Data Summary Report:
Fish and Game Tissue Assessment

Libby Asbestos Superfund Site
Libby, Montana

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Libby Asbestos Superfund Site
Libby, Montana

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List of Acronyms and Abbreviations

%	percent
Ago	area of grid opening
CB&I	CB&I Federal Services, LLC
CDM Smith	CDM Federal Programs Corporation
CH	chrysotile
CHISQ	chi-square
COC	chain of custody
DQA	data quality assessment
DQO	data quality objectives
EDD	electronic data deliverable
EDS	energy dispersive spectroscopy
EFA	effective filter area
EPA	U.S. Environmental Protection Agency
ESAT	Environmental Sampling Assistance Team
F	fraction of the original tissue sample applied to the filter
FSDS	field sample data sheet
g	grams
GO	grid opening
ID	identification
IDW	investigation derived waste
ISO	International Standards Organization
LA	Libby amphibole
MFWP	Montana Fish, Wildlife and Parks
mL	milliliter
mm^2	square millimeters
N	number of asbestos structures counted
NAM	non-asbestos materials
NFG	National Functional Guidelines
NTP	National Toxicology Program
NVLAP	National Voluntary Laboratory Accreditation Program
OA	other amphibole
OU	Operable Unit
QA	quality assurance
QAPP	quality assurance project plan
QATS	Quality Assurance Technical Support
QC	quality control
ROM	record of modification
S	analytical sensitivity
s	structures
SAED	selective 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
TS	tissue study
µm	micrometers
USFWS	U.S. Fish and Wildlife Service
UTV	utility vehicle
ww	wet weight

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 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 National Priorities List in October 2002.

1.2 Document Purpose

Historic mining and milling operations at the Site have resulted in the release of LA to the environment. Previous investigations have demonstrated that LA is present in soils, sediments, surface water, soil, duff[1], and tree bark at the Site. Although the exposure pathway of primary concern for humans is inhalation of LA, some studies in animals suggest that ingestion of asbestos fibers can result in the growth of benign intestinal polyps (National Toxicology Program [NTP] 1985).

In 2012, the U.S. Environmental Protection Agency (EPA) conducted a study, referred to as the *Fish and Game Tissue Assessment*, to investigate LA tissue burdens in fish and large game collected from the Site (EPA 2012a). This document summarizes the results of this study.

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.

[1] Duff is comprised of un-decomposed twigs, needles, and other vegetation and the layer of partially- to fully-decomposed litter that occurs on top of the mineral soil in forested areas.

Section 3 This section summarizes the design of the study, and describes the data that were collected in this investigation, the analytical methods used for estimating the level of LA in tissues, as well as the data reduction methods utilized in this report.

Section 4 This section summarizes the results for data that were collected as part of this study, including an evaluation of the levels of LA in each tissue type.

Section 5 This section presents the results of the data quality assessment, including a summary of program audits, modifications, data verification efforts, an evaluation of quality control samples, and a data adequacy assessment.

Section 6 This section provides full citations for all analytical methods, site-related documents, and scientific publications referenced in this document.

Referenced tables and figures are provided at the end of this document. Appendices A and B are provided electronically; all other appendices are provided at the end of this document.

2 DATA MANAGEMENT

2.1 Sample Collection, Documentation, Handling, and Custody

All samples generated as part of this investigation were collected, documented, and handled in accordance with Libby-specific standard operating procedures (SOPs), as specified in the governing sampling and analysis plan/quality assurance project plans (SAP/QAPPs) (EPA 2012a, 2012b, 2012c).

All tissue samples collected in this study were identified with sample identification numbers (IDs) that included a program-specific prefix of "TS" (e.g. TS-00001). Data on the sample type, location, collection method, and collection date of all samples were recorded on a field sample data sheet (FSDS) designed to facilitate data entry into the field Scribe project database (see below). All samples collected in the field were maintained under chain of custody during sample handling, preparation, shipment, and analysis.

2.2 Analytical Results Recording

Standardized data entry spreadsheets (electronic data deliverables [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 (COCs) generated during these investigations are stored in the CDM Smith field office in Libby, Montana. **Appendix A.1** of this report provides copies of the field documentation.

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., EPA's Environmental Services Assistance Team [ESAT] contractor, TechLaw) and stored electronically. **Appendix A.2** of this report provides copies of all the analytical laboratory reports for analyses performed as part of these investigations.

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 6/24/2013, into a Microsoft Access® database by CDM Smith. A frozen copy of this Access database is provided in **Appendix B** of this report.

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 Access database.

3 FISH & GAME TISSUE ASSESSMENT STUDY

3.1 Study Design

The purpose of the study was to collect data on tissue burdens in large game and fish that could be used to evaluate two potential human ingestion exposure scenarios:

> Ingestion of Game. One exposure scenario is the ingestion of edible tissue from hunted game that forage at the Site. Large game, including deer and elk, have been observed at the Site and may be exposed to LA in a variety of potential exposure media. It is possible that these animals may have accumulated LA in their tissues as a result of these exposures.
>
> Ingestion of Fish. Another exposure scenario is the ingestion of LA in edible fish tissue (fillets) from fish caught from local streams and ponds that contain LA.

Detailed information on this sampling study, including study-specific data quality objectives (DQOs) is provided in the governing SAP/QAPPs (EPA 2012a, 2012b, 2012c). The DQOs and study design for the collection of fish tissue (which were collected as part of an OU3-specific investigation) are provided in the *Phase V SAP/QAPP for Operable Unit 3 (OU3), Libby Asbestos Superfund Site, Part B: 2012 Ecological Studies* (EPA 2012b). The DQOs and study design for the collection of game tissue and the analysis of tissue burdens in fish and game tissues are provided in the *Fish and Game Tissue Assessment SAP/QAPP* (EPA 2012a). The study design for the evaluation of asbestos in fixed game tissue samples is summarized in an addendum (EPA 2012c) to the *Fish and Game Tissue Assessment SAP/QAPP.* An overview of the study designs developed to address each exposure scenario is summarized below.

3.1.1 Game

3.1.1.1 Target Sampling Location

The level of LA in game tissue is assumed to be related to the concentration of LA in various exposure media (e.g., soil, duff material) and the length of time the animal may have been exposed to these media (i.e., older game animals are likely to have higher tissue concentrations than younger animals). Studies conducted at the Site have shown elevated concentrations of LA in various environmental media at the mine site and in the forested areas surrounding the mine site (i.e., OU3). To ensure that this assessment focused on the high-end of the potential range of exposure conditions, the mine site and forested areas immediately surrounding the mine site were the target sampling locations for the collection of game animals (see **Figure 3-1**).

3.1.1.2 Target Species

Two types of large game animals were identified for potential collection, including deer (either mule deer, *Odocoileus hemionus*, or white-tailed deer, *Odocoileus virginianus*) and elk (*Cervus elaphus*). These animals are the most common large game animals consumed by humans in the Libby area.

3.1.2 Fish

3.1.2.1 Target Sampling Location

The level of LA in fish tissue is assumed to be related to the concentration of LA in surface water and sediment, as well as the length of time the fish may have been exposed to these media (i.e., older fish are likely to have higher tissue concentrations than younger fish). Studies conducted at the Site have shown elevated concentrations of LA in surface water and sediment in the streams and ponds on the mine site (i.e., OU3). Within OU3, one location – the Mill Pond (see **Figure 3-2**) – has water concentrations of LA that are high (measured concentrations of total LA were often greater than 5 million fibers per liter in the pond) and large fish are known to be present. Other locations in OU3 (e.g., lower Rainy Creek, Carney Creek, Fleetwood Creek, tailings impoundment) have elevated levels of LA, but the sizes of the fish present are relatively small or fish are absent. Fish caught from the Kootenai River below the confluence with Rainy Creek may be large, but water concentrations of LA are much lower in the Kootenai River than in onsite OU3 waters. Therefore, even though access to the Mill Pond is currently restricted to include only authorized personnel, the Mill Pond was selected as the target sampling location to ensure that fish tissues were at the high-end of the potential range of exposures.

3.1.1.2 Target Species and Size

Based on fish population sampling conducted at OU3 in 2008 and 2009, the predominant species in site streams and ponds are rainbow trout (*Oncorhynchus mykiss*), cutthroat trout (*Oncorhynchus clarki*), and rainbow/cutthroat ("cutbow") hybrids (Parametrix 2009, 2010). Because all these species may be kept for human consumption, any of these species were deemed appropriate for collection as part of this study. Only fish 8 inches or longer were targeted for collection, since this is the size range that is likely to be kept and ingested by humans (Montana Fish, Wildlife and Parks [MFWP] 2011).

3.2 Collection Methods

3.2.1 Game

3.2.1.1 Animal Collection

The SAP/QAPP (EPA 2012a) specified the use of bait sites with monitoring by motion activated game cameras for the identification of areas used by deer or elk. Bait sites were set by field personnel using corn in October of 2012. However, these bait sites were not needed and cameras were not used as the sacrificed deer was spotted by the U.S. Fish and Wildlife Service (USFWS) employee from an upper tier of the mine and shot.

One game animal, a female mule deer (*Odocoileus hemionus*), was collected by a USFWS employee on October 22, 2012, from within OU3 (see **Figure 3-3**). The animal was collected by rifle with one bullet which entered the right side of the neck and exited behind the left shoulder. The deer ran about 40 yards where it was recovered. The collection met the requirements of the MFWP Scientific Collection Permit.

At the point of collection, the animal was wrapped in polysheeting and removed from OU3 by use of a utility vehicle (UTV). The animal was moved to the amphitheatre area (see **Figure 3-3**) where it was hung using a gamble, bled out, and the hide and skin were removed. The hide, head, and legs were disposed of at the mine. To make transport easier, all four legs were removed at the knees as well as the head. The lower jaw was removed from the head for the purposes of aging. The remaining deer and the lower jaw were wrapped in clean poly sheeting and the UTV was decontaminated. The deer and lower jaw were placed back in the UTV where they were removed from the exclusion zone to the green gate area of Rainy Creek Road (see **Figure 3-3**) for tissue sample collection.

3.2.1.2 Tissue Sample Collection

Once the animal was removed from the exclusion zone, tissue samples were collected by gross dissections. The gross necropsy and collection of tissue samples was conducted in general accordance with the procedures specified in Libby-specific SOP EPA-LIBBY-2012-15, *Gross Necropsy and Tissue Sample Collection for Game Animals*. The gross necropsy was performed by EPA personnel with field documentation assistance by CDM Smith personnel.

Inside shoulder and backstrap muscle samples were collected for assessing potential human health risks associated with the ingestion of LA in deer or elk tissue. Other target tissues were also collected to confirm exposures to asbestos including the heart, liver, lung, kidney, and diaphragm. SOP EPA-LIBBY-2012-15 provides detailed information on the collection procedures for each tissue type. During the necropsy, samples were kept on wet ice. At the completion of the necropsy, samples for tissue burden analysis were frozen and then shipped to the analytical laboratory on wet ice for analysis of LA.

In addition to collecting tissue samples for the purposes of quantifying LA tissue burdens, tissue samples of muscle, heart, liver, lung, pleura, trachea, diaphragm, large intestine, and kidney were also collected and fixed for examination to provide information on the location of LA fibers in game tissue and the types of specific intercellular interactions and responses to the presence of LA fibers. Detailed information on the tissue fixation process is provided as an addendum (EPA 2012c) to the *Fish and Game Tissue Assessment SAP/QAPP*.

After the collection of the target tissues, the lower jawbone was transferred to a local MFWP office for aging. The local biologist estimated the deer to be about 8 years old. The remaining jaw and muscle tissues were frozen and archived at the CDM Smith field office in Libby. Per the MFWP permit, the remaining muscle tissue was given to MFWP for use as bait after being deemed fit for consumption (based on the analytical results). The ribcage and internal organs were disposed of as investigation-derived waste (IDW) at the landfill.

3.2.2 Fish

3.2.2.1 Fish Collection

A total of seven fish were collected from the Mill Pond (see **Figure 3-2**) on August 6, 2012. The fish were collected by use of a fishing pole and lure. Collected fish included two rainbow trout, one cutthroat trout, and four cutbow trout. Following collection, fish were frozen whole and then shipped to the analytical laboratory on wet ice for analysis of LA.

3.2.2.2 Tissue Sample Collection

Fish were filleted by the analytical laboratory in accordance with the procedures specified in Libby-specific SOP EPA-LIBBY-2012-14, *Filleting Fish Samples*. In brief, one skin-off fillet from each fish was collected. The remainder of the fish (i.e., the other fillet, organs, carcass) was frozen and placed in archive at the analytical laboratory.

3.3 Sample Preparation and Analysis Methods

3.3.1 Sample Preparation

Tissue samples were prepared and analyzed in basic accordance with the Libby-specific SOP EPA-LIBBY-2012-13, *Analysis of Tissue for Asbestos*. In brief, each sample was dried and ashed, and an aliquot of the resulting ash residue was acidified, suspended in water, and filtered. One filter was created for each tissue sample. Each filter was used to prepare a minimum of three grids using the grid preparation techniques described in Section 9.3 of International Organization for Standardization (ISO) 10312:1995(E) (ISO 1995).

3.3.2 Analysis Method

3.3.2.1 Counting and Recording Rules

Grids were examined by transmission electron microscopy (TEM) in basic accordance with the recording procedures described in ISO 10312:1995(E), as modified by the most recent versions of Libby Laboratory Modifications LB-000016, LB-000029, LB-000066, LB-000067, and LB-000085. During the analysis, the analyst recorded the size (length, width) and mineral type of each individual asbestos structure that was observed. Only asbestos structures having a length greater than or equal to (≥) 0.5 micrometers (µm) and an aspect ratio (length: width) ≥ 3:1, were recorded as countable structures. Mineral type was determined by selected area electron diffraction (SAED) and energy dispersive spectroscopy (EDS), and each structure was 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.

CH Chrysotile fibers. Structures having a serpentine SAED pattern and an elemental composition characteristic of chrysotile. There is presently no evidence that chrysotile fibers are associated with the Libby mine. For the purposes of this investigation, chrysotile structures were recorded if observed, but chrysotile structure counting stopped after 25 structures were recorded.

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 was not required for these investigations.*

In addition, information on the sodium and potassium content and mineral identification (e.g., winchite, tremolite), as determined by EDS, of each amphibole asbestos structure observed was also recorded.

3.3.2.2 Stopping Rules

The stopping rules for the TEM analysis of tissue samples were as follows:

1. Count a minimum of two grid openings from each of two grids.
2. Continue counting until one of the following is achieved:
   a. 25 LA structures have been observed.
   b. A total filter area of 0.25 square millimeters (mm^2) has been examined (this is approximately 25 grid openings).

When one of these criteria was satisfied, the analyst was instructed to complete the examination of the final grid opening and stop.

3.3.3 Results Reporting

3.3.3.1 Calculation of Tissue Burden

The results for each tissue analysis were expressed in terms of LA structures per gram of tissue on a wet weight basis (s/g, ww). The concentration of LA in tissue is given by:

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

where:

C_{tissue} = Tissue concentration, expressed as structures per gram of tissue, wet weight (s/g, ww)
N = Number of LA structures observed
S = Analytical sensitivity (per grams, wet weight [g, ww^{-1}])

For tissue, the analytical sensitivity is calculated as:

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

where:

S = Analytical sensitivity (g, ww^{-1})
EFA = Effective filter area (mm^2)
GO = Number of grid openings counted
Ago = Area of a grid opening (mm^2)
Mass = Mass of the tissue aliquot taken for analysis (g, ww)
F = Fraction of the original tissue sample applied to the filter, calculated as:

Volume applied to filter, milliliter (mL) / 100 mL

3.3.3.2 Combining Results from Multiple Replicate Filters

The best estimate of the mean tissue concentration across a set of multiple samples is calculated simply by averaging the individual concentration values. Note that samples with a count of zero (and hence a concentration of zero) are evaluated as zero when computing the best estimate of the mean (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.

4 RESULTS

4.1 Fish Tissue

Table 4-1 presents a summary of the results for fish collected from the Mill Pond in OU3. This table provides detailed information on each fish collected (species, length, weight), as well as the analysis results. Structure counts and tissue concentrations are presented based on both total LA (all recorded structures) and LA structures longer than 10 µm, because this is the concentration metric that is used for the purposes of evaluating potential ingestion exposures.

As seen, LA was detected in all fish fillet samples. Tissue burdens for total LA were quite variable, ranging from 9.4E+03 to 6.4E+06 s/g, ww, with a mean concentration of 1.2E+06 s/g, ww. The mean concentration based on LA structures longer than 10 µm was 4.2E+04 s/g, ww. No asbestos was detected in the field blank sample.

Note that an evaluation of potential exposure and risk from ingestion of LA in fish tissue is beyond the scope of this data summary report. Screening level risk estimates will be provided as part of the human health risk assessment for the Site.

4.2 Game Tissue

Appendix C provides a narrative and photographs of the deer necropsy and tissue collection.

Table 4-2 presents a summary of the tissue burden results for analyses of game tissue samples for LA. This table provides detailed information on each game tissue type collected, as well as the analysis results. As described above, structure counts and tissue concentrations are presented based on both total LA and LA structures longer than 10 µm. As seen, LA was not detected in any of the game tissue samples or in the field blank sample.

In addition to collecting tissue samples for the purposes of quantifying LA tissue burdens, tissue samples of muscle, heart, liver, lung, pleura, trachea, diaphragm, large intestine, and kidney were also collected and fixed for examination to provide information on the location of LA fibers in game tissue and the types of specific intercellular interactions and responses to the presence of LA fibers. The detailed results of the game tissue fixation are provided as **Appendix D**. LA fibers were not observed in any of the fixed tissue samples.

5 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 2006).

5.1 Oversight

5.1.1 Field

Due to the opportunistic nature of this study, no formal field surveillances or audits were performed. However, CDM Smith field personnel were onsite during the collection of all game tissue samples to assist with all field collection and documentation procedures and ensure that processes followed the Libby-specific SOPs that governed this collection effort.

5.1.2 Laboratory

Laboratory audits are conducted to evaluate laboratory personnel to ensure that samples are handled and analyzed in accord 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 through September 2012 to evaluate all of the Libby laboratories. Detailed audit findings for each laboratory are documented in separate laboratory-specific audit reports (CB&I Federal Services, LLC [CB&I], formerly Shaw Environmental & Infrastructure Group [Shaw E&I] 2012a-f). No critical deficiencies were noted during the 2012 laboratory audits that would be expected to impact data quality for TEM analyses.

5.2 Field and Laboratory Modifications

All field deviations from, and modifications to, the governing SAP/QAPPs were recorded on a field Libby Record of Modification (ROM) Form. The ROM forms are used to document all permanent and temporary changes to procedures contained in guidance documents governing investigation that have the potential to impact data quality or usability.

During the Fish and Game Tissue Assessment, one field modification (LFO-000173) was created that documented changes from sample collection and analysis methodology specified in the SAP/QAPP (EPA 2012a). No laboratory modifications were created for samples collected as part of this study. **Appendix E** provides a copy of LFO-000173. **Table 5-1** summarizes the

modifications for this investigation and notes the impact of each deviation on the quality and usability of the data. As indicated, none of the modifications are expected to have a negative impact on data quality or usability.

5.3 Data Verification and Validation

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.

5.3.1 Data Verification

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 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 the original hard copy analytical bench sheets for that sample.

Appendix F presents a summary of the findings of the data verification for this investigation. In brief, a total of three TEM analyses (13%) were reviewed in accordance with SOP EPA-LIBBY-09 as part of the detailed data verification effort. Hard copy FSDS forms were reviewed in accordance with SOP EPA-LIBBY-11 for these three samples. No critical issues (i.e., those that could potentially impact the reported asbestos structure counts or concentrations) were identified. A few non-critical issues were identified (typographical error in grid opening name and missing Event ID information), as well as an issue related to a Scribe upload error (the data in the EDD were correctly reported, but were not imported into the project database properly).

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

5.3.2 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.

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

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 analysis method, 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.

A copy of the program-wide QA/QC summary report covering samples collected and analyzed in 2010-2012 (CB&I 2013) is currently pending. When this report is finalized, it will be located on the Libby Lab eRoom. Interpretation of the data quality is subject to change upon completion of this report.

5.5 Quality Control Sample Evaluation

5.5.1 Field Quality Control

Field-based QC samples are those samples that are prepared in the field and submitted to the laboratory for analysis concomitant with the field samples. Three types of field QC samples were collected for tissue – field blanks, field duplicates, and equipment blanks.

5.5.1.1 Field Blanks

A field blank is a sample of the same medium as field samples, but which does not contain any contaminant. Field blanks were prepared by processing store-bought whole trout and beef steak in the same manner as the field samples. One field blank was submitted for fish and one field blank was submitted for game. The field blanks were analyzed for asbestos fibers by the same method as was used for field sample analysis. The field blanks were submitted to the laboratory in a blind fashion (i.e., the laboratory is not aware the sample is a QC sample, and treats the sample in the same way as a field sample). The results for the field blanks are presented in **Table 4-1** for fish and **Table 4-2** for game. As seen, all field blank samples were non-detect for LA. These results demonstrate that LA was not introduced into the samples as a consequence of sample collection and handling or analysis.

5.5.1.2 Field Duplicates

Field duplicates for tissue are the analyses of a second sample of the same tissue type from a field sample. The field duplicates were collected using the same collection technique as the parent field samples. One field duplicate was submitted for fish and one field duplicate was submitted for game. For fish, the field duplicate was the other fillet from one of the field samples (i.e., the right fillet was submitted as the field sample and the left fillet was submitted as the field duplicate). Because the analytical laboratory performed the filleting, the field duplicate for fish was not blind to the laboratory. For game, a second portion of shoulder muscle tissue was submitted as the field duplicate. Field duplicates for game were blind to the analytical laboratories (i.e., the laboratory could not distinguish between field samples and field duplicates). Field duplicates were sent for analysis by the same method as the field samples.

For game, both the field sample and the associated field duplicate were non-detect for LA structures. These results show that the game tissue results are reproducible.

For fish, the original and field duplicate sample results were compared using the Poisson ratio test recommended by Nelson (1982). As shown in **Table 5-2**, the total LA concentrations differed by a factor of about ten, and results were statistically different based on the Poisson ratio comparison (90% confidence interval). These results indicate that the difference between the field sample and field duplicate is more than would be expected based on analytic variability (i.e., Poisson counting error) alone. These results show that there is inherent within-sample variability in fish tissue concentrations that must be considered when drawing conclusions from these results.

5.5.1.3 Equipment Rinsates

Equipment rinsate samples are collected to evaluate potential contamination that arises to due inadequate decontamination of sampling equipment. Following decontamination efforts the field sampling equipment used to collect game tissues (i.e., scalpels, and other tissue collection instruments), the decontaminated equipment was rinsed with distilled water and the resulting rinsate collected in a container for preparation, filtration, and analysis by TEM (see the SAP/QAPP [EPA 2012a] for detailed information on preparation and analysis methods).

No asbestos structures were observed in an examination of 25 grid openings (achieved analytical sensitivity of 39,846 L^{-1}). These results show that cross-contamination of tissue samples due to inadequate decontamination procedures is not of concern.

5.5.2 Laboratory Quality Control

The Libby-specific QC requirements for TEM analyses of asbestos are patterned after the requirements set forth by the National Voluntary Laboratory Accreditation Program (NVLAP). In brief, there are three types of laboratory-based QC analyses for TEM – laboratory blanks,

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

Laboratory QC analyses will evaluated by the EPA QATS contractor on a program-wide basis rather than on an investigation-specific basis. The rationale for this is that the number of preparation and laboratory QC samples directly related to this investigation is too limited to draw meaningful conclusions regarding overall data quality. Refer to the pending program-wide QA/QC summary report covering samples collected and analyzed in 2010-2012 (CB&I 2013) for information regarding program-wide data quality of the preparation and analytical laboratories. As noted previously, interpretation of the data quality is subject to change upon completion of this report.

5.6 Data Adequacy Evaluation

A comparison of the data collected as part of this study with the DQOs summarized in the governing SAP/QAPPs (EPA 2012a, 2012b) is presented below.

5.6.1 Completeness

As specified in EPA (2012b), the goal was to collect 5-10 trout (rainbow trout, cutthroat trout, or cutbow hybrids) from the Mill Pond that were 8 inches or longer in length. As shown in **Table 4-1**, this study objective was met.

As specified in EPA (2012a), the goal was to collect one female deer and one female elk from within OU3. If an elk was not available, a second deer was to be collected. For assessing potential human health risks associated with the ingestion of LA in game tissue, flank and backstrap muscle samples were to be collected for tissue burden analysis. To confirm exposures to asbestos, other target tissues, including the heart, liver, lung, kidney, and diaphragm, were also be collected for tissue burden analysis. As shown in **Table 4-2**, there are two deviations from the original study objectives. First, only one female deer was collected (i.e., no elk or second deer were collected). Second, rather than collecting flank tissue, muscle tissue from the inside shoulder was collected. Since this type of muscle tissue is expected to be consumed by humans, this deviation does not affect study completeness.

All collected game and fish tissue samples were successfully analyzed by TEM in accordance with the methods and recording rules specified in the SAP/QAPP (EPA 2012a).

5.6.2 Analytical Requirements

As described above (see Section 3.3.2.2), the stopping rules for the TEM analysis of tissue samples were as follows:

1. Count a minimum of two grid openings from each of two grids.
2. Continue counting until one of the following is achieved:
   a. 25 LA structures have been observed
   b. A total filter area of 0.25 mm^2

Inspection of the analytical information in **Table 4-1** (fish) and **Table 4-2** (game) shows that all tissue analyses evaluated four or more grid openings. All game tissue analyses examined a total of 25 grid openings (a total filter area of 0.325 mm^2), which meets the total filter area stopping rule. With the exception of two analyses, all fish tissue analyses reported more than 25 total LA structures. However, the number of LA structures longer than 10 µm was less than 5 structures for all fish tissue samples. **Table 4-1** (fish) and **Table 4-2** (game) includes the 90% Poisson confidence interval for each sample to illustrate the effect of analytic uncertainty due to Poisson counting error on the reported tissue burdens. For the two analyses that did not achieve the structure stopping rule, the analysis met the total filter area stopping rule (i.e., a total filter area of 0.325 mm^2 was examined). Thus, all tissue analyses achieved the analytical requirements specified in the SAP/QAPP (EPA 2012a).

5.6.3 Evenness of Filter Loading

The TEM analysis of filters generated from tissue samples examines only a portion of the total filter. For the purposes of computing concentration in the tissue 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 E. 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. **Table 5-3** presents the CHISQ results for each tissue sample where one or more LA structures were detected. Inspection of the p-values for the tissue analyses shows that all filters passed the CHISQ test for evenness (i.e., p-value > 0.001). Thus, it is concluded that uneven filter loading is not of significant concern for the tissue samples analyzed in this study.

5.6.4 Data Adequacy Conclusions

Based on the data adequacy assessment presented above it is concluded that the data generated during the Fish and Game Tissue Assessment study met the DQOs stated in the governing SAP/QAPPs and results are adequate to support the data evaluations presented in this report.

5.7 Data Quality Conclusions

Taken together, these results indicate that data collected as part of the *Fish and Game Tissue Assessment* study are representative, of acceptable quality, and considered to be reliable and appropriate for use without qualification.

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Figures

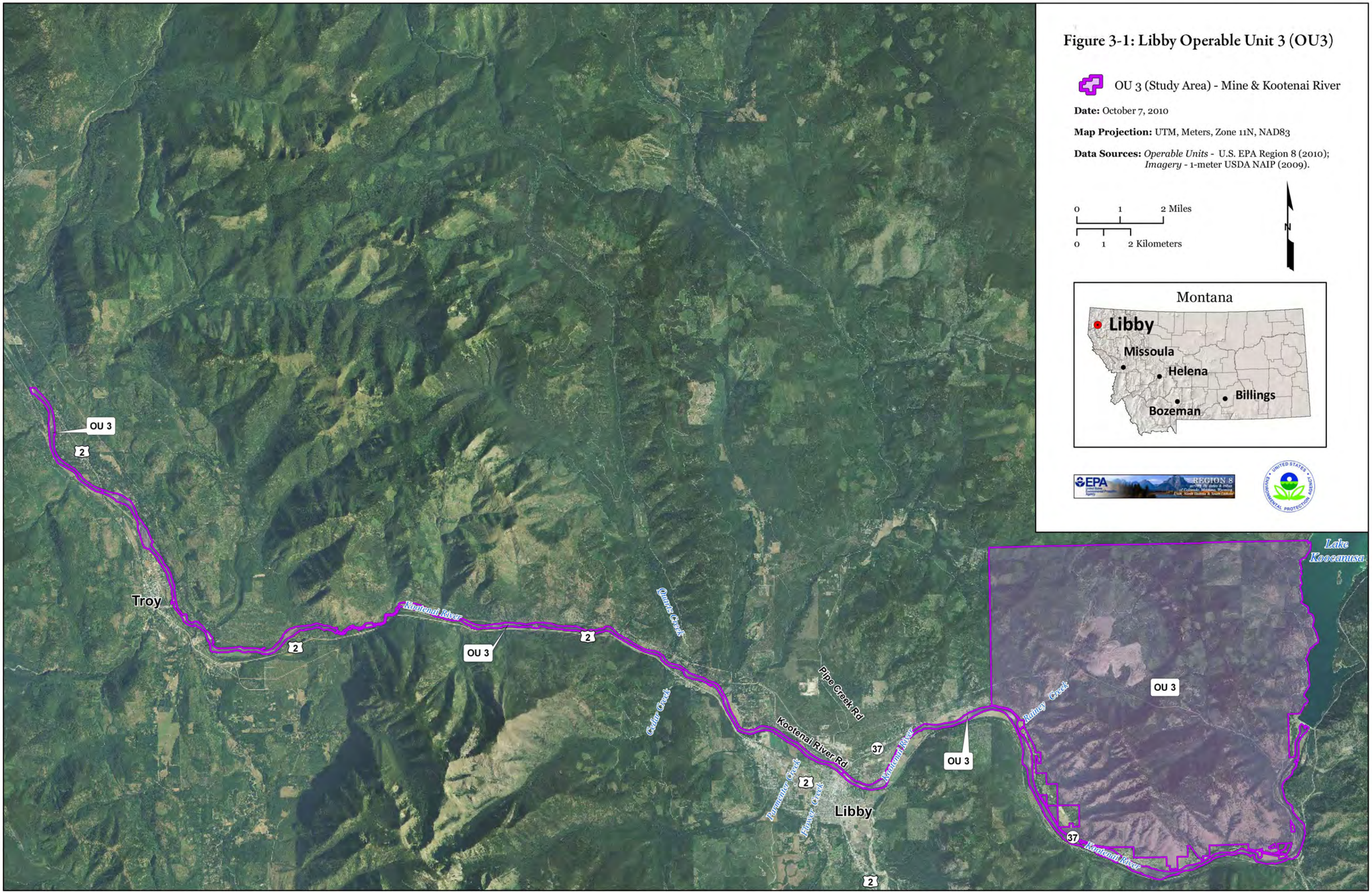

Figure 3-1: Libby Operable Unit 3 (OU3)

County Road
Primary Road
Perennial Stream
Intermittent Stream
Open Water

Figure 3-2
Location of the Mill Pond in Libby OU3

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County Road
Primary Road
Perennial Stream
Intermittent Stream
Open Water

Note: These locations are approximate and not based on GPS coordinates.

Figure 3-3
Location of Deer Collection in Libby OU3

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Tables

TABLE 4-1 FISH FILLET TISSUE BURDEN RESULTS

Sample Information						Analysis Information						Results					
												Total LA			LA > 10 µm		
Field ID	Species	Length (inches)	Weight (grams)	Sample ID	Sample Type	EFA (mm^2)	Ago (mm^2)	F-factor	GOx	Mass (g, ww)	Sensitivity (1/g, ww)	Structures Counted	Tissue Burden (s/g, ww)	90% Poisson Confidence Interval on Tissue Burden	Structures Counted	Tissue Burden (s/g, ww)	90% Poisson Confidence Interval on Tissue Burden
MP-Fish-1	Rainbow Trout	9.6	140	TS-00001	Field Sample	365	0.013	0.2	4	3	1.2E+04	27	3.2E+05	2.3E+05 - 4.3E+05	3	3.5E+04	1.3E+04 - 8.2E+04
MP-Fish-2	Cutbow Trout	11.4	280	TS-00002	Field Sample	365	0.013	0.2	25	3	1.9E+03	5	9.4E+03	4.3E+03 - 1.8E+04	0	0.0E+00	0.0E+00 - 3.6E+03
MP-Fish-3	Cutthroat Trout	14.6	540	TS-00003	Field Sample	365	0.013	0.2	4	3	1.2E+04	72	8.4E+05	6.9E+05 - 1.0E+06	2	2.3E+04	6.7E+03 - 6.5E+04
MP-Fish-4	Cutbow Trout	14.6	560	TS-00004	Field Sample	365	0.013	0.2	4	3	1.2E+04	35	4.1E+05	3.1E+05 - 5.4E+05	3	3.5E+04	1.3E+04 - 8.2E+04
MP-Fish-5	Rainbow Trout	14.2	550	TS-00005	Field Sample	365	0.013	0.05	4	3	4.7E+04	136	6.4E+06	5.5E+06 - 7.3E+06	4	1.9E+05	7.8E+04 - 4.0E+05
MP-Fish-6	Cutbow Trout	13.0	450	TS-00006	Field Sample	365	0.013	0.2	8	3	5.8E+03	25	1.5E+05	1.0E+05 - 2.0E+05	2	1.2E+04	3.4E+03 - 3.2E+04
MP-Fish-7	Cutbow Trout	15.2	595	TS-00007	Field Sample	365	0.013	0.2	25	3	1.9E+03	18	3.4E+04	2.3E+04 - 4.9E+04	0	0.0E+00	0.0E+00 - 3.6E+03
				TS-00008	Field Duplicate	365	0.013	0.2	4	3	1.2E+04	29	3.4E+05	2.5E+05 - 4.6E+05	1	1.2E+04	2.1E+03 - 4.6E+04
---	Farm-raised Trout	---	---	TS-00009	Field Blank	365	0.013	0.05	25	3	7.5E+03	0	0.0E+00	0.0E+00 - 1.4E+04	0	0.0E+00	0.0E+00 - 1.4E+04
												mean*:	**1.2E+06**		**mean*:**	**4.2E+04**	

Ago - area of grid opening
EFA - effective filter area
GOx - grid openings counted
ID - identifier
LA - Libby amphibole
mm^2 - square millimeters
s/g, ww - structures per gram, wet weight
µm - micrometers
g, ww - grams, wet weight
% - percent

*excludes field quality control samples

TABLE 4-2 DEER TISSUE BURDEN RESULTS

Sample Information			Analysis Information						Results[++]		
									Total LA		
Tissue Description	Sample ID	Sample Type	EFA (mm^2)	Ago (mm^2)	F-factor	GOx	Mass (g, ww)	Sensitivity (1/g, ww)	Structures Counted	Tissue Burden (s/g, ww)	90% Poisson Confidence Interval on Tissue Burden
Heart	TS-00010	Field Sample	365	0.013	0.04	25	3	9.4E+03	0	0.0E+00	0.0E+00 - 1.8E+04
Kidney, Sample #1	TS-00012	Field Sample	365	0.013	0.15	25	3	2.5E+03	0	0.0E+00	0.0E+00 - 4.8E+03
Kidney, Sample #2	TS-00013	Field Sample	365	0.013	0.04	25	3	9.4E+03	0	0.0E+00	0.0E+00 - 1.8E+04
Inside Shoulder Muscle	TS-00015	Field Sample	365	0.013	0.04	25	3	9.4E+03	0	0.0E+00	0.0E+00 - 1.8E+04
	TS-00016	Field Duplicate	365	0.013	0.04	25	3	9.4E+03	0	0.0E+00	0.0E+00 - 1.8E+04
Diaphragm, Sample #2	TS-00018	Field Sample	365	0.013	0.04	25	3	9.4E+03	0	0.0E+00	0.0E+00 - 1.8E+04
Diaphragm, Sample #1	TS-00019	Field Sample	365	0.013	0.04	25	3	9.4E+03	0	0.0E+00	0.0E+00 - 1.8E+04
Backstrap Muscle, Sample #1	TS-00021	Field Sample	365	0.013	0.04	25	3	9.4E+03	0	0.0E+00	0.0E+00 - 1.8E+04
Backstrap Muscle, Sample #2	TS-00022	Field Sample	365	0.013	0.04	25	3	9.4E+03	0	0.0E+00	0.0E+00 - 1.8E+04
Lung, Sample #1	TS-00024	Field Sample	365	0.013	0.15	25	3	2.5E+03	0	0.0E+00	0.0E+00 - 4.8E+03
Lung, Sample #2	TS-00025	Field Sample	365	0.013	0.15	25	3	2.5E+03	0	0.0E+00	0.0E+00 - 4.8E+03
Liver, Sample #1	TS-00027	Field Sample	365	0.013	0.04	25	3	9.4E+03	0	0.0E+00	0.0E+00 - 1.8E+04
Liver, Sample #2	TS-00028	Field Sample	365	0.013	0.02	25	3	1.9E+04	0	0.0E+00	0.0E+00 - 3.6E+04
Muscle (Store-bought Beef Steak)	TS-00030	Field Blank	365	0.013	0.04	25	3	9.4E+03	0	0.0E+00	0.0E+00 - 1.8E+04

[++] Because no total LA structures were observed results based on structures longer than 10 µm are not displayed.

mean*: 0.0E+00

*excludes field quality control samples

Ago - area of grid opening
EFA - effective filter area
GOx - grid openings counted
ID - identifier
LA - Libby amphibole
mm^2 - square millimeters
s/g, ww - structures per gram, wet weight
g, ww - grams, wet weight
% - percent

Table 5-1
Description and Implications of Fish and Game Tissue Assessment SAP/QAPP Modifications

Modification (Effective Date)	Description of Modification	Implications of Modification	Data Quality Indicator
LFO-000173 (10/22/2012)	The Tissue Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP) specified collection of two game animals including one deer and one elk. If an elk could not be collected then two deer were to be collected. Only one game animal was collected, a deer.	Tissue burden results may not be adequate to support risk management decision-making.	No Bias
	In order to identify a location where deer and elk may occur and be collected, selected areas within Operable Unit 3 (OU3) were to be baited to attract the game animals. Motion activated game cameras were to be used to monitor use of the area remotely. The cameras were to be periodically visited and photos downloaded. Once the use of the area was established by deer and/or elk, the sampler could enter the site and collect the target species. Once animals were harvested, or if bear activity was detected, all baiting materials were to be collected and removed to eliminate the temptation for animals to return to area. Game cameras were not used. Baiting was performed but the deer collected was not taken off of the baits. The baits were not removed.	There are no anticipated negative implications of these modifications.	No Bias
	The SAP/QAPP specified the collection of global positioning system (GPS) coordinates for all bait and camera locations, as well as the specific area where deer and elk are collected. GPS location coordinates were not recorded.	There are no anticipated negative implications of this modification.	No Bias
	One tissue sample was to be collected for LA tissue burden for flank muscle, backstrap muscle, heart, liver, lung, kidney and diaphragm. Two samples of each tissue type were submitted for analyses instead of one.	There are no anticipated negative implications of this modification.	No Bias
	Muscle tissue samples were collected from the inside shoulder instead of the flank.	There are no anticipated negative implications of this modification.	No Bias
	Photographs were not collected of the animal prior to processing or all steps of the gross dissection process as specified by the standard operating procedure (SOP).	Confirmation of the location of tissue sample collections are not available.	No Bias
	Lung tissue was to be collected from the peripheral tip of one of the lobes. The location of the lung tissue samples was not noted in the field logbook or field sample data sheet (FSDS) form. There are also lesions observed on the lungs in photographs and these are not mentioned in the field documentation.	There are no anticipated negative implications of this modification.	No Bias

TABLE 5-2 EVALUATION OF FIELD DUPLICATE FOR FISH TISSUE

Sample Information				Sensitivity (1/g, ww)	Total LA Structures Counted	Total LA Tissue Burden (s/g, ww)	Poisson Ratio Test (90% Confidence Interval)
Field ID	Species	Sample ID	Sample Type				
MP-Fish-7	Cutbow Trout	TS-00007	Field Sample	1.9E+03	18	3.4E+04	[0.06-0.17] Rate 1 is less than Rate 2
		TS-00008	Field Duplicate	1.2E+04	29	3.4E+05	

ID - identifier

LA - Libby amphibole

s/g, ww - structures per gram, wet weight

1/g, ww - per grams, wet weight

% - percent

TABLE 5-3 CHISQ TEST RESULTS FOR FILTERS WITH LA STRUCTURES

Field ID	Species	Sample ID	Sample Type	CHISQ p-value
MP-Fish-1	Rainbow Trout	TS-00001	Field Sample	0.53
MP-Fish-2	Cutbow Trout	TS-00002	Field Sample	0.00
MP-Fish-3	Cutthroat Trout	TS-00003	Field Sample	0.80
MP-Fish-4	Cutbow Trout	TS-00004	Field Sample	0.46
MP-Fish-5	Rainbow Trout	TS-00005	Field Sample	0.05
MP-Fish-6	Cutbow Trout	TS-00006	Field Sample	0.77
MP-Fish-7	Cutbow Trout	TS-00007	Field Sample	0.04
		TS-00008	Field Duplicate	0.24

CHISQ = Chi-square

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Appendix A.1
Field Documentation (FSDS Forms and Field Logbook Notes)
[provided electronically upon request]

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Appendix A.2
Analytical Laboratory Job Reports
[provided electronically upon request]

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Appendix B
Microsoft Access® Database for the Tissue Study (as of 6/24/2013)

[provided electronically upon request]

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Appendix C
Game Tissue Assessment, Necropsy Narrative

APPENDIX C: GAME TISSUE ASSESSMENT, NECROPSY NARRATIVE

LIBBY ASBESTOS SUPERFUND SITE, LIBBY, MONTANA

Game tissue sampling activities began on October 22, 2013, at approximately 1315 hours when D. Repine (CDM Smith) and B. Forsythe (U.S. Fish and Wildlife Service) arrived at the decontamination trailer area of the former W.R. Grace mine. The carcass of the female mule deer harvested from the mine area was placed on a table covered with poly sheeting. D. McKean (U.S. Environmental Protection Agency, Region 8) performed the dissection of the animal and collected the necessary tissue samples. The tissue sampling activities occurred as follows:

- 1325 hours – Deer trachea sample for fixation was collected. Sample # TS-00034

The carcass of the deer was then manipulated such that the back straps were accessible and the removal of the back strap muscles began.

- 1330 hours – Deer back strap muscle for tissue burden was collected; note that both back strap muscles were collected for sampling purposes. Samples # TS-00021 & TS-00022
- 1332 hours – Deer back strap muscle for fixation was collected. Sample # TS-00023

After the samples had been collected from the back strap muscles and back straps removed, the deer was manipulated such that samples could be collected from the internal organs. The first organ to be removed and to have samples collected was the liver.

- 1340 hours – Deer liver for fixation was collected. Sample # TS-00029
- 1345 hours – Deer liver (sample #1) for tissue burden was collected. Sample # TS-00027
- 1349 hours – Deer liver (sample #2) for tissue burden was collected. Sample # TS-00028

Following the collection of the samples from the liver, a fixation sample was collected from the large intestine.

- 1352 hours – Deer large intestine for fixation was collected. Sample # TS-00033

The chest cavity was then opened and sample collection began of the pleural lining. Note that only fixation samples were collected from the pleural lining, no tissue burden samples were collected.

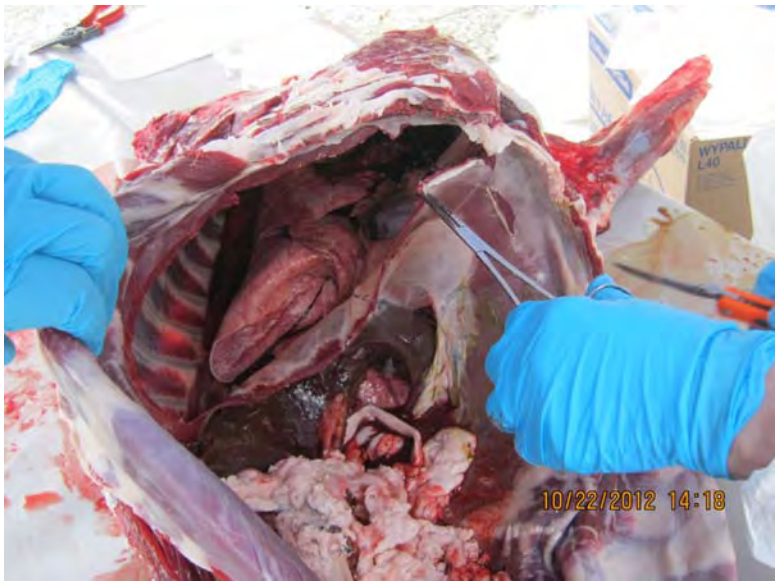
- 1354 hours – Deer Pleural lining (sample #1) for fixation was collected. Sample # TS-00031
- 1356 hours – Deer Pleural lining (sample #2) for fixation was collected. Sample # TS-00032

Following the collection of the pleural lining samples, the kidneys of the deer were removed and tissue sampling was completed.

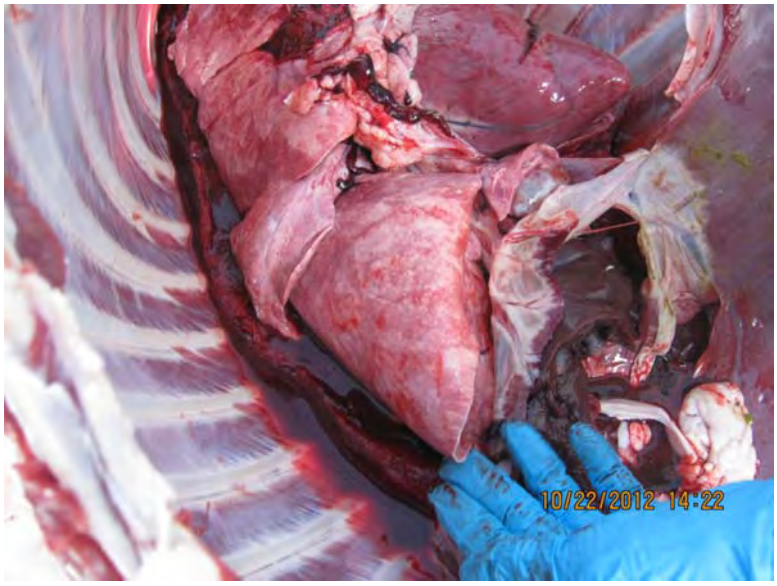
- 1400 hours – Deer kidney for fixation was collected. Sample # TS-00014
- 1404 hours – Deer kidney (sample #1) for tissue burden was collected. Sample # TS-00012
- 1405 hours – Deer kidney (sample #2) for tissue burden was collected. Sample # TS-00013

Before the sampling of the lungs and heart could be completed; samples of the diaphragm were collected.

- 1410 hours – Deer diaphragm (sample #1) for tissue burden was collected. Sample # TS-00019
- 1412 hours – Deer diaphragm (sample #2) for tissue burden was collected. Sample # TS-00018
- 1412 hours – Deer diaphragm for fixation was collected. Sample # TS-00020

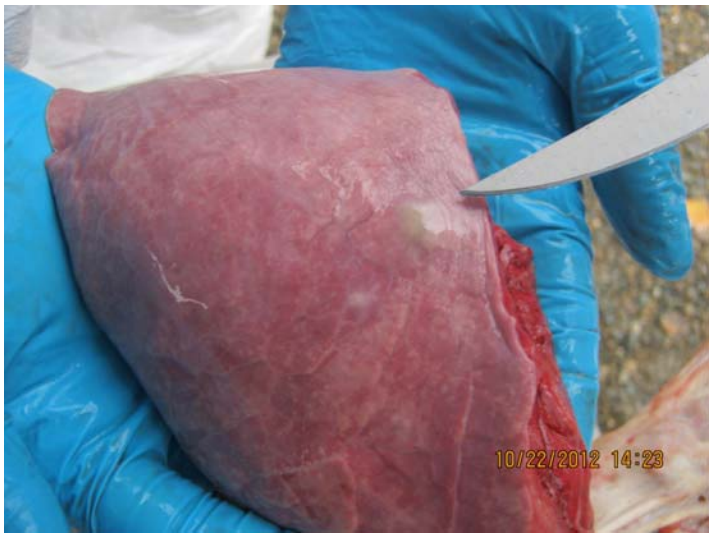


With sampling of the diaphragm completed, sampling of the lungs and heart began. Lung samples were collected first.

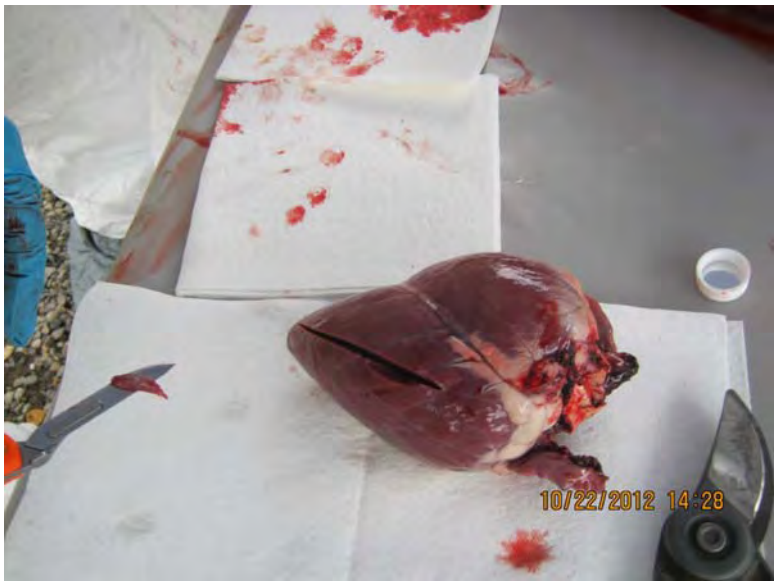


- 1420 hours – Deer lung for fixation was collected. Sample # TS-00026
- 1422 hours – Deer lung (sample #1) for tissue burden was collected. Sample # TS-00024
- 1422 hours – Deer lung (sample #2) for tissue burden was collected. Sample # TS-00025

A small (approximately 3 centimeters in diameter) cyst filled with clear fluid was noted on the lung. No other lesions were noted in any other tissue.



Following the collection of the samples from the lungs, samples from the heart were collected.



- 1430 hours – Deer heart for fixation was collected. Sample # TS-00011
- 1432 hours – Deer heart for tissue burden was collected. Sample # TS-00010

Rather than collecting samples from the flank of the animal, the sampling team elected to collect samples from the inside shoulder muscle of the animal, i.e., from the inside front left quarter of the animal. This deviation from the governing SAP was documented in field modification form #LFO-000173_Tissue SAP.

- 1438 hours – Deer shoulder muscle for fixation was collected. Sample # TS-00017
- 1440 hours – Deer shoulder muscle (sample #1) for tissue burden was collected. Sample # TS-00015
- 1442 hours – Deer shoulder muscle (sample #2) for tissue burden was collected. Sample # TS-00016

Following the collection of the inside shoulder muscle samples, the remainder of the carcass was wrapped in poly sheeting and placed in poly bags. The carcass and quarters were transported to the CDM Smith office in Libby, Montana to be frozen for storage. A field blank sample was collected using a beef steak.

- 1530 hours – Deer field blank (beef steak) for tissue burden was collected. Sample # TS-00030

Following the collection of the field blank, all equipment used in the sampling effort was washed and decontaminated with a bleach solution. An equipment rinsate sample was collected from the sampling equipment following decontamination.

- 1540 hours – Rinsate sample was collected. Sample # TS-00035

At 1545 hours, all sampling was completed.

Data Summary Report:
Fish and Game Tissue Assessment
Libby Asbestos Superfund Site
Libby, Montana

Appendix D
Deer Tissue Fixation Laboratory Report

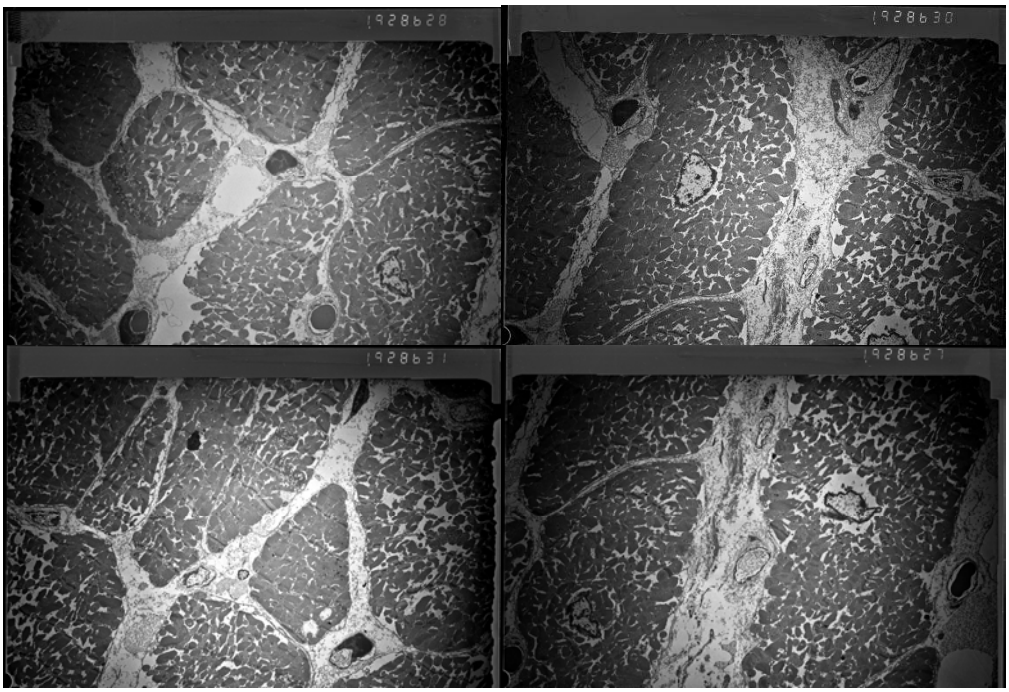
23216_271201100

Analysts: E.Wyatt-Pescador
R. Pescador
Samples Received: 10/23/12
Preparation Start Date: 10/25/12
Preparers: R. Pescador, E.Wyatt-Pescador, D. Barney

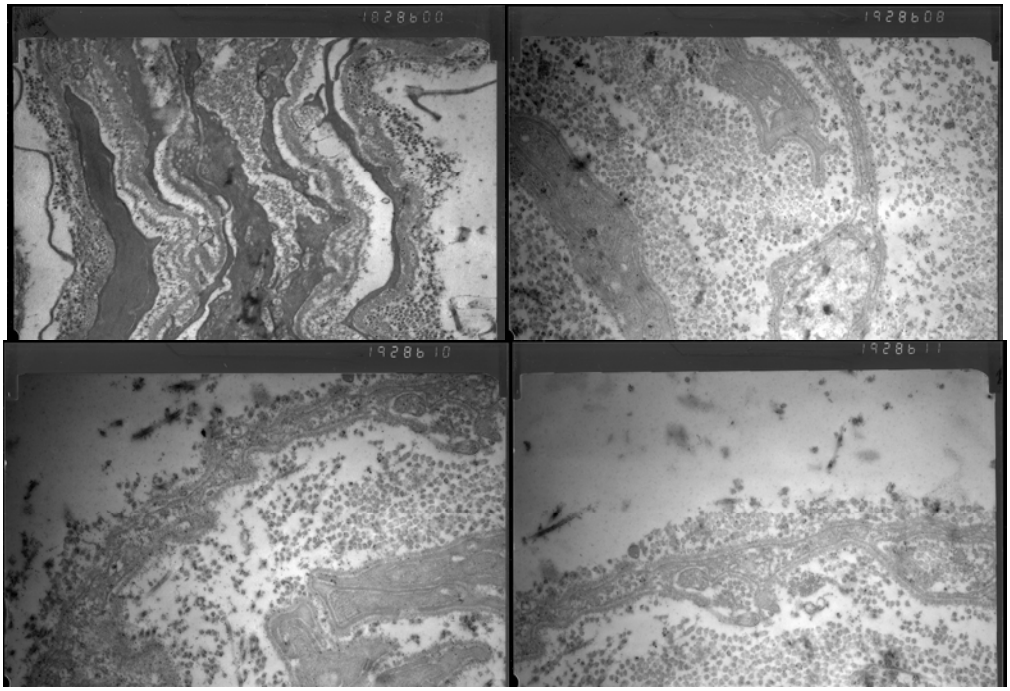
Method:
Preparation and analysis procedures were followed according to the Libby Asbestos Superfund Site Standard Operating Procedure Analysis of Tissue for Asbestos with Addendum: Fixation of Game Tissue Samples for Analysis by TEM or SEM (October 22, 2012). Sectioning was performed on Reichert Ultracut E Ultramicrotome with using glass knives. No deviation from SOP was performed.

Results:

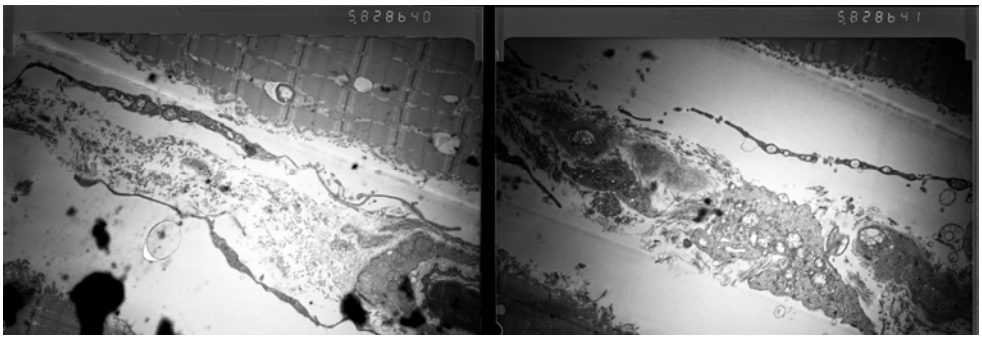
a. TS-00011-Heart: Tissue appeared normal and void of inclusions. No evidence of inflammation or granulation observed.



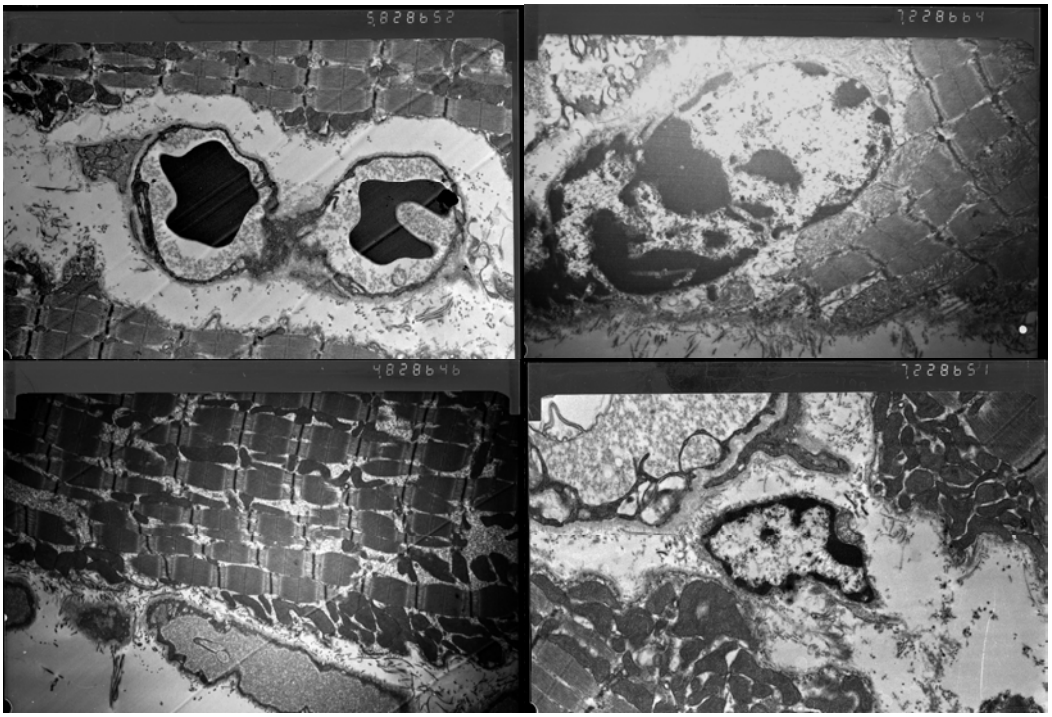
b. TS-00014-Kidney: Tissue appeared normal and void of inclusions. Glomeruli are present but no inclusions or deposits were observed. No signs of inflammation or granulation were observed.



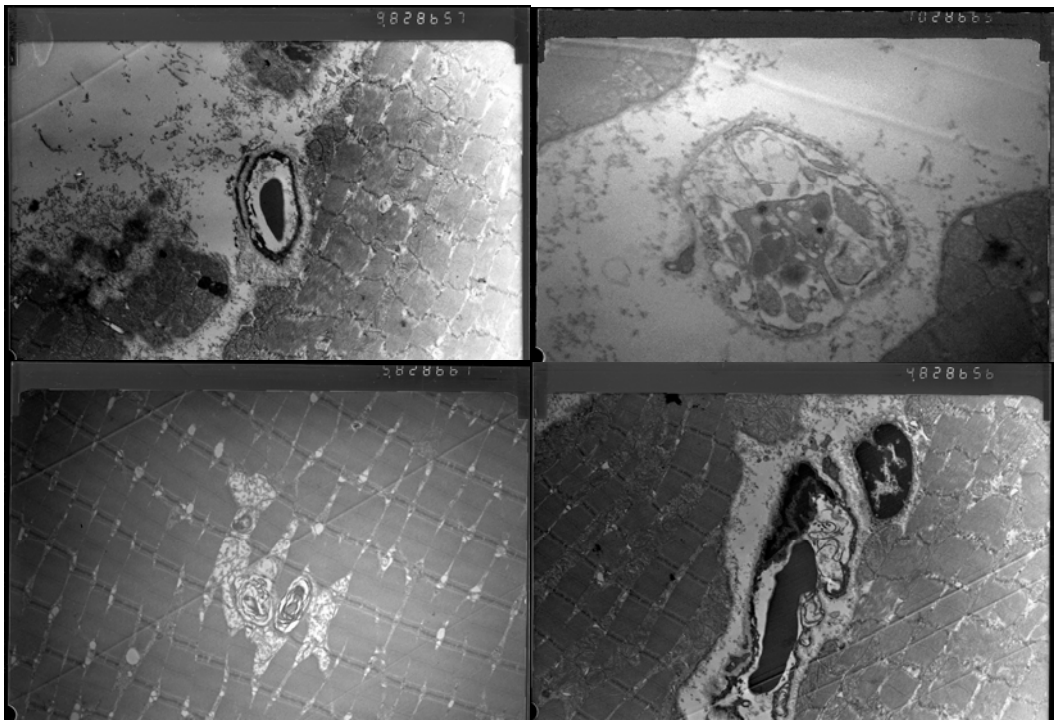
c. TS-00017-Shoulder: Muscle tissue appears normal. Microfilaments are well defined with minimal loss in structure. No signs of inflammation or granulation were observed.



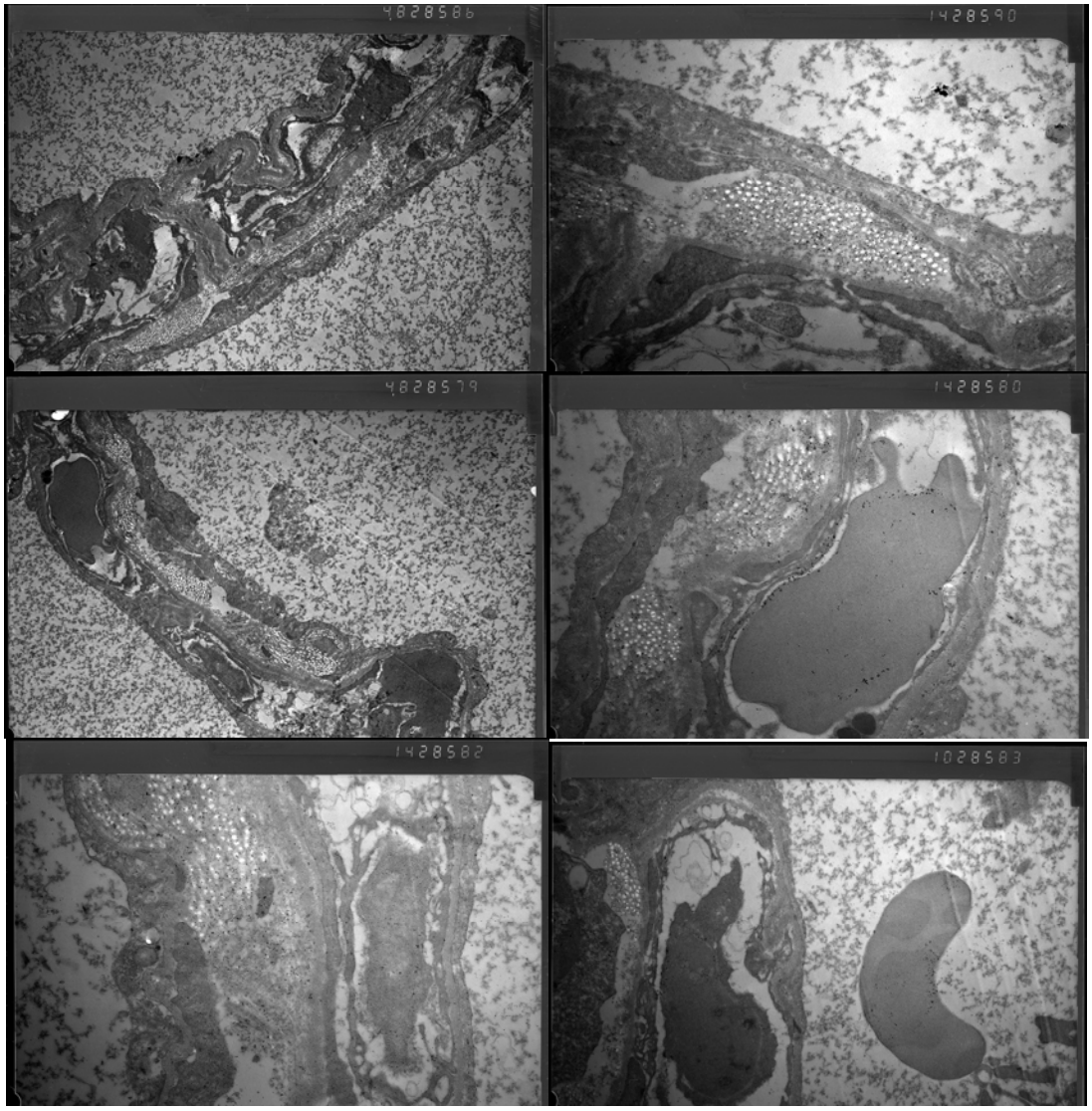
d. TS-00020-Diaphragm: Tissue appeared normal and void of inclusions. No signs of inflammation or granulation were observed.



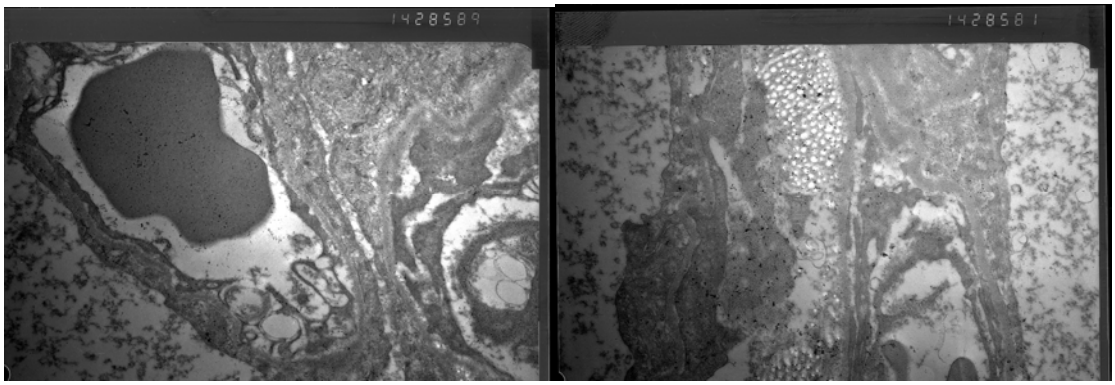
e. TS-00023-Backstrap: Tissue appeared normal and void of inclusions. No signs of inflammation or granulation were observed,



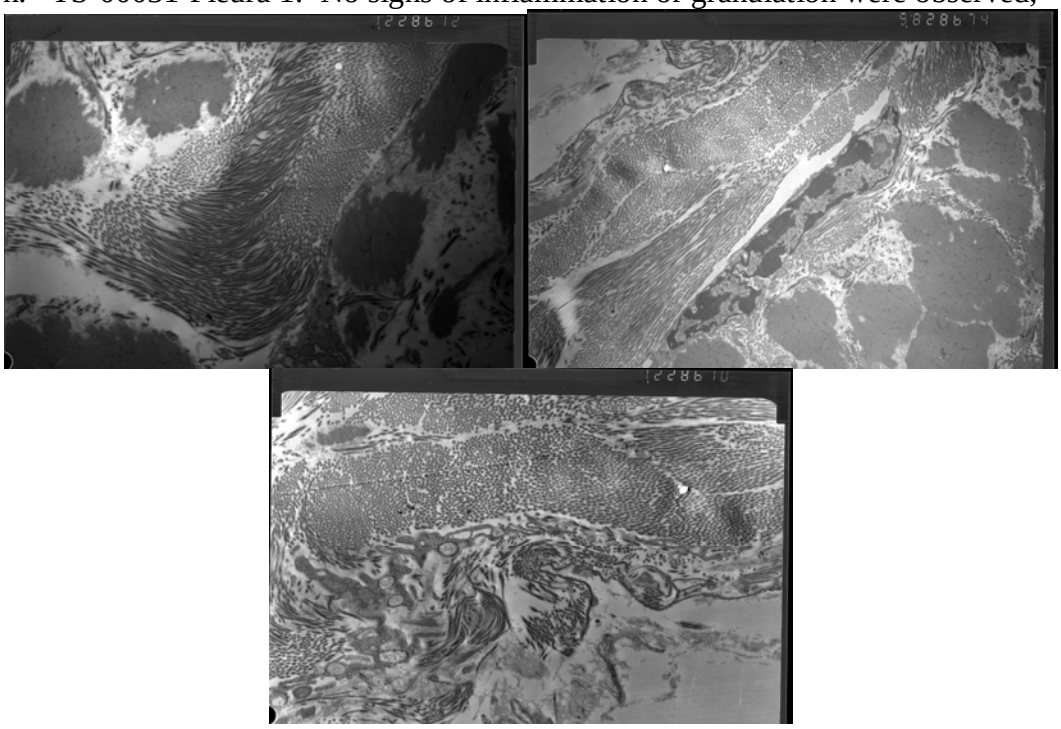
f. TS-00026-Lung: Surfactant was not observed in the alveoli. The alveoli appear normal. No apparent signs of necrosis were observed. No signs of inflammation or granulation were observed.



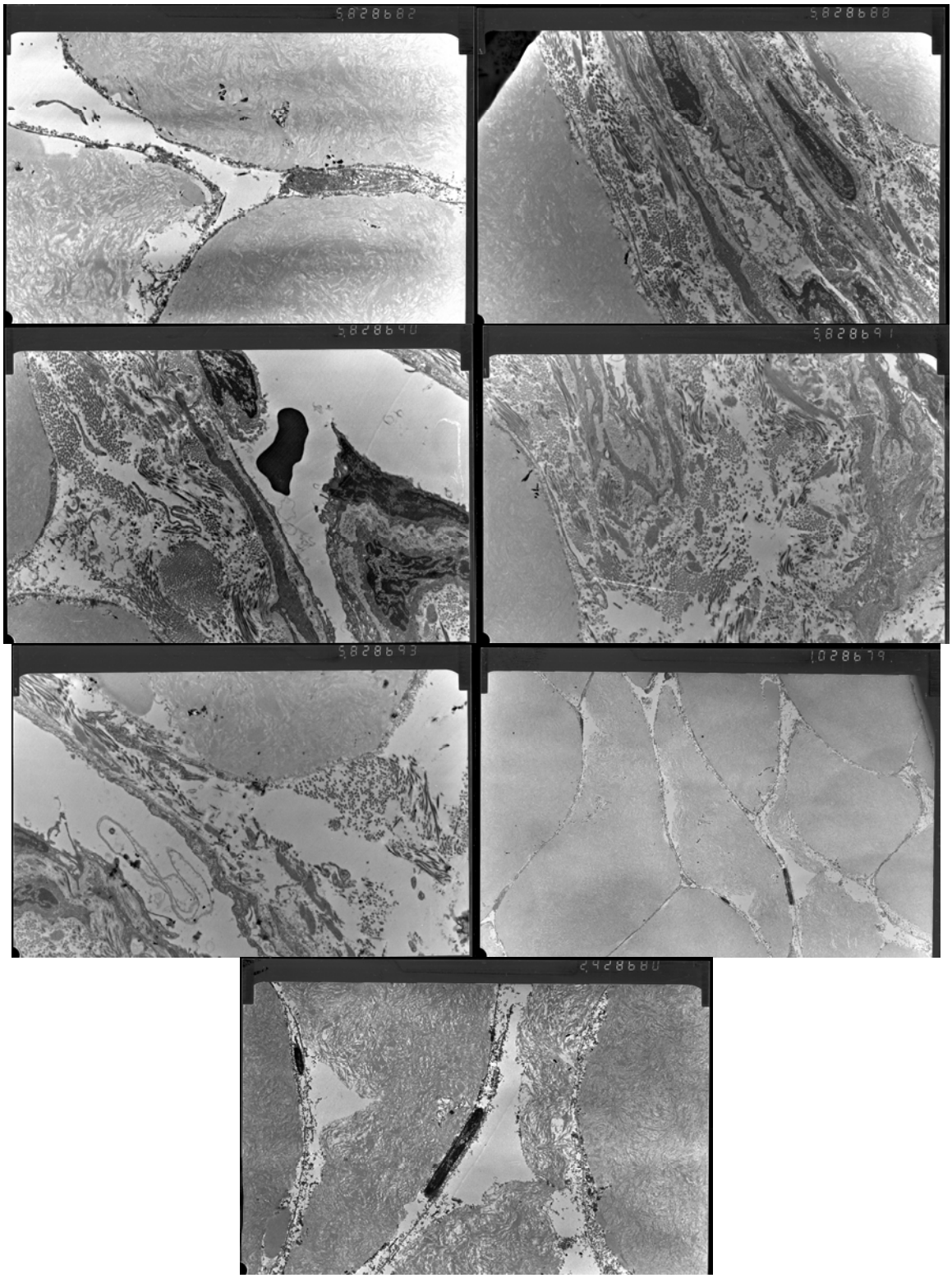
g. TS-00029-Liver: Hepatocytes are clear and well defined. Mitochondria appear to be well fixed. No signs of inclusions observed. No signs of inflammation or granulation were observed.



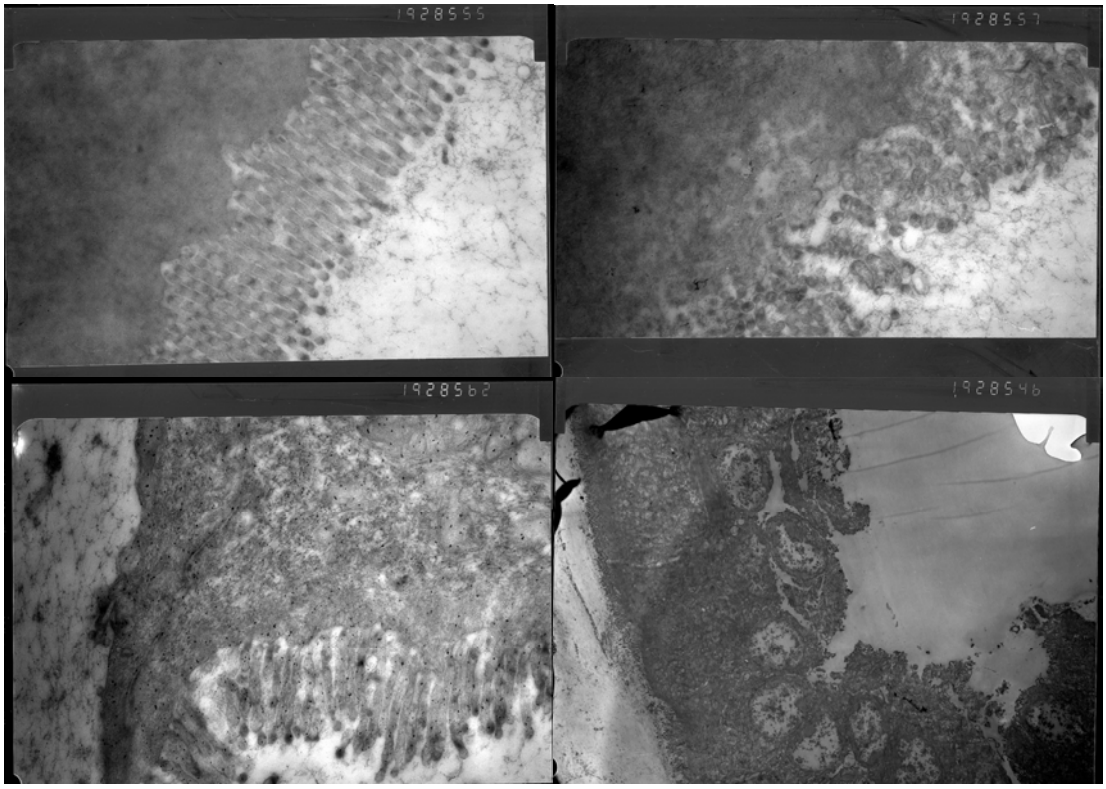
h. TS-00031-Pleura 1: No signs of inflammation or granulation were observed,



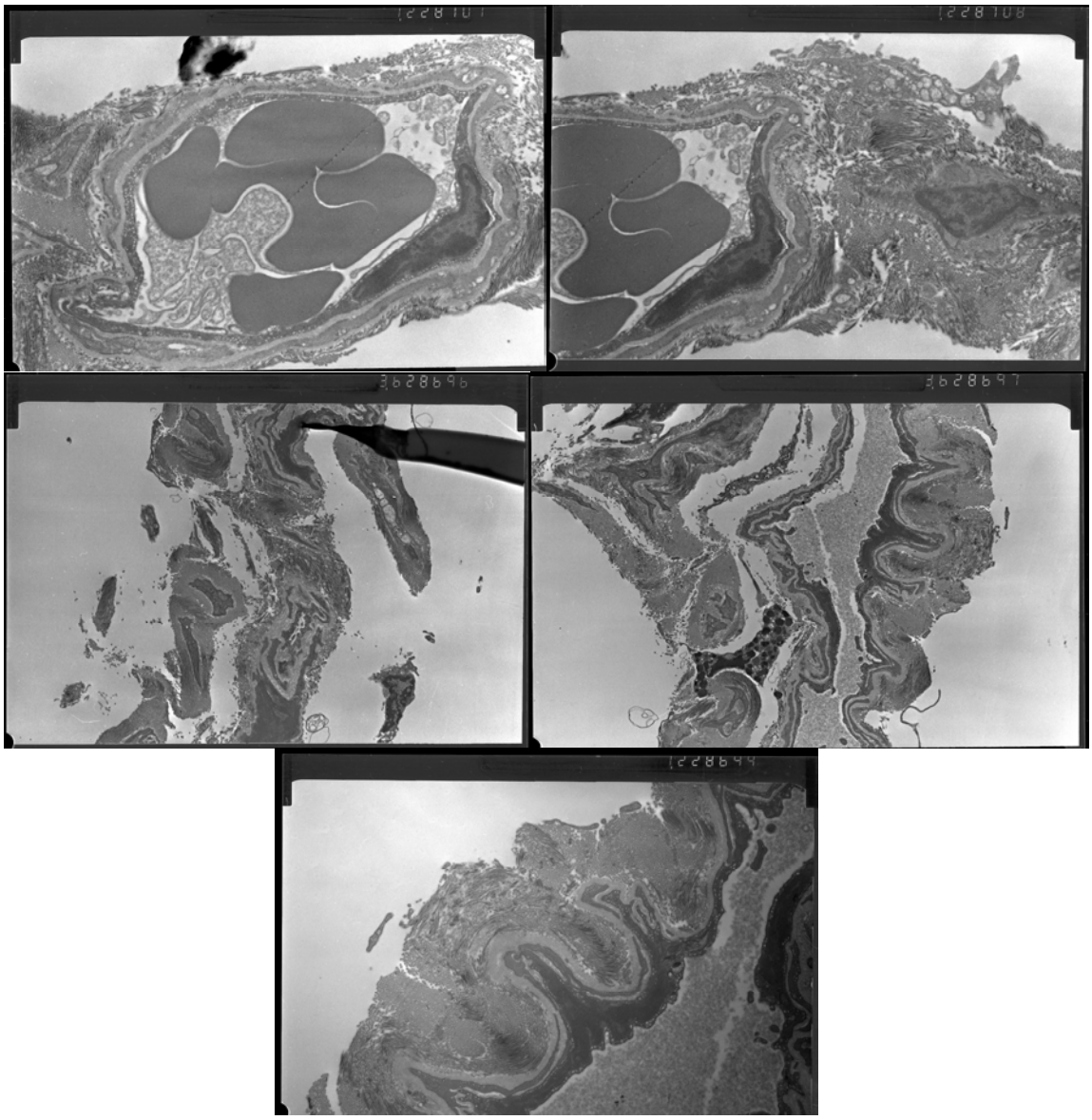
i. TS-00032-Pleura 2: No signs of inflammation or granulation were observed.



j. TS-00033-Large Intestine: Microvilli appear to be well fixed. No asbestos structures were observed within the microvilli. No inclusions were observed between the microvilli and basal cells.



k. TS-00034- Trachea: No signs of inflammation or granulation were observed



Additional tissues may be suggested for future analysis: Tongue, small intestine, hooves and skin including fur. Any mucosal membranes (e.g. eyes and nasal passages) may also be collected. Thin sectioning focuses its study at the cellular level. Inflammation and/or granulation levels will need to be at an extremely high level to be captured and recorded. These are representative micrographs collected after the required 50 grid opening analysis minimum. In addition, sectioning asbestos with glass is generally a difficult task. While sectioning the various samples it observed that no such difficultly was present. It may be concluded that there were no asbestos present in the sections which correlates to the absence in the sections observed under TEM.

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Data Summary Report:
Fish and Game Tissue Assessment
Libby Asbestos Superfund Site
Libby, Montana

Appendix E
Record of Modification

Record of Modification

to Documents Governing Field Activities

Libby Asbestos Project

Form No. LFO-000173

Instructions: Complete form and obtain necessary approval(s). File approved copy in the project file and post final version to the Libby Field eRoom.

Requester: Damon Repine
Title: Field support staff
Company: CDM Smith
Date: 2/26/2013

Governing document (title and approved date) or SOP (title and SOP number): *Sampling and Analysis Plan/Quality Assurance Project Plan: Fish and Game Tissue Assessment*. Libby Asbestos Site, Operable Unit 4. Revision 1 – October 2012.

Field logbook and page number where modification is documented (or attach associated correspondence): Modifications are not recorded in logbook (see attached table)

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

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

Duration of modification (indicate one):

Temporary Date(s): _____

[Permanent] Effective Date: 10/22/2012

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

- ☐ Not Applicable
- ☐ Low Bias
- ☐ High Bias
- ☐ Reject
- ☐ Estimate
- X No Bias

Prepared by: Damon Repine
(Team Leader or designate)
Date: 6/19/13

Approved by: [signature]
(EPA RPM or designate)
Date: 6/19/13

DATA QUALITY INDICATOR DEFINITIONS

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

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

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

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

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

Description of Modification	Section/Document	Implications	Data Quality Indicator
One game animal was collected instead of two.	Sections A6.1, B1.2, B2.1.1, of SAP/ QAPP	Tissue burden results may not be adequate to support risk management decision-making	No Bias
Motion activated game cameras were not used.	Section B2.1.1 of SAP/ QAPP	No negative implications were identified.	No Bias
Baiting was performed but the deer collected was not taken off of the baits.	Section B2.1.1 of SAP/ QAPP	No negative implications were identified.	No Bias
Baiting materials were not collected and removed after use.	Section B2.1.1 of SAP/ QAPP	No negative data quality implications were identified.	No Bias
Global positioning system (GPS) location coordinates were not recorded for bait and camera locations, as well as the specific area where the deer was collected. The general location of the deer collection and processing were described by field personnel.	Section B2.2 of SAP/ QAPP	No negative implications were identified.	No Bias
Muscle tissue samples were collected from the inside shoulder instead of the flank.	Section B2.1.1 of SAP/ QAPP and SOP EPA-LIBBY-2012-15	No negative implications were identified.	No Bias
Two samples were submitted for analyses of LA tissue burden instead of one sample for backstrap muscle, inside shoulder muscle, heart, liver, lung, kidney and diaphragm.	Section B2.1.1 of SAP/ QAPP and SOP EPA-LIBBY-2012-15	No negative implications were identified.	No Bias
Photographs were not collected of the animal prior to processing or all steps of the gross dissection process as specified by the SOP.	SOP EPA-LIBBY-2012-15	Confirmation of the location of tissue sample collections are not available.	No Bias
The field logbook did not note deviations from the governing documents.	Section B3.1.3 of SAP/ QAPP	No negative implications were identified.	No Bias
Lung tissue was to be collected from the peripheral tip of one of the lobes. The location of the lung tissue samples was not noted in the field logbook or FSDS form. There are also lesions observed on the lungs in photographs and these are not mentioned in the field documentation.	Page 8 of SOP EPA-LIBBY-2012-15	No negative implications were identified.	No Bias

Data Summary Report:
Fish and Game Tissue Assessment
Libby Asbestos Superfund Site
Libby, Montana

Appendix F
Data Verification Summary Report

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Data Verification Report
Fish and Game Tissue Assessment

Libby Asbestos Superfund Site
Libby, Montana

June 2013

Contract No. EP-W-05-049
Work Assignment No. 329-RICO-08BC

Prepared for:

U.S. ENVIRONMENTAL PROTECTION AGENCY
Region 8

Prepared by:

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

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FIELD SAMPLE INFORMATION DATA TRANSFER VERIFICATION REPORT

Project/Dataset Description: **Libby Asbestos Superfund Site, Fish and Game Tissue Assessment**

SUMMARY OF FINDINGS AND DATA QUALITY IMPLICATIONS

A verification of 10% of the field sample data sheet (FSDS) information was performed for tissue samples in basic accordance with Standard Operating Procedure EPA-LIBBY-11 (revision 0). The samples selected for field sample data verification were the same samples selected for analytical data verification.

No discrepancies were identified in the transfer of field information from the FSDS forms into the project database. An issue was identified in which the Event ID (e.g., TS-080012) was unreadable on the FSDS form for one sample. Field personnel confirmed that the same Event ID applied to all tissue samples and was correctly entered in the project database.

The Data Verification Coordinator performed a check of 5% of the analyses verified to ensure that any potential issues were identified correctly. No deficiencies were noted.

RECOMMENDATIONS FOR FUTURE VERIFICATION

No discrepancies were identified; therefore, there is no need to perform future review or verification efforts for this dataset.

Data Verifier: Natalie Ross *Date:* 6.20.13

Data Verification Coordinator: [illegible] *Date:* 6/20/13

Verification Data Manager:* Natalie Ross *Date:* 6.20.13

The Verification Data Manager acknowledges that all issues discovered during the verification process have been resolved and that the following criteria have been met:

--All necessary corrections have been made to the field sample documentation forms utilized in the verification (FSDS forms, field logbooks, COC forms, etc.).
--The corrected field sample documentation forms have been re-submitted to the appropriate parties (as specified in the governing project documents).
--All necessary corrections have been made to the project database.

SAMPLE SELECTION

A verification of sample information was performed for the list of samples that were selected for analytical verification for this dataset.

DATA TRANSFER VERIFICATION RESULTS

Number of samples verified: 3

Number of samples with data transfer issues identified: 0 (0% of total samples verified)

Comments: Attachment 1 (Data Summary Table for Water Samples) contain the details of the verification. Attachment 2 contains the field documentation forms that were used for this verification effort.

ATTACHMENT 1. DATA SUMMARY TABLE FOR TISSUE SAMPLES

DVC - 5%	Sample ID	Matrix	Event ID	Address	Field Data Sheet	Sample Date	Property ID	Field Logbook	Field Logbook Page	Sampler	Location ID	Sample Time	Sample Venue	Sample PrePostClear	Sample Type	Sample Parent ID	Sample Composite (Y/N)	Sample ABS	Sample Aliquots	Sample Field Comments	Verifier's Company	Verifier's Name	Comment	Correction Date
EF	TS-00003	Tissue	TS-080012	NA	B-100008	8/6/2012	AD-OU3NA	NA	NA	Volosin J | Anchor QEA	AD-OU3NA	16:10	NA	NA	Field Sample		No	No	0	MP-Fish-3 Cutthroat Trout	CDM Smith	NR		
	TS-00007	Tissue	TS-080012	NA	B-100010	8/6/2012	AD-OU3NA	NA	NA	Volosin J | Anchor QEA	AD-OU3NA	19:55	NA	NA	Field Sample		No	No	0	MP-Fish-7 Cutbow Trout	CDM Smith	NR		
	TS-00025	Tissue	TS-080012	NA	B-100017	10/22/2012	AD-OU3NA	101391	3	Repine D |CDMSmith	XX-017361	14:22	NA	NA	Field Sample		No	No	0	Deer Lung for Tissue Burden (2)	CDM Smith	NR	Event ID is unreadable on the FSDS. Applies to 10 FSDS forms.	3/13/2013

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ATTACHMENT 2 – FIELD DOCUMENTATION FORMS

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Event ID TS-080012

Libby Bulk-Like Sample & Location
Field Sample Data Sheet

FSDS # **B - 100008**

Address NA

Date 8/6/12

Property ID: AD- 043NA Logbook # NA Pgs NA Sampler(s)** Volosin, Joseph (Anchor QEA)

Data Item	1	2	3
Location ID	AD-043NA	→	→
Is this a new Location	Yes (No) Revised *If No, "Z" through location section*	Yes (No) Revised *If No, "Z" through location section*	Yes (No) Revised *If No, "Z" through location section*
Location Type			
Location Description			
Location Area (ft^2)			
Location Comment			
Location Comment2			
Sample ID	**TS- 00001**	**TS- 00002**	**TS- 00003**
Sample Time	1610	1610	1610
ABS	(N) Y	(N) Y	(N) Y
Matrix if other than Bulk	(Tissue) Ash Other _____	(Tissue) Ash Other _____	(Tissue) Ash Other _____
Sample Venue	Indoor Outdoor (NA)	Indoor Outdoor (NA)	Indoor Outdoor (NA)
Sample Pre Post Clear	(NA) Other: _____	(NA) Other: _____	(NA) Other: _____
Sample Type	(FS) FD Other_____	(FS) FD Other_____	(FS) FD Other_____
Sample Parent ID			
Composite	Y (N)	Y (N)	Y (N)
Sample/Inspection Aliquots	30 Other _____ (0)	30 Other _____ (0)	30 Other _____ (0)
Sample Location Description			
Sample Field Comments	MP-Fish-1 Rainbow Trout	MP-Fish-2 Cutbow Trout	MP-Fish-3 Cutthroat Trout SL DVC-EF

23256

V 120120 *Required Field **List company after Sampler(s) if not "CDM Smith"

For Field Team Completion: Completed by [illegible] QC by [illegible] | For Data Entry: Entered by [illegible] QC by [illegible]

Event ID TS-080612

Libby Bulk-Like Sample & Location
Field Sample Data Sheet

FSDS # **B - 100010**

Address NA

Date 8/6/12

Property ID: AD-043NA Logbook # NA Pgs NA Sampler(s)** Volosin, Joseph (Anchor QEA)

Data Item	1	2	3
Location ID	AD-043NA		
Is this a new Location	Yes (No) Revised *If No, "Z" through location section*	Yes (No) Revised *If No, "Z" through location section*	Yes No Revised *If No, "Z" through location section*
Location Type			
Location Description			
Location Area (ft^2)			
Location Comment			
Location Comment2			
Sample ID	**TS- 00007**	**TS- 00008**	10/22/12
Sample Time	1955	1955	
ABS	(N) Y	(N) Y	N Y
Matrix If other than Bulk	(Tissue) ~~Ash~~ MJP 10/21/12 Other _____	(Tissue) Ash Other _____	Tissue Ash Other _____
Sample Venue	Indoor Outdoor (NA)	Indoor Outdoor (NA)	Indoor Outdoor NA
Sample Pre Post Clear	(NA) Other: _____	(NA) Other: _____	NA Other: _____
Sample Type	(FS) FD Other_____	FS (FD) Other_____	FS FD Other_____
Sample Parent ID		TS-00007	
Composite	Y (N)	Y (N)	Y N
Sample/Inspection Aliquots	30 Other _____ (0)	30 Other _____ (0)	30 Other _____ 0
Sample Location Description			
Sample Field Comments	MP-Fish-7 Cutbow Trout	MP-Fish-7 Cutbow Trout Field Dup	

V 120120 *Required Field **List company after Sampler(s) if not "CDM Smith"

For Field Team Completion: Completed by: [illegible] QC by: [illegible] | For Data Entry: Entered by: [illegible] QC by: [illegible]

Form ID: [illegible]

Libby Bulk-Like Sample & Location
Field Sample Data Sheet

FSDS # **B - 100017**

Address N/A

Date 10/22/12

Property ID: AD- 003MA Logbook # 10139 Pgs 3 Sampler(s)** B. FORSYTHE (USFWS) A. WIDAY D. REPPAHE M. CIRIAN (EPA) D. MCKEAN (EPA)

	Data Item	1	2	3
*	**Location ID**	XX-017361	→	→
*	**Is this a new Location**	Yes (No) Revised *If No, "Z" through location section*	Yes (No) Revised *If No, "Z" through location section*	Yes (No) Revised *If No, "Z" through location section*
*	**Location Type**			
*	**Location Description**			
	Location Area (ft^2)			
	Location Comment	AW 10/23/12	AW 10/23/12	AW 10/23/12
	Location Comment2			
*	**Sample ID**	**TS- 00025**	**TS- 00026**	**TS- 00027**
*	**Sample Time**	1422	1420	1345
*	**ABS**	(N) Y	(N) Y	(N) Y
	Matrix if other than Bulk	(Tissue) Ash Other	(Tissue) Ash Other	(Tissue) Ash Other
*	**Sample Venue**	Indoor Outdoor (NA)	Indoor Outdoor (NA)	Indoor Outdoor (NA)
*	**Sample Pre Post Clear**	(NA) Other:	(NA) Other:	(NA) Other:
*	**Sample Type**	(FS) FD Other	(FS) FD Other	(FS) FD Other
	Sample Parent ID			
*	**Composite**	Y (N)	Y (N)	Y (N)
*	**Sample/Inspection Aliquots**	30 Other (0)	30 Other (0)	30 Other (0)
	Sample Location Description			
	Sample Field Comments	Deer Lung for Tissue Burden (2)	Deer Lung For Fixation	Deer Liver For Tissue Burden (1)

v 20120 *Required Field **List company after Sampler(s) if not "CDM Smith"

For Field Team Completion: Completed by: AW QC by: DA

For Data Entry: Entered by: [illegible] QC by: [illegible]

VNW

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TEM CONSISTENCY REVIEW AND DATA TRANSFER VERIFICATION REPORT

Project/Dataset Description: **Libby Asbestos Superfund Site, Fish and Game Tissue Assessment**

SUMMARY OF FINDINGS AND DATA QUALITY IMPLICATIONS

A verification of 10% of the tissue sample results analyzed by transmission electron microscopy (TEM) International Organization for Standardization (ISO) 10312 was performed. This verification effort was based on the Libby Scribe databases and the final laboratory reports as provided by TechLaw in accordance with Standard Operating Procedure EPA-LIBBY-09 (revision 2).

One non-critical discrepancy was identified in which a grid opening name (i.e., C7) was incorrectly transferred from the benchsheet to the electronic data deliverable (EDD). This issue has been resolved by the analytical laboratory and the necessary corrections have been made to the EDD and loaded to the project database.

One issue was identified in which correct analytical information (e.g., minimum aspect ratio recording rule) from the EDD was modified during the upload process to the project database resulting in erroneous data being presented in the database. The data upload process has since been modified to correctly load the values presented in the EDDs.

The Data Verification Coordinator has performed a check of 5% of the analyses verified to ensure that any potential issues were identified correctly. No deficiencies were noted.

RECOMMENDATIONS FOR FUTURE REVIEW AND VERIFICATION

There is no need to perform future review or verification efforts for this dataset and there are no negative data quality implications because the issues discovered during the verification effort were non-critical, non-systematic issues and have been resolved.

Data Verifier: Natalie Ron *Date:* 6.20.13

Data Verification Coordinator: [signature] *Date:* 6/20/13

Verification Data Manager:* Natalie Ron *Date:* 6.20.13

**The Verification Data Manager acknowledges that all issues discovered during the verification process have been resolved and that the following criteria have been met:*

- All necessary corrections have been made to the laboratory EDD.
- The corrected laboratory EDD has been re-submitted by the analytical laboratory to the appropriate parties (as specified in the governing project documents).
- The corrected laboratory EDD has uploaded to the project database.
- All necessary corrections have been made to the hand-written laboratory benchsheet.
- The corrected hand-written laboratory benchsheet has been re-submitted by the analytical laboratory to the appropriate parties.

TEM ISO 10312 SELECTION AND CONSISTENCY REVIEW RESULTS

Analyst, Lab	Number of TEM ISO 10312 Analyses			Number of TEM ISO 10312 Analyses Selected for Review		
	Detect	Non-Detect	Total	Detect	Non-Detect	Total
E. Wyatt-Pescador, EMSL27	6	0	6	1	0	1
R. Pescador, EMSL27	1	12	13	1	1	2
Total	7	12	19	2	1	3

	Goal	Actual
Selected Total	2	3
Selected Detects	1	2
Selected Non-Detects	1	1

Detailed summary of bench sheet consistency review –

Number of analyses reviewed: 3 (100% of total analyses selected)

If not all analyses could be reviewed, provide a brief explanation for why: N/A

Number of analyses with recording issues identified: 0 (0% of total analyses reviewed)

DATA TRANSFER VERIFICATION RESULTS

Number of analyses verified: 3 (100% of total analyses selected)

Laboratory:

Number of analyses with data transfer issues identified: 1 (14% of total analyses verified)

Types of data transfer issues identified:

1 Incorrect/missing information on raw structure details – grid opening name

A subsequent investigation of all samples in this dataset was performed to ensure that the grid opening names in the project database were consistent with the analytical method. No additional discrepancies were noted.

Do the data transfer issues identified appear to be associated with a particular analyst or laboratory?

☐ Yes ☒ No

Database:

Number of analyses with data transfer issues identified: 3 (100% of total analyses verified)

Types of data transfer issues identified:

3 Analytical information (e.g., aspect ratio recording rule) was modified during the upload process to the project database

A subsequent investigation of all samples in this dataset was performed to check for accuracy of the aspect ratio field and all analyses within the dataset (N=23) were found to be impacted by the same issue. The data upload process has since been modified to correctly load the values presented in the EDDs.

Comments: Attachment 1A (Data Summary of Analytical and Result Information) and 1B (Data Summary of Structure Information) contain the details of the verification findings along with the corrected data. Attachment 2 contains the laboratory benchsheets that were used for this verification effort, including the data verifier's notes, and all corrections received from the laboratory.

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ATTACHMENT 1A. DATA SUMMARY OF ANALYTICAL AND RESULT INFORMATION

DVC - 5%	Samp No	File Revision No	Lab ID	Instrument	Mag High	GO Size	EFA	Tag	Sample Mass	Sample Mass Units	Receipt Date	Lab Job Number	Lab SampleID	Number Grid Prep	Preparer Name	Prep Date	Analyst Name	Analysis Date	Prep Method	Analysis Method	Analysis Method SOP	Aliquot 1	Volume 1	Est Filter Loading	F-Factor	Analysis Comments
X-EF	TS-00003	1	EMSL27	JEOL 100 CX II (27-2)	19000	0.013	365	Rep1	3	g ww	10/26/2012	271201120	271201120-0003	5	E. Wyatt-Pescador	1/8/2013	E. Wyatt-Pescador	1/14/2013	Indirect - Ashed	TEM-ISO	ISO 10312	20	100	20	0.2	C1 on 3/14/
	TS-00007	0	EMSL27	JEOL 100 CX II (27-2)	19000	0.013	365	Rep1	3	g ww	10/26/2012	271201120	271201120-0007	5	E. Wyatt-Pescador	1/8/2013	R. Pescador	1/15/2013	Indirect - Ashed	TEM-ISO	ISO 10312	20	100	10	0.2	
	TS-00025	0	EMSL27	JEOL 100 CX II (27-2)	19000	0.013	365	Rep1	3	g ww	10/26/2012	271201119	271201119-0011	3	R. Pescador	1/12/2013	R. Pescador	1/16/2013	Indirect - Ashed	TEM-ISO	ISO 10312	15	100	15	0.15	

DVC - 5%	Recording Rules			Stopping Rules			Grid Openings Counted		STRUCTCNTHIGHMAG			STRUCTCNTPCME			Sensitivity		STRUCTCONCHIGHMAG			STRUCTCONCPCME			Stopping Rule Achieved	maximum area examined	Verifier's Company	Verifier's Name	Comment - Lab	Correction Date
	Min AR High	Min Length High	Min Width High	Target Sens	Max Area Examined	Target N Strucs	Chrys High	LA/OA High	LA	OA	CH	LA	OA	CH	LA/OA	CH	LA	OA	CH	LA	OA	CH						
X-EF	3:1	0.5	0		0.25	25	4	4	72	0	0	15	0	0	1.2E+04	1.2E+04	8.4E+05	0	0	1.8E+05	0	0	Structure Count	0.05	CDM Smith	N. Ross	Grid_grid opening is C1_C9, not C1_C7 according to benchsheet (last three rows of page 2). Structure Comments in EDD (str crosses non countable grid bar) were not recorded on benchsheet. MinARHigh should be 3:1, not 3:01 in the database.	3/21/2013
	3:1	0.5	0		0.25	25	25	25	18	0	0	3	0	0	1.9E+03	1.9E+03	3.4E+04	0	0	5.6E+03	0	0	Max Area Examined	0.33	CDM Smith	N. Ross	MinARHigh should be 3:1, not 3:01 in the database.	3/21/2013
	3:1	0.5	0		0.25	25	25	25	0	0	0	0	0	0	2.5E+03	2.5E+03	0	0	0	0	0	0	Max Area Examined	0.33	CDM Smith	N. Ross	MinARHigh should be 3:1, not 3:01 in the database.	3/21/2013

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ATTACHMENT 1B. DATA SUMMARY OF STRUCTURE INFORMATION

Samp No	Structure ID	Row Index	Grid	Grid Opening	Structure Type	Primary	Total	Length	Width	AR	Mineral Class	Mineral Desc	EDXA Observation	Structure Identification	Chrysotile Count	Low Mag	Structure Comment	Verifier's Company	Verifier's Name	Comment	Correction Date	DVC - 5%
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_1	1	C1	C7	F	1	1	5.75	0.25	23	LA	WRTA	NaK	ADX	Yes	No	Photo 2871	CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_2	2	C1	C7	F	2	2	3.4	0.2	17	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_3	3	C1	C7	B	3	3	10.3	0.3	34.333333	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_4	4	C1	C7	B	4	4	4.5	0.4	11.25	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_5	5	C1	C7	F	5	5	1.8	0.2	9	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_6	6	C1	C7	B	6	6	2.2	0.75	2.9333333	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_7	7	C1	C7	B	7	7	11.5	1.9	6.0526316	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_8	8	C1	C7	F	8	8	5.15	0.35	14.714286	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_9	9	C1	C7	F	9	9	6	0.25	24	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_10	10	C1	C7	B	10	10	1.75	0.35	5	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_11	11	C1	C7	MD21	11									Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_12	12	C1	C7	MB		11	5.5	0.75	7.3333333	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_13	13	C1	C7	MB		12	2.25	0.3	7.5	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_14	14	C1	C7	F	12	13	1.2	0.2	6	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_15	15	C1	C7	F	13	14	1.15	0.2	5.75	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_16	16	C1	C7	MD10	14									Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_17	17	C1	C7	MF		15	3	0.3	10	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_18	18	C1	C7	F	15	16	5.5	0.25	22	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_19	19	C1	C7	F	16	17	1.65	0.15	11	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_20	20	C1	C7	F	17	18	1.7	0.15	11.333333	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_21	21	C1	C7	F	18	19	2	0.2	10	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_22	22	C1	C7	F	19	20	1.25	0.2	6.25	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_23	23	C1	C9	B	0	0	20	0.5	40	LA	WRTA	NaK	ADX	Yes	No	str crosses r	CDM Smith	N. Ross	Grid_grid opening is C1_C3, not C1_C7 according to benchsheet (last three rows of page 2). Structure Comments (str crosses non countable grid bar) was not recorded on benchsheet.	3/21/2013	EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_24	24	C1	C9	F	20	21	1.4	0.2	7	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross	Grid_grid opening is C1_C9, not C1_C7 according to benchsheet (last three rows of page 2)	3/21/2013	EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_25	25	C1	C9	CD20	21									Yes	No		CDM Smith	N. Ross	Grid_grid opening is C1_C9, not C1_C7 according to benchsheet (last three rows of page 2)	3/21/2013	EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_26	26	C1	C9	CF		22	3.7	0.2	18.5	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_27	27	C1	C9	CF		23	2.55	0.15	17	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_28	28	C1	C9	F	22	24	2.3	0.3	7.6666667	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_29	29	C1	C9	F	23	25	2	0.2	10	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_30	30	C1	C9	F	24	26	1.15	0.25	4.6	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_31	31	C1	C9	F	25	27	1.7	0.3	5.6666667	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_32	32	C1	C9	B	26	28	0.8	0.15	5.3333333	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_33	33	C1	C9	MD10	27									Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_34	34	C1	C9	MF		29	1.25	0.25	5	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_35	35	C1	C9	MD11	28									Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_36	36	C1	C9	MF		30	5.8	0.25	23.2	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_37	37	C1	C9	F	29	31	3.1	0.25	12.4	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_38	38	C1	C9	F	30	32	1.9	0.25	7.6	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_39	39	C1	C9	F	31	33	2.4	0.1	24	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_40	40	C1	C9	F	32	34	1.3	0.3	4.3333333	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_41	41	C1	C9	F	33	35	4.8	0.15	32	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_42	42	C1	C9	F	34	36	2.7	0.25	10.8	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_43	43	C1	C9	F	35	37	1.75	0.25	7	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_44	44	C1	C9	F	36	38	5.25	0.3	17.5	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_45	45	C1	C9	F	37	39	3.2	0.2	16	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_46	46	C3	B7	B	38	40	3.75	0.2	18.75	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_47	47	C3	B7	F	39	41	3.7	0.15	24.666667	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_48	48	C3	B7	F	40	42	1.5	0.3	5	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_49	49	C3	B7	B	41	43	2.95	0.25	11.8	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_50	50	C3	B7	F	42	44	2.25	0.15	15	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_51	51	C3	B7	F	43	45	2.95	0.15	19.666667	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_52	52	C3	B7	F	44	46	3.2	0.15	21.333333	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_53	53	C3	B7	F	45	47	2.4	0.15	16	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_54	54	C3	B7	F	46	48	4.4	0.35	12.571429	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_55	55	C3	B7	F	47	49	2.6	0.2	13	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_56	56	C3	B7	F	48	50	3	0.25	12	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_57	57	C3	B7	B	49	51	8.9	0.45	19.777778	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_58	58	C3	B7	F	50	52	1.65	0.15	11	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_59	59	C3	B7	B	51	53	7	0.7	10	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_60	60	C3	B7	B	52	54	1.35	0.2	6.75	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_61	61	C3	B9	F	53	55	1.4	0.2	7	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_62	62	C3	B9	F	54	56	1.8	0.15	12	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_63	63	C3	B9	F	55	57	1.5	0.2	7.5	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_64	64	C3	B9	F	56	58	5.85	0.3	19.5	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_65	65	C3	B9	F	57	59	1.35	0.3	4.5	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_66	66	C3	B9	F	58	60	2.9	0.45	6.4444444	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_67	67	C3	B9	B	59	61	2.3	0.35	6.5714286	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_68	68	C3	B9	F	60	62	1.5	0.25	6	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_69	69	C3	B9	F	61	63	8.2	0.3	27.333333	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_70	70	C3	B9	F	62	64	5.15	0.2	25.75	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_71	71	C3	B9	F	63	65	2.2	0.25	8.8	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_72	72	C3	B9	MD10	64									Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_73	73	C3	B9	MF		66	3.5	0.2	17.5	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_74	74	C3	B9	B	65	67	7.2	0.4	18	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_75	75	C3	B9	MD10	66									Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_76	76	C3	B9	MF		68	5.2	0.25	20.8	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_77	77	C3	B9	F	67	69	3	0.45	6.6666667	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_78	78	C3	B9	F	68	70	2.9	0.35	8.2857143	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_79	79	C3	B9	B	69	71	1.75	0.2	8.75	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00003	271201120-0003_Indirect-Ashed_NotQC_TEM-ISO_80	80	C3	B9	F	70	72	6.5	0.15	43.333333	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			EF
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_1	1	G1	F4	ND										Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_2	2	G1	F6	ND										Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_3	3	G1	F8	ND										Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_4	4	G1	F10	F	1	1	4	0.25	16	LA	WRTA	NaK	ADX	Yes	No	Photo 2872	CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_5	5	G1	H2	ND										Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_6	6	G1	H4	ND										Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_7	7	G1	H6	ND										Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_8	8	G3	F3	B	2	2	1.75	0.35	5	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_9	9	G3	F5	MD11	3									Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_10	10	G3	F5	MF		3	5.4	0.35	15.428571	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_11	11	G3	F5	F	4	4	2	0.25	8	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_12	12	G3	F7	ND										Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_13	13	G3	F9	F	5	5	2.25	0.25	9	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_14	14	G3	F9	F	6	6	3.6	0.25	14.4	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_15	15	G3	H4	ND										Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_16	16	G3	H6	F	7	7	3.2	0.4	8	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_17	17	G3	H8	ND										Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_18	18	G3	H10	F	8	8	3.25	0.2	16.25	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_19	19	G3	H10	F	9	9	2.35	0.25	9.4	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_20	20	G3	H10	MD11	10									Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_21	21	G3	H10	MF		10	5.3	0.5	10.6	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_22	22	G5	G2	F	11	11	1.5	0.25	6	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_23	23	G5	G4	F	12	12	6.4	0.5	12.8	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_24	24	G5	G4	F	13	13	1.4	0.25	5.6	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_25	25	G5	G4	F	14	14	2.5	0.1	25	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_26	26	G5	G4	F	15	15	2.6	0.2	13	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_27	27	G5	G6	ND										Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_28	28	G5	G8	F	16	16	4	0.6	6.6666667	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_29	29	G5	G10	ND										Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_30	30	G5	I2	ND										Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_31	31	G5	I4	ND										Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_32	32	G5	I6	F	17	17	1.85	0.35	5.2857143	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_33	33	G5	I8	F	18	18	3.4	0.25	13.6	LA	WRTA	NaK	ADX	Yes	No		CDM Smith	N. Ross			
TS-00007	271201120-0007_Indirect-Ashed_NotQC_TEM-ISO_34	34	G5	I10	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_1	1	F1	D9	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_2	2	F1	D7	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_3	3	F1	D5	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_4	4	F1	D3	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_5	5	F1	D1	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_6	6	F1	C10	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_7	7	F1	C8	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_8	8	F1	C6	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_9	9	F1	C4	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_10	10	F1	C2	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_11	11	F2	D1	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_12	12	F2	D3	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_13	13	F2	D5	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_14	14	F2	D7	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_15	15	F2	D9	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_16	16	F2	E2	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_17	17	F2	E4	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_18	18	F2	E6	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_19	19	F2	E8	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_20	20	F2	E10	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_21	21	F3	E9	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_22	22	F3	E7	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_23	23	F3	E5	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_24	24	F3	E3	ND										Yes	No		CDM Smith	N. Ross			
TS-00025	271201119-0011_Indirect-Ashed_NotQC_TEM-ISO_25	25	F3	E1	ND										Yes	No		CDM Smith	N. Ross			

Page 1 of 1

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ATTACHMENT 2 – TEM LABORATORY BENCHSHEETS

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LIBBY

TEM Asbestos Structure Count_TissueEDD_1a

Laboratory ID:	EMSL27
Instrument ID	JEOL 100 CX II (27-2)
Voltage (KV)	100
Mag.	19,000 HIGH / LOW
Grid opening area (mm2)	0.013
Scale: 1L =	1
Scale: 1D =	1
Filter pore size (um)	0.2
Effective Filter Area (mm2)	365
Category	Field

EPA Sample Number	TS-00003	Tag:	REDI ~~ALL~~ 1/7/13
Matrix			Tissue
Sample Mass (g wet weight)			3
Date received by lab			10/26/12
Lab Job Number:			271201120
Lab Sample Number:			271201120-0003
Number of grids prepared			5
Prepared by			E.Wyatt-Pescador
Preparation date			01/08/13
EPA COC Number:			~~23246~~ 23256 11/15/13

Analyzed by:	E.Wyatt-Pescador
Analysis date	~~[illegible]~~ 1/14/13
Prep Method	Indirect-Ashed
Estimated Particulate Loading (%)	20
Analysis Method	TEM-ISO
Grid storage location	2713-LIB-7
Archive filter(s) storage location	ESAT Archive
Lab QC Type (Not QC, Recount Same, Recount Different, Re-prep, Verified Analysis, Reconciliation, Lab Blank, Filtration Blank, Drying Blank, Lab Duplicate, Interlab)	Not QC

F-Factor Calculation (Indirect Preps Only):

Enter data in appropriate cells provided to the right——>

Recording Rules:

Minimum Aspect Ratio (circle one): none (≥ 3:1) ≥ 5:1

Minimum Length (um): 0.5

Minimum Width (um): none

Stopping Rules:

Target Sensitivity:

Max Area Examined: 0.25

Target # of Structures: 25

Grid	Grid Opening	Structure Type	No. of Structures Primary	No. of Structures Total	Dimensions Length	Dimensions Width	Identification	Mineral Class (see below) LA	OA	CH	NAM	Mineral Desc	EDXA	Sketch/ Comments	1 = yes, blank = no Sketch	Photo	EDS	CH Not Counted
C1	C7	F	1	1	5.75	0.25	ADX	1				WRTA	NaK		1	28715 28716	1	
		F	2	2	3.40	0.20	ADX	1				WRTA	NaK		1			
		B	3	3	10.30	0.30	ADX	1				WRTA	NaK		1		1	
		B	4	4	4.50	0.40	ADX	1				WRTA	NaK		1		1	
		F	5	5	1.80	0.20	ADX	1				WRTA	NaK		1		1	
		B	6	6	2.20	0.75	ADX	1				WRTA	NaK		1		1	
		B	7	7	11.50	1.90	ADX	1				WRTA	NaK		1			
		F	8	8	5.15	0.35	ADX	1				WRTA	NaK		1			
		F	9	9	6.00	0.25	ADX	1				WRTA	NaK		1			
		B	10	10	1.75	0.35	ADX	1				WRTA	NaK		1			

F-factor Calculation:

100	Resuspension volume (mL)
20	Volume applied to filter (mL)

LA = Libby-type amphibole OA = Other (non-Libby type) amphibole CH = Chrysotile NAM = Non-asbestos material

If sample was analyzed by more than one analyst or across multiple analysis dates, enter analysis details below.

	Analyst #2	Analyst #3
Analyzed by:		
Analysis date:		
Instrument:		

Grid opening traverse direction (circle one): H Horizontal (V) Vertical

Are prepped grids acceptable for analysis? (circle one) (Yes) No

If No, explain:

52

52 vDVC-EF

72/4

MW

LIBBY

TEM Asbestos Structure Count_TissueEDD_1a

Laboratory ID	EMSL27	EPA Sample Number	TS-00003	Lab QC Type	Not QC	Lab Job Number	271201120
Lab Sample Number	271201120-0003	Matrix	Tissue	Analyst Name	E.Wyatt-Pescador	Grid Storage Loc.	2713-LIB-7

Grid	Grid Opening	Structure Type	No. of Structures		Dimensions		Identification	Mineral Class				Mineral Desc	EDXA	Sketch/Comments	1 = yes, blank = no			CH Not Counted
			Primary	Total	Length	Width		LA	OA	CH	NAM				Sketch	Photo	EDS	
C1	C7	MD21	11															
		MB		11	5.50	0.75	ADX	1				WRTA	NOK	(11)	1			
		MB		12	2.25	0.30	ADX	1				WRTA	NOK	(12)	1			
		F	12	13	1.20	0.20	ADX	1				WRTA	NOK		1			
		F	13	14	1.15	0.20	ADX	1				WRTA	NOK		1			
		MD10	14															
		MF		15	3.00	0.30	ADX	1				WRTA	NOK		1			
		F	15	16	5.50	0.25	ADX	1				WRTA	NOK		1			
		F	16	17	1.65	0.15	ADX	1				WRTA	NOK		1			
		F	17	18	1.70	0.15	ADX	1				WRTA	NOK		1			
		F	18	19	2.00	0.20	ADX	1				WRTA	NOK		1			
		F	19	20	1.25	0.20	ADX	1				WRTA	NOK		1			
	C9	B	0	0	20.00	0.50	ADX	1				WRTA	NOK		1			
		F	20	21	1.40	0.20	ADX	1				WRTA	NOK		1			
		CD20	21															

Revised

LIBBY

TEM Asbestos Structure Count_TissueEDD_1a

Laboratory ID	EMSL27	EPA Sample Number	TS-00003	Lab QC Type	Not QC	Lab Job Number	271201120
Lab Sample Number	271201120-0003	Matrix	Tissue	Analyst Name	E.Wyatt-Pescador	Grid Storage Loc.	2713-LIB-7

Grid	Grid Opening	Structure Type	No. of Structures		Dimensions		Identification	Mineral Class				Mineral Desc	EDXA	Sketch/Comments	1 = yes, blank = no			CH Not Counted
			Primary	Total	Length	Width		LA	OA	CH	NAM				Sketch	Photo	EDS	
C1	C7	MD21	11															
		MB		11	5.50	0.75	ADX	1				WRTH	NAK	(11)	1			
		MB		12	2.25	0.30	ADX	1				WRTH	NAK	(12)	1			
		F	12	13	1.20	0.20	ADX	1				WRTH	NAK		1			
		F	13	14	1.15	0.20	ADX	1				WRTH	NAK		1			
		MD10	14															
		MF		15	3.00	0.30	ADX	1				WRTH	NAK		1			
		F	15	16	5.50	0.25	ADX	1				WRTH	NAK		1			
		F	16	17	1.65	0.15	ADX	1				WRTH	NAK		1			
		F	17	18	1.70	0.15	ADX	1				WRTH	NAK		1			
		F	18	19	2.00	0.20	ADX	1				WRTH	NAK		1			
		F	19	20	1.25	0.20	ADX	1				WRTH	NAK		1			
	C9	B	0	0	20.00	0.50	ADX	1				WRTH	NAK	☆	1			
		F	20	21	1.40	0.20	ADX	1				WRTH	NAK		1			
		CD20	21															

☆ str crosses non countable grid bar ✓

MW

LIBBY

TEM Asbestos Structure Count_TissueEDD_1a

Laboratory ID	EMSL27	EPA Sample Number	TS-00003	Lab QC Type	Not QC	Lab Job Number	271201120
Lab Sample Number	271201120-0003	Matrix	Tissue	Analyst Name	E.Wyatt-Pescador	Grid Storage Loc.	2713-LIB-7

Grid	Grid Opening	Structure Type	No. of Structures		Dimensions		Identification	Mineral Class				Mineral Desc	EDXA	Sketch/Comments	1 = yes, blank = no			CH Not Counted
			Primary	Total	Length	Width		LA	OA	CH	NAM				Sketch	Photo	EDS	
C1	C9	CF		22	3.70	0.20	ADX	1				WRTA	Nak	23	1			
		CF		23	2.55	0.15	ADX	1				WRTA	Nak	22	1			
		F	22	24	2.30	0.30	ADX	1				WRTA	Nak		1			
		F	23	25	2.00	0.20	ADX	1				WRTA	Nak		1			
		F	24	26	1.15	0.25	ADX	1				WRTA	Nak		1			
		F	25	27	1.70	0.30	ADX	1				WRTA	Nak		1			
		B	26	28	0.80	0.15	ADX	1				WRTA	Nak		1			
		MDID	27															
		MF		29	1.25	0.25	ADX	1				WRTA	Nak		1			
		MDII	28															
		MF		30	5.80	0.25	ADX	1				WRTA	Nak		1			
		F	29	31	3.10	0.25	ADX	1				WRTA	Nak		1			
		F	30	32	1.90	0.25	ADX	1				WRTA	Nak		1			
		F	31	33	2.40	0.10	ADX	1				WRTA	Nak		1			
		F	32	34	1.30	0.30	ADX	1				WRTA	Nak		1			

LIBBY

TEM Asbestos Structure Count_TissueEDD_1a

Laboratory ID	EMSL27	EPA Sample Number	TS-00003	Lab QC Type	Not QC	Lab Job Number	271201120
Lab Sample Number	271201120-0003	Matrix	Tissue	Analyst Name	E.Wyatt-Pescador	Grid Storage Loc.	2713-LIB-7

Grid	Grid Opening	Structure Type	No. of Structures		Dimensions		Identification	Mineral Class				Mineral Desc	EDXA	Sketch/Comments	1 = yes, blank = no			CH Not Counted
			Primary	Total	Length	Width		LA	OA	CH	NAM				Sketch	Photo	EDS	
C1	C9	F	33	35	4.80	0.15	AOX	1				WRTA	Nak		1			
		F	34	36	2.70	0.25	AOX	1				WRTA	Nak		1			
		F	35	37	1.75	0.25	AOX	1				WRTA	Nak		1			
		F	36	38	5.25	0.30	AOX	1				WRTA	Nak		1			
		F	37	39	3.20	0.20	AOX	1				WRTA	Nak		1			
C3	B7	B	38	40	3.15	0.20	AOX	1				WRTA	Nak		1			
		F	39	41	3.70	0.15	AOX	1				WRTA	Nak		1			
		F	40	42	1.50	0.30	AOX	1				WRTA	Nak		1			
		B	41	43	2.95	0.25	AOX	1				WRTA	Nak		1			
		F	42	44	2.25	0.15	AOX	1				WRTA	Nak		1			
		F	43	45	2.95	0.15	AOX	1				WRTA	Nak		1			
		F	44	46	3.20	0.15	AOX	1				WRTA	Nak		1			
		F	45	47	2.40	0.15	AOX	1				WRTA	Nak		1			
		F	46	48	4.40	0.35	AOX	1				WRTA	Nak		1			
		F	47	49	2.60	0.20	AOX	1				WRTA	Nak		1			

LIBBY

TEM Asbestos Structure Count_TissueEDD_1a

Laboratory ID	EMSL27	EPA Sample Number	TS-00003	Lab QC Type	Not QC	Lab Job Number	271201120
Lab Sample Number	271201120-0003	Matrix	Tissue	Analyst Name	E.Wyatt-Pescador	Grid Storage Loc.	2713-LIB-7

Grid	Grid Opening	Structure Type	No. of Structures		Dimensions		Identification	Mineral Class				Mineral Desc	EDXA	Sketch/Comments	1 = yes, blank = no			CH Not Counted
			Primary	Total	Length	Width		LA	OA	CH	NAM				Sketch	Photo	EDS	
C3	B7	F	48	50	3.00	0.25	AOX	1				WRTA	NaK		1			
		B	49	51	8.90	0.45	AOX	1				WRTA	NaK		1			
		F	50	52	1.65	0.15	AOX	1				WRTA	NaK		1			
		B	51	53	7.00	0.70	AOX	1				WRTA	NaK		1			
		B	52	54	1.35	0.20	AOX	1				WRTA	NaK		1			
	B9	F	53	55	1.40	0.20	AOX	1				WRTA	NaK		1			
		F	54	56	1.80	0.15	AOX	1				WRTA	NaK		1			
		F	55	57	1.50	0.20	AOX	1				WRTA	NaK		1			
		F	56	58	5.85	0.30	AOX	1				WRTA	NaK		1			
		F	57	59	1.35	0.30	AOX	1				WRTA	NaK		1			
		F	58	60	2.90	0.45	AOX	1				WRTA	NaK		1			
		B	59	61	8.30	0.35	AOX	1				WRTA	NaK		1			
		F	60	62	1.50	0.25	AOX	1				WRTA	NaK		1			
		F	61	63	8.20	0.30	AOX	1				WRTA	NaK		1			
		F	62	64	5.15	0.20	AOX	1				WRTA	NaK		1			

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TEM Asbestos Structure Count_TissueEDD_1a

Laboratory ID	EMSL27	EPA Sample Number	TS-00003	Lab QC Type	Not QC	Lab Job Number	271201120
Lab Sample Number	271201120-0003	Matrix	Tissue	Analyst Name	E.Wyatt-Pescador	Grid Storage Loc.	2713-LJB-7

Grid	Grid Opening	Structure Type	No. of Structures		Dimensions		Identification	Mineral Class				Mineral Desc	EDXA	Sketch/Comments	1 = yes, blank = no			CH Not Counted
			Primary	Total	Length	Width		LA	OA	CH	NAM				Sketch	Photo	EDS	
C3	B9	F	63	65	2.20	0.25	ADX	1				WRTA	NOK		1			
		MDID	64															
		MF		66	3.50	0.20	ADX	1				WRTA	NOK		1			
		B	65	67	7.20	0.40	ADX	1				WRTA	NOK		1			
		MDID	66															
		MF		68	5.20	0.25	ADX	1				WRTA	NOK		1			
		F	67	69	3.00	0.45	ADX	1				WRTA	NOK		1			
		F	68	70	2.90	0.35	ADX	1				WRTA	NOK		1			
		B	69	71	1.75	0.20	ADX	1				WRTA	NOK		1			
		F	70	72	6.50	0.15	ADX	1				WRTA	NOK		1			

EMW 1/14/2013

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TEM Asbestos Structure Count_TissueEDD_1a

Laboratory ID:	EMSL27
Instrument ID	JEOL 100 CX II (27-2)
Voltage (KV)	100
Mag.	19,000 HIGH / LOW
Grid opening area (mm2)	0.013
Scale: 1L =	1
Scale: 1D =	1
Filter pore size (um)	0.2
Effective Filter Area (mm2)	365
Category	Field

EPA Sample Number	TS-00007	Tag:	REP1 ALI
Matrix	Tissue		
Sample Mass (g wet weight)	3		
Date received by lab	10/26/12		
Lab Job Number:	271201120		
Lab Sample Number:	271201120-0007		
Number of grids prepared	5		
Prepared by	E.Wyatt-Pescador		
Preparation date	01/08/13		
EPA COC Number:	~~23246~~ 23256		

Analyzed by:	R. Pescador
Analysis date	01/15/13
Prep Method	Indirect-Ashed
Estimated Particulate Loading (%)	10
Analysis Method	TEM-ISO
Grid storage location	2713-LIB-7
Archive filter(s) storage location	ESAT Archive
Lab QC Type (Not QC, Recount Same, Recount Different, Re-prep, Verified Analysis, Reconciliation, Lab Blank, Filtration Blank, Drying Blank, Lab Duplicate, interlab)	Not QC

F-Factor Calculation (Indirect Preps Only):

Enter data in appropriate cells provided to the right---->

Recording Rules:	
Minimum Aspect Ratio (circle one):	none / ≥ 3:1 / ≥ 5:1
Minimum Length (um):	0.5
Minimum Width (um):	none

Stopping Rules:	
Target Sensitivity:	
Max Area Examined:	0.25
Target # of Structures:	25

Grid	Grid Opening	Structure Type	No. of Structures		Dimensions		Identification	Mineral Class (see below)				Mineral Desc	EDXA	Sketch/ Comments	1 = yes, blank = no			CH Not Counted
			Primary	Total	Length	Width		LA	OA	CH	NAM				Sketch	Photo	EDS	
G1	F4	nd																
	F6	nd																
	F8	nd																
	F10	F	1	1	4.0	0.25	ADX	1				WRTA	Nak		1	28721 28723	1	
	H2	nd																
	H4	nd																
	H6	nd																
G3	F3	B	2	2	1.25	0.35	ADX	1				WRTA	Nak		1		1	
	F5	MD11	3															
		MF		3	5.40	0.35	ADX	1				WRTA	Nak		1		1	

F-factor Calculation:

100	Resuspension volume (mL)
20	Volume applied to filter (mL)

LA = Libby-type amphibole OA = Other (non-Libby type) amphibole CH = Chrysotile NAM = Non-asbestos material

If sample was analyzed by more than one analyst or across multiple analysis dates, enter analysis details below.

	Analyst #2	Analyst #3
Analyzed by:		
Analysis date:		
Instrument:		

Grid opening traverse direction (circle one):
H Horizontal
V Vertical

Are prepped grids acceptable for analysis? (circle one) Yes No
If No, explain:

18 | 25

93

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TEM Asbestos Structure Count_TissueEDD_1a

Laboratory ID	EMSL27	EPA Sample Number	TS-00007	Lab QC Type	Not QC	Lab Job Number	271201120
Lab Sample Number	271201120-0007	Matrix	Tissue	Analyst Name	R. Pescador	Grid Storage Loc.	2713-LIB-7

Grid	Grid Opening	Structure Type	No. of Structures		Dimensions		Identification	Mineral Class				Mineral Desc	EDXA	Sketch/Comments	1 = yes, blank = no			CH Not Counted
			Primary	Total	Length	Width		LA	OA	CH	NAM				Sketch	Photo	EDS	
G3	F5	F	4	4	2.0	0.25	ADX	1				WRTA	Nak		1		1	
	F7	nd																
	F9	F	5	5	2.25	0.25	ADX	1				WRTA	Nak		1		1	
		F	6	6	3.60	0.25	ADX	1				WRTA	Nak		1			
	H4	nd																
	H6	F	7	7	3.20	0.40	ADX	1				WRTA	Nak		1			
	H8	nd																
	H10	F	8	8	3.25	0.20	ADX	1				WRTA	Nak		1			
		F	9	9	2.35	0.25	ADX	1				WRTA	Nak		1			
		MD11	10															
		MF		10	5.30	0.50	ADX	1				WRTA	Nak		1			
G5	G2	F	11	11	1.50	0.25	ADX	1				WRTA	Nak		1			
	G4	F	12	12	6.40	0.50	ADX	1				WRTA	Nak		1			
		F	13	13	1.40	0.25	ADX	1				WRTA	Nak		1			
		F	14	14	2.50	0.10	ADX	1				WRTA	Nak		1			

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TEM Asbestos Structure Count_TissueEDD_1a

Laboratory ID	EMSL27	EPA Sample Number	TS-00007	Lab QC Type	Not QC	Lab Job Number	271201120
Lab Sample Number	271201120-0007	Matrix	Tissue	Analyst Name	R. Pescador	Grid Storage Loc.	2713-LIB-7

Grid	Grid Opening	Structure Type	No. of Structures		Dimensions		Identification	Mineral Class				Mineral Desc	EDXA	Sketch/Comments	1 = yes, blank = no			CH Not Counted
			Primary	Total	Length	Width		LA	OA	CH	NAM				Sketch	Photo	EDS	
G5	G4	F	15	15	2.60	0.20	ADX	1				WRTA	Nak		1			
	G6	nd																
	G8	F	16	16	4.0	0.60	ADX	1				WRTA	Nak		1			
	G10	nd																
	I2	nd																
	I4	nd																
	I6	F	17	17	1.85	0.35	ADX	1				WRTA	Nak		1			
	I8	F	18	18	3.40	0.25	ADX	1				WRTA	Nak		1			
	I10	nd																

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TEM Asbestos Structure Count_TissueEDD_1a

Laboratory ID:	EMSL27
Instrument ID	JEOL 100 CX II (27-2)
Voltage (KV)	100
Mag.	19,000 HIGH / LOW
Grid opening area (mm2)	0.013
Scale: 1L =	1
Scale: 1D =	1
Filter pore size (um)	0.2
Effective Filter Area (mm2)	365
Category	Field

EPA Sample Number	TS-00025
Tag:	RGEP1 A11
Matrix	Tissue
Sample Mass (g wet weight)	3
Date received by lab	10/26/12
Lab Job Number:	271201119
Lab Sample Number:	271201119-0011
Number of grids prepared	3
Prepared by	R. Pescador
Preparation date	01/12/13
EPA COC Number:	23215

1/17/13

Analyzed by:	R. Pescador
Analysis date	01/16/13
Prep Method	Indirect-Ashed
Estimated Particulate Loading (%)	N
Analysis Method	TEM-ISO
Grid storage location	2713-LIB-11
Archive filter(s) storage location	ESAT Archive
Lab QC Type (Not QC, Recount Same, Recount Different, Re-prep, Verified Analysis, Reconciliation, Lab Blank, Filtration Blank, Drying Blank, Lab Duplicate, Interlab)	Not QC

F-Factor Calculation (Indirect Preps Only):

Enter data in appropriate cells provided to the right---->

Recording Rules:

Minimum Aspect Ratio (circle one): none (≥ 3:1) ≥ 5:1

Minimum Length (um): 0.5

Minimum Width (um): none

Stopping Rules:

Target Sensitivity:

Max Area Examined: 0.25

Target # of Structures: 25

Grid	Grid Opening	Structure Type	No. of Structures		Dimensions		Identification	Mineral Class (see below)				Mineral Desc	EDXA	Sketch/ Comments	1 = yes, blank = no			CH Not Counted
			Primary	Total	Length	Width		LA	OA	CH	NAM				Sketch	Photo	EDS	
F1	D9	nd																
	D7	nd																
	D5	nd																
	D3	nd																
	D1	nd																
F1	C10	nd																
	C8	nd																
	C6	nd																
	C4	nd																
	C2	nd																

F-factor Calculation:

100	Resuspension volume (mL)
N	Volume applied to filter (mL)

LA = Libby-type amphibole OA = Other (non-Libby type) amphibole CH = Chrysotile NAM = Non-asbestos material

If sample was analyzed by more than one analyst or across multiple analysis dates, enter analysis details below.

	Analyst #2	Analyst #3
Analyzed by:		
Analysis date:		
Instrument:		

Grid opening traverse direction (circle one):
H Horizontal
V Vertical

Are prepped grids acceptable for analysis? (circle one) Yes No
If No, explain:

0/25

67

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TEM Asbestos Structure Count_TissueEDD_1a

Laboratory ID	EMSL27	EPA Sample Number	TS-00025	Lab QC Type	Not QC	Lab Job Number	271201119
Lab Sample Number	271201119-0011	Matrix	Tissue	Analyst Name	R. Pescador	Grid Storage Loc.	2713-LIB-11

Grid	Grid Opening	Structure Type	No. of Structures		Dimensions		Identification	Mineral Class				Mineral Desc	EDXA	Sketch/Comments	1 = yes, blank = no			CH Not Counted
			Primary	Total	Length	Width		LA	OA	CH	NAM				Sketch	Photo	EDS	
F2	D1	nd																
	D3	nd																
	D5	nd																
	D7	nd																
	D9	nd																
	E2	nd																
	E4	nd																
	E6	nd																
	E8	nd																
	E10	nd																
F3	E9	nd																
	E7	nd																
	E5	nd																
	E3	nd																
	E1	nd																