 385 | 0.00983 | 68 | 1 | 14,738 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02568 | 6/30/12 | ESATR8 | NOT QC | 7/18/12 | TEM-ISO | Direct | 385 | 0.00983 | 68 | 1 | 14,817 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02583 | 7/14/12 | RESI | NOT QC | 7/27/12 | TEM-ISO | Direct | 385 | 0.01 | 92 | 1 | 11,180 | 3.7E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02604 | 7/28/12 | Hygeia | NOT QC | 8/6/12 | TEM-ISO | Direct | 385 | 0.0097 | 66 | 1 | 15,192 | 4.0E-05 | 1 | 1 | 0 | 0 | 4.0E-05 | 4.0E-05 | 0 | 0 |
| AA-02620 | 8/11/12 | EMSL22 | NOT QC | 8/22/12 | TEM-ISO | Direct | 385 | 0.0129 | 53 | 1 | 14,112 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02640 | 8/25/12 | RESI | NOT QC | 9/5/12 | TEM-ISO | Direct | 385 | 0.01 | 85 | 1 | 14,770 | 3.1E-05 | 1 | 0 | 0 | 0 | 3.1E-05 | 0 | 0 | 0 |
| AA-02659 | 9/15/12 | Hygeia | NOT QC | 10/1/12 | TEM-ISO | Indirect - Ashed | 346 | 0.01 | 234 | 0.25 | 14,800 | 4.0E-05 | 12 | 7 | 3 | 1 | 4.8E-04 | 2.8E-04 | 1.2E-04 | 4.0E-05 |
| AA-02683 | 9/29/12 | ESATR8 | NOT QC | 10/19/12 | TEM-ISO | Direct | 385 | 0.0099 | 68 | 1 | 14,461 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02692 | 10/13/12 | ESATR8 | NOT QC | 11/1/12 | TEM-ISO | Direct | 385 | 0.0099 | 69 | 1 | 14,160 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02707 | 10/27/12 | Hygeia | NOT QC | 11/5/12 | TEM-ISO | Direct | 385 | 0.01 | 91 | 1 | 10,692 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02726 | 11/17/12 | RESI | NOT QC | 12/6/12 | TEM-ISO | Direct | 385 | 0.01 | 66 | 1 | 15,084 | 3.9E-05 | 1 | 1 | 0 | 0 | 3.9E-05 | 3.9E-05 | 0 | 0 |
| AA-02822 | 12/15/12 | RESI | NOT QC | 12/28/12 | TEM-ISO | Direct | 385 | 0.01 | 77 | 1 | 14,893 | 3.4E-05 | 1 | 0 | 0 | 0 | 3.4E-05 | 0 | 0 | 0 |
| AA-02841 | 1/19/13 | ESATR8 | NOT QC | 2/6/13 | TEM-ISO | Direct | 385 | 0.0099 | 96 | 1 | 10,215 | 4.0E-05 | 2 | 0 | 2 | 0 | 7.9E-05 | 0 | 7.9E-05 | 0 |
| AA-02859 | 2/16/13 | RESI | NOT QC | 3/2/13 | TEM-ISO | Indirect - Ashed | 346 | 0.01 | 465 | 0.125 | 15,240 | 3.9E-05 | 69 | 9 | 35 | 6 | 2.7E-03 | 3.5E-04 | 1.4E-03 | 2.3E-04 |
| AA-02875 | 3/16/13 | Hygeia | NOT QC | 3/28/13 | TEM-ISO | Indirect - Ashed | 346 | 0.01 | 234 | 0.25 | 14,843 | 4.0E-05 | 22 | 4 | 15 | 2 | 8.8E-04 | 1.6E-04 | 6.0E-04 | 8.0E-05 |

**Notes:**
QC - quality control
TEM - transmission electron microscopy
ISO - international organization for standardization
EFA - effective filter area
mm - millimeter
GO - grid opening
L - liter
cc - cubic centimeter
N - number of asbestos structures
LA - Libby amphibole
NaK - sodium/potassium
PCME - phase contrast microscopy-equivalent
s/cc - structures per cubic centimeter
n/a - not applicable

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**Appendix E. Detailed Results of Ambient Air Field Blanks**
*Libby Asbestos Superfund Site, Libby, Montana*

| Sample ID | Sample Date | Sample Type | Laboratory Name | Laboratory QC Type | Analysis Date | Analysis Method | Preparation Method | EFA ($mm^2$) | GO Size ($mm^2$) | GOs Counted | F-factor | N Structures | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | N Total LA | N PCME LA |
| AA-02006 | 5/17/10 | Field Blank | EMSL27 | NOT QC | 6/1/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02019 | 6/2/10 | Field Blank | EMSL27 | NOT QC | 6/16/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02038 | 6/19/10 | Field Blank | EMSL27 | NOT QC | 7/20/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02053 | 7/11/10 | Field Blank | EMSL27 | NOT QC | 7/21/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02071 | 7/31/10 | Field Blank | EMSL27 | NOT QC | 8/4/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02085 | 8/14/10 | Field Blank | EMSL27 | NOT QC | 8/25/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02103 | 8/28/10 | Field Blank | EMSL27 | NOT QC | 9/10/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02120 | 9/11/10 | Field Blank | EMSL27 | NOT QC | 10/13/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02135 | 9/25/10 | Field Blank | EMSL27 | NOT QC | 10/6/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02151 | 10/9/10 | Field Blank | EMSL27 | NOT QC | 10/21/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02167 | 10/23/10 | Field Blank | EMSL27 | NOT QC | 11/5/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02184 | 11/6/10 | Field Blank | EMSL27 | NOT QC | 11/17/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02199 | 11/16/10 | Field Blank | EMSL27 | NOT QC | 12/1/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02216 | 12/20/10 | Field Blank | EMSL27 | NOT QC | 1/3/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02232 | 1/17/11 | Field Blank | EMSL27 | NOT QC | 2/3/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02247 | 2/20/11 | Field Blank | EMSL27 | NOT QC | 2/28/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02263 | 3/20/11 | Field Blank | EMSL27 | NOT QC | 3/31/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02279 | 4/16/11 | Field Blank | EMSL27 | NOT QC | 5/4/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02296 | 7/2/11 | Field Blank | EMSL27 | NOT QC | 7/18/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02309 | 7/16/11 | Field Blank | EMSL27 | NOT QC | 8/1/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02317 | 7/30/11 | Field Blank | EMSL27 | NOT QC | 8/10/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02337 | 8/13/11 | Field Blank | EMSL27 | NOT QC | 8/31/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02350 | 8/27/11 | Field Blank | EMSL27 | NOT QC | 9/19/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02366 | 9/17/11 | Field Blank | EMSL27 | NOT QC | 10/5/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02382 | 10/1/11 | Field Blank | EMSL27 | NOT QC | 10/12/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02390 | 10/15/11 | Field Blank | EMSL27 | NOT QC | 10/28/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02408 | 10/29/11 | Field Blank | EMSL27 | NOT QC | 11/22/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02422 | 11/12/11 | Field Blank | EMSL27 | NOT QC | 12/1/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02434 | 11/19/11 | Field Blank | EMSL27 | NOT QC | 12/5/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02459 | 12/17/11 | Field Blank | EMSL27 | NOT QC | 1/9/12 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02472 | 1/21/12 | Field Blank | EMSL27 | NOT QC | 2/10/12 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02487 | 2/18/12 | Field Blank | EMSL27 | NOT QC | 3/15/12 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02502 | 3/17/12 | Field Blank | EMSL27 | NOT QC | 4/5/12 | TEM-ISO | Direct | 385 | 0.013 | 8 | 1 | 0 | 0 |
| AA-02508 | 4/14/12 | Field Blank | EMSL27 | NOT QC | 4/24/12 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02528 | 5/5/12 | Field Blank | EMSL27 | NOT QC | 5/18/12 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02546 | 5/26/12 | Field Blank | RESI | NOT QC | 6/22/12 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02554 | 6/16/12 | Field Blank | ESATR8 | NOT QC | 6/28/12 | TEM-ISO | Direct | 385 | 0.00983 | 11 | 1 | 0 | 0 |
| AA-02572 | 6/30/12 | Field Blank | ESATR8 | NOT QC | 7/19/12 | TEM-ISO | Direct | 385 | 0.00983 | 11 | 1 | 0 | 0 |
| AA-02594 | 7/14/12 | Field Blank | RESI | NOT QC | 7/28/12 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02610 | 7/28/12 | Field Blank | Hygeia | NOT QC | 8/6/12 | TEM-ISO | Direct | 385 | 0.0097 | 11 | 1 | 0 | 0 |
| AA-02630 | 8/11/12 | Field Blank | EMSL22 | NOT QC | 8/28/12 | TEM-ISO | Direct | 385 | 0.0129 | 10 | 1 | 0 | 0 |
| AA-02642 | 8/25/12 | Field Blank | RESI | NOT QC | 9/5/12 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02654 | 9/15/12 | Field Blank | Hygeia | NOT QC | 9/26/12 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02678 | 9/29/12 | Field Blank | ESATR8 | NOT QC | 10/18/12 | TEM-ISO | Direct | 385 | 0.0099 | 11 | 1 | 0 | 0 |

**Appendix E. Detailed Results of Ambient Air Field Blanks**
*Libby Asbestos Superfund Site, Libby, Montana*

| Sample ID | Sample Date | Sample Type | Laboratory Name | Laboratory QC Type | Analysis Date | Analysis Method | Preparation Method | EFA ($mm^2$) | GO Size ($mm^2$) | GOs Counted | F-factor | N Structures | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | N Total LA | N PCME LA |
| AA-02698 | 10/13/12 | Field Blank | ESATR8 | NOT QC | 11/13/12 | TEM-ISO | Direct | 385 | 0.0099 | 11 | 1 | 0 | 0 |
| AA-02716 | 10/27/12 | Field Blank | Hygeia | NOT QC | 11/6/12 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02732 | 11/17/12 | Field Blank | RESI | NOT QC | 12/6/12 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02824 | 12/15/12 | Field Blank | RESI | NOT QC | 12/31/12 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02844 | 1/19/13 | Field Blank | ESATR8 | NOT QC | 2/8/13 | TEM-ISO | Direct | 385 | 0.0099 | 11 | 1 | 0 | 0 |
| AA-02854 | 2/16/13 | Field Blank | RESI | NOT QC | 2/22/13 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02872 | 3/16/13 | Field Blank | Hygeia | NOT QC | 3/25/13 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02746 | 4/27/13 | Field Blank | EMSL27 | NOT QC | 5/6/13 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02754 | 5/11/13 | Field Blank | RESI | NOT QC | 5/18/13 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02762 | 5/25/13 | Field Blank | EMSL27 | NOT QC | 6/3/13 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02772 | 6/15/13 | Field Blank | Hygeia | NOT QC | 6/22/13 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02782 | 6/29/13 | Field Blank | Hygeia | NOT QC | 7/6/13 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02796 | 7/27/13 | Field Blank | ESATR8 | NOT QC | 8/7/13 | TEM-ISO | Direct | 385 | 0.0099 | 11 | 1 | 0 | 0 |
| AA-02810 | 8/10/13 | Field Blank | ESATR8 | NOT QC | 8/20/13 | TEM-ISO | Direct | 385 | 0.0099 | 11 | 1 | 0 | 0 |
| AA-02886 | 7/13/13 | Field Blank | ESATR8 | NOT QC | 7/25/13 | TEM-ISO | Direct | 385 | 0.0099 | 11 | 1 | 0 | 0 |
| AA-02902 | 8/24/13 | Field Blank | EMSL27 | NOT QC | 9/3/13 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |

**Notes:**
QC - quality control
TEM - transmission electron microscopy
ISO - international organization for standardization
EFA - effective filter area
mm - millimeter
GO - grid opening
L - liter
cc - cubic centimeter
N - number of asbestos structures
LA - Libby amphibole
PCME - phase contrast microscopy-equivalent
s/cc - structures per cubic centimeter

**Appendix E. Detailed Results of Ambient Air Field Duplicates**
*Libby Asbestos Superfund Site, Libby, Montana*

| | | | | | | | | | | | | | | | N Structures | | | | Air Concentration (s/cc) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | Sample Date | Sample Type | Parent ID | Laboratory Name | Laboratory QC Type | Analysis Date | Analysis Method | Preparation Method | EFA ($mm^2$) | GO Size ($mm^2$) | GOs Counted | F-factor | Sample Volume (L) | Sensitivity (1/cc) | N Total LA | N PCME LA | N Total LA NaK | N PCME LA NaK | Total LA | PCME LA | Total LA NaK | PCME LA NaK |
| AA-01998 | 5/17/10 | Field Sample | AA-01986 | EMSL27 | NOT QC | 6/1/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,047 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02022 | 6/2/10 | Field Sample | AA-02010 | EMSL27 | NOT QC | 6/15/10 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,400 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02032 | 6/19/10 | Field Sample | AA-02030 | EMSL27 | NOT QC | 7/14/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,186 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02051 | 7/11/10 | Field Sample | AA-02049 | EMSL27 | NOT QC | 7/27/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,265 | 3.8E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02061 | 7/31/10 | Field Sample | AA-02059 | EMSL27 | NOT QC | 8/4/10 | TEM-ISO | Direct | 385 | 0.013 | 108 | 1 | 8,062 | 3.4E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02087 | 8/14/10 | Field Sample | AA-02073 | EMSL27 | NOT QC | 8/24/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 13,991 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02102 | 8/28/10 | Field Sample | AA-02096 | EMSL27 | NOT QC | 10/1/10 | TEM-ISO | Direct | 385 | 0.013 | 70 | 1 | 10,817 | 3.9E-05 | 3 | 2 | 3 | 2 | 1.2E-04 | 7.8E-05 | 1.2E-04 | 3.1E-09 |
| AA-02113 | 9/11/10 | Field Sample | AA-02111 | EMSL27 | NOT QC | 9/21/10 | TEM-ISO | Direct | 385 | 0.013 | 54 | 1 | 13,745 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02131 | 9/25/10 | Field Sample | AA-02129 | EMSL27 | NOT QC | 10/6/10 | TEM-ISO | Direct | 385 | 0.013 | 62 | 1 | 12,028 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02149 | 10/9/10 | Field Sample | AA-02147 | EMSL27 | NOT QC | 10/21/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,626 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02161 | 10/23/10 | Field Sample | AA-02159 | EMSL27 | NOT QC | 11/5/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,893 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02178 | 11/6/10 | Field Sample | AA-02180 | EMSL27 | NOT QC | 11/17/10 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,906 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02187 | 11/20/10 | Field Sample | AA-02185 | EMSL27 | NOT QC | 11/30/10 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,162 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02207 | 12/20/10 | Field Sample | AA-02205 | EMSL27 | NOT QC | 1/3/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,021 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02223 | 1/17/11 | Field Sample | AA-02221 | EMSL27 | NOT QC | 2/4/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,014 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02241 | 2/20/11 | Field Sample | AA-02239 | EMSL27 | NOT QC | 3/1/11 | TEM-ISO | Direct | 385 | 0.013 | 53 | 1 | 14,005 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02259 | 3/20/11 | Field Sample | AA-02257 | EMSL27 | NOT QC | 3/30/11 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,035 | 3.8E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02277 | 4/16/11 | Field Sample | AA-02275 | EMSL27 | NOT QC | 5/4/11 | TEM-ISO | Direct | 385 | 0.013 | 54 | 1 | 14,045 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02305 | 7/16/11 | Field Sample | AA-02303 | EMSL27 | NOT QC | 8/1/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,304 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02333 | 8/13/11 | Field Sample | AA-02331 | EMSL27 | NOT QC | 9/7/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,223 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02351 | 8/27/11 | Field Sample | AA-02348 | EMSL27 | NOT QC | 9/19/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,247 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02360 | 9/17/11 | Field Sample | AA-02358 | EMSL27 | NOT QC | 10/5/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,485 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02372 | 10/1/11 | Field Sample | AA-02370 | EMSL27 | NOT QC | 10/12/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 14,824 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02386 | 10/15/11 | Field Sample | AA-02388 | EMSL27 | NOT QC | 10/28/11 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,240 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02409 | 10/29/11 | Field Sample | AA-02406 | EMSL27 | NOT QC | 11/22/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,696 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02423 | 11/12/11 | Field Sample | AA-02420 | EMSL27 | NOT QC | 12/1/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,795 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02435 | 11/19/11 | Field Sample | AA-02432 | EMSL27 | NOT QC | 12/5/11 | TEM-ISO | Direct | 385 | 0.013 | 52 | 1 | 14,703 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02450 | 12/17/11 | Field Sample | AA-02448 | EMSL27 | NOT QC | 1/9/12 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,210 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02470 | 1/21/12 | Field Sample | AA-02468 | EMSL27 | NOT QC | 2/10/12 | TEM-ISO | Direct | 385 | 0.013 | 48 | 1 | 15,753 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02478 | 2/18/12 | Field Sample | AA-02476 | EMSL27 | NOT QC | 3/8/12 | TEM-ISO | Direct | 385 | 0.013 | 50 | 1 | 15,262 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02498 | 3/17/12 | Field Sample | AA-02496 | EMSL27 | NOT QC | 4/9/12 | TEM-ISO | Direct | 385 | 0.013 | 51 | 1 | 14,764 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02509 | 4/14/12 | Field Sample | AA-02506 | EMSL27 | NOT QC | 4/27/12 | TEM-ISO | Direct | 385 | 0.013 | 74 | 1 | 14,798 | 2.7E-05 | 3 | 0 | 3 | 0 | 8.1E-05 | 0 | 8.1E-05 | 0 |
| AA-02526 | 5/5/12 | Field Sample | AA-02524 | EMSL27 | NOT QC | 5/18/12 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 13,977 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02547 | 5/26/12 | Field Sample | AA-02544 | RESI | NOT QC | 6/21/12 | TEM-ISO | Direct | 385 | 0.01 | 70 | 1 | 14,745 | 3.7E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02552 | 6/16/12 | Field Sample | AA-02555 | ESATR8 | NOT QC | 6/28/12 | TEM-ISO | Direct | 385 | 0.00983 | 68 | 1 | 14,738 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02574 | 6/30/12 | Field Sample | AA-02570 | ESATR8 | NOT QC | 7/19/12 | TEM-ISO | Direct | 385 | 0.00983 | 98 | 1 | 10,160 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02595 | 7/14/12 | Field Sample | AA-02592 | RESI | NOT QC | 7/28/12 | TEM-ISO | Direct | 385 | 0.01 | 80 | 1 | 14,083 | 3.4E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02611 | 7/28/12 | Field Sample | AA-02608 | Hygeia | NOT QC | 8/6/12 | TEM-ISO | Direct | 385 | 0.0097 | 66 | 1 | 15,118 | 4.0E-05 | 7 | 4 | 5 | 2 | 2.8E-04 | 1.6E-04 | 2.0E-04 | 6.3E-09 |
| AA-02626 | 8/11/12 | Field Sample | AA-02628 | EMSL22 | NOT QC | 8/25/12 | TEM-ISO | Direct | 385 | 0.0129 | 53 | 1 | 14,148 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02643 | 8/25/12 | Field Sample | AA-02640 | RESI | NOT QC | 8/31/12 | TEM-ISO | Direct | 385 | 0.01 | 77 | 1 | 14,770 | 3.4E-05 | 1 | 1 | 1 | 1 | 3.4E-05 | 3.4E-05 | 3.4E-05 | 1.1E-09 |
| AA-02656 | 9/15/12 | Field Sample | AA-02652 | Hygeia | NOT QC | 9/26/12 | TEM-ISO | Direct | 385 | 0.01 | 92 | 1 | 10,606 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02679 | 9/29/12 | Field Sample | AA-02676 | ESATR8 | NOT QC | 10/18/12 | TEM-ISO | Direct | 385 | 0.0099 | 67 | 1 | 14,573 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02699 | 10/13/12 | Field Sample | AA-02696 | ESATR8 | NOT QC | 11/13/12 | TEM-ISO | Direct | 385 | 0.0099 | 69 | 1 | 14,150 | 4.0E-05 | 1 | 0 | 1 | 0 | 4.0E-05 | 0 | 4.0E-05 | 0 |
| AA-02718 | 10/27/12 | Field Sample | AA-02715 | Hygeia | NOT QC | 11/6/12 | TEM-ISO | Direct | 385 | 0.01 | 91 | 1 | 10,596 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02733 | 11/17/12 | Field Sample | AA-02730 | RESI | NOT QC | 12/7/12 | TEM-ISO | Direct | 385 | 0.01 | 75 | 1 | 14,982 | 3.4E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02825 | 12/15/12 | Field Sample | AA-02822 | RESI | NOT QC | 12/31/12 | TEM-ISO | Direct | 385 | 0.01 | 85 | 1 | 14,893 | 3.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02845 | 1/19/13 | Field Sample | AA-02843 | ESATR8 | NOT QC | 2/4/13 | TEM-ISO | Direct | 385 | 0.0099 | 66 | 1 | 14,768 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02855 | 2/16/13 | Field Sample | AA-02852 | RESI | NOT QC | 2/22/13 | TEM-ISO | Direct | 385 | 0.01 | 64 | 1 | 15,211 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02874 | 3/16/13 | Field Sample | AA-02871 | Hygeia | NOT QC | 3/25/13 | TEM-ISO | Direct | 385 | 0.01 | 95 | 1 | 10,208 | 4.0E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02747 | 4/27/13 | Field Sample | AA-02744 | EMSL27 | NOT QC | 5/6/13 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,781 | 3.6E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02755 | 5/11/13 | Field Sample | AA-02752 | RESI | NOT QC | 5/18/13 | TEM-ISO | Direct | 385 | 0.01 | 69 | 1 | 15,056 | 3.7E-05 | 1 | 1 | 0 | 0 | 3.7E-05 | 3.7E-05 | 0 | 1.4E-09 |
| AA-02763 | 5/25/13 | Field Sample | AA-02760 | EMSL27 | NOT QC | 6/3/13 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,967 | 3.6E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02773 | 6/15/13 | Field Sample | AA-02770 | Hygeia | NOT QC | 6/22/13 | TEM-ISO | Indirect - Ashed | 346 | 0.01 | 80 | 0.75 | 14,439 | 4.0E-05 | 3 | 2 | 2 | 1 | 1.2E-04 | 8.0E-05 | 8.0E-05 | 3.2E-09 |
| AA-02783 | 6/29/13 | Field Sample | AA-02780 | Hygeia | NOT QC | 7/10/13 | TEM-ISO | Indirect - Ashed | 346 | 0.01 | 80 | 0.75 | 14,477 | 4.0E-05 | 1 | 0 | 0 | 0 | 4.0E-05 | 0 | 0 | 0 |
| AA-02887 | 7/13/13 | Field Sample | AA-02884 | ESATR8 | NOT QC | 7/24/13 | TEM-ISO | Direct | 385 | 0.0099 | 69 | 1 | 14,502 | 3.9E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AA-02797 | 7/27/13 | Field Sample | AA-02795 | ESATR8 | NOT QC | 8/8/13 | TEM-ISO | Direct | 385 | 0.0099 | 70 | 1 | 14,215 | 3.9E-05 | 1 | 1 | 0 | 0 | 3.9E-05 | 3.9E-05 | 0 | 1.5E-09 |
| AA-02903 | 8/24/13 | Field Sample | AA-02900 | EMSL27 | NOT QC | 9/3/13 | TEM-ISO | Direct | 385 | 0.013 | 55 | 1 | 14,649 | 3.7E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Notes:**
QC - quality control
TEM - transmission electron microscopy
ISO - international organization for standardization
EFA - effective filter area
mm - millimeter
GO - grid opening
L - liter
cc - cubic centimeter
N - number of asbestos structures
LA - Libby amphibole
NaK - sodium/potassium
PCME - phase contrast microscopy-equivalent
s/cc - structures per cubic centimeter

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**Appendix E. Detailed Results of Ambient Air Preparation Drying Blanks**
*Libby Asbestos Superfund Site, Libby, Montana*

| Sample ID | Sample Date | Sample Type | Laboratory Name | Laboratory QC Type | Analysis Date | Analysis Method | Preparation Method | EFA ($mm^2$) | GO Size ($mm^2$) | GOs Counted | F-factor | N Structures | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | N Total LA | N PCME LA |
| AA-02007 | 5/17/10 | Prep Blank-Drying | EMSL27 | NOT QC | 6/1/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02021 | 6/2/10 | Prep Blank-Drying | EMSL27 | NOT QC | 6/15/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02039 | 6/19/10 | Prep Blank-Drying | EMSL27 | NOT QC | 6/30/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02054 | 7/11/10 | Prep Blank-Drying | EMSL27 | NOT QC | 7/28/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02072 | 7/31/10 | Prep Blank-Drying | EMSL27 | NOT QC | 8/4/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02086 | 8/14/10 | Prep Blank-Drying | EMSL27 | NOT QC | 8/18/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02104 | 8/28/10 | Prep Blank-Drying | EMSL27 | NOT QC | 9/9/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02119 | 9/11/10 | Prep Blank-Drying | EMSL27 | NOT QC | 9/21/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02136 | 9/25/10 | Prep Blank-Drying | EMSL27 | NOT QC | 10/6/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02152 | 10/9/10 | Prep Blank-Drying | EMSL27 | NOT QC | 10/18/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02168 | 10/23/10 | Prep Blank-Drying | EMSL27 | NOT QC | 11/4/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02173 | 11/6/10 | Prep Blank-Drying | EMSL27 | NOT QC | 11/15/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02200 | 11/20/10 | Prep Blank-Drying | EMSL27 | NOT QC | 11/24/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02215 | 12/20/10 | Prep Blank-Drying | EMSL27 | NOT QC | 12/28/10 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02231 | 1/17/11 | Prep Blank-Drying | EMSL27 | NOT QC | 2/3/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02248 | 2/20/11 | Prep Blank-Drying | EMSL27 | NOT QC | 2/28/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02264 | 3/20/11 | Prep Blank-Drying | EMSL27 | NOT QC | 3/23/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02280 | 4/16/11 | Prep Blank-Drying | EMSL27 | NOT QC | 5/3/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02295 | 7/2/11 | Prep Blank-Drying | EMSL27 | NOT QC | 7/13/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02310 | 7/16/11 | Prep Blank-Drying | EMSL27 | NOT QC | 7/22/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02324 | 7/30/11 | Prep Blank-Drying | EMSL27 | NOT QC | 8/4/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02338 | 8/13/11 | Prep Blank-Drying | EMSL27 | NOT QC | 8/25/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02353 | 8/27/11 | Prep Blank-Drying | EMSL27 | NOT QC | 9/1/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02367 | 9/17/11 | Prep Blank-Drying | EMSL27 | NOT QC | 10/4/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02383 | 10/1/11 | Prep Blank-Drying | EMSL27 | NOT QC | 10/6/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02401 | 10/15/11 | Prep Blank-Drying | EMSL27 | NOT QC | 10/18/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02417 | 10/29/11 | Prep Blank-Drying | EMSL27 | NOT QC | 11/22/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02431 | 11/12/11 | Prep Blank-Drying | EMSL27 | NOT QC | 12/1/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02445 | 11/19/11 | Prep Blank-Drying | EMSL27 | NOT QC | 12/2/11 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02458 | 12/17/11 | Prep Blank-Drying | EMSL27 | NOT QC | 1/9/12 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02473 | 1/21/12 | Prep Blank-Drying | EMSL27 | NOT QC | 2/10/12 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02486 | 2/18/12 | Prep Blank-Drying | EMSL27 | NOT QC | 3/15/12 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02503 | 3/17/12 | Prep Blank-Drying | EMSL27 | NOT QC | 4/5/12 | TEM-ISO | Direct | 385 | 0.013 | 8 | 1 | 0 | 0 |
| AA-02517 | 4/14/12 | Prep Blank-Drying | EMSL27 | NOT QC | 4/24/12 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02533 | 5/5/12 | Prep Blank-Drying | EMSL27 | NOT QC | 5/18/12 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02549 | 5/26/12 | Prep Blank-Drying | RESI | NOT QC | 6/22/12 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02565 | 6/16/12 | Prep Blank-Drying | ESATR8 | NOT QC | 7/3/12 | TEM-ISO | Direct | 385 | 0.00983 | 11 | 1 | 0 | 0 |
| AA-02581 | 6/30/12 | Prep Blank-Drying | ESATR8 | NOT QC | 7/24/12 | TEM-ISO | Direct | 385 | 0.00983 | 11 | 1 | 0 | 0 |
| AA-02597 | 7/14/12 | Prep Blank-Drying | RESI | NOT QC | 7/28/12 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02615 | 7/28/12 | Prep Blank-Drying | Hygeia | NOT QC | 8/7/12 | TEM-ISO | Direct | 385 | 0.0097 | 11 | 1 | 0 | 0 |
| AA-02633 | 8/11/12 | Prep Blank-Drying | EMSL22 | NOT QC | 8/28/12 | TEM-ISO | Direct | 385 | 0.0129 | 10 | 1 | 0 | 0 |
| AA-02651 | 8/25/12 | Prep Blank-Drying | RESI | NOT QC | 9/4/12 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02669 | 9/15/12 | Prep Blank-Drying | Hygeia | NOT QC | 9/26/12 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02687 | 9/29/12 | Prep Blank-Drying | ESATR8 | NOT QC | 10/22/12 | TEM-ISO | Direct | 385 | 0.0099 | 11 | 1 | 0 | 0 |
| AA-02703 | 10/13/12 | Prep Blank-Drying | ESATR8 | NOT QC | 11/14/12 | TEM-ISO | Direct | 385 | 0.0099 | 11 | 1 | 0 | 0 |

**Appendix E. Detailed Results of Ambient Air Preparation Drying Blanks**
*Libby Asbestos Superfund Site, Libby, Montana*

| Sample ID | Sample Date | Sample Type | Laboratory Name | Laboratory QC Type | Analysis Date | Analysis Method | Preparation Method | EFA ($mm^2$) | GO Size ($mm^2$) | GOs Counted | F-factor | N Structures | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | N Total LA | N PCME LA |
| AA-02719 | 10/27/12 | Prep Blank-Drying | Hygeia | NOT QC | 11/6/12 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02735 | 11/17/12 | Prep Blank-Drying | RESI | NOT QC | 12/6/12 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02835 | 12/15/12 | Prep Blank-Drying | RESI | NOT QC | 1/1/13 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02851 | 1/19/13 | Prep Blank-Drying | ESATR8 | NOT QC | 2/8/13 | TEM-ISO | Direct | 385 | 0.0099 | 11 | 1 | 0 | 0 |
| AA-02867 | 2/16/13 | Prep Blank-Drying | RESI | NOT QC | 2/26/13 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02883 | 3/16/13 | Prep Blank-Drying | Hygeia | NOT QC | 3/26/13 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02749 | 4/27/13 | Prep Blank-Drying | EMSL27 | NOT QC | 5/6/13 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02759 | 5/11/13 | Prep Blank-Drying | RESI | NOT QC | 5/18/13 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02769 | 5/25/13 | Prep Blank-Drying | EMSL27 | NOT QC | 6/3/13 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |
| AA-02779 | 6/15/13 | Prep Blank-Drying | Hygeia | NOT QC | 6/23/13 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02789 | 6/29/13 | Prep Blank-Drying | Hygeia | NOT QC | 7/8/13 | TEM-ISO | Direct | 385 | 0.01 | 10 | 1 | 0 | 0 |
| AA-02893 | 7/13/13 | Prep Blank-Drying | ESATR8 | NOT QC | 7/25/13 | TEM-ISO | Direct | 385 | 0.0099 | 11 | 1 | 0 | 0 |
| AA-02799 | 7/27/13 | Prep Blank-Drying | ESATR8 | NOT QC | 8/8/13 | TEM-ISO | Direct | 385 | 0.0099 | 11 | 1 | 0 | 0 |
| AA-02815 | 8/10/13 | Prep Blank-Drying | ESATR8 | NOT QC | 8/21/13 | TEM-ISO | Direct | 385 | 0.0099 | 11 | 1 | 0 | 0 |
| AA-02909 | 8/24/13 | Prep Blank-Drying | EMSL27 | NOT QC | 9/3/13 | TEM-ISO | Direct | 385 | 0.013 | 10 | 1 | 0 | 0 |

**Notes:**
QC - quality control
TEM - transmission electron microscopy
ISO - international organization for standardization
EFA - effective filter area
mm - millimeter
GO - grid opening
L - liter
cc - cubic centimeter
N - number of asbestos structures
LA - Libby amphibole
PCME - phase contrast microscopy-equivalent
s/cc - structures per cubic centimeter

# Summary of Outdoor Ambient Air Monitoring for Asbestos at the Libby Asbestos Superfund Site

## Appendix F

## Field and Laboratory Modification Forms

*[provided electronically]*

# Summary of Outdoor Ambient Air Monitoring for Asbestos at the Libby Asbestos Superfund Site

## Appendix G

## Data Verification Reports

*[provided electronically]*