FINAL

SUMMARY OF OUTDOOR AMBIENT AIR MONITORING FOR ASBESTOS AT THE LIBBY ASBESTOS SITE LIBBY, MONTANA

(October 2006 to June 2008)

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ACRONYMS

C	Concentration of asbestos in air (structures per cc of air)
CTE	Central Tendency Exposure
DQA	Data Quality Assessment
DQOs	Data Quality Objectives
EDD	Electronic Data Deliverable
EDS	Energy Dispersive Spectroscopy
EPA	Environmental Protection Agency
ISO	International Organization for Standardization
LA	Libby Amphibole Asbestos
MCE	Mixed Cellulose Ester
N	Number of asbestos particles counted in a sample
OU	Operable Unit
PCM	Phase Contrast Microscopy
PCME	PCM-Equivalent
RME	Reasonable Maximum Exposure
S	Sensitivity (1/cc)
SAED	Selected Area Electron Diffraction
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
TEM	Transmission Electron Microscopy
TWF	Time weighting factor
$UR_{a,d}$	Unit risk of cancer for exposure starting at age a and continuing for duration d
QA	Quality Assurance
QC	Quality Control

1.0 INTRODUCTION

Libby is a community in northwestern Montana that is located near a large open-pit vermiculite mine. Vermiculite from this mine contains varying levels of a mixture of various types of amphibole asbestos collectively referred to as Libby Amphibole (LA). Historic mining, milling, and processing operations at the Site are known to have caused releases of vermiculite and LA into the environment, and these releases have caused a range of adverse health effects in exposed people, including not only former workers at the mine and processing facilities (Amandus and Wheeler 1987; McDonald et al. 1986a 1986b, 2004), but also residents of Libby (Peipins et al. 2003).

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 ambient outdoor air. Beginning around 2000 and continuing through the year 2002, the Environmental Protection Agency (EPA) collected outdoor ambient air samples of opportunity (or in conjunction with cleanup monitoring activities) at a number of locations around Libby. While these samples were not collected under a sampling and analysis plan (SAP) specifically designed to determine outdoor ambient air levels, the data were culled from various collection efforts in order to gain an initial understanding of the levels of LA typically observed in outdoor air. These data were summarized in an internal draft report prepared in 2005 (USEPA 2005). The conclusions of this draft report were:

- LA fibers were found to occur in outdoor ambient air samples collected around the Libby community.
- Sources of the LA fibers found in outdoor ambient air in Libby could not be identified with certainty, but windborne transport of fibers present in soils and dust around the community was identified as one component that was likely to be significant.
- Concentration levels did not appear to be substantially different at different locations within the main residential-commercial section of Libby, but there was a slight tendency for values to be higher in areas closest to the mine.
- Data were too limited to determine if any time trend towards changed levels in outdoor ambient air was occurring as a result of on-going EPA clean-up activities.
- If an individual were exposed to ambient air continuously (24 hours per day) for a lifetime, cancer risk estimates would be within EPA's risk range of 1E-04 to 1E-06.

EPA (2006a) reviewed the draft report, and identified a number of limitations, including the following:

- Data presented in the draft are incomplete because of lack of seasonal and geographic representation over time, and there are an insufficient number of data points at adequate sensitivity
- The analysis presented in the draft document preliminarily assumes that "non-detect" values are equal to zero[1]
- The methodology for estimating risk ranges is preliminary and should be considered draft
- Evaluation of risks in the draft document is limited to a single pathway and does not address cumulative exposure from multiple pathways at the site

Based on these limitations, EPA determined that the outdoor ambient air data, while useful to provide initial impressions of outdoor ambient air levels, were not sufficiently extensive or representative in time and space to draw strong conclusions regarding the true levels of exposure and risk from ambient air. Consequently, EPA determined that there was a need for the collection of additional ambient air data that would be sufficiently representative and of adequate quality to estimate human health risks associated with inhalation of LA in outdoor ambient air in and around the town of Libby, and to characterize spatial patterns and temporal trends of LA occurrence in outdoor ambient air. This report summarizes the ambient air sampling program that was established, and presents a summary and interpretation of the data that were collected.

2.0 STUDY DESIGN

2.1 Year 1 Study Design

Outdoor ambient air sampling under the new program began in October 2006 at 14 sampling stations in the community of Libby and at two off-site reference stations. The details of the Sampling and Analysis Plan (SAP) for the first year of the program are provided in USEPA (2006b), and the key features are described below.

2.1.1 Selection of Sampling Stations

For the first year of the program, outdoor ambient air sampling was conducted at 14 stations in the main residential/commercial area of Libby (Operable Unit 4), as shown by the purple triangles labeled L1 to L14 in Figure 2-1. The number and location of stations were selected so that the study area could be divided into four sub-areas (north, east, central, south) to allow for evaluation of spatial variability in long-term averages. In addition, reference stations were established in Eureka and Helena, Montana. The purpose of these stations was to establish a frame of reference to which observations in Libby could be compared.

[1] EPA has further evaluated this approach and determined that it is appropriate to evaluate "non-detects" as zero when computing the mean of a number of samples (see Appendix C for more detail).

The location of one station (L5) was changed after 16 sampling events (on 03/28/07) due to repeated vandalism. The new station (J. Neils Park) is located a short distance south of the original station (1427 Highway 37).

2.1.2 Year 1 Sampling Protocol

Outdoor ambient air samples were collected and equipment was calibrated in accordance with SOP CDM-LIBBY-07 (USEPA 2006b) for asbestos air sampling. At each of the 14 stations in Libby, samples were collected over a 6 day interval, with five days between each interval. Sampling pumps were checked 1-2 times per day to ensure proper operation. Sampling at the Helena station occurred on a 5-day schedule (Monday through Friday) every other week. Sampling at the Eureka station also occurred once per two weeks, but due to the inability to check the monitor in Eureka on a regular basis, the sampling time was limited to 32 hours per sample.

<u>Flow Rate</u>

Two samples were collected at each station. One sample was collected at a flow rate of 1.4 L/minute, which resulted in a total volume over 6 days of about 14,000 L. This sample is referred to as the high volume sample. Additionally, a second sample was collected at a flow rate of 1.0 L/min over the same period of time and is referred to as the low volume sample. This sample was collected to serve as a backup for use if the high volume sample was overloaded or damaged. Because sampling time was lower at Eureka than other stations, the flow rates at this station were increased to 8 L/min (high flow) and 5 L/min (low flow) in order to generate samples of similar volume.

<u>Filter Type</u>

Samples were collected using 25-millimeter diameter, 0.8 µm pore size mixed cellulose ester (MCE) filter cassettes. In order to investigate whether the choice of pore size is an important determinant of observed concentrations, samples using 0.45 µm pore size filters were collected intermittently at selected stations. These stations were selected so that sampling stations from the each study area were represented.

<u>Sample Height</u>

Samples were collected at approximately 5 to 6 feet above ground level at all stations. This height was selected because it represents the breathing zone height of most adults. In order to investigate whether levels might be different at a child's breathing height (3 feet), samples were intermittently collected 3 feet above ground level at selected sampling locations. As above, these locations were selected to represent each study area.

Quality Control Samples

Three types of quality control (QC) samples were collected in the field. Lot blanks were collected at a rate of 1 per lot to ensure that filters were not contaminated before use. If any contamination was detected on a lot blank, the entire lot was discarded. Field blanks were collected at a rate of 1-2 per day. These were collected to determine if contamination was occurring prior to or during sampling and analysis. Co-located samples (field duplicates) were collected at a rate of 1-2 samples per sampling event (both high and low volume) to help characterize the magnitude of sampling variability.

2.2 Year 2 Study Design

As the ambient air sampling program approached one year, EPA determined that it would be valuable to collect ambient air from several additional stations in Libby, with the specific aim of providing data that would be relevant to some of the other Operable Units (OUs) besides OU4. In addition, it was determined that the number and frequency of sampling at the existing stations in OU4 could be decreased. The sampling program for year 2 is described in detail in an Addendum to the Sampling Plan (USEPA 2007), and the main features are summarized below.

2.2.1 Selection of New Sampling Stations

New sampling locations were added to characterize ambient air in the vicinity of OU2 (the former screening plant) and OU6 (Burlington Northern Santa Fe railroad property). Specific sampling locations within each OU were selected so that each had available electricity and could be accessed year-round. Two stations were selected in each OU, as indicated by the red circles (OU2) and blue "+"s (OU6) in Figure 2-1.

2.2.2 Revised List of OU4 Stations

Of the original set of 14 stations in OU4, seven were retained for continued monitoring into year 2 (after September 16, 2007). These 7 stations were selected to maintain spatial representativeness, with two in the northern segment (L1 and L4), two in the eastern segment (L5 and L6), two in the central segment (L7 and L9), and one in the southern segment (L14). Likewise, of the two original reference stations, one (Helena) was retained for continued monitoring.

2.2.3 Year 2 Sampling Protocol

Samples collected in year 2 of the program were collected using the same equipment and techniques as described above. However, the sampling schedule was revised to be 5 days of sample collection followed by 10 off (non-collection) days. The sampling schedule for Helena was changed as well. It became synchronous with OU2 and OU6 after the first full year of

sample collection was completed (beginning on 10/22/07). Originally, it was planned that monitoring would continue at all of these stations for one additional year. However, because the observed concentration values continued to be relatively low, sampling at the OU4 stations was discontinued in December 2007, while sampling at the OU2, OU6, and Helena stations continued through June 2008.

2.3 Summary of Sample Collection Schedule

Figure 2-2 identifies all of the stations at which ambient air samples were collected during year 1 and year 2 of the ambient air program, and indicates the calendar period over which sampling occurred at each station.

3.0 LABORATORY ANALYSIS METHODS AND REQUIREMENTS

3.1 Initial Analytical Methods and Requirements

All outdoor ambient air and QC samples were submitted to the analytical laboratory for analysis by transmission electron microscopy (TEM) in basic accord with the International Organization for Standardization (ISO) Method 10312, also known as ISO 10312:1995(E), with a number of project specific modifications, as follows:

Modification	Purpose
LB-000016	Clarify ISO 10312 counting rules
LB-000019	Standardize the recording format of grid openings where no countable structures are seen ("ND")
LB-000028	Standardize the selection of additional grids for reanalysis of TEM samples
LB-000029 LB-000029a	Standardize the frequency of preparation of laboratory QC samples by TEM and procedures for interpretation of results
LB-000030	Standardize procedure used for recording sketches of asbestos structures

Studies of asbestos from the mine in Libby indicate that the asbestos present in the mine is a composite of structurally related minerals with varying chemical compositions often referred as a "solid solution series", including winchite and richterite (these are the primary forms) as well as tremolite and actinolite (these are minor forms) (Meeker et al. 2003). Based on this, all analytical laboratories supporting the Libby project classify a particle as LA if that particle a) meets morphological requirements (e.g., length ≥ 0.5 um, aspect ratio ≥ 3:1), b) has an selected area electron diffraction (SAED) pattern that is consistent with amphibole, and c) has an energy-dispersive (EDS) spectrum that is consistent with any of the range of mineral compositions observed in the mine in Libby.

The target analytical sensitivity for all samples was 0.00004 cc^{-1}. Whenever possible, the high volume samples collected at each station was preferred for analysis, because it required counting

less grid openings to achieve the target sensitivity. However, whenever the high volume sample was overloaded, lost, or damaged, the low volume sample was analyzed.

3.2 Supplemental Analytical Requirements

On February 23, 2007 (about event 14 of the year 1 sampling program), EPA created temporary Laboratory Modification 66 (LB-000066) to determine the feasibility of capturing more detailed information on the attributes of particles classified as LA. This modification requires that all laboratories provide information on the occurrence of sodium (Na) and potassium (K) in the particles observed. While recognizing the inherent analytical uncertainty in using the EDS for mineral identification ranges anywhere from 20-40%, it was hypothesized that if Na-K information could be captured reliably, it may be useful for LA testing since both elements are often present at detectable levels in a large majority of particles from the mine when analyzed using a different instrumental analysis called electron microprobe (Meeker et al. 2003).

All TEM analyses performed for the outdoor ambient air program after February 23, 2007, were analyzed in accord with this temporary laboratory modification. Because samples analyzed before this date had not captured information on the presence of sodium and potassium in LA particles, all of the samples from events 1-3 that contained one or more LA fibers were re-analyzed in accord with Modification 66. Samples from events 4-13 were not re-analyzed in accord with Laboratory Modification 66, but there were only two LA particles detected across all of these samples.

Implementation of Laboratory Modification 66 applied not only to the outdoor ambient air sample analyses, but also to all investigative samples collected at the Libby Asbestos Site for TEM analysis. This represents a wide range of sample media and sample locations for which Na-K LA data are available. A separate report shall summarize the findings for data collected under Laboratory Modification 66.

4.0 RESULTS

4.1 Raw Data

Appendix A presents the detailed analytical results for each station for each sampling date. Key findings for total LA are summarized below.

4.2 Spatial Pattern

Figure 4-1 displays the average concentration of total LA in each of the main geographic areas of the ambient air study. Because concentration values appear to vary seasonally (see below), the data used to compute the mean for each location is restricted to one full calendar year to avoid any bias.

The mean results for different areas were compared to each other using the Wilcoxon rank sum test. This test was selected for use because it is non-parametric, and can accommodate many samples of the same rank (non-detect). The results for year 1 are presented in Table 4-1 Panel A. For total LA, there were no statistically significant differences among the four different parts of OU4 (north, east, central, south), although the northern and eastern portions of OU4 were statistically different (higher) than Eureka, and the central portion was nearly significant ($p = 0.06$).

The results for year 2 are presented in Panel B. As shown, there were no statistically significant differences between OU2, OU6, and Helena for total LA .

4.3 Temporal Patterns

4.3.1 Seasonal Variation

Figure 4-2 plots the mean concentration of total LA as a function of sampling date for OU4, OU2, and OU6. As seen, at all locations, mean concentration values tended to be low during the winter months, with the highest levels observed in mid- to late-summer. This result is consistent with the hypothesis that releases are lowest when the ground is frozen or snow-covered, and highest when the ground is dry. A noticeable "spike" occurred in all three locations at the same time (09/03/08), also supporting the concept that meteorological conditions (soil moisture, wind speed, etc.) are likely to be important factors in determining releases of LA into ambient air. However, a detailed analysis of the reasons for the "spike" was not pursued because risk to humans is related to the long term average concentration, not to short-term peak values.

4.3.2 Long-Term Trends

Data from the most recent study of ambient air in Libby (summarized in this report) span too narrow a time interval (2006-2008) to evaluate long-term time trends. However, a semi-quantitative conclusion can be obtained by comparing ambient air data collected in Libby the 2000-2002 time frame (as summarized in USEPA 2005) with those collected in 2006-2008 (this report). As described in USEPA (2005) (see Table 2 of that report), for 261 ambient air samples collected from the main section of Libby (corresponding to zones 1, 2 and 3 in the original report), the mean concentration of total LA was estimated to be about 1E-05 s/cc. This may be compared with the mean concentration of total LA for OU4 under current site conditions, which is about 9E-06 s/cc. This result is consistent with the hypothesis that ambient air levels of LA have not changed substantially over the time frame from 2001 to 2008. However, because of the limitations (discussed above) in the representativeness and sensitivity of the data from 2000-2002, it is not possible to draw a firm conclusion regarding the presence or absence of a long-term time trend.

4.4 Effect of Sample Height (Adult vs. Child)

Table 4-2 presents a comparison of 20 sample pairs matched on collection time and location, but with differing collection heights (adult vs. child height). Results for each sample pair were compared using the Poisson ratio test (Nelson 1982). As seen, there were no pairs that were statistically different from each other at the 95% confidence level for either total LA or chrysotile. This is consistent with the hypothesis that the concentration level of LA and other forms of asbestos in outdoor ambient air is not substantially different as a function of sampling height when no active soil disturbance is occurring.

4.5 Effect of Pore Size (0.8 µm vs. 0.45 µm)

Table 4-3 presents a comparison of 20 sample pairs matched on collection time, location, and height, but with differing filter pore sizes (0.45 µm vs. 0.8 µm). Results for each sample pair were compared using the Poisson ratio test (Nelson 1982). As seen, there were no pairs that were statistically different from each other for total LA at the 95% confidence level, although there was one pair that was different for chrysotile ($p < 0.05$). These results are consistent with the hypothesis that filter pore size has no substantial effect on the retention or analysis of LA structures. The basis for the one sample that was different for chrysotile is uncertain. However, because the difference was quite large, it seems unlikely that the reason could be differences in filter retention only.

4.6 Level of Human Health Risk

Inhalation exposure to asbestos increases the risk of both non-cancer effects (asbestosis, pleural changes) and cancer effects (lung cancer and mesothelioma) in humans (ATSDR 2001). The USEPA is currently working to develop a method for quantifying risks of non-cancer effects, but at present no approved method is available. Therefore, risk of non-cancer effects are not evaluated in this document. However, the Agency has developed a method for estimating excess risk of death from cancer due to inhalation exposure to asbestos, as described in the following sections.

4.6.1 Basic Equation

The basic equation used to estimate excess lifetime cancer risk is (USEPA 2008):

$$\text{Risk} = C_{PCME} \cdot TWF \cdot UR_{a,d}$$

where:

C_{PCME} = Average concentration of PCME asbestos fibers in inhaled air (s/cc)

TWF = Time weighting factor to account for less than continuous exposure (unitless)
$UR_{a,d}$ = Unit risk $(s/cc)^{-1}$ based on continuous exposure beginning at age "a" and continuing for duration "d" years

4.6.2 Inputs to the Equation

Estimation of C_{PCME}

As noted above, all ambient air samples were analyzed for LA using TEM. However, the risk model recommended for use by EPA (USEPA 2008) requires asbestos concentration to be expressed in terms of phase contrast microscopy (PCM) fibers. This is done by identifying all LA fibers detected by TEM that satisfy the counting rules for PCM (length > 5 um, aspect ratio ≥ 3, thickness ≥ 0.25 um). For convenience, particles that are indentified under TEM that meet PCM counting rules are referred to as PCM-equivalent (PCME).

The concentrations of PCME LA (based on total LA) are provided for each sample in Appendix A. The mean concentrations for each area in OU4, OU2, and OU6 are provided below:

Location	Mean LA Concentration (PCME s/cc)
OU4-North	7.00E-06
OU4-East	9.22E-06
OU4-Central	3.75E-06
OU4-South	2.54E-06
OU2	2.27E-06
OU6	8.59E-06

Time Weighting Factor (TWF)

Central Tendency Exposure (CTE)
Exposure to ambient air occurs only when a person is outside. Based on EPA's Exposure Factors Handbook (USEPA 1997), most people are outdoors an average of only about 3 hrs/day, and this value is selected for use as the central tendency exposure (CTE) estimate. Assuming exposure occurs 350 days per year (USEPA 1989, 1991), the TWF for the CTE is calculated as follows:

$$TWF(CTE) = (3/24)\cdot(350/365) = 0.120$$

Reasonable Maximum Exposure (RME)
Some individuals may have average outdoor exposures longer than 3 hours/day, especially people who work outdoors. The Exposure Factors Handbook does not provide an estimate of the upper bound, so a value of 8 hours/day is assumed. It is considered unlikely that a person will spend 8 hours per day outside every day, so an exposure frequency of 200 days/yr is selected as a

reasonable upper bound estimate. On other days, outdoor exposure is assumed to occur an average of 3 hrs/day. Based on this, the TWF for the reasonable maximum exposure (RME) is:

$$TWF(RME) = (8/24)\cdot(200/365) + (3/24)\cdot(150/365) = 0.234$$

Unit Risk Values

The unit risk value for lifetime exposure to asbestos is 0.23 $(PCM\ s/cc)^{-1}$ (USEPA 2008). Risks to any individual with exposures that are less than lifetime may be calculated using the equations presented in USEPA (2008). The required inputs for the calculation are the age at first exposure and the duration of exposure.

Because risk is highest for individuals who are exposed early in life, the age at first exposure is assumed to be zero (birth) for all individuals. The typical default values for exposure duration of a resident are 9 years (CTE) and 30 years (RME) (USEPA 1989, 1991). However, based on professional judgment, the values for Libby are set to 30 years for the CTE receptor and 50 years for the RME receptor. Based on these assumptions, the unit risk values are:

Receptor Category	Age at Start (yrs)	Exposure Duration (yrs)	Unit Risk $(PCM\ s/cc)^{-1}$
CTE	0	30	0.173
RME	0	50	0.208

4.6.3 Results

Based on the equation and data values described above, estimated lifetime excess cancer risks attributable to inhalation exposure to total LA in outdoor ambient air are as follows:

	Excess Cancer Risk	
Location	CTE	RME
OU4-North	1E-07	3E-07
OU4-East	2E-07	4E-07
OU4-Central	8E-08	2E-07
OU4-South	5E-08	1E-07
OU2	5E-08	1E-07
OU6	2E-07	4E-07

As shown, risks are generally low, with all values below EPA's risk range of 1E-04 to 1E-06. These results support the conclusion that inhalation of ambient air in and around the community of Libby is unlikely to be a source of significant excess cancer risk to area residents or workers.

In considering these results, it is important to emphasize that residents and workers in Libby may be exposed to LA by several different pathways, including not only inhalation of LA in outdoor ambient air, but also by inhalation of LA while indoors (at home or at work), and inhalation of LA in outdoor air when engaging in activities that disturb LA in soil (e.g., mowing, raking, digging). The results presented here are for the outdoor ambient air pathway only, and should not be confused with an estimate of total risk summed across all pathways.

4.6.4 Uncertainties

There are number of sources of uncertainty in the risk calculations presented above. The most important of these are summarized briefly below.

Uncertainty in LA Concentrations in Outdoor Ambient Air

When air samples are measured by any microscopic technique, the number of fibers observed is a random variable that is described by the Poisson distribution. This source of error is most important for samples where the number of particles counted is small, and tends to diminish in importance as the number of particles counted becomes larger. For the outdoor ambient air data set, the average number of particles counted per analysis is small (about 0.2), so each individual measurement has substantial uncertainty. However, because of the large number of samples that have been collected (439 from OU4 for year 1), the uncertainty in the mean of the samples is much lower, and this is only a minor source of uncertainty in this case.

Risk calculations based on mean outdoor ambient air concentrations, rather than the 95th UCL, represent an additional source of uncertainty. A consequence of the lack of a method for calculating the 95th UCL, this uncertainty could result in an underestimation of risk.

Uncertainty in the Cancer Exposure-Response Relationship

The method currently recommended for evaluating cancer risk from inhalation exposure to asbestos (USEPA 2008) has some potential limitations, as follows:

- The unit risk values reported by USEPA (1986) and used by USEPA (2008) are based on measures of exposure expressed as PCM fibers, without any distinction to mineral type (chrysotile, amphibole). However, there are a number of studies which suggest that mineral type may be an important determinant of potency, with amphibole tending to be somewhat more potent than chrysotile, at least for mesothelioma (e.g., Hodgson and Darnton 2000). To the extent that amphibole is more potent that chrysotile, use of the current method may tend to underestimate risks in Libby, where the mineral form of concern is amphibole.

- The unit risk values are based on observations of cancer occurrence in workers exposed to asbestos in the workplace, and do not address susceptible populations or episodic exposures.

- The unit risk values represent the central tendency estimates of the potency factors, not an upper bound on the values. This is especially important, because exposure estimates provided in the epidemiological reports that are used to derive the potency and unit risk values are often highly uncertain, and hence the true unit risk values might be either higher or lower than the values selected.

An additional concern is that the cancer unit risks derived by USEPA (1986) and USEPA (2008) are based on mortality statistics from the 1970's. Thus, they may not be applicable to populations that are exposed to asbestos today. In particular, as life expectancy has increased, the risk of developing cancer from an exposure to asbestos has also tended to increase. Thus, cancer risk predications based on the current method may tend to be too low by about 20%.

Uncertainty in Human Exposure Patterns

Risk from asbestos is dependent on the frequency of exposure and the age when exposure begins and ends. The exposure parameters used in these calculations for CTE and RME receptors are believed to be somewhat conservative, so that risks based on these values are more likely to be high than low. However, true values are uncertain, and a survey of actual exposure or residents and workers to outdoor ambient air in Libby would be needed to derive more accurate and reliable values.

Lack of an Approved Method for Evaluating Non-Cancer Risks

As noted above, EPA has not yet developed national guidance for evaluating the risk of non-cancer effects (asbestosis, pleural changes) from inhalation exposure to asbestos. For most chemicals that cause both cancer and non-cancer effects, it is usually true that unacceptable risks from cancer occur at lower environmental exposure levels than unacceptable risks of non-cancer effects. However, this may not be the case for inhalation exposure to LA or other forms of asbestos. Thus, it should not be presumed that cancer risk is the "risk driver" for exposure to ambient air or other exposure pathways to LA.

Uncertainty from Cumulative Exposures at Other Locations

Risk calculations presented in this document include only the risks attributable to exposure to outdoor ambient air in Libby. However, as noted previously, many people who live or work in Libby will also be exposed to LA by other pathways, so total risks to an individual must consider not only those contributed by outdoor ambient air but from all other site-related pathways as well.

4.7 Data Quality Assessment

Data quality assessment (DQA) is the process of reviewing existing data to determine the quality of the data and to determine how any data quality limitations may influence data interpretation.

4.7.1 Data Validation

The Libby project database has a number of built-in quality control checks to identify unexpected or unallowable data values during upload into the database. Any unexpected or unallowable values identified by these automatic upload checks were resolved by consultation with the analytical laboratory before entry of the data into the database.

After entry of the data into the database, several additional data validation/verification steps were taken to ensure the data were recorded and entered correctly. Validation consisted of the following steps:

- Confirming that sample information recorded by field personnel on Field Sample Data Sheets were accurately transferred into the Libby project database
- Ensuring that TEM data entry onto analytical laboratory bench sheets was performed in accord with project-specific data recording requirements
- Confirming that data recorded on analytical laboratory bench sheets were accurately transferred into the electronic data deliverables (EDDs), and that these EDDs were accurately uploaded into the Libby project database
- Manually recalculating randomly selected analytical results to verify the accuracy of the values reported in the Libby project database
- Ensuring that lot blanks and field blanks were free of asbestos

Initially, 100% of the data were validated. This continued through the sampling event on March 17-24, 2007. Because very few significant errors were found and because the frequency of structures was low, the validation frequency after this date was reduced to 10%, with more extensive validation being performed only as needed. Table 4-4lists the types and number of errors identified during data validation. All "critical" errors (those that influence the quantitative results or were essential for sample tracking) were corrected in the field or laboratory sheets by the appropriate field or laboratory staff, and the database was updated to show the corrected values.

4.7.2 Completeness

Completeness is defined as the fraction of samples that were planned that were successfully collected and analyzed. Table 4-5 summarizes the completeness for each sampling station in each year of the study. As indicated, completeness was high (94-100%) for all OU4 stations and both reference stations in year 1. Likewise, completeness was high (89-100%) for stations in OU2, OU6 and Helena for year 2. Because sampling in OU4 was terminated earlier than planned in year 2, completeness for year 2 is low (28-33%). Because the data for OU4 in year 2 do not span a full year, and because values tend to vary seasonally across each year, the data from OU4 for year 2 can not be properly combined with the results from year 1.

4.7.3 Lot Blanks/Field Blanks

Results of the structure counts for lot blanks and field blanks are contained in Appendix B. No asbestos structures were detected in any of the 42 lot blanks or in any of 138 field blanks. This indicates that no significant asbestos contamination occurred during sample collection or laboratory analysis.

4.7.4 Co-Located Samples

The results of 44 co-located sample pairs are presented in Table 4-6. 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 38 of 44 pairs in which both samples were non-detect (i.e., no LA structures were detected on either sample). By definition, these results are not different from each other. For 6 of the 44 sample pairs, one or more LA particles 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 each of the measured values is reproducible.

4.7.5 Evaluation of Field and Laboratory Modifications

As noted above, a number of laboratory modifications were created that apply to the TEM analysis of air samples performed as part of this program. In addition, a number of field modifications were created that apply to the methods used for sample collection. Table 4-7 summarizes the field and laboratory modifications that are applicable to the ambient air monitoring program, and notes the impact of each on the quality and usability of the data. As indicated, none of the modification are expected to have an impact on data quality or usability.

5.0 SUMMARY

The USEPA has collected data on the level of LA in outdoor ambient air at numerous monitoring locations in and around the community of Libby. Concentration levels of LA in ambient air tend to be very low in winter, and higher in the middle to late summer, when conditions are usually dry. Mean concentrations of LA tend to be somewhat higher in the northern and eastern portion of Libby than in the central and southern regions, although these differences are not statistically significant. Cancer risk estimates computed using the risk model currently recommended by EPA are below a level of 1E-06, indicating that inhalation of LA in outdoor ambient air in and about the community of Libby is unlikely to be a source of significant cancer risk to area residents or workers.

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